Graduate Catalog

Graduate Catalog 2023-2024

Catalog of Record

This Khalifa University of Science and Technology (KU) Graduate Catalog is intended for students of the University who are admitted to a Master's or Doctorate program in the 2023– 2024 Academic Year. Students admitted to College of Medicine and Health Sciences programs should also refer to the *CMHS Medical Student Handbook.*

Provost’s Message

Welcome to Khalifa University, where you will spend the next few years of your educational journey.

High-quality education is beneficial to you and an important prerequisite towards understanding and addressing societal challenges relating to energy, environment, healthcare, security, communications, transportation and civil infrastructure, amongst others.

The diverse community of scholars at Khalifa University will help prepare you to face these challenges and to make your unique contribution to the solutions demanded by them. Beyond a high-quality grounding in your chosen subject area, you will also need a variety of other attributes to succeed as a leader, including the ability to communicate and to work in teams, competence in working within economic and societal constraints, a sense of professional and personal ethics, managerial and business acumen and the interest and capacity to serve others. We are dedicated to helping you develop and refine all of these skills.

Our University is a dynamic institution offering high quality education and practical experience. We strive to create a learning culture that exemplifies excellence in teaching and scholarship, which promotes lifelong learning and prepares individuals for leadership and service in the global society. We have the responsibility to help you develop as complete and well-rounded individuals and maximize your potential to pursue careers with passion and purpose.

We offer a diverse range of degree programs that are designed to meet the criteria set by national and international accreditation bodies. Our faculty and staff are highly qualified, experienced and dedicated professionals, who are always willing to impart their knowledge and experience to our students. The University has world-class facilities which will make your learning experience productive and enjoyable.

This Catalog provides you with information to make your academic planning easier. Decisions about majors, specializations and courses require careful consideration, and the Catalog will help you plan your degree from your first year through to your final year. If you need more information or advice, please take advantage of the professional expertise of our faculty and administrative staff. Your academic advisor will be happy to give you the appropriate advice.

I look forward to meeting you and to sharing the great adventure of university life with you and the rest of our community. I believe you will find Khalifa University to be a stimulating and supportive environment in which to shape your future and wish you every success and happiness during your time here.

Professor Bayan Sharif
Office of the Provost,
Khalifa University

Academic Calendar

Fall Semester 2023

	Date	Event Name	Type
August	21	Faculty reporting	Academic
	22-25	New student orientation	Academic
	28	Classes begin - Fall	Academic
September	1	End of add/drop for UG & PG	Academic
	22	Run Census Report	Academic
	27	Prophet Birthday	Public Holiday
October	20	Mid-Grade Due Date	Academic
	29	Makeup Day as per 4th Dec Schedule	Academic
November	3	Last Day to withdraw with “W”	Academic
	5	Makeup Day as per 5th Dec Schedule	Academic
	12	Makeup Day as per 6th Dec Schedule	Academic
	19	Makeup Day as per 7th Dec Schedule	Academic
	13-17	Advisement Period for Spring 2024	Academic
	20-24	Early Registration for Spring 2024	Academic
December	1	Commemoration Day	Public Holiday
	2	National Day	Public Holiday
	4-12	No Classes	COP28 Students Participation
	8	Last day of classes	Academic
	11	Final Exam Begin & Thesis Submission	Academic
	22	Final Exam End	Academic
	25	Final Grades Due	Academic
	25	Winter Break	Academic

Spring Semester 2024

	Date	Event Name	Type
January	8	Faculty Reporting	Academic
	9-10	New Student Orientation	Academic
	15	Classes Begin	Academic
	19	End of add/drop UG & PG	Academic
February	9	Run Census Report	Academic
March	8	Mid-Grade Due Date	Academic
	22	Last day to Withdraw with “W”	Academic
	25-29	Spring Break	Academic
April	1-5	Advisement Period for Summer/ Fall 2024	Academic
	10-12	Eid El Fitr	Public Holiday
	15-19	Early Registration Summer /Fall 2024	Academic
May	3	Last day of Classes	Academic
	6	Final Exam Begin & Thesis Submission	Academic
	16	Final Exam End	Academic
	20	Final Grades Due	Academic
June	3	Summer 2024 - Classes Begin & Internship Begin	Academic
	5	End of add/drop for UG & PG	Academic

	17-19	Eid Al Adha	Public Holiday
	21	Mid-Grade Due Date	Academic
July	1	Last day to withdraw with "W" & Run Census Report	Academic
	15	Last day of Classes	Academic
	16	Final Exams Begin	Academic
	18	Final Exams Begin	Academic
	22	Final Grades Due	Academic

NOTE: Islamic Holidays are subject to change. This calendar does not apply to the College of Medicine and Health Sciences.

E-Mail Directory

Alumni Services
E-mail: kualumni@ku.ac.ae

Career Services
E-mail: careerservices@ku.ac.ae

Center for Teaching and Learning
E-mail: ctl@ku.ac.ae

Counseling
E-mail: counselors@ku.ac.ae

Emergency
Telephone: +971 2 312 3999

Facilities Management
E-mail: fmhelpdesk@ku.ac.ae

Finance Department (Payments)
E-mail: kuaccountreceivables@ku.ac.ae

Government Relations
E-mail: kugovernmentrelations@ku.ac.ae

Graduate Admissions
E-mail: pgadmission@ku.ac.ae

Graduate Student Accommodation
E-mail: pgr.life@ku.ac.ae

Graduate Studies Office
E-mail: gso@ku.ac.ae

Human Resources
E-mail: askhr@ku.ac.ae

Information Technology (IT)
E-mail: servicedesk@ku.ac.ae

Medical Clinic and Nurse
Telephone: +971 2 401 8014
E-mail: nurse.auh@ku.ac.ae

Registrar’s Office
E-mail: registration.office@ku.ac.ae

Security
Telephone: +971 2 401 8100

Student Services
E-mail: ss.helpdesk@ku.ac.ae

Student Transportation
E-mail: studenttransporation@ku.ac.ae

The University

History of Khalifa University

In 2017, UAE President and Ruler of Abu Dhabi, His Highness Sheikh Khalifa bin Zayed Al Nahyan, issued a decree to merge Khalifa University of Science, Technology and Research, Masdar Institute of Science and Technology, and The Petroleum Institute under one university called Khalifa University of Science and Technology (Khalifa University).

Khalifa University is a comprehensive research-intensive university with three colleges, three research institutes, 18 research centers, and 36 departments covering a broad range of disciplines in science, engineering, and medicine. The internationally top-ranked university is the one university in the UAE with the research and academic programs that address the entire range of strategic, scientific and industrial challenges facing the UAE's knowledge economy transformation and our rapidly evolving world.

Khalifa University's world-class faculty and state-of-the-art research facilities provide an unparalleled learning experience to students from the UAE and around the world. The university brings together the best in science, engineering and medicine in the UAE, to offer specialized degrees that can take promising high school graduates all the way to top-rated doctorate degree holders. It will continue to evolve with the UAE's rapidly developing national goals and needs and nurture the innovation ecosystem required for the country's targeted knowledge economy transformation.

The histories of the three merged institutions are integral to the vision and mission of the unified university. Khalifa University of Science, Technology and Research (KUSTAR) was inaugurated on 13 February 2007 by the President of the UAE, His Highness Sheikh Khalifa bin Zayed Al Nahyan, and had in its remit to provide Bachelor's, Master's and Doctoral-level education primarily in engineering and the sciences. The university opened its Abu Dhabi campus (now the Main Campus) in October 2008 to add to the campus in Sharjah (formerly Etisalat University College, EUC). The Sharjah branch campus, which has since closed, had a very proud history that stretched back to 1989.

The establishment of Masdar Institute of Science and Technology (MI) on 25 February 2007 as a graduate-only institute was part of a resource diversification plan for the Emirate of Abu Dhabi. Abu Dhabi's leadership views research and education in alternative energy fields as a cornerstone for the future development of the Emirate and expressed their commitment through the establishment of the Masdar Initiative, Masdar City, the Zayed Future Energy Prize (renamed Zayed Sustainability Prize), and the Masdar Institute.

The Petroleum Institute (PI) was established in 2000 through Emiri decree. Prior to the merger with KUSTAR and MI, it was financed and governed by a consortium of five major oil companies: ADNOC, Royal Dutch Shell, BP, Total S.A., and Japan Oil Development Company, a wholly owned subsidiary of INPEX. PI admitted its first students in the Fall of 2001 and offered Bachelor's and Master's programs, as well as a research program tailored to the needs of the oil and gas industry. The purpose of the PI, as part of Khalifa University, will continue to provide highly-trained engineers and geoscientists for the UAE oil, gas and broader energy industries.

University Vision and Mission Statement

To be a catalyst for the growth of Abu Dhabi and the UAE's rapidly developing knowledge economy, the engineering and science education destination of choice, and a global leader among research intensive universities in the 21st century.

University Strategic Goals

As a world-class, research-intensive institution, Khalifa University will:

- Set new standards in education, research, and scholarship that will benefit the UAE and the world.
- Drive Abu Dhabi and the UAE as a knowledge destination and engine for socio-economic growth through active translation of research into the nation's economy.
- Seamlessly integrate research and education to produce world leaders and critical thinkers in applied science, engineering, management, and medicine.
- Continuously innovate and integrate the global standard in methods of learning and discovery.
- Build a diverse community of service-oriented, ambitious and talented individuals, through an environment that encourages and nurtures creative

inquiry, critical thinking, and human values.

- Empower the community with practical and social skills, business acumen and a capability for lifetime learning that will enrich the workforce of the country.

Research

The KU research community responsibly manages funding, collaborations and research compliance in a manner consistent with international standards, and the mission and objectives of KU. The university provides support for the development, submission, and management of proposals and awards for both internal and external funding. KU's research priorities address specific industry and sector needs, technical platforms and expertise. These include clean and renewable energy, water and environment, hydrocarbon exploration and production, healthcare, aerospace, supply chain and logistics, advanced materials and manufacturing, robotics, AI and data science, information and communication technologies.

Licensure and Accreditation

Khalifa University of Science and Technology, located in the Emirate of Abu Dhabi, is officially licensed by the Ministry of Education of the United Arab Emirates to award degrees/qualifications in higher education. All the academic programs offered by Khalifa University of Science and Technology are accredited by the Commission for Academic Accreditation (CAA) of the United Arab Emirates.

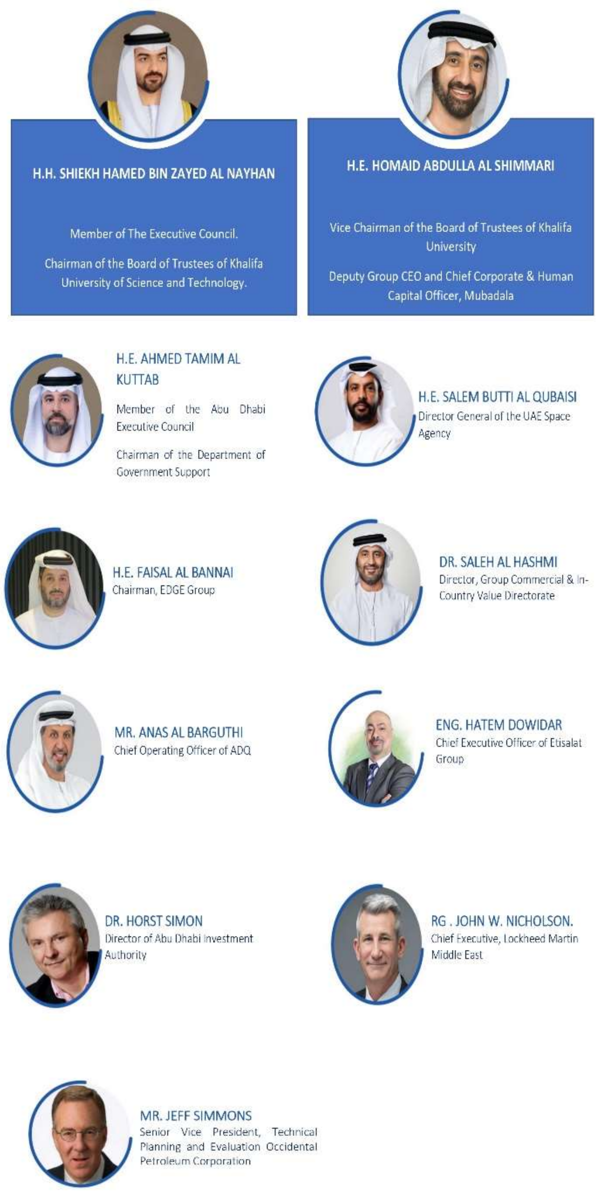
A number of our undergraduate programs are also accredited by the international engineering accreditation body ABET:

- BSc. Aerospace Engineering
- BSc. Biomedical Engineering
- BSc. Chemical Engineering
- BSc. Civil Engineering
- BSc. Computer Engineering
- BSc. Electrical Engineering
- BSc. Industrial and Systems Engineering
- BSc. Mechanical Engineering
- BSc. Petroleum Engineering
- BSc. Petroleum Geoscience

University Financial Resources

Khalifa University of Science and Technology is a not-for-profit, public institution. The core budget of the University is provided by the Government of the Emirate of Abu Dhabi. The University is a semi-government entity with an independent legal personality, financial and administrative independence, and full legal competence to practice its activities and achieve its objectives.

Board of Trustees



Chairman of the Board of Trustees of Khalifa University	H.H. Sheikh Hamed Bin Zayed Al Nahyan Member of the Abu Dhabi Executive Council
Vice Chairman of the Board of Trustees of Khalifa University	H.E. Homaid Abdulla Al Shimmari, Deputy Group CEO and Chief Corporate & Human Capital Officer,Mubadala
Member of the Board of Trustees of Khalifa University	H.E. Ahmed Tamim Al Kuttab, Member of the Abu Dhabi Executive Council Chairman of the Department of Government Support
Member of the Board of Trustees of Khalifa University	H.E. Salem Butti Al Qubaisi, Director General of the UAE Space Agency
Member of the Board of Trustees of Khalifa University	H.E. Faisal Al Bannai, Chairman, EDGE Group
Member of the Board of Trustees of Khalifa University	Dr. Saleh Al Hashmi, Director, Group Commercial & In-Country Value Directorate
Member of the Board of Trustees of Khalifa University	Mr. Anas Al Barguthi, Chief Operating Officer of ADQ
Member of the Board of Trustees of Khalifa University	Eng. Hatem Dowidar, Chief Executive Officer of Etisalat Group
Member of the Board of Trustees of Khalifa University	Dr. Horst Simon, Director of Abu Dhabi Investment Authority
Member of the Board of Trustees of Khalifa University	RG. John Nicholson, Chief Executive, Lockheed Martain Middle East
Member of the Board of Trustees of Khalifa University	Mr. Jeff Simmons, Senior Vice President, Technical Planning and Evaluation Occidental Petroleum Corporation

University Leadership

Prof. Sir John O'Reilly
President

Dr. Arif Sultan Al Hammadi
Executive Vice President

Dr. Bayan Sharif
Provost

Dr. Steven Wesley Griffiths
Senior Vice President, Research and Development

Dr. Ebrahim Al-Hajri
Senior Vice President, Support Services

Mr. Jalal El Jazzar
Senior Vice President, Finance and Investment

Dr. Yousof Al-Hammadi
Acting Senior Vice President, Academic and Student Services

Mr. Mosallam Suhail Al Katheeri
Vice President, Human Resources

Mr. Ebrahim Jafar Alahmed
Vice President, Finance and Budget

Mr. Rudolph Waels
Vice President, Investment

Mr. Abdulaziz Abdulla Al Khoori
Vice President, Audit

Mr. Adnan Jasem Al Mansoori
Vice President, Administration, Facilities and EHS

Mr. Esmaeel Abdulkarim Alahmed
Vice President, Procurement and Contracts

Mr. Fahem Salem Al Nuaimi
CEO Ankabut

Dr. David Sheehan
Dean of Science

Dr. Ehab El Sadaany
Acting Dean of Engineering

Dr. Senthil Kumar Rajasekaran
Acting Dean of Medicine and Health Sciences

Dr. Waleed Salem Alameri
Assistant Vice President, Student Affairs and Outreach

Dr. Mohamed Saeed Al Shehhi
Assistant Vice President, Strategic Enrollment Management

Dr. Abdulla Khaleifa Al Hefeiti
Assistant Vice President, Libraries

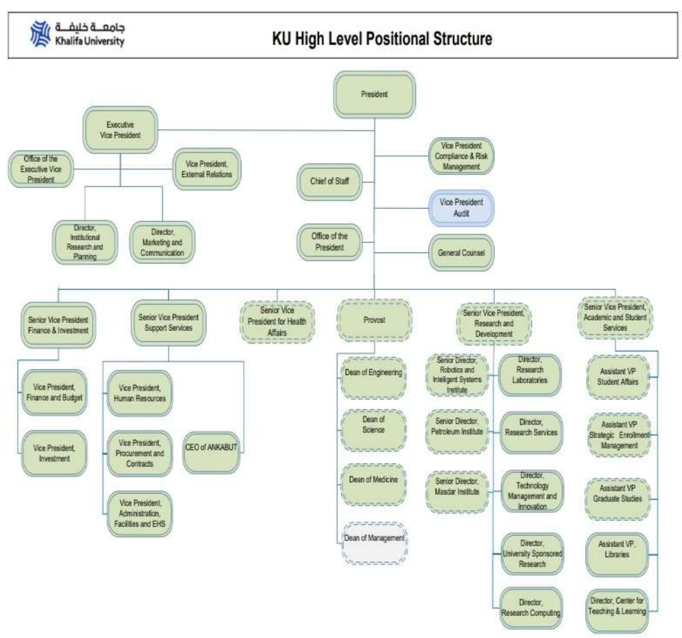
Dr. Ali Al Mansoori
Associate Provost for Education

Dr. Hassan Barada
Associate Provost for Faculty Affairs

Dr. Mahmoud Al Qutayri
Associate Provost for Academic Operations

Dr. Ahmed Al Durra
Associate Provost for Research

Organizational Structure



University Facilities

Main Campus

Banking Services

A number of ATMs are provided on the Main Campus for the convenience of students, faculty, and staff. The ATMs are located in the G-Building and near the E-Building reception area.

Building Access After-Hours

Students may be granted building access during non-operational hours provided that a responsible University employee completes an online request form and submits it to the relevant Department Head. The form must contain the names of each student being granted access and the termination date for this access. Student access will be automatically terminated at the end of each semester. The relevant Department Head and employee must approve the form. Facilities Management will reprogram the electronic lock within three days of the receipt of the request or issue a key as applicable.

Emergency Services

Emergency services are provided by the campus Security Department, which operates 24 hours daily. These services can be requested by calling or contacting the Security Department. Emergency phones are located throughout campus for your safety and convenience. Please refer to the University's Emergency Plan for additional information. Rapid response is generally initiated when Security Services is contacted by staff, students or visitors by:

- Calling to the emergency line 02 312 3999
- Approaching one of the Patrolling Security on the campus
- Any lift phone
- Alarm notification, e.g. fire alarm

Environment, Health, and Safety

The University conducts periodic Environment, Health and Safety (EHS) online training / briefings, which are mandatory for students. Students are responsible for understanding the environment, health and safety training materials and instructions presented at these briefings and for acting in accordance with them. Further information is available in the Environment, Health and Safety manuals.

In an engineering university, students are expected to use instruments, equipment, and materials that are potentially hazardous. For this reason, students are required to attend mandatory environment, health, and safety laboratory inductions and orientations, and to read the Environment, Health and Safety manuals associated with all lab and workshop activities. Students will not be allowed to participate in lab or workshop activities unless they have demonstrated clear understanding of the safety procedures involved and have approved risk assessment for the activities /experiment to be performed inside the lab.

Students may not work alone in a hazardous lab or workshop and report to EHS department in case of any incident or medical emergency. Inattention or disruptive behavior will not be tolerated in any lab or workshop activity. Repeated cases will be referred for disciplinary action. Equipment, tools, and materials must be handled in a manner that is safe for the student as well as for other students and the instructor. Students have a responsibility to report any infringements that they witness.

Food Outlets and Retailers

The primary dining area and main restaurant are located in the Student Hub, E-Building, and offers students a comfortable place to relax between classes, do classwork, or have a lunch or coffee with friends. There are a wide variety of restaurant and food options on the Main Campus, including:

- **Main Restaurant (So Daily)** - Located in (food court) building E, Ground floor. Breakfast is served from 7:30 AM to 11:00 AM and lunch from 11:00 AM to 4:00 PM.
- **Taboon** - Located in (food court) building E, Ground floor. Arabic food restaurant.
- **House Of Tea** - Located in (food court) building E, Ground floor. Cafeteria.
- **Basil** - Located in (food court) building E, Ground floor. Italian food restaurant.
- **Starbucks -** Located in building E, Ground floor. Café.

- **Blue Mart -** Located in building E, Ground floor. Mini mart.
- **Magrudy Enterprises -** Located in building E, Ground floor. Bookstore.
- **Acai Xpress** - Located in building E, Ground floor. Acai shop.
- **Chubby Cheeks** - Located in building D, Ground floor. Nursery.
- **Green for Life** - Located in the spine between C-D, Ground floor. Healthy snacks.
- **Haagen Dazs** - Located in the spine between B-C, Ground floor. Ice cream shop.
- **Shot café** - Located in building B, Ground floor (outdoor). Café.
- **Bike Shop** - Located in building B, Ground floor (outdoor). Khalifa University Bike Shop.
- **Delimarche (Lavazza)** - Located in building A, Ground floor. Café.
- **Oriental Spa** - Located in building D, First floor gym. Female Salon.
- **Costa** - Located besides of building R. Café.
- **Bloom Room** - Located besides of building R. Flower shop & Café.
- **Low Calories** - Located in building L, Ground floor. Healthy food restaurant.
- **Sky Line** - Located in building M, Ground floor. Electronics shop for student projects.
- **Geo Car wash -** Car wash service available in Main and SAN Campus parking.

Health Services

The Main Campus Clinic is located on the ground floor of D Building. Male and female nurses provide first aid services, emergency care and can also give advice on healthy lifestyle and other related health issues. Students are required to complete a Medical Record Form giving details of their medical history and specific instructions for emergency situations. Students should inform the nurse of any medical ailments or ongoing treatment. A female nurse is on full time duty to care for female students who require emergency treatment while on campus. Minor ailments will be treated at the First Aid Clinic in private treatment rooms. Clinics are also located in the female dorm at Umm Al Lulu and female dorm Resident Hall.

In cases of accident or emergency, a nurse is on call to attend to the patient. Except in life threatening situations, the patient will not be moved, until an authorized person arrives and assesses the injury. Guardians will be notified as quickly as possible and instructions on the student's Medical Record Form adhered to where possible.

Nursery

The Nursery is planned to open on the Main Campus. The aim of the Nursery is to provide a warm, caring and safe environment for the small children of our students, to develop their abilities by using play and planned activities for all age ranges. We look forward to working with you and your child to ensure that their time spent at the nursery is productive and happy.

Prayer Rooms

Purpose built rooms are located across all campuses for prayers, including separate areas for wudhu ablution. Prayer rooms for male and female students are located in the R-Building, L-Building, G-Building and E-Building.

Safety and Security

The University maintains public areas that are open, well-lit and staffed by receptionists and uniformed security personnel. Although movement on the campus is free, female students are encouraged not to linger in public areas in the interest of safety. Female students may request a personal safety escort to and from any campus location, should they be on campus after dark.

Sport Facilities

All sports and fitness facilities are gender specific and provided for the use of University students with a valid student card. The facilities are strictly for the University's students, staff and faculty and all users are required to produce their ID cards if so requested by staff manning the Reception area or security. The Sports Complex in the Main Campus is located in Building D, next to the Student Hub. The state-of-the-art sports facility includes:

- Climbing wall (planned to open inside female gym)
- Squash court (located inside male gym)
- Weightlifting area (male/female sections)
- Cardio area (male/female sections)

- Stretching area
- Group exercise studios (three studios for each gender)
- Multi-use indoor fields for basketball, football, handball, volleyball, badminton, etc.
- Table tennis room
- Outdoor tennis court
- Outdoor basketball court (5 on 5)
- Outdoor running track / tracking field
- Outdoor miniature basketball court (3 on 3)

Student Lounges

Separate lounge areas are provided for male and female students. Please refer to the campus map to locate the student lounges.

Main Campus Map

Sas Al Nakhl Campus

Banking Services

A number of ATMs are provided on the SAN Campus for the convenience of students, faculty, and staff. The ATMs are located in Bu Hasa and Arzanah building.

Dining Services

ADNH (So Daily) cafeterias, open for breakfast, lunch, and snacks, are located in Habshan, and Satah Buildings. Costa café is also available in Bu Hasa and Arzanah Buildings offering coffee, breakfast, light lunch and snacks. Green for Life healthy restaurant available in building Zarkuh, Shot Café available in Ruwais building and ADNOC Oasis convenience store is located in the center of the Campus.

House Of Tea - Located in (Student Center) Satah building, Ground floor. Cafeteria.

Green for Life - Located in (Zarkuh) Building 1. Healthy snacks.

Costa - Located in (Bu Hasa) Building 2 & (Arzanah) Building 8. Café.

Shot café - Located in (Ruwais) Building 3. Café

CAF - Located in (Arzanah) Building 8. Café

Geo Car wash - Car wash service available in Main and SAN Campus parking.

Health Services

First Aid Clinics provide primary health care to the students, faculty, and staff members on the Sas Al Nakhl Campus. The Sas Al Nakhl Clinic (open to male) is open 24-hour 7 days, accident and emergency care. Depending on the nature of the illness, patients may be referred to other hospitals or clinics for further treatment and for female student's service available from 8am to 4pm Monday to Friday.

Housing

The Um Al Lulu Housing Complex at SAN Campus houses female graduate students. Each student is provided with a single bedroom, as well as a shared living room and kitchen facilities. Daily shuttle bus to Main Campus.

Prayer Rooms and Masjid

Purpose built rooms are located across all campuses for prayers, including separate areas for wudhu ablution. Prayer rooms are available in Bu Hasa, Ruwais and Arzanah as well as main Masjid behind Habshan building.

Sports and Fitness Facilities

The men's section of the campus has a grass soccer field and outdoor basketball court. The second floor of the Satah, Student Center houses a variety of fitness and weightlifting equipment and is open for use from 7:00am - 11:00pm daily. A variety of indoor and outdoor facilities is available:

- Indoor pool / billiards (Satah 2nd floor)
- Indoor table tennis (Satah 2nd floor)
- Outdoor football (2 Grass fields)
- Falcon outdoor court (basketball, volleyball and

badminton)

The women's section of the campus features a gym, an outdoor volleyball and badminton court and a jogging and circuit fitness track. Regular intramural sports tournaments are organized, including indoor soccer, basketball, volleyball and table tennis. The women's dorm has a multi-function fitness room in Tower 2, the main administrative building. Furthermore, one of the residential villas contains a variety of fitness equipment, bicycle 'spinning' room and floor exercise facilities.

Student Centers

The Student Centers are located in the Bu Hasa Building in the co-ed section and the Arzanah Building in the women's section. A number of student lounges are also available. These student-centered facilities provide a dedicated setting for social, organizational, and extracurricular activities. The Student Centers are equipped with computers, gaming tables, large flat screen televisions, etc.

Sas Al Nakhl Campus Map

Graduate Programs and Degree Structure

Khalifa University of Science and Technology (KU) offers a range of graduate programs designed for the pursuit of advanced specialized knowledge and skills in engineering, medicine, security, science and technology. Students engage in cutting-edge research and formulate innovative solutions to contemporary global challenges. Selected programs also allow students to focus their coursework in a chosen area via an optional track or concentration.

Master of Arts (MA)

Program Outline

The Master of Arts (MA) is designed for students seeking advanced training in fields focused on international, regional and civil security. The MA is a nationally-ranked, research-intensive, graduate program which advances the critical and analytical skills of students. KU offers the following MA program:

- International and Civil Security *(Program offered to UAE Nationals only)*

Program Components

The MA program typically consists of 30 credit hours.

- *Taught Courses:* In this component students are required to complete a program of advanced study in a given area. The taught courses component is equivalent to a minimum of 21 credit hours and typically consists of seven courses comprising a combination of core and electives.
- *Thesis:* In this component students are required to carry out an independent investigation in their chosen area of study. The thesis component is typically equivalent to a minimum of 9 credit hours. Students must successfully defend the thesis in an oral examination.

Master of Engineering (MEng)

Program Outline

The Master of Engineering (MEng) is directed towards engineers that would like to pursue advanced studies and intend to have a professional career in industry. The program consists of courses, which emphasize applications of fundamental engineering concepts to industrial problems, including advanced technical and business management elements. KU offers MEng programs in:

- Health, Safety and Environmental Engineering

Program Components

A MEng by Courses degree typically consists of a minimum of 30 credit hours.

- *Taught Courses:* In this component the student is required to complete a set of taught core and elective courses equivalent to a minimum of 30 credit hours.

Master of Science (MSc)

Program Outline

The Master of Science (MSc) programs emphasize fundamental concepts and are designed for students that wish to become involved in research, either through a PhD degree or in a corporate environment. The MSc program consists of core and elective courses, as well as research work culminating in a Master's thesis. KU offers MSc programs in:

- Aerospace Engineering
- Applied Chemistry
- Biomedical Engineering
- Chemical Engineering
- Civil and Infrastructural Engineering
- Computational Data Science
- Computer Science
- Cyber Security
- Electrical and Computer Engineering
- Engineering Systems and Management
- Materials Science and Engineering
- Mechanical Engineering
- Medical Physics
- Nuclear Engineering *(Program offered to UAE National and sponsored Saudi Arabia National students only)*

- Petroleum Engineering
- Petroleum Geoscience
- Sustainable Critical Infrastructure
- Water and Environmental Engineering

Program Components

An MSc by Courses and Thesis program typically consists of:

- *Taught Courses:* In this component the student is required to complete a program of advanced study in a given area. The taught courses component typically comprises a combination of core and elective courses.
- *Thesis:* In this component the student is required to carry out an independent investigation in the area of study. The student must successfully defend the thesis in an oral examination.

Accelerated Master's Program

The Accelerated Master of Science Programs enable exceptional senior undergraduate students to start earning credits towards their Master's while pursuing their undergraduate education.

Through the Accelerated MSc program option, highly motivated students with the help of their academic advisors can plan to finish their undergraduate and Master's degrees within a minimum period of five years.

The accelerated program is intended to allow undergraduate students to register for a maximum of two Master level courses, where these courses can count to satisfy the technical elective requirement for the undergraduate level. It is required that an undergraduate CGPA of at least 3.5 is maintained and grades of B or better are received in the completed dual-counted graduate courses. To be able to apply to the Accelerated Master of Science Programs, students must be on senior standing and having a minimum CGPA 3.5. Students wishing to apply for the Accelerated Master of Science Programs must complete the application form, which is available from the Registrar's Office. To be granted permission for the Accelerated Master of Science Programs, the application should be approved by the Scholarship Office, the Academic Advisor, the Department Head, the Associate Dean of Undergraduate Studies and finally the Associate Dean for Graduate Studies at the relevant College.

Doctor of Philosophy (PhD)

Program Outline

The Doctor of Philosophy (PhD) endeavors to stimulate research and development to foster innovative solutions to challenges in science, technology, and engineering. The PhD programs are structured with integral taught core and elective courses in addition to the central research component. A shared pool of elective courses from different departments is available to students undertaking each program. KU offers the following PhD programs:

College of Science

- PhD in Chemistry
- PhD in Earth Sciences
- PhD in Mathematics
- PhD in Physics

College of Engineering

- PhD in Engineering:
    - Aerospace Engineering
    - Biomedical Engineering
    - Chemical Engineering
    - Civil Infrastructure and Environmental Engineering
    - Electrical and Computer Engineering
    - Engineering Systems and Management
    - Material Science and Engineering
    - Mechanical Engineering
    - Nuclear Engineering *(Program offered to UAE National and sponsored Saudi Arabia National students only)*
    - Petroleum Engineering
    - Robotics

Program Components

The PhD program typically consists of 60 credit hours for the regular PhD (With MSC) and 72 credit hours for the Direct PhD (Without MSC).

- *Taught Courses:* In this component the student is required to complete a program of advanced study in a given area. The taught courses component is equivalent to a minimum of 24 credit hours and typically consists of eight courses comprising one core course and seven electives for the Regular PhD (With MSC) programs. and 36 credit hours comprising four core courses and seven electives for the Direct PhD (Without MSC).
- *Dissertation:* In this component the student is required to carry out an independent investigation in the area of study. The research component is typically equivalent to a minimum of 36 credit hours. The student must successfully defend the dissertation in an oral examination.

For the award of the PhD degree, the student must satisfy the following requirements:

- *Courses:* The student must satisfy all taught course requirements of the program.
- *Written Qualifying Examination (WQE):* The student must successfully pass a written qualifying examination on a set of topical areas.
- *Research Proposal Examination (RPE):* The student must prepare a research proposal and pass an oral research proposal examination before being allowed to progress further in the program.
- *Dissertation Examination:* The student must complete a dissertation on original research and defend it successfully in a dissertation oral examination (Dissertation Defense).

Doctor of Medicine (MD)

The mission of the College of Medicine and Health Sciences is to enhance the healthcare ecosystem of Abu Dhabi and the United Arab Emirates through outstanding education, research, healthcare, and service to the community. The Doctor of Medicine program is a four-year, graduate-level degree program that prepares the highest quality physicians who are able to seamlessly integrate technology into medical practice.

Medical students must meet established minimum requirements in order to complete the Doctor of Medicine (MD) degree. For the award of the MD degree, the student must meet the following requirements for promotion and graduation:

- *Promotion to Period 2:* Students must pass all courses (P or PR) in Period 1 and meet the Professionalism Standards and Technical Standards of the CMHS.
- *Promotion to Period 3:* Students must pass all courses (P or PR) in Period 2 and meet the Professionalism Standards and Technical Standards of the CMHS.
- *Promotion to Period 4:* Students must pass all courses and clerkships (P or PR) in Period 3 and meet the Professionalism Standards and Technical Standards of the CMHS.
- *Graduation:* Students must pass all required courses and complete the required number of elective courses in Period 4; complete all Period 4 capstone requirements; and meet the Professionalism Standards and Technical Standards of the CMHS. Students must take the International Foundations of Medicine (IFOM) examination; additional examinations are required for application to residency training programs outside of the UAE or USA. Students must complete all of these requirements within 6 years of enrollment in the MD degree program (excluding leaves of absence for military service).

For policies and processes concerning the College of Medicine and Health Sciences, please refer to the *CMHS Medical Student Handbook.*

Program Concentrations and Tracks

The below definitions of concentrations and tracks are applicable unless stated otherwise in the relevant section of the specific program outline. Students should familiarize themselves with the definitions and requirements applicable to their program of study.

Concentration

Concentrations refer to a grouping of courses which represent a sub-specialization taken within the major field of study. A concentration at Khalifa University of Science and Technology leads to a specialized degree. It will be specified on the student’s academic record (transcript), and/or the degree certificate, depending on the program.

Track

A track is a narrow area within the major field of study which the student may choose to follow, but does not lead to a specialized award or degree and is not listed on the diploma nor the academic record (transcript). Tracks are normally used to help students focus their selection of advanced elective courses within the chosen program.

Graduate Admission and Scholarships

Admission to graduate programs at Khalifa University of Science and Technology is open to highly qualified students from the UAE and abroad. Admission of graduate students is governed by KU Academic Policy *ACA 5150 Graduate Admissions.* For policies and processes concerning the College of Medicine and Health Sciences, please refer to the *CMHS Medical Student Handbook.*

Required Qualifications

Full Admission

Applicants seeking admission to a graduate program at Khalifa University must meet the following *minimum* criteria in order for the application to be considered:

Master's Program Applicants

- Completed Bachelor's degree in a relevant discipline with a minimum Cumulative Grade Point Average (CGPA) of 3.0 out of 4.0, or equivalent, from an accredited institution;
- Minimum level of English proficiency in the form of an iBT TOEFL (internet-based test) score of 91 or equivalent, an overall academic IELTS score of 6.5, or an EmSAT English score of 1550;
- Minimum quantitative score of 150 in the general Graduate Record Examination (GRE) for all programs, with the exception of Master of Engineering in Health, Safety and Environment Engineering and the Master of Arts in International and Civil Security, where a minimum threshold is not set. Applicants for all programs should attempt all three sections of the GRE.
- Statement of Purpose (500 – 1,000 words);
- Minimum of two referee recommendations; and
- Admission interview.

Doctorate Program Applicants

- Completed Master's degree in a relevant discipline with a minimum CGPA of 3.25 out of 4.0, or equivalent, from a reputable accredited institution;
- Minimum level of English proficiency in the form of an iBT TOEFL (internet-based test) score of 91 or equivalent, an overall academic IELTS score of 6.5, or an EmSAT English score of 1550;
- Minimum quantitative score of 150 in the general Graduate Record Examination (GRE) is required for admission to all Doctorate programs. Applicants for all programs should attempt all three sections of the GRE;
- Minimum of two referee recommendations;
- Statement of Purpose (500-1,000 words);
- Research Statement (500-1,000 words); and
- Admission interview.

Subject to review and approval, the English test score requirement may be waived for an applicant who is:

- A native English speaker who has completed his/her Bachelor's/Master's qualification in an English medium institution, or
- A graduate from an English-medium institution who can provide evidence of acquiring a minimum overall academic IELTS score of 6.0, or a minimum TOEFL score of 79 iBT (or equivalent), or a minimum EmSAT English score of 1400 at the time of admission to the completed Bachelor's/Master's degree program.

All applicants must provide evidence of meeting the English language requirement by uploading the relevant document with their application, even if he/she may be eligible for an exemption.

Conditional Admission

- Applicants with a lower CGPA score (minimum 2.5 out of 4.0 or equivalent) may be considered for conditional admission to a Master's program in special circumstances. If conditional admission is granted, the student must achieve a minimum CGPA of 3.0 out of 4.0 in the first nine credits of taught courses. In addition, each academic program has specific conditions that must be satisfied for the student to remain in the program. If the student fails to satisfy the conditions, then his/her registration will be terminated.
- Applicants with a recognized Bachelor degree and

iBT TOEFL score of 79 or equivalent, or an overall academic IELTS score of 6.0, or an EmSAT English score of 1400 may be considered for conditional admission to a Master's program in special circumstances. If conditional admission is granted, the student must achieve a minimum iBT TOEFL score of 91 or equivalent, or an overall academic IELTS score of 6.5 by the end of his/her first semester of registration.

- Applicants who do not attain the minimum GRE quantitative score required for the relevant Master's program may be considered for conditional admission. If conditional admission is granted, the student will be required to achieve a minimum GRE quantitative score of 150 by the end of his/her first semester of registration.
- Applicants with insufficient prior background in the chosen Master's or Doctorate program may be considered for conditional admission, but will be assigned undergraduate and/or graduate courses and/or specially tailored remedial courses as specified by the relevant program. Credits from these prerequisite bridging courses do not count toward fulfilment of the particular degree requirements and are not used to calculate the graduate Cumulative Grade Point Average (CGPA).

Transfer Students

A student who has completed at least one semester of graduate studies at an accredited or recognized institution may be considered for admission as a transfer student. Admission as a transfer student is highly competitive and is based on the number of students that can be accommodated in a particular program or level of study. The decision to admit a transfer student takes into account the student's record of achievement in both undergraduate and graduate studies. The following rules apply:

- Only students in good academic standing with a cumulative grade point average (CGPA) of 3.0 or greater (out of 4.0, or equivalent) will be considered for transfer admission.
- Only students transferring from a federal or recognized and lawfully accredited institution in the UAE, or a recognized and lawfully accredited foreign institution of higher learning, are eligible for admission.
- Transfer applicants must meet the Khalifa University graduate program admission requirements in effect for the semester in which they intend to enroll.
- Official transcripts from all institutions of higher learning previously attended must be submitted.
- Students must be eligible to continue their enrollment at the institution from which they wish to transfer.
- Up to a maximum of nine credit hours may be approved as transfer credits for taught graduate courses.
- Graduate courses with a minimum grade of B and deemed equivalent in content and level to those offered at KU will be transferred as equivalent KU courses. Other appropriate graduate courses with a minimum grade of B may be transferred as free/open electives or unassigned courses in the relevant area. No transfer credit will be awarded for taught coursework taken on a pass/fail basis.
- Courses completed more than five years prior to being admitted as a graduate student at KU are not transferable.
- Graduate program credits will not be given for work experience, vocational or training courses or coursework that is not considered graduate level.

If a transfer student is admitted, the student may request to transfer courses and credit hours (not grades) from the student's previous institution to Khalifa University. This request and all supporting documents must be submitted at least two weeks prior to the start date of the first semester of enrollment at KU. A decision to accept a course in transfer will be provided before the end of the Add/Drop period of that semester. The decision to accept a course in transfer is discretionary. The application for transfer credit hours will follow the policy provisions of KU Academic Policy *ACA 3270 Transfer Credits and Advanced Standing.* The CMHS MD degree program does not accept transfer students.

Admission of Non-Degree Seeking Students

At the discretion of the University, a limited number of individuals may be admitted as non-degree seeking students on either a full-time or part-time basis. Non-degree students are not candidates for a KU degree and may be enrolled temporarily for personal/professional improvement. Admission of non-degree seeking students is governed by KU Academic Policy *ACA 5150 Graduate Admissions.*

- Non-degree seeking students must demonstrate that they are qualified to undertake graduate course work, satisfy the admission and English proficiency requirements at the time of their admission, and have met prerequisite requirements for any courses taken.
- Students enrolling in courses as an exchange student are governed by the exchange agreement between KU and the student's home institution.
- Admission as a non-degree graduate student is valid only for one semester and a new application for each subsequent semester must be approved. Approval can only be granted if the student has earned a minimum grade of B in all courses taken in previous semesters.
- Admission as a non-degree graduate student does not imply any commitment on the part of KU toward an individual's admissibility to regular student status. If a non-degree graduate student is subsequently admitted as a regular graduate student, courses completed may be used in partial fulfillment of the requirements for an advanced degree. The program faculty will determine the extent to which the courses meet the requirement of the desired program.

Deferred Admission

Admission is valid only for the academic semester specified in the offer letter. If an applicant is offered admission, but for any reason intends to join the University in a subsequent semester, then he/she must submit a written request to the Admissions Team. Requests for deferred admission are subject to approval and the following guidelines:

- Admission may normally be deferred for one regular semester only. The University reserves the right not to offer admission deferral.
- Deferral for National Service is automatically granted. The student must register for classes in the semester immediately following the completion of National Service.
- If a student is unable to enroll in the semester to which they were deferred, he/she must re-apply for admission.

Application Procedure

Applications for Khalifa University graduate programs are accepted online, via the University's Graduate Admission Portal. Applications must be made by the deadline published on the University website for the relevant semester (Fall or Spring). Applicants must complete the application form and upload the following documents (incomplete applications may not be considered):

- Certified copy of Bachelor's/Master's degree certificate.
- Certified copy of Bachelor's/Master's transcript showing the grading scale.
- Equivalency certificate(s) issued by the UAE Ministry of Education for applicants that have graduated from institutions outside of the UAE.
- English language proficiency score certificate (IELTS, TOEFL or EmSAT). Official TOEFL score reports can be sent directly by your institution to Khalifa University of Science and Technology using the institutional TOEFL code 0960.
- Graduate Record Examination (GRE) score report. Official score reports can be sent directly to Khalifa University of Science and Technology using the institutional GRE code 0822.
- Detailed Curriculum Vitae (CV).
- Statement of Purpose (500 to 1,000 words)
- Research Statement (500 to 1,000 words – PhD applicants only)
- Passport-style photograph on a white background.
- Valid passport (for UAE National applicants should include the union number page).
- Valid UAE visa (for international applicants who reside in the UAE).
- Valid Emirates ID Card (for UAE National and international applicants who reside in the UAE).
- Family Book (Khulasat Al Qaid for UAE National applicants only).

All documents supplied for admission purposes become the property of the University and will not be returned to the applicant.

Admission decisions are made in good faith and on the basis of the information provided in the application form. The University reserves the right to withdraw any admission offer or terminate a student's registration if it is found that an applicant has made a false statement or has omitted significant information.

Scholarships

Khalifa University offers graduate students comprehensive scholarships that cover educational expenses and may provide an opportunity to earn a monthly stipend. Please refer to the University website for detailed information on the range of scholarships available. Graduate scholarship provisions are governed by KU Academic Policy *ACA 5160 Graduate Scholarships and Stipends.*

Applicants to Khalifa University graduate programs are automatically considered for a scholarship, if applicable. No additional scholarship application is required. The recipients will be confirmed at the conclusion of the admission process.

All graduate students admitted under a Khalifa University scholarship must sign the relevant award contract or agreement before the end of the Add/Drop period in the first semester of registration. Students must abide by the terms and conditions stipulated in the award contract or agreement to maintain scholarship eligibility. KU scholarship students are required to pay a security deposit during the first semester of registration, by the deadline indicated in the Fees and Payment Guide provided to students via e-mail.

Master Scholarship for International Students

The scholarship supports international students pursuing a Master's degree at Khalifa University. Scholarship eligibility is assessed as part of the admission process and applicants are not required to submit a separate scholarship application. The number of available scholarship slots is limited. All applicants are evaluated and mapped to a specific scholarship Tier on the basis of academic merit and other relevant factors, in line with Khalifa University's strategic priorities, rules and regulations. Meeting the minimum eligibility criteria does not guarantee a scholarship award.

Tier I and Tier II

- Full coverage of tuition fees.
- Textbooks provided by the University.
- Free University accommodation for eligible full-time students only.
- Medical insurance coverage for full-time international students sponsored by Khalifa University.
- Mobilization and demobilization flights for full-time overseas international students.
- Coverage of UAE visa application fees for full-time international students.

Tier III

- 50% waiver of tuition fees.
- Textbooks provided by the University.
- Medical insurance coverage for full-time international students sponsored by Khalifa University.
- Mobilization and demobilization flights for full-time overseas international students.
- Coverage of UAE visa application fees for full-time international students.

Tier IV

- Textbooks provided by the University.
- Medical insurance coverage for full-time international students sponsored by Khalifa University.
- Mobilization and demobilization flights for full-time overseas international students.
- Coverage of UAE visa application fees for full-time international students.

Master Scholarship for UAE National Students

The scholarship supports UAE National students pursuing a Master's degree at Khalifa University. Scholarship eligibility is assessed as part of the admission process and applicants are not required to submit a separate scholarship application. The number of available scholarship slots is limited. All applicants are evaluated and mapped to a specific scholarship Tier on the basis of academic merit and other relevant factors, in line with Khalifa University's strategic priorities, rules and regulations. Meeting the minimum eligibility criteria does not guarantee a scholarship award.

Tier I and Tier II

- Full coverage of tuition fees.
- Textbooks provided by the University.
- Free University accommodation for eligible full-time students only.

Tier III

- 50% waiver of tuition fees.
- Textbooks provided by the University.

Tier IV

- Textbooks provided by the University.

PhD Scholarship for UAE National Students

The scholarship supports UAE National students pursuing a Doctoral degree at Khalifa University. Scholarship eligibility is assessed as part of the admission process and applicants are not required to submit a separate scholarship application. The number of available scholarship slots is limited. All applicants are evaluated and mapped to a specific scholarship Tier on the basis of academic merit, research potential and other relevant factors, in line with Khalifa University's strategic priorities, rules and regulations. Meeting the minimum eligibility criteria does not guarantee a scholarship award.

Research Path (with work commitment)

Scholarship offered to full-time PhD students only. Students are reassessed for scholarship eligibility annually.

Tier I (Full-Time only)

- Full coverage of tuition fees.
- Basic monthly stipend of 25,000 AED (pensionable).
- Additional monthly allowance of 35,000 AED, subject to approval and meeting scholarship progression criteria.
- Registration in the Abu Dhabi Retirement Pensions and Benefits Fund.
- Textbooks provided by the University.
- Support to attend international research conferences, subject to approval.
- Commitment to work with Khalifa University or a nominated entity upon graduation for a period equivalent to the period of study. The University reserves the right for any reason not to offer the student a post after graduation.

Tier II (Full-Time only)

- Full coverage of tuition fees.
- Basic monthly stipend of 25,000 AED (pensionable).
- Additional monthly allowance of 15,000 AED, subject to approval and meeting scholarship progression criteria.
- Registration in the Abu Dhabi Retirement Pensions and Benefits Fund.
- Textbooks provided by the University.
- Support to attend international research conferences, subject to approval.
- Commitment to work with Khalifa University or a nominated entity upon graduation for a period equivalent to the period of study. The University reserves the right for any reason not to offer the student a post after graduation.

Tier III (Full-Time only)

- Full coverage of tuition fees.
- Monthly stipend of 25,000 AED (pensionable).
- Registration in the Abu Dhabi Retirement Pensions and Benefits Fund.
- Textbooks provided by the University.
- Support to attend international research conferences, subject to approval.
- Commitment to work with Khalifa University or a nominated entity upon graduation for a period equivalent to the period of study. The University reserves the right for any reason not to offer the student a post after graduation.

Tier IV (Full-Time only)

- 75% waiver of tuition fees.

- Free University accommodation for eligible full-time students only.
- Textbooks provided by the University.
- Commitment to work with Khalifa University or a nominated entity upon graduation for a period equivalent to the period of study. The University reserves the right for any reason not to offer the student a post after graduation.

Study Path (without work commitment)

Students are reassessed for scholarship eligibility annually.

Tier I (Full-Time only)

- Full coverage of tuition fees.
- Monthly stipend of 10,000 AED.
- Free University accommodation for eligible full-time students only.
- Textbooks provided by the University.
- Support to attend international research conferences, subject to approval.

Tier II (Full-Time only)

- Full coverage of tuition fees.
- Monthly stipend of 5,000 AED.
- Free University accommodation for eligible full-time students only.
- Textbooks provided by the University.
- Support to attend international research conferences, subject to approval.

Tier III (Full-Time or Part-Time)

- 50% waiver of tuition fees.
- Free University accommodation for eligible full-time students only.
- Textbooks provided by the University.

Tier IV (Full-Time or Part-Time)

- 25% waiver of tuition fees.
- Free University accommodation for eligible full-time students only.
- Textbooks provided by the University.

PhD Scholarship for International Students

The scholarship supports international students pursuing a Doctoral degree at Khalifa University. Scholarship eligibility is assessed as part of the admission process and applicants are not required to submit a separate scholarship application. The number of available scholarship slots is limited. All applicants are evaluated and mapped to a specific scholarship Tier on the basis of academic merit, research potential and other relevant factors, in line with Khalifa University's strategic priorities, rules and regulations. Meeting the minimum eligibility criteria does not guarantee a scholarship award.

Research Path (with work commitment)

Scholarship offered to full-time PhD students only. Students are reassessed for scholarship eligibility annually.

Tier I (Full-Time only)

- Full coverage of tuition fees.
- Basic monthly stipend of 20,000 AED.
- Additional monthly allowance of 20,000 AED, subject to approval and meeting scholarship progression criteria.
- Textbooks provided by the University.
- Support to attend international research conferences, subject to approval.
- Medical insurance coverage for full-time international students sponsored by Khalifa University.
- Mobilization and demobilization flights for full-time overseas international students.
- Coverage of UAE visa application fees for full-time international students.

- Commitment to work with Khalifa University or a nominated entity upon graduation for a period equivalent to the period of study. The University reserves the right for any reason not to offer the student a post after graduation.

Tier II (Full-Time only)

- Full coverage of tuition fees.
- Basic monthly stipend of 20,000 AED.
- Additional monthly allowance of 10,000 AED, subject to approval and meeting scholarship progression criteria.
- Textbooks provided by the University.
- Support to attend international research conferences, subject to approval.
- Medical insurance coverage for full-time international students sponsored by Khalifa University.
- Mobilization and demobilization flights for full-time overseas international students.
- Coverage of UAE visa application fees for full-time international students.
- Commitment to work with Khalifa University or a nominated entity upon graduation for a period equivalent to the period of study. The University reserves the right for any reason not to offer the student a post after graduation.

Tier III (Full-Time only)

- 75% waiver of tuition fees.
- Monthly stipend of 20,000 AED.
- Textbooks provided by the University.
- Support to attend international research conferences, subject to approval.
- Medical insurance coverage for full-time international students sponsored by Khalifa University.
- Mobilization and demobilization flights for full-time overseas international students.
- Coverage of UAE visa application fees for full-time international students.
- Commitment to work with Khalifa University or a nominated entity upon graduation for a period equivalent to the period of study. The University reserves the right for any reason not to offer the student a post after graduation.

Tier IV (Full-Time only)

- 50% waiver of tuition fees.
- Free University accommodation for eligible full-time students only.
- Textbooks provided by the University.
- Medical insurance coverage for full-time international students sponsored by Khalifa University.
- Mobilization and demobilization flights for full-time overseas international students.
- Coverage of UAE visa application fees for full-time international students.
- Commitment to work with Khalifa University or a nominated entity upon graduation for a period equivalent to the period of study. The University reserves the right for any reason not to offer the student a post after graduation.

Study Path (without work commitment)

Students are reassessed for scholarship eligibility annually.

Tier I (Full-Time only)

- Full coverage of tuition fees.
- Monthly stipend of 4,000 AED.
- Free University accommodation for eligible full-time students only.
- Textbooks provided by the University.
- Support to attend international research conferences, subject to approval.
- Medical insurance coverage for full-time international students sponsored by Khalifa University.

- Mobilization and demobilization flights for full-time overseas international students.
- Coverage of UAE visa application fees for full-time international students.

Tier II (Full-Time only)

- 75% waiver of tuition fees.
- Monthly stipend of 2,000 AED.
- Free University accommodation for eligible full-time students only.
- Textbooks provided by the University.
- Support to attend international research conferences, subject to approval.
- Medical insurance coverage for full-time international students sponsored by Khalifa University.
- Mobilization and demobilization flights for full-time overseas international students.
- Coverage of UAE visa application fees for full-time international students.

Tier III (Full-Time or Part-Time)

- 50% waiver of tuition fees.
- Free University accommodation for eligible full-time students only.
- Textbooks provided by the University.
- Medical insurance coverage for full-time international students sponsored by Khalifa University.
- Mobilization and demobilization flights for full-time overseas international students.
- Coverage of UAE visa application fees for full-time international students.

Tier IV (Full-Time or Part-Time)

- 25% waiver of tuition fees.
- Free University accommodation for eligible full-time students only.
- Textbooks provided by the University.
- Medical insurance coverage for full-time international students sponsored by Khalifa University.
- Mobilization and demobilization flights for full-time overseas international students.
- Coverage of UAE visa application fees for full-time international students.

International Buhooth Scholarship for UAE National Students

The International Buhooth Scholarship Program is an ambitious initiative that aims to achieve the vision of His Highness Sheikh Mohammed Bin Zayed Al Nahyan, President of the United Arab Emirates and Ruler of Abu Dhabi, to transform the UAE into a center of excellence in engineering and science research. The initiative offers scholarships to UAE Nationals with the aim of promoting graduate studies and research, as well as developing specialized human capital in the areas of science and engineering for the benefit of national institutions. Students accepted to the International Buhooth program will be registered in selected graduate programs offered by top international universities.

International Buhooth Scholarship Benefits

Please note that scholarship benefits are subject to change.

- Full coverage of tuition fees.
- Monthly stipend.
- Additional overseas allowance, applicable while student is residing overseas.
- Support to attend international research conferences, subject to approval.
- Registration in the Abu Dhabi Retirement Pensions and Benefits Fund.
- Commitment to work with Khalifa University or a nominated entity upon graduation for a period equivalent to the period of study. The University reserves the right for any reason not to offer the student a post after graduation.
- International Buhooth scholarship recipients will

receive medical insurance for themselves, their spouse and eligible dependents.

- Recipients of this scholarship are eligible for yearly round trip airline tickets for themselves, their spouse and eligible dependents.

Eligibility Criteria for International Buhooth Scholarship

- Applicants must be UAE Nationals.
- Applicants must have graduated from Khalifa University. On an exceptional basis, graduates from other institutions may be considered.
- Applications must be submitted online, through the Khalifa University Admission Portal. Applicants must satisfy the full admission requirements of the Khalifa University academic program that they are applying to with the following minimum CGPA criteria:
- Minimum Bachelor CGPA of 3.50 (or equivalent) for applications to Master's programs.
- Minimum Bachelor CGPA of 3.50 (or equivalent) and Master CGPA of 3.70 (or equivalent) for applications to PhD programs.
- Applicants must provide an admission offer letter from a top-ranked international institution (preferred top 50 QS or THE ranking). The letter should be submitted at the time of application to Khalifa University.
- The scholarship is open for selected majors only, as determined by Khalifa University of Science and Technology.
- The scholarship is highly competitive and will only be offered to a limited number of successful applicants each year.

How to Apply

Please refer to the Graduate Admissions webpage for details on how to apply to Khalifa University of Science and Technology. Applicants are automatically considered for a graduate scholarship, if applicable. No additional scholarship application is required. The recipients will be confirmed at the conclusion of the admission process.

China Scholarship Council / Khalifa University Joint PhD (CSC-KU) Scholarship – China National Students

Khalifa University, in collaboration with the China Scholarship Council (CSC), offers the CSC-KU Scholarship to highly qualified Chinese nationals admitted to a PhD in Engineering or Science on a full-time basis. The scholarship benefits include:

- Monthly stipend from KU and an additional stipend from CSC.
- Flight tickets provided by CSC.
- Full coverage of tuition fees and any research-associated fees.
- Free University accommodation for the student only (or accommodation assistance only if University accommodation is not available for the eligible student, as per the University's rules and regulations).
- Medical insurance coverage for students holding a Khalifa University sponsored visa and visa processing costs.

KU Medical Scholarship – UAE National and International Students

The KU Medical Scholarship program supports students who have chosen to pursue a career that will positively impact on people's lives. This program offers scholarships to all students to support graduate studies in medicine. Students who receive a Khalifa University (KU) Medical Scholarship will be registered in the Pre-Medicine Bridge program. Please note that scholarship benefits are subject to change.

- Monthly stipend.
- Full coverage of tuition fees.
- Support to attend educational events locally and internationally.
- Housing in University accommodation at no cost, subject to availability.

- Textbooks are provided by the University.

Tuition Fees

Please note that tuition fees are subject to review. Tuition fees for graduate students admitted starting Fall 2017 are as follows:

Program Level	**Tuition Fees**
Master	AED 5,000 per credit hour
Doctoral	AED 6,666 per credit hour

Payments

Detailed guidance on fees, payment processes and deadlines can be found in the *KU Fees, Scholarships and Payment Guide,* which is published by the Registrar's Office every semester.

Disclaimer

The University reserves the right to make changes to the published scholarship and fees information without prior notice, at any time before the beginning of an academic semester.

Registration

Orientation

Newly-admitted students participate in an orientation event that introduces them to various aspects of the Khalifa University community. During orientation, students can plan their academic program, register for courses, learn about University resources and campus life, and meet with faculty, staff and new classmates. Orientation sessions are normally held in the Fall and Spring semesters. For policies and processes concerning the College of Medicine and Health Sciences, please refer to the *CMHS Medical Student Handbook.*

Number of Degrees

A student may be registered for only one degree at any time, and work to be submitted for a degree cannot be submitted elsewhere for a degree or other similar award.

Registration Process

The Registrar's Office is responsible for the management of the registration process by which students enroll in classes. Registration information is provided to students before the registration period begins. Through the registration process, students assume academic and financial responsibilities for the classes or research in which they enroll. All graduate students are required to re-register on a semester basis. Such re-registration is subject to satisfactory progress.

Registration Deadlines

Khalifa University policies determine when students may enroll or adjust their enrollment in classes. The Registrar's Office has the most up to date information regarding these policies. The registration period and other important dates are published in the Academic Calendar, which can be downloaded from the University website.

Registration Holds

Students will not be permitted to register if there is a "hold" on their record. Holds may be related to academic standing (probation or dismissal), non-academic offense violations (disciplinary), incomplete admission (missing documents), financial or scholarship matters. Holds may also be placed on students who are not UAE citizens and have not submitted required immigration documentation. To clear a hold, the student must contact the office that has issued the hold to find out what must be done to fulfil the obligation(s).

Academic Advising

In order to register each semester, students must meet with a faculty advisor to discuss their academic progress, course selection and obtain approval for registration. This process ensures that the student is on track to meet the graduation requirements of his or her degree program. Academic advising is an integral aspect of academic progress and a shared responsibility between the student and his/her advisor.

The appropriate Department Chair (or designee) will serve as the academic advisor for all newly admitted graduate students in their first semester of study. By the end of the first semester, full-time students will have an opportunity to nominate their preferred research project and research advisor. For part-time students, this is normally completed by the end of the second semester of study. MEng students are not required to complete a research thesis and their academic advisor will be appointed by the relevant academic department. Please refer to the **"Research Project Allocation and Advisor Appointment** (p. 41)**"** section of this catalog for further details.

Academic Advising Guiding Principles

Academic advising is guided by the following principles:

- Effective academic advising can play an integral role in student development.
- Mutual respect and shared responsibility should govern the personal interactions between advisors and students.
- Students and advisors must prepare for, actively participate in, and take appropriate action following advising sessions.
- Advising information provided to students must be accurate, accessible, and timely.
- Academic advising should encourage students to explore many possibilities and broaden their educational experience.
- Academic advising should encourage a positive attitude toward lifelong learning.
- Academic advising should use all available resources and means to provide advising tailored to the

individual needs of students.

- Academic advisors should keep records of the advising sessions held with a student.

Faculty Office Hours

Faculty office hours are allocated for student consultation. Faculty are required to display office hours on their office doors. Students are encouraged to make use of these times for consulting with faculty on the courses they are taking.

Study Plan

The study plan outlines the minimum academic requirements of the degree program, which must be completed by a student in order to be eligible to graduate. Study plans change over time, and consequently students are required to follow the approved plan and degree requirements that were in effect at the time of their admission to the academic program. Students may petition the Department Chair for approval of changes to the prescribed study plan. Small changes may be approved by the Department Chair. Significant changes require approval from the Department Chair, Associate Dean for Graduate Studies at the relevant College and the Dean of Graduate Studies.

Academic Regulations

The Academic Year

The academic year at Khalifa University includes two regular semesters (Fall and Spring), as well as a Summer Term. There are normally fifteen weeks of teaching in a regular semester and six weeks of teaching during the Summer Term. For policies and processes concerning the College of Medicine and Health Sciences, please refer to the *CMHS Medical Student Handbook.*

Language of Instruction and Examination

English is the official language of Khalifa University. All courses are taught and examined in English with the exception of non-English content courses such as Arabic language.

Official Communication Method (E-mail)

Khalifa University has adopted e-mail as the primary means for official communication to its students, faculty, and staff. The university will send all official communication regarding academic and administrative matters, important information, and time-sensitive notices to the e-mail accounts provided by the university. It is the student's responsibility to monitor his/her university e-mail regularly to ensure that such communication is received. Failure to check e-mail, errors in forwarding e-mail, and returned e-mail due to full mailbox, will not excuse a student from missing announcements or deadlines. Students are expected to use the e-mail account provided by the university to communicate official matters to the university.

Duration and Modes of Study

Students are required to make steady progress towards meeting degree requirements and must successfully pass all program components (taught course and thesis/dissertation) within the **normal** allowed time to completion. Any Khalifa University scholarship is generally awarded only for the duration of the **normal** time to completion. Graduate program completion and graduation requirements are governed by KU Academic Policy *ACA 3250 Graduate Program Completion Requirements.*

Program Level	**Study Mode**	**Time to Completion**		
		Minimum	**Normal**	**Maximum**
Master's	Full-time	1 years	1 years	3 years
Master's	Part-time	1.5 years	2.5 years	4 years
Doctorate - Regular PhD (With MSC)	Full-time	3 years	4 years	7 years
Doctorate - Regular PhD (With MSC)	Part-time	5 years	6 years	8 years
Doctorate - Direct PhD (Without MSC)	Full-time	4 years	5 years	8 years

Extension of Duration of Study

Students must satisfy degree requirements within the **normal** time to completion specified in the "Duration of Study" section of this Catalog. In exceptional circumstances, an extension of registration may be granted by the AVP of Graduate Studies on the recommendation of the student's academic department and approval from the Associate Dean for Graduate Studies of the relevant College. The student must submit an Exception to Policy Request and attach a supporting letter from his/her Advisor(s) providing justification for seeking an extension and clearly outlining the student's plan of work towards graduation. Students sponsored by external entities must also attach written approval from their sponsor.

Students should note that any extension will normally only be granted within the maximum allowable time to completion. The maximum allowable time to completion includes any periods of leave taken by the student and the time taken to write-up the thesis/dissertation. An approved academic extension does not automatically grant or guarantee continuation of any scholarship benefits.

Students seeking a scholarship extension must submit a separate appeal to the Graduate Studies Office, which will be reviewed by the appropriate committee.

Modes of Study

Students are admitted to graduate study on a full-time or part-time basis. To be considered full-time, a student must be registered for nine or more credit hours during a regular semester. Due to the intense nature of summer coursework, students may take no more than two courses or six credits in the Summer Term. Summer Term registration is mandatory for full-time students.

Study Mode	Fall or Spring Semester	Summer Term
Full-time	Minimum 9cp / Maximum 12cp	Maximum 6cp
Part-time	Typically 6cp	Maximum 6cp

Registration above or below the standard credit hour limits requires advance approval from the student's Advisor, Department Chair (or designee) and Associate Dean for Graduate Studies at the relevant College. Registration below nine credit hours for full-time students requires additional approval from the AVP of Graduate Studies. Externally sponsored students must obtain the written approval of their sponsor before varying the registration credit load.

The status of a student is determined by the number of credits for which he/she is registered at the close of the Add/Drop period published in the Academic Calendar. Full-time students who fail to earn a minimum of nine credit hours in a regular semester are at risk of not completing their degree program in the allotted time and may be issued an academic progress warning if prior permission was not obtained. For potential impacts on scholarships, refer to KU Academic Policy *ACA 5160 Graduate Scholarships and Stipends.*

Change of Program, Scholarship or Study Mode

A student may request to change his/her degree program or study mode after admission to Khalifa University. Normally, the student must be in good academic standing and submit the Request to Change Graduate Degree Program before completing no more than 12 credit hours of taught courses. All such requests must be approved by the relevant Department Chair(s), Associate Dean for Graduate Studies and the AVP of Graduate Studies. Students must note that a change of program, research project or study mode may delay their graduation, affect their scholarship eligibility and render the student liable for a financial penalty if a scholarship contract is breached. Students are advised to refer to the terms and conditions of their scholarship award before applying to change study mode or program. Students sponsored by organizations external to KU must obtain the approval of their sponsor.

Grades and Grade Point Average (GPA)

Grading Scale

Grades are an important component of the learning assessment process. All courses must be assigned a grade in the middle and end of the semester in which the course is offered. It is the responsibility of the course instructor to inform each class at the beginning of the semester of the nature of the course assessment and corresponding grades assigned. Each course instructor should include a grading metric in the course syllabus. The grades and guidelines below are used at KU for graduate programs (refer to KU Academic Policy *ACA 3350 Grading System, GPA and Course Repetition*). For policies and processes concerning the College of Medicine and Health Sciences, please refer to the *CMHS Medical Student Handbook.*

Letter Grade	Grade Point	Description
A	4.00	Excellent
A-	3.70	Very Good
B+	3.30	Good
B	3.00	Satisfactory
B-	2.70	
C+	2.30	Less than Satisfactory
C	2.00	
F	0.00	Fail
XF	0.00	Failure Due to Academic Dishonesty*
WF	0.00	Withdrew Failing

**XF:* Failure Due to Academic Dishonesty (this grade can only be assigned after an academic dishonesty hearing; student may petition to change this grade to F).

Additional letter grades are used to denote special cases. These letter grades do not have corresponding grade points, and hence are not used in calculating a student's grade point average.

Letter Grade	**Description**
AUD	Audit
EX	Student Exempt from a Course (no credit given)
I	Incomplete*
IP	In Progress (may be assigned prior to a final grade in a multi-course sequence)
N	No Grade Submitted
S	Satisfactory (denotes passing in a Pass/Fail course)
TR	Transfer (credit counted)
U	Unsatisfactory (denotes failing in a Pass/Fail course)
W	Withdrew between end of late registration and deadline for course withdrawal
WA	Administratively withdrawn due to absences
WP	Withdrew Passing after the deadline for course withdrawal through the last day of classes (must be approved by the Dean or designee)

**Incomplete Grade:* The incomplete grade is an exceptional grade that can only be assigned when a student has satisfactorily completed a major portion of the work in a course but, for non-academic reasons beyond the student's control and deemed to be acceptable in accordance with university regulations, was unable to meet the full requirements of the course. It is the student's responsibility to meet with the instructor and request arrangements for the completion of the missing required coursework. A grade change request to remove the incomplete grade must be submitted no later than the end of the first week of classes in the following term. Failure to remove the "I" grade by this deadline will result in the "I" grade changing to "F".

***No Grade Submitted:* The N grade is a temporary grade that is assigned when the final grade is not submitted. Unresolved N grades will be converted to F or U as per the grade submission guidelines published by the Registrar's Office.

Grade Point Average

The Grade Point Average (GPA) is the cumulative numerical average, which measures student academic achievement at the university. It is reflective of the credit hours the student has completed and the grades that the student has earned. A student transcript will display both a Semester GPA (SGPA) and a Cumulative GPA (CGPA).

The GPA is calculated by multiplying the grade point value of the letter grade by the number of credit hours of the course. The result is the quality points that the student has achieved in the particular course. The sum of the quality points of the courses taken is divided by the total credit hours completed to obtain the GPA. Grades without a corresponding value (AUD, EX, I, IP, N, S, TR, U, W, WA and WP) are not included in the computation of the cumulative grade point average. A sample GPA calculation is shown in the table below.

Sample GPA Calculation

Semester	Course	Credit Hours	Grade	Grade Value	Quality Points
Fall	MEEN 601	3	B	3.00	9.00
	MEEN 603	3	A	4.00	12.00
	MEEN 622	3	B+	3.30	9.90
Fall Semester Total		9			30.90

Semester GPA: 30.90 ÷ 9 = 3.43

Spring	MEEN 605	3	B	3.00	9.00
	MEEN 630	3	A	4.00	12.00
	MEEN 631	3	A-	3.70	11.10
Spring Semester Total		9			32.10

Semester GPA: 32.1 ÷ 9 = 3.57

Cumulative Total		18			63.00

Cumulative GPA: 63 ÷ 18 = 3.50

Grade Changes and Appeals

Final course grades are officially reported by the instructor at the end of an academic semester and recorded by the Registrar's Office. Officially recorded grades can only be changed with the approval of the Department Chair and Associate Dean for Graduate Studies. A request to change a grade may be initiated in writing by the student or by the course instructor.

A student may appeal an officially recorded grade by submitting a "Grade Appeal" form to the Registrar's Office no later than the first day of classes of the next regular semester. Grade appeals will be processed as per the provisions in KU Policy *STL 5450 Student Grievances and Appeals.*

Managing Courses

Course Title, Code, Credit Value and Description

Each course offered at the University has a unique alphanumeric code, a title and a credit value. The course code consists of four letters that reflect its discipline or field of study, followed by a three-digit number that indicates its level. The title of the course gives an indication of its content. The course credit value consists of three numbers: the first indicates the number of lecture hours per week, the second shows the number of laboratory or problem solving hours per week, and the third gives the overall credit hours of the course. The example below further explains the course code and value information.

ENGR	**605**	**Optimization Methods for Engineers**	**(3-0-3)**
Letter part of the code.	Numeric part of the code.	Course title.	Lecture hours per week (3). Laboratory hours per week (0). Overall credit value (3).

Adding/Dropping Courses

Students may add or drop a course, or change a course section at the beginning of a semester during the official Add/Drop period. Such changes are not recorded on the student's transcript, provided that they are finalized by the end of Add/Drop for graduate courses, as specified in the Academic Calendar. Provisions and guidelines related to course management are outlined in KU Academic Policy *ACA 3700 Withdrawal, Discontinuing and Resuming Studies.* For policies and processes concerning the College of Medicine and Health Sciences, please refer to the *CMHS Medical Student Handbook.*

Course Withdrawal

Courses that are dropped after the Add/Drop deadline will be assigned a "W" grade on the student's transcript, provided that the request is submitted during the official withdrawal period published in the Academic Calendar.

The "W" grade will not affect the student's Grade Point Average (GPA).

A student who withdraws from a course after the deadline for withdrawal has passed will be assigned a grade of "WF" (Withdrew Failing). The "WF" is equivalent to an "F" (0.0 quality points), and is used in the calculation of the GPA (see *ACA 3350 Grading System, GPA, and Course Repetition*). Upon appeal, this grade may be changed to a WP (Withdrew Passing).

Students should consult their academic advisor before making changes to course registration. Withdrawing from a course may affect the student's timely progress toward graduation and impact the terms of his/her scholarship. Full-time students must normally maintain a minimum load of nine credit hours in a regular semester, while part-time students must normally maintain a minimum load of six credit hours. Under exceptional circumstances, a student's credit load may drop below these minimum requirements, subject to approval from the Associate Dean for Graduate Studies at the relevant College and the AVP of Graduate Studies.

Course Restrictions, Prerequisites and Co-requisites

Enrollment in some courses may be restricted. For example, a course may be open to students within a specific program or require that a student has Master's or Doctoral level standing. In some cases, registration may not be permitted without the approval of the course instructor.

A program of study may also require that courses be taken in a certain order or taken together. A course that is required to be taken before another course is called a "pre-requisite". Students are not permitted to register for a course with a pre-requisite unless the pre-requisite course has been completed with a passing grade or student has an approved pre-requisite waiver. Approval for a pre-requisite waiver should be obtained from the course instructor, Main Advisor, Department Cahir and the Associate Dean for Graduate Studies at the relevant College.

A "co-requisite" is a course that is designed to be taken together with another course.

- A co-requisite course may be satisfied if the student has previously completed it with a passing grade.
- Students may not drop a course if it is a co-requisite of another course in their schedule. In this case both courses would have to be dropped.
- If a student repeats a co-requisite course in which the student earned a grade of B- or lower, the companion course (if passed) does not have to be repeated.

Repetition of Courses

Students should meet with their advisor before repeating a course, as it may affect the student's academic standing and scholarship. A repeated course must be taken when it is regularly offered and cannot be taken in independent or individual format. Graduate students may repeat a course subject to the following:

- A given taught course can be repeated only once. Approval of the Dean of the relevant College (or designee) is required if a student wishes to repeat a course in which he/she previously earned a grade of B- or higher.
- A maximum of two taught courses can be repeated during the student's enrolment in a particular graduate program at the university.
- Degree credit for a course is only given once, but the grade assigned each time the course is taken is permanently recorded on the transcript.
- Only the highest grade earned for a repeated course will be used in calculating the grade point average.
- A student who fails a course/exam twice is subject to dismissal for failure to make satisfactory academic progress (see *ACA 3650 Academic Standing Graduate Programs*). This rule does not apply to seminar courses.
- A repeat course must be taken at Khalifa University.

Auditing Courses

Subject to availability, admitted degree students in good academic standing may audit graduate courses without credit, with the permission of the instructor and the approval of the Department Chair and Associate Dean for Graduate Studies at the relevant College. Approvals must be obtained prior to registration, and the student must register as an auditor. Registration priority will be given to matriculated degree-seeking students.

Auditors are required to follow the same registration procedures as persons taking the course for credit. Auditors do not receive grades or credits. Participation in class discussion and written work is permitted at the discretion of the instructor. A fee per credit hour will be charged and must be paid prior to registration. The status of Auditor cannot be changed after the course has begun. The

University reserves the right to cancel an audit registration if the class size is an issue.

Normally, a student will not be permitted to audit a course if this results in exceeding the maximum allowable credit load per semester. Furthermore, a student cannot use course audit to change his/her study mode (full-time/part-time).

Course Substitution

Graduate students are expected to satisfy all degree program requirements that were in effect when the student was first admitted or most recently re-enrolled as a degree candidate. A student seeking a minor deviation from program requirements must submit a Variation to Academic Program request and if needed, a Prerequisite Waiver request. The student's advisor, the Department Chair and the Dean of the relevant College (or designee) must approve the request. The course to be substituted must be at the same level as the required course and the student must be in good academic standing when the permission for deviation is requested.

Limitation of Courses Offered

The University reserves the right to cancel any course listed in the Catalog or scheduled to be offered. Notification of a cancelled course will be sent to any affected students at their University email address.

Class Cancellations

On rare occasions, it may be necessary to cancel a scheduled class. Under such circumstances, students will be notified in advance, as much as possible. Alternative course registration options should be provided to the student by the relevant academic department.

Course Feedback

Students are required to give their feedback on all courses at the end of every semester, which ensures the quality of course delivery. Student feedback is further considered during course review and development.

Attendance, Leave and Withdrawal

Graduate students are expected to regularly attend University and participate in all elements of their program of study, including taught coursework, research and teaching duties. All faculty members are required to maintain accurate and up-to-date records of graduate student attendance. A student who is not able to attend University for any reason is required to inform the relevant course instructor, student's Main Advisor and/or the Graduate Studies Office (as applicable). Student attendance is governed by KU Academic Policy *ACA 3555 Student Attendance (Graduate Programs).* The University recognizes that personal circumstances may require a student to temporarily or permanently withdraw from his/her studies. Provisions for managing such circumstances are outlined in KU Academic Policy *ACA 3700 Withdrawal, Discontinuing and Resuming Studies.* For policies and processes concerning the College of Medicine and Health Sciences, please refer to the *CMHS Medical Student Handbook.*

Institutional Sanctions for Non-Attendance

The following shall apply when a graduate student has been absent for more than 30% of scheduled classes in which he/she is currently enrolled (either excused or unexcused):

- If the 30% limit is reached on or before the last day to withdraw from classes, as specified in the Academic Calendar, a letter grade of WA (Withdrawn Administratively) will be automatically assigned.
- In all other cases a letter grade of WF (Withdrew Failing) will be assigned.
- Appeals must be submitted with all necessary documentation within three working days of the WA or WF grade notification. All appeals should be referred to the Graduate Studies Council, which will provide a recommendation to the Provost whose decision is final.
- Full-time students holding a KU scholarship are expected to be on campus full-time (including during official study breaks), unless a period of absence is approved by the Graduate Studies Office. Unapproved absence may result in the loss or suspension of the student's scholarship.

Excused Absence (Short-Term)

Students who participate in KU sanctioned activities or encounter unavoidable circumstances can apply to obtain an excused absence for failure to attend a scheduled class or other University activity. Applications should be submitted through the Office of Student Success and students should seek prior approval whenever possible. Applications to excuse absence post facto must be made no later than three working days after the absence. An excused absence may be approved with implication on attendance record (absence is removed from the percentage) or without implication on attendance record (percentage of missed contact time remains unchanged). If the student is applying for excused absence on medical grounds, the application will be verified and approved by the KU nurse.

Where an excused absence causes a student to miss an assessment, then the student's grade for the assessment shall be calculated in accordance with the course syllabus and the guidelines of the relevant College. Unexcused absences that cause a student to miss an assessment will result in the student receiving a grade of zero for the missed assessment with a concomitant effect upon the student's final grade.

The decision by Student Success in consultation with the Graduate Studies Office to grant or decline a student's application is final, notwithstanding an appeal submitted by the student. The following excused absence types shall be considered:

- Appointment with official authorities.
- Legal and judicial orders.
- National Service duties (short-term).
- Representing KU on official business (e.g. conference, presentation, fieldtrip, internship).
- Hospitalization (in patient for more than one night).
- Serious injury.
- Contagious disease.
- Medical treatment abroad either personal or escorting an immediate family member - parent, grandparent, sibling, spouse, child (may be granted to students who have not reached 50% absences, with pre-approval).
- Death of an immediate family member - parent, grandparent, sibling, spouse, child (may be granted for up to five calendar days).
- Maternity leave (may be granted for up to fourteen calendar days).
- Paternity leave (may be granted for up to three calendar days).
- Hajj (pre-approval is required minimum ten working days prior to travel).
- Emergency (determined by Office of Student Success).

National Service Leave

Leave for National Service is automatically granted. The student must return to the university in the semester immediately following the completion of National Service. Leave taken for National Service does not affect the student's Leave of Absence entitlement.

Annual Leave

Full-time graduate students holding a Khalifa University scholarship may be eligible to take annual leave as per the entitlement stated in the relevant scholarship award contract. Students must meet, discuss and obtain the approval of their Advisor(s) prior to applying for leave. The Advisor is responsible for guiding the student and approving annual leave requests on behalf of the Department. In all cases, annual leave for graduate students must be approved by the Advisor and the AVP of Graduate Studies (or designee). The Graduate Studies Office oversees the leave process for graduate students and the decision of the AVP of Graduate Studies is final. Students can apply for annual leave in accordance with the following guidelines:

- Students must apply for annual leave at least two weeks prior to the first day of absence. In exceptional circumstances, this requirement may be waived.
- Students may be granted a maximum number of leave days within the period of study or any related extension in accordance with provisions made in the relevant scholarship award contract.
- Generally, annual leave can be taken only during the official study breaks published in the Khalifa University Academic Calendar, i.e. Summer, Winter or Spring. In exceptional circumstances, the AVP of Graduate Studies may approve leave days outside official study breaks, in consultation with the student's Advisor(s).
- Annual leave will be accrued pro-rata on the basis of time studied and the accrual rate will be based on the student's annual entitlement.
- Annual leave must be taken within the calendar year, during the period of study. Leave days not utilized at the end of each year will be forfeited. Leave days not utilized at the end of the study period, any related extension or at the end of the scholarship award contract will be forfeited.
- In exceptional circumstances, students may apply to exceed their annual leave entitlement and must provide justification, as well as supporting documents. Any additional leave days will normally

be unpaid and can be granted only with approval from the AVP of Graduate Studies.

- Students are eligible for all paid Public Holidays announced by the University.
- Taking leave without approval may lead to termination of scholarship or stipend deductions.

Leave of Absence and Resuming Studies

Under exceptional circumstances, students may apply for a temporary Leave of Absence (LoA) for a maximum of two semesters during their degree studies. Students should be aware that taking leave will have an impact on their scholarship terms and timely progress toward graduation. The LoA must be approved by the student's Advisor, Department Chair, the Associate Dean for Graduate Studies at the relevant College and the AVP of Graduate Studies. The following guidelines apply:

- Generally, a student must be in good academic standing.
- The student must submit the LoA request, specifying the reason and duration of requested leave, supported by relevant documentation.
- If the LoA request is submitted on or before the last day of the Add/Drop Period, as specified in the Academic Calendar, student will be automatically withdrawn from all registered courses for the semester in which LoA is approved.
- If the LoA request is submitted on or before the last day to withdraw from courses, a letter grade of "W" (Withdrew) will be assigned for all registered courses. If the LoA request is submitted after this date, a letter grade of "WF" (Withdrew Failing) will be assigned for all registered courses.
- Students are not eligible to receive scholarship benefits for the semester in which LoA is approved.
- Students sponsored by non-KU agencies may not take a Leave of Absence without their sponsor's approval.

To resume studies after LoA, students must contact the Registrar's Office to request re-activation latest before the end of the Add/Drop period for the relevant semester. The Registrar's Office will notify the relevant departments. The student is allowed to resume his/her studies as long as there is no active administrative hold placed on the student. A student who does not return from LoA by the next regular semester as specified in the leave request, is dismissed from the University.

A student who is away from the university, for any reason other than National Service, for more than two consecutive regular semesters must submit a new application for admission, prior to the semester for which registration is sought. Students will be required to follow the graduate catalog and program study plan for the semester in which they are re-admitted.

Permanent Withdrawal from the University

A student may voluntarily withdraw from the university in accordance with withdrawal clearance procedures and subject to the terms and conditions of his/her scholarship contract or agreement, as applicable. The student must withdraw officially and complete the clearance process, which can be initiated by submitting the Application for Permanent Withdrawal. The withdrawal is effective on the date the form is received by the Registrar's Office.

- No record of enrollment in courses will appear on the transcript of a student who withdraws during the official Add/Drop period.
- A student who withdraws before the deadline for course withdrawal, but after the official Add/Drop period, will receive a grade of "W" for all courses in progress.
- Students withdrawing after the course withdrawal deadline and before the last day of classes will receive a grade of "WF" for all courses. The student has the right to appeal a grade of WF as per the provisions of *STL 5450 Student Grievances and Appeals*. In cases of a successful appeal, a grade of WP will be assigned.
- Any student who leaves the university before the close of a semester without withdrawing officially will receive a failing grade of "F" in each course for which the student was registered.

Dismissal or Suspension from the University

A student may be dismissed from the university for, but not limited to, the following reasons:

- The student fails to satisfy the progression rules of the program.
- The student fails to satisfy the completion requirements of the program.
- The student does not maintain adequate contact with his/her thesis/dissertation Advisor.

- The student is in violation of the university code of conduct.
- The student is in violation of the academic integrity policy.

A student who was dismissed from the university will not be readmitted. A student who was suspended for a period of time can be readmitted to the university after completion of the suspension period, subject to the student signing an undertaking of not repeating the cause of suspension.

Refer to the **"Academic Standing** (p. 39)**"** section of this Catalog for guidelines relating to academic dismissal.

Assessment and Academic Standing

Assessment of Student Learning

Achievement of intended learning outcomes shall be evaluated through a variety of assessment instruments in a process of frequent evaluation that includes regular and timely feedback to students regarding their performance (refer to KU Academic Policy *ACA 3300 Assessment of Student Learning*). For policies and processes concerning the College of Medicine and Health Sciences, please refer to the *CMHS Medical Student Handbook.* Final grades are determined by the student's performance in a combination of the following:

- Assigned work, term papers, projects, presentations.
- Progress tests.
- Laboratory tests and/or laboratory work.
- Semester and/or final examinations.
- Level of written expression.

The performance of each student in a course must be evaluated by the instructor(s) responsible for that course. The weight accorded to the various elements is at the discretion of the academic department responsible for the course. Course policies regarding the submission, grading, return and weighting of all assessment instruments must be clearly communicated in the course syllabus, which is to be shared with students on the first day of class.

To assist students in preparing for final exams, no tests or significant assessments should be administered during the final week of classes.

Examinations

One or more major examinations may be administered for a course to assess achievement of learning outcomes. All examinations at Khalifa University must follow clear and established guidelines to ensure examination integrity and compliance with best practices. Major examinations shall be included in the course syllabus and any changes communicated to students in advance. Final examinations are scheduled through the Registrar's Office. Guidelines and procedures governing the administration of examinations are outlined in KU Academic Policy *ACA 3370 Examinations.* Normally, instructors will submit final grades no later than three days after the scheduled final examination in a course or, where there is no final examination, seven days after the last scheduled class in a course.

A student who is absent from an examination without a valid excuse will normally receive a "zero" for that examination. For provisions governing excused absences see *ACA 3555 Student Attendance (Graduate Programs).*

Coursework

Coursework is an essential component at all levels of study and normally takes the form of a combination of assignments, projects and quizzes. Students should be given clear deadlines for coursework submission. Penalties for late submission or missing coursework must be clearly communicated to students at the beginning of the semester. If late submission is unavoidable due to circumstances beyond the student's control (e.g. serious illness), the student must inform the concerned instructor as soon as possible and present relevant documentary evidence. The approval of the excuse and any make-up assessment is at the discretion of the instructor. Students should receive timely grades and comments on submitted coursework. In some cases, the instructor may keep the student's work but must allow students access to review it and the grading breakdown.

Research

The student's research progress is assessed in each semester that he/she registers for thesis/dissertation credits. The student's Main Advisor must submit the progress evaluation to the Registrar's Office latest by the end of the final examination period in the relevant semester. Accordingly, a grade of Satisfactory (S) or Unsatisfactory (U) will be recorded on the student's transcript for the thesis/dissertation course.

Records and Transcripts

A permanent academic record for each student enrolled in the University is maintained in the Registrar's Office. The written consent of the student is officially required to disclose his/her academic record. Exceptions are made for parents, sponsors, and authorized University officials and in compliance with a judicial order. Students may obtain official transcripts of their academic records from the Registrar's Office. A transcript will only be released with a signed request from the student concerned.

Academic Standing

Academic standing is based on the Cumulative Grade Point Average (CGPA) and indicates if a student is meeting the University's standard for expected academic performance. Academic excellence, rigorous scholarship, demonstrated attainment of learning outcomes and timely progress towards graduation are critical measures of student academic success. The standards of academic standing for graduate students are stipulated by KU Academic Policy *ACA 3650 Academic Standing (Graduate Programs).*

Good Standing

A student with a CGPA of 3.00 or higher is in good standing and eligible to register for courses.

Academic Probation

A student whose CGPA falls below 3.00 and/or who receives a grade of Unsatisfactory (U) for thesis/dissertation credits or Written Qualifying Exam (WQE or Research Proposal Exam (RPE), is placed on academic probation for the following regular semester. A note is made on the student's academic record (transcript). The following provisions apply for a student on academic probation:

- Unless otherwise approved by the AVP of Graduate Studies, a full-time graduate student on probation is allowed to register for a maximum of nine credit hours per semester;
- Unless otherwise approved by the AVP of Graduate Studies, a part-time graduate student on probation is allowed to register for a maximum of six credit hours per semester;
- While on probation, a student may enroll in a course on a Pass/Fail basis.

The student will return to good academic standing if he/she achieves a minimum CGPA of 3.00 and/or a grade of Satisfactory (S) for thesis/dissertation credits by the end of a regular semester on probation.

Academic Dismissal

If, at the end of one regular semester on academic probation, the student's CGPA remains below 3.00 or student receives a subsequent Unsatisfactory (U) thesis/dissertation grade, the student shall be academically dismissed from the University.

If, subsequent to returning to good standing after having been on Academic Probation, a student's CGPA falls below 3.00 a second time, or the student receives a second grade of Unsatisfactory (U) for thesis credits, or the student receives a second grade of Unsatisfactory in the Written Qualifying Exam (WQE) or Research Proposal Exam (RPE), the student shall be academically dismissed from the University. A student who receives 'Fail' as an outcome of the Master's Thesis Defense, the PhD Research Proposal Examination (RPE), or PhD Dissertation Defense will be dismissed.

Students have the right to appeal a dismissal (refer to KU Policy *STL 5450 Student Grievances and Appeals*) and must comply with the following provisions:

- All appeals must be submitted in writing to the Registrar's Office within ten working days from the dismissal decision date. The Registrar's Office will forward the appeal to the Graduate Studies Council for consideration in line with relevant policy.
- In the case of a successful appeal of a dismissal decision, the student shall be placed on academic probation upon resumption of studies.
- A successful dismissal appeal does not guarantee reinstatement of scholarship benefits.
- A dismissed student is prohibited from re-enrolling at KU.

Progression and Completion Requirements

Students must meet established minimum requirements for the award of a graduate degree. It is the student's responsibility to familiarize themselves with the requirements specific to his/her program. Students can refer to the **"Academic Regulations** (p. 31)**", "Research Milestones"** and **"Graduate Programs** (p. 15)**"** sections of this catalog, as well as relevant KU policy. In addition, each department shall provide relevant program information to all incoming graduate students. For policies and processes concerning the College of Medicine and Health Sciences, please refer to the *CMHS Medical Student Handbook.*

Research Project Allocation and Advisor Appointment for MSC students

The appropriate Department Chair (or nominee) will serve as the academic advisor for all newly admitted graduate students and will guide the students' course selection in their first semester of study. Within one month of the first semester, full-time students will have an opportunity to select their preferred research projects and research advisors. For part-time students, this is normally completed in the second semester of study.

The College will instruct eligible students on the research project selection process and appropriate timelines. Generally, a new student should approach the faculty members of his/her department and specify the tentative thesis title, problem statement, desirable outcomes as well as the advisory team made up of KU faculty and industry experts (if appropriate).
Each student must submit his/her project selections by the specified deadline. In cases where a student does not make a selection, a project and main advisor will be allocated based on the recommendation of the student's academic department.

The final allocation of a research project to each graduate student will be approved by the relevant Department Chair and Associate Dean for Graduate Studies of the College. Once the allocation is confirmed, the faculty member listed as the Main Advisor will take the leading role in guiding the student in course selection and supervising his/her research work until graduation. The following guidelines apply:

• The Main Advisor must be a faculty member from the student's home department. An exception to this requirement may be made for multidisciplinary fields such as Robotics and programs that have cross-departmental support, such as MSc in Water and Environmental Engineering, or cross-College support, such as MSc in Computational Data Science.
• In addition to the Main Advisor, the student must have at least one Co-Advisor to provide support to the research supervision process and guidance of the student. The Co-Advisor does not necessarily have to be from the student's home department.
• The Main Advisor and Co-Advisor must be full-time members of KU faculty with professorial rank appointments (Professor, Associate Professor, Assistant Professor). Subject to approval, additional co-advisors may be selected from adjunct professors and on/off-campus experts from industry or academia.

The MEng degree program does not include a thesis component, thus MEng students are not required to participate in the research project allocation process and complete research milestones. The student's academic advisor will be appointed by the Department Chair.

Students who are sponsored by organizations external to KU must have their sponsor's approval before a research project can be allocated.

Research Project Allocation and Advisor Appointment for PhD students

The appropriate Department Chair (or nominee) will serve as the academic advisor for all newly admitted graduate students and will guide the students' course selection in their first semester of study. By the end of the first semester, full-time students will have an opportunity to nominate their preferred research project and research advisor. For part-time students, this is normally completed in the second semester of study.

The Graduate Studies Office will instruct eligible students on the research project selection process and appropriate timelines. Generally, students are asked to select from a list of research projects available in the present semester. Each project outline will specify the problem statement, desirable outcomes, tentative thesis title, as well as the advisory team made up of KU faculty and industry experts (if appropriate). The research project will form the student's thesis/dissertation work, therefore each student must ensure that he/she contacts the Main Advisor of each project they are interested in to discuss objectives and requirements before making the final selection.

Each student must submit his/her project nominations by the specified deadline. In cases where a student does not make a selection, a project will be allocated based on the recommendation of the student's academic department.

The final allocation of a research project to each graduate student will be made by a committee and approved by the relevant Department Chair, Associate Dean for Graduate Studies and the AVP of Graduate Studies. Once the allocation is confirmed, the faculty member listed as the Main Advisor (this may or may not be the project Principal Investigator) will take the leading role in guiding the student in course selection and supervising his/her research work until graduation. The following guidelines apply:

- The Main Advisor must be a faculty member from the student's home department. An exception to this requirement may be made for multidisciplinary fields such as Robotics and programs that have cross-departmental support.
- In addition to the Main Advisor, the student must have at least one Co-Advisor to provide support to the research supervision process and guidance of the student. The Co-Advisor does not necessarily have to be from the student's home department.
- The Main Advisor and Co-Advisor must be full-time members of KU faculty with professorial rank appointments (Professor, Associate Professor, Assistant Professor). Subject to approval, additional co-advisors may be selected from adjunct professors and on/off-campus experts from industry or academia.
- At least one of the Advisors must have prior experience in supervising a graduate research thesis or dissertation.

Students who are sponsored by organizations external to KU must have their sponsor's approval before a research project can be allocated.

Change Advisor or Reserch Project

Change of Advisor

A change of assigned advisor may be requested in exceptional circumstances, for example if the advisor leaves the University or in the case of communication difficulties between the student and the advisor. Students and advisors must make an effort to resolve any differences as early as possible and should consult with the Department Chair before formally requesting a change.

Change of MSC Advisor:

- The Department Chair (or Associate Chair) can initiate the main advisor change request by completing the "Change of Supervisory Arrangement" request
- The request to be approved by the Department Chair, Associate Dean for Graduate Studies
- The notification goes to the Registration Office to implement the change of the advisor assignment.

Change of PhD Advisor:

- The Main Advisor or the Department Chair can initiate the process by completing the "Change of Supervisory Arrangement" request.
- The request to be approved by the Department Chair, Associate Dean for Graduate Studies and the Graduate Studies Office.
- Accordingly, the relevant systems are updated to reflect the change.

Change of Research Project

A change of research project may be requested by the student and/or advisor on exceptional basis by providing clear justification/ reasons for requesting such a change. A 'Request to Change Research Project' must be completed to initiate this process. Students must attach a description of the newly proposed project to the request. Students sponsored by external organizations must also attach an approval letter from their sponsor.

Change of MSC Research Project:

Any request to change the allocated research project will be submitted through the Request to Change Research Project'. Students must attach a description of the newly proposed project to the request. Students sponsored by external organizations must also attach an approval letter from their sponsor

The following approvals are required:

- Department Chair (or Associate Chair)
- Associate Dean for Graduate Studies of the College.

Change of PhD Research Project:

A 'Request to Change Research Project' must be completed to initiate this process. Students must attach a description of the newly proposed project to the request. Students sponsored by external organizations must also attach an approval letter from their sponsor. Any request to change the allocated research project will require the approval and confirmation of the Graduate Student Project Allocation Committee, consisting of Department Chair (or Associate Chair), Associate Dean for Graduate Studies and Graduate Studies Office.

Forming the Research Committee

Following research project allocation and Main Advisor appointment, a research committee must be formed for each student. While the Advisors assume primary responsibility for monitoring and directing the student's research, the role of the committee is to evaluate the student's progress, provide comments and finally, decide on the recommendation to award the graduate degree. The committee is formed in consultation with the student and typically consists of the Main Advisor, Co-Advisor(s) and two additional full-time KU faculty members who are familiar with the student's area of study. Committee members are recommended by the student's Main Advisor, appointed by the relevant Department Chair and the Associate Dean for Graduate Studies, and approved by the AVP of Graduate Studies. The following guidelines apply:

MA Students

- MA students are required to complete a Thesis Workshop course and the student's research is supervised by his/her Advisor(s).

MSc Students

- The Research Supervisory Committee (RSC) should be formed within a month of the confirmed research project allocation.
- The student's Main Advisor serves as the Chair of the RSC and he/she is responsible for leading meetings of the RSC.
- One of the two additional RSC members must be KU faculty from the student's home department.

PhD Students

- The Research Supervisory Committee (RSC) should be formed following the confirmed research project allocation and latest by end of the semester prior to the PhD Research Proposal Examination (RPE).
- The student's Main Advisor serves as Chair and he/she is responsible for leading all meetings of the RSC, including Research Proposal Examination (RPE), with the exception of the student's final dissertation defense.
- One of the two additional RSC members must be KU faculty from the student's home department.
- An additional external member of the RSC may be selected as follows:
    - Faculty from a department at KU, a national or a regional university, or an industry expert. In this case, the member must possess a Doctoral degree.
    - Faculty from a reputable international university. Such members are likely, but not necessarily, drawn from departments working on collaborative projects with KU.

Registration for Thesis or Dissertation

Thesis/dissertation registration is mandatory in every regular semester following research project allocation and until the student's successful final defense (subject to good academic standing). Students must register for research credit hours appropriate to the level and discipline of their program: Master's Thesis or PhD Dissertation. All full-time students holding a Khalifa University scholarship must also register for thesis/dissertation in the Summer Term. Failure to register for thesis/dissertation in the Summer Term may result in the loss or suspension of the student's scholarship. In exceptional circumstances, registration for thesis/dissertation may be approved in the first semester of study by the Department Chair, the Associate Dean for Graduate Studies at the relevant College and the AVP of Graduate Studies.

Registration for thesis or dissertation is not required in a regular semester if a student successfully completes thesis/ dissertation defense in the previous regular semester even though the CGPA is below 3.0 and the student is required to register for courses in the following semester in order to raise the CGPA to 3.0.

Graduating in Expected Time

Students must regularly consult their Advisor(s) to ensure that their academic preparation is appropriate for the courses they plan to undertake. It is important to understand the content of the chosen degree program and the options it will provide for future studies and employment.

Students must be aware of the structure of their degree and the number of credit hours required to graduate. In order to graduate within allowable time, each year students must fulfill the minimum number of credit hours according to their study-mode and the appropriate research milestones.

Core courses should be completed as soon as possible (as not all courses are offered every semester) and students should be flexible about course times. If a required course is not available, advisors can help determine an alternative.

Completion Requirements

In order to be awarded the MA or MSc degree, a student must:

- Successfully pass all program components (taught courses, research proposal and thesis).
- Achieve a minimum overall Cumulative Grade Point Average of 3.0 out of 4.0.
- Complete all graduation requirements within the maximum allowable time to completion.

In order to be awarded the MEng degree, a student must:

- Successfully pass all program components (taught courses).
- Achieve a minimum overall Cumulative Grade Point Average of 3.0 out of 4.0.
- Complete all graduation requirements within the maximum allowable time to completion.

In order to be awarded the PhD degree, a student must:

- Successfully pass all program components (taught courses, qualifying examinations, research proposal and dissertation).
- Achieve a minimum overall Cumulative Grade Point Average of 3.0 out of 4.0.
- Fulfil the journal paper requirement for PhD students.
- Complete all graduation requirements within the maximum allowable time to completion.

Journal Paper Requirement for PhD Students

Every Doctor of Philosophy (PhD) student must have at least one full paper accepted for publication in a quartile one ranked journal, per Scopus, in the research field of her/his dissertation before submitting the request of intent to defend the dissertation. The paper must be based on one of the research contributions in the dissertation, and the student must be the lead author of the paper.

Applying to Graduate

It is mandatory for **all** graduate students to submit the "Intent to Graduate" form via the Student Information System in the penultimate semester. The Registrar's Office will check to ensure that all degree requirements have been met before the student becomes eligible to graduate. The Catalog of Record is used for purposes of academic standing and degree requirements verification.

Time Limit on Duration of Study and Re-Admission

All graduate degree requirements must be completed within the maximum allowable time for the relevant program, inclusive of all periods of leave (refer to the **"Duration of Study** (p. 31)**"** section in this catalog). A student who is away from the university, for any reason other than National Service, for more than two consecutive regular semesters must submit a new application for admission, prior to the semester for which registration is sought. Students will be required to follow the graduate catalog and program study plan for the semester in which they are re-admitted.

Publication Guidelines for Thesis or Dissertation

Deferred Access to Thesis or Dissertation

Students may request to defer public access to the final thesis/dissertation for a designated period of 6 months, 1 year or 2 years. Such an embargo may be requested due to contractual obligations, ethical confidentiality, a pending patent or publication. The student must submit a "Request to Defer Access to Graduate Thesis or Dissertation" at the time of final submission and any such request is governed by KU Policy *ACA 3900 Publishing a Thesis or Dissertation.*

Publications

Advisors should encourage their students to publish their thesis/dissertation results in refereed international conferences and journals. This provides a useful measure of the quality of the work undertaken by the student.

Intellectual Property

Khalifa University promotes academic research, scientific discoveries, technology advancements, and innovation. KU recognizes the importance of Intellectual Property and innovation in transferring scientific knowledge and discoveries into products or services for the public benefit and the economic development of Abu Dhabi, the UAE and the rest of the world.

Students should acknowledge and must agree to abide by the University's Intellectual Property policy *(R&D 4100 Intellectual Property),* including the stipulations concerning allocation of income arising from the exploitation of intellectual property rights.

Copyright

Khalifa University encourages and promotes the dissemination of knowledge through publications and other scholarly works. Students involved in academic and scholarly activities, including research, must adhere to University policy *KUP 9250 Copyright Ownership and Right to Publish.* KU authors must follow *R&D 4950 Research Integrity* policy regarding the principles of authorship.

Ethical Approval Requirements

All human subjects research requires prior approval from the Khalifa University Research Ethics Committee (REC). All animal research needs review and approval from the Animal Research Oversight Committee (AROC). Please login to KU Portal for more information and the appropriate forms: KU Portal > Research > Compliance and Ethics. Completed forms can be sent to the Office of Research Compliance and Training, Research Services:

Phone: +971 (0) 2 312 4010

E-Mail: research.compliance@ku.ac.ae

Compliance and Ethics

The compliance section manages three areas relevant to ethics:

- Human subjects in research
- Animal use in the institution
- Conflict of Interest

For faculty, staff and student training, or guidance on how to get started, please contact:

Dina Muhieddine
E-Mail: dina.muhieddine@ku.ac.ae

Lama Omar Jamhawi
E-Mail: lama.jamhawi@ku.ac.ae

Master's Research Milestones

Research milestones for Master's students are summarized in the table below. The typical timeline is made with reference to regular academic semesters (i.e. Fall and Spring), however students are expected to continue to work on their research during the Summer Term.

Research Milestone		Timeline for Expected Normal Progression*	
		Full-Time Students	**Part-Time Students**
1	Research Project Allocation and Advisor Appointment	Within one month after orientation	By end of the 1st semester of study
2	Forming the Research Supervisory Committee (RSC)	Within one month of the confirmed research project allocation	Within one month of the confirmed research project allocation
3	Registration for Thesis	Thesis registration since the 2nd semester (including Summer) until final defense	Thesis registration since the 2nd semester until final defense
4	Thesis Proposal and Presentation	By middle of the 2nd semester of study	By middle of the 2nd year of study
5	Submit "Intent to Graduate" form via Banner.	By end of the Summer semester of study; Otherwise, Thesis Progress Report should be submitted.	By end of the 2nd year of study; Otherwise, annual Thesis Progress Report should be submitted.
6	Thesis Defense and Final Submission**	Defense to be conducted two weeks prior to the start of the new academic year. Final thesis submission within one	By end of the 1st semester of 3rd year of study, according to published Graduation Timeline

week after defense, according to published Graduation Timeline

**The research milestones and timeline for students undertaking the MSc in Medical Physics program may vary.*
***Exception is allowed for full/part-time students to extend study for a semester with justification.*

Thesis Proposal and Presentation

Students must write and defend a Thesis Proposal, which consists of the following:

- The main research problem that the student intends to work on and why it is important.
- A review of the principal literature relevant to the thesis research topic.
- Results the student expects to achieve, and why they would be of significant value in the area of research.
- The general strategy that the student intends to pursue in dealing with the research problem, together with a work-plan for the stages of the work.

The proposal should be submitted to the Main Advisor and Co-Advisor(s) for approval, before being circulated to RSC members. The Main Advisor will arrange for a presentation typically within two weeks of receipt of the Thesis Proposal. MA students will complete the presentation at the end of the Thesis Workshop course. The presentation will normally take 30 minutes (20 minutes for student's presentation and 10 minutes for questions). In his/her written proposal and during the presentation, the student is required to:

- Demonstrate a clear understanding of the research problem;
- Defend the general strategy that he/she intends to pursue in dealing with the research problem;
- Write clearly, accurately, cogently, and in a style appropriate to purpose;
- Construct coherent arguments and articulate ideas clearly; and
- Present a plan to execute the entire work.

RSC members will evaluate the student's Thesis Proposal and presentation. Any comments made by the RSC should be taken into account by the student and his/her Advisor(s) during the execution of the thesis work.

In case the MSc proposal does not meet the RSC expectation, the full-time student should improve the proposal and resubmit it to RSC for approval by the end of that semester, and part-time student should submit the revised proposal for RSC approval by the end of next semester.

Following the RSC decision, the Main Advisor must forward a copy of the student's Thesis Proposal and the completed Research Proposal Evaluation Report to the Department Chair (or designee), Associate Dean for Graduate Studies at the relevant College and the Graduate Studies Office.

Thesis Progress Report

It is mandatory for students to submit an annual Thesis Progress Report if graduation has to be postponed, as outlined in the **Master's Research Milestones** (p. 46) section. The Progress Report should include:

- A summary of the main research problem, its importance, and the general strategy that the student is pursuing in dealing with the problem;
- A critical review of the principal literature relevant to the thesis topic placing the student's contribution in context, accompanied by a full bibliography of relevant sources;
- An outline of work that the student has already carried out in the area and a discussion of results;
- A review of the status of each task and sub-task of the work and, if applicable, a revised work-plan;
- A provisional table of contents for the thesis.

The Thesis Progress Report (approximately 10 pages) should be submitted to the Main Advisor and Co-Advisor(s) for approval, before being circulated to RSC members.

Summer Research Progress

All students registered for thesis in the Summer semester are allocated this milestone. Students are required to carry out research work under the supervision and guidance of their Advisor(s). Full-time MSc students are expected to submit the "Intent to Graduate" at the end of Summer semester, and Part-time students need to submit the intent by the end of the second year of study. Otherwise, along with the request for postponing graduation, an annual Thesis Progress Report should be submitted to all the RSC members with an optional presentation.

Thesis Defense and Final Submission

The respective Colleges publish a Graduation Timeline for the Fall, Spring and Summer semesters. The timeline provides a guide to processes students and faculty must complete leading up to the final thesis submission and defense, including the thesis formatting guidelines. Graduate students are required to follow this timeline and adhere to the specified deadlines during their final semester of study in order to graduate on time. A student should normally be in good academic standing and registered for thesis credits during the semester he/she intends to defend.

The Department Chair (or nominee) appoints a Thesis Defense Coordinator. The Coordinator can be any full-time KU faculty member from the home department of the student. The primary responsibilities of the Defense Coordinator are:

- Schedule the final thesis defense in consultation with all RSC members, make the relevant logistical arrangements and inform the student about the date and time.
- Attend the final thesis defense and the private RSC meeting to ensure that the examination is conducted in accordance with all relevant KU academic policies and procedures. The Defense Coordinator does not have a role in the final outcome of the thesis defense.
- Report the examination result to the Graduate Studies Office and confirm that the correct examination process was followed.

The student must submit an initial thesis draft to the Main Advisor and Co-Advisor(s), who will work with the student on the necessary revisions. Upon receiving the approval of the advisors, the revised thesis is submitted to all RSC members and the Defense Coordinator for examination. The student must submit his/her thesis to the RSC by the deadline published in the Graduation Timeline for the relevant semester.

The final thesis defense consists of two parts: a public presentation and a private examination. In the first part, the student delivers a thesis presentation open to the public (normally 30 minutes), followed by questions (normally 10-15 minutes). The second part is a private examination with a nominal duration of 60 minutes, attended by the RSC members, the Defense Coordinator and any relevant ex-officio members. During the private examination, the committee will interview the student, ask more detailed questions and examine a demonstration of the completed work, if applicable. The committee will also convey to the student any changes that he/she is required to make before the final submission of the thesis.

During the final thesis presentation and defense, the student is required to:

- Demonstrate a high level of understanding and specialization in the thesis area;
- Show evidence that he/she has conducted an independent investigation with rigor and discrimination;
- Demonstrate the acquisition and collation of information through the effective use of appropriate sources and equipment;
- Appreciate the relationship of the area of his/her thesis to a wider field of knowledge;
- Demonstrate a critical appreciation of the literature in his/her thesis area;
- Demonstrate an ability to appraise critically his/her contribution in the context of his/her overall investigation;
- Constructively defend his/her thesis outcomes;
- Make reference to the thesis that has been written clearly, accurately, cogently, and in a style appropriate to purpose; and
- Construct coherent arguments and articulate ideas clearly.

Following the examination, the RSC members and the Defense Coordinator will meet privately to decide on whether the student has successfully defended the thesis. The advisor(s) decision is divided equally among the Main Advisor and Co-Advisor(s) such that each may decide independently but the total advisor(s) decision equals one. The other RSC members have one decision each, with the exception of any external members who do not have a role in the final decision. However, feedback from external members on the thesis and any suggested improvements should be recorded in the examination report.

The final decision on the outcome of the thesis defense will be the lowest thesis defense outcome reported by the RSC committee members. The Thesis Defense Coordinator communicates this decision to student, RSC members, Associate Dean for Graduate Studies and the AVP of Graduate Studies.

The following RSC recommendations are possible:

Pass	That the candidate be recommended for the award of Master's degree. No further revisions are required for the thesis.
Pass with Minor Corrections	That the candidate be recommended for the award of Master's degree, subject to the satisfactory completion of such minor corrections as may be required by the RSC. Minor corrections shall normally be completed within a period of one week after defence. The RSC may stipulate that the minor corrections made shall be scrutinized by the RSC as a whole or by the Main Advisor prior to the award process being initiated.
Fail with Revise and Resubmit	The thesis should be referred back for major revisions. This normally means there are some major conceptual issues with the thesis and/or the student's performance during the oral examination does not meet the required standards. The student is failed in the thesis evaluation in the semester in which the thesis examination is conducted. However, the revised thesis may be re-submitted for a second and final attempt at passing the examination subject to the conditions specified by the examination committee. In a regular semester, the re-submission shall normally take place within a period not exceeding 12 weeks from the date of the decision of the RSC. The RSC must specify in the examination report whether they require (a) re-submission of the revised thesis without oral examination or (b) full re-examination of the revised thesis including the oral defense.
Fail	That the candidate be not recommended for the award of Master's degree and no further submission is permitted. The candidate must then be terminated from the Master's program.

The final, corrected copy of the thesis post-examination and endorsement of the student's Main Advisor, Co-Advisor(s) and RSC members must be submitted to the Associate Dean for Graduate Studies at the relevant College and subsequently to the AVP of Graduate Studies for approval.

PhD Research Milestones

Research milestones for regular PhD students (with MSc Degree) and Direct PhD students are summarized in the tables below. The typical timeline is made with reference to regular academic semesters (i.e. Fall and Spring), however full-time students are expected to continue to work on their research during the Summer Term.

Research Milestone for PhD Students (with MSc Degree)		**Timeline for Expected Normal Progression**	
	Full-Time Students	**Part-Time Students**	
1	Research Project Allocation and Advisor Appointment	By end of the 1st semester of study.	By end of the 2nd semester of study.
2	Forming the Research Supervisory Committee (RSC)	Latest by end of semester prior to RPE exam.	Latest by end of semester prior to RPE exam.
3	Registration for Dissertation	Normally, in semester immediately following research project allocation. Dissertation registration is required every semester (including Summer) until final defense.	Normally, in semester immediately following research project allocation. Dissertation registration is required every semester until final defense.
4	Dissertation Progress Review	Progress review meeting required by advisor(s) every semester prior to RPE exam.	Progress review meeting required by advisor(s) every semester prior to RPE exam.
5	Written Qualifying Exam (WQE)	By end of the 2nd semester of study for College of Engineering. By end of the 3rd semester of study for College of	By end of the 4th semester of study.

		Science.	
6	Research Proposal Exam (RPE)	By end of the 4th semester of study.	By end of the 6th semester of study.
7	Dissertation Progress Report (DPR)	By end of each semester following successfully passing RPE. Oral presentation to all the RSC members required one year after successful completion of RPE.	By end of each semester following successfully passing RPE. Oral presentation to all the RSC members required annually for two years after successful completion of RPE.
8	Submit "Intent to Graduate" form via Banner	By end of 7th semester of study.	By end of the 11th semester of study.
9	Submit "Intent to Submit PhD Dissertation for Examination" form	By end of 7th semester of study.	By end of the 11th semester of study.
10	Dissertation Defense and Final Submission	During the 8th semester of study, according to published Graduation Timeline.	During the 12th semester of study, according to published Graduation Timeline.

	Research Milestone for PhD Students (with only BSc Degree)	**Timeline for Expected Normal Progression**
	Full-Time Students	
1	Research Project Allocation and Advisor Appointment	By end of the 1st semester of study.
2	Forming the Research Supervisory Committee (RSC)	Latest by end of semester prior to RPE exam.
3	Registration for Dissertation	Normally, in semester immediately following research project allocation. Dissertation registration is required every semester (including Summer) until final defense.
4	Dissertation Progress Review	Progress review meeting required by advisor(s) every semester prior to RPE exam.
5	Written Qualifying Exam (WQE)	By end of the 4th semester of study (students must finish a minimum of 27 credits of coursework before attempting WQE).
6	Research Proposal Exam (RPE)	By end of the 6th semester of study.
7	Dissertation Progress Report (DPR)	By end of each semester following successfully passing RPE. Oral presentation to all the RSC members required one year after successful completion of RPE.
8	Submit "Intent to Graduate" form via Banner.	By end of the 9thsemester of study.
9	Submit "Intent to Submit PhD Dissertation for Examination" form	By end of the 9th semester of study.

10	Dissertation Defense and Final Submission	During the 10^{th} semester of study, according to published Graduation Timeline.

PhD Qualifying Examinations

Achieving PhD candidacy is contingent upon successfully passing a two-stage qualifying examination. The purpose of the qualifying examinations is (a) to ensure that the student has the required breadth and depth of content knowledge, and (b) to evaluate the student's ability to research a specific topic and critique its state of the art.

Stage One: Written Qualifying Examination (WQE)

The main objectives of the Written Qualifying Examination (WQE) are (a) to enable early assessment of the technical background of the student in the selected major field of study, and (b) to provide an opportunity for early evaluation of the potential of the student to satisfactorily complete the PhD program.

The WQE is intended to test the student's understanding of the chosen field of study as evidenced by his/her proficiency in three pertinent topical areas. Each topical area will have a well-defined syllabus, similar to that of a standard course, which details its scope and content, as well as a recommended list of references and supplementary material. The student must choose three exam topical areas from an approved list, in consultation with his/her Main Advisor and Co-Advisor(s).

Students must register for the WQE before the end of the Add/Drop period of the semester in which they plan to take the WQE. At the time of application, the student must indicate three topical areas chosen from an approved list. The exams are held twice in each academic year over a one-week period. The duration for each exam is three hours. A minimum score of 73 percent is required to pass the exam for each topical area.

Failing any topical area of the WQE will result in the student failing the entire WQE. However, a failed WQE can be retaken only once and passed upon the next offering of the examination. If the student repeats the WQE, then he/she will be required only to retake the exams in the topical areas that he/she failed during the WQE at the first attempt. The student may have the option to retake the exams in topical areas other than those he/she failed at the first attempt. PhD students who fail the PhD WQE at the second attempt will be placed on Academic Probation Level 2 and will be subject to dismissal from the PhD program.

Full-time students who get admitted to a PhD program and already have an MSc degree, normally take the WQE by the end of the 2^{nd} semester of study in the case of College of Engineering and the end of the 3^{rd} semester in the case of College of Science. However, students who get admitted to a PhD program and only have a BSc degree, must finish a minimum of 27 credits of coursework before taking the WQE.

- College of Engineering WQE

The examination is coordinated by the Associate Dean for Graduate Studies and the Chair(s) of the relevant Department(s) (or designees).

- College of Science WQE

The examination is coordinated by the Department Graduate Committee (DGC) and the Department Chair. The DGC is appointed by the Department Chair and is usually composed of the Graduate Program Coordinator (Chair of the DGC), as well as three faculty members, who are not on the student's advisory committee.

Stage Two: Dissertation Proposal and Examination

Following successful completion of the Written Qualifying Exam (WQE), the student is required to submit a written Dissertation Proposal to his/her research committee (RSC), who will conduct a Research Proposal Examination (RPE, as detailed below). Students must submit and successfully defend the research proposal in order to be eligible to proceed to PhD Dissertation research.

The purpose of preparing the **Dissertation Proposal** is to focus the student's attention on a careful description of the proposed research problem and its background and context. The proposal should clearly specify the following:

- The main problem that the student intends to work on and why it is important;
- The kind of results which the student hopes to achieve, and why they would be original and of significant value in the area of research;
- A critical review of the principal literature relevant to the research topic placing the student's contribution in context, accompanied by a full bibliography of relevant sources;
- An outline of work that the student has already carried out in the area and how it supports the proposed research;

- The general strategy that the student intends to pursue in dealing with the research problem, together with a work-plan for the stages of research; and
- A provisional table of contents for the dissertation.

All students must register for the **Research Proposal Examination (RPE)** before the end of the Add/Drop period of the semester in which they plan to take the exam. The RPE consists of a public presentation of the proposal followed by a private examination session with the RSC as described below.

The RPE will typically be arranged within two weeks of receiving the Dissertation Proposal from the student. The Main Advisor serves as the RPE Committee (RPEC) Chair.

The RPE generally consists of a public presentation of approximately 45 minutes' duration (typically, 30 minutes for student presentation and 10-15 minutes for questions) followed by a private examination session of typically up to 60 minutes' duration (which can be extended to 90 minutes, if needed). Following the examination, the RPEC members including the Chair will meet privately to decide on whether the student has successfully defended the research proposal. The advisor(s) decision is divided equally among the Main Advisor and Co-Advisor(s) such that each may decide independently but the total advisor(s) decision equals one. The other RPEC members have one decision each, with the exception of any external members who do not have a role in the outcome of the examination. The final outcome of the Dissertation Proposal and Examination will be the lowest outcome reported by the RPEC. The Chair will report the examination result to Associate Dean for Graduate Studies who subsequently informs the Graduate Studies Office.

Typically, the questions presented to the student at the proposal examination will address the research proposal and topics related to the general subject area of the proposal. The purpose of the examination is to:

- Evaluate the proposed research problem to ensure that, if completed as proposed, it constitutes an original contribution to knowledge;
- Evaluate the progress made by the student since starting to work on the research problem;
- Ensure that the relevant expertise and facilities are available within the University to support the proposed research;
- Determine whether the student is adequately prepared to undertake the proposed research and communicate the results; and
- Provide the student with research direction and feedback.

Dissertation Proposal Examination outcome for Regular PhD students**(with MSc Degree)**.

The following outcomes of the dissertation proposal and examination are possible:

Pass	The proposal should be accepted*as it stands.*The student is passed and should be allowed to progress further on the program.
Pass with Minor Corrections	The proposal should be accepted*subject to inclusion of minor corrections and revisions.*This normally means that there are some editorial errors and/or minor conceptual issues that need to be addressed before the proposal is approved. The student is passed and should be allowed to progress further on the program once the corrections and revisions are approved. The re-submission of the revised proposal shall take place within a period not exceeding 4 weeks from the date the student is formally informed of the decision of the examination committee.
Fail with Revise and Resubmit	The proposal should be*referred back for major revisions.*This normally means there are some major conceptual issues with the research proposal and/or the student's performance during the proposal oral examination does not meet the required standards. The student is failed in the research proposal examination in the semester in which the proposal examination is conducted. However, the revised proposal may be re-submitted for a second and final attempt at passing the examination subject to the conditions specified by the examination committee. The re-submission shall take place within a period not exceeding 24 weeks from the date of the decision of the examination committee. The examination committee must specify in the examination report whether they require (a) re-submission of the revised research proposal without oral examination or (b) full re-examination of the revised research proposal including the oral examination.
Fail	The proposal should be rejected outright. This normally means that the proposal is conceptually very weak and/or the student's performance during the oral examination is well below the required standards. The student is failed and his/her registration on the program should be terminated.

Dissertation Proposal Examination outcome for Direct PhD students **(with only BSc Degree)**.

The following outcomes of the dissertation proposal and examination are possible:

Pass The proposal should be accepted *as it stands.* The student is passed and should be allowed to progress further on the program.

Pass with Minor Corrections The proposal should be accepted *subject to inclusion of minor corrections and revisions.* This normally means that there are some editorial errors and/or minor conceptual issues that need to be addressed before the proposal is approved. The student is passed and should be allowed to progress further on the program once the corrections and revisions are approved. The re-submission of the revised proposal shall take place within a period not exceeding 4 weeks from the date the student is formally informed of the decision of the examination committee.

Fail with Revise and Resubmit The proposal should be *referred back for major revisions.* This normally means there are some major conceptual issues with the research proposal and/or the student's performance during the proposal oral examination does not meet the required standards. The student is failed in the research proposal examination in the semester in which the proposal examination is conducted. However, the revised proposal may be re-submitted for a second and final attempt at passing the examination subject to the conditions specified by the examination committee. The re-submission shall take place within a period not exceeding 24 weeks from the date of the decision of the examination committee. The examination committee must specify in the examination report whether they require (a) re-submission of the revised research proposal without oral examination or (b) full re-examination of the revised research proposal including the oral examination.

Fail The proposal should be rejected outright. This normally means that the proposal is conceptually very weak and/or the student's performance during the oral examination is well below the required standards. The student is failed and his/her registration on the program should be terminated.

Fail with Recommended Master Degree Pathway The proposal does not meet the required standards for a PhD program. It is recommended that the student is considered for the exit pathway to a relevant Master degree program, subject to approval of the Graduate Studies Council.

Dissertation Progress Report (DPR)

The Dissertation Progress Report (DPR) is a tool for the PhD student to provide an update on his/her progress, difficulties, resource requirements, publications, and planning for the next semester. Towards the end of each semester (typically week 10) following successful completion of the RPE, students should submit a short progress report to the RSC. The committee reviews the DPR and provides feedback to the Advisors. The Main Advisor should consider this feedback when submitting the research progress evaluation of the student at the end of the semester. The DPR shall include, but not necessarily be limited to, the following:

- Original/revised research goals;
- Completed work;
- Status of completed and proposed goals; and
- Publications.

Completion of the DPR on a semester basis helps students to carry out well-paced research, making it easier to complete their dissertation and publications in time. It also acts as an important communication channel between the student and his/her research committee, especially when a large team is involved.

All PhD students should give an oral presentation annually to the RSC members after successful completion of the PhD Research Proposal Examination (RPE).

Dissertation Progress Review

Students are required to carry out research work under the supervision and guidance of their Advisor(s) in regular semesters before Research Proposal Exam. Submitting a report and presenting it to the RSC members are not mandatory.

Summer Research Progress

All students registered for dissertation in the Summer Semester are allocated this milestone. Students are required to carry out research work under the supervision and guidance of their Advisor(s). Submitting a report and presenting it to the RSC members are not mandatory.

Dissertation Defense Committee (DDC) and External Examiner

The Dissertation Defense Committee (DDC) shall include members of the RSC and a PhD External Examiner. The External Examiner should be a full professor from a reputable international university who is an internationally recognized researcher in the subject area of the dissertation. To avoid any potential conflict of interest, the External Examiner must not have been affiliated with KU in the last five years up to the present day, in any capacity including the examination of dissertation. Furthermore, the Main Advisor and/or Co-advisor(s) must not have had joint publications or any collaboration with the External Examiner over the past five years.

The External Examiner is nominated by the Main Advisor in consultation with the Co-Advisor(s), relevant Department Chair (or nominee) and Associate Dean for Graduate Studies, and appointed as a voting member of the DDC by the AVP of Graduate Studies. External Examiners will be invited to evaluate the PhD dissertation remotely and join the defense online. Distinguished professors from the world's top ranked institutions may be invited to attend the final dissertation defense in person. Such nominations will require strong justification from the student's Main Advisor, endorsement from the Department Chair (or nominee), the Associate Dean for Graduate Studies and approval from the AVP of Graduate Studies.

Dissertation Defense

Every semester, the Graduate Studies Office publishes a Graduation Timeline specific to the current term. The timeline provides a guide to processes students and faculty must complete leading up to the final dissertation submission and defense, including the dissertation formatting guidelines. Graduate students are required to follow this timeline and adhere to the specified deadlines during their final semester of study. A student should normally be in good academic standing and registered for dissertation credits during the semester he/she intends to defend.

The Graduate Studies Office schedules the final dissertation defense in accordance with the approved "Intent to Submit PhD Dissertation for Examination" request and in consultation with all DDC members. Graduate Studies Office will make the relevant logistical arrangements and inform the student about the date and time.

The Associate Dean for Graduate Studies at the relevant College chairs the DDC or appoints a full-time KU faculty member as DDC Chair in consultation with the relevant Department Chair. The composition of the DDC is communicated to the AVP of Graduate Studies. The primary responsibilities of the DDC Chair are:

- Attend the final dissertation defense and the private DDC meeting to ensure that the examination is conducted in accordance with all relevant KU academic policies and procedures. The DDC Chair does not have a role in the final outcome of the dissertation defense.
- Report the examination result to the Graduate Studies Office through the Associate Dean for Graduate Studies and confirm that the correct examination process was followed.

The student must submit an initial dissertation draft to the Main Advisor and Co-Advisor(s), who will work with the student on the necessary revisions. Upon receiving the approval of the advisors, the revised dissertation is submitted to all RSC members and the Graduate Studies Office, who will forward it to the External Examiner. The student must submit his/her dissertation by the deadline published in the Graduation Timeline for the relevant semester.

The final dissertation defense consists of two parts: a public presentation and a private examination. In the first part, the student delivers a presentation open to the public (typically 45 minutes), followed by questions (typically 10-15 minutes). The second part is a private examination, which does not normally exceed 180 minutes, attended by the DDC members, the DDC Chair and any relevant ex-officio members. During the private examination, the committee will interview the student, ask more detailed questions and examine a demonstration of the completed work, if applicable. The committee will also convey to the student any changes that he/she is required to make before the final submission of the dissertation.

A high level of achievement is expected for the award of the PhD degree. In his/her dissertation and during the viva voce examination, a candidate for the degree of PhD is required to:

- Demonstrate a high level of understanding and specialization in his/her field of study;
- Show evidence that he/she is able to conduct independent investigation with rigor and discrimination;
- Demonstrate the ability to acquire and collate information through the effective use of appropriate sources and equipment;
- Appreciate the relationship of the area of his/her research to a wider field of knowledge;
- Demonstrate a critical appreciation of the literature in his/her area of research;
- Demonstrate an ability to recognize and validate research problems;
- Demonstrate an understanding of relevant research methodologies and techniques and their appropriate application to his/her research;
- Have made a significant and original contribution to the body of knowledge in his/her field of study;
- Demonstrate an ability to appraise critically his/her contribution in the context of his/her overall investigation;
- Constructively defend his/her research outcomes;
- Write clearly, accurately, cogently, and in a style appropriate to purpose;
- Construct coherent arguments and articulate ideas clearly; and
- Show awareness of relevant research issues including environmental, political, economic, social, copyright, ethical, health and safety, exploitation of results, and intellectual property rights.

Following the examination, the DDC members and the Chair will meet privately to decide on whether the student has successfully defended the dissertation. The advisor(s) decision is divided equally among the Main Advisor and Co-Advisor(s) such that each may decide independently but the total advisor(s) decision equals one. The External Examiner and the other DDC members have one decision each, any other external members do not have a role in the outcome of the defense. The DDC Chair will report the examination result to the Graduate Studies Office through the Associate Dean for Graduate Studies.

The final decision on the outcome of the dissertation defense will be the lowest outcome reported by the DDC. The DDC Chair communicates this decision to student, DDC members, Associate Dean for Graduate Studies and the Dean of Graduate Studies.

The following DDC recommendations are possible:

Pass	That the candidate be recommended for the award of PhD. No further revisions are required for the dissertation.
Pass with Minor Corrections	That the candidate be recommended for the award of PhD, subject to the satisfactory completion of such minor corrections as may be required by the DDC. This normally means that there are typographical, grammatical and/or editorial errors that need correcting before the dissertation is approved. Such minor corrections shall be completed within a nominal period of four weeks of the decision of the DDC. The DDC may stipulate that the minor corrections made shall be scrutinized by the DDC as a whole or by the Main Advisor prior to the award process being initiated.
Fail with Revise and Resubmit	That the candidate be not recommended for the award of PhD, but be allowed to modify the dissertation and re-submit it for the award of PhD on one further occasion. This normally means there are some major conceptual issues with the dissertation and/or the student's performance during the oral defense does not meet the required standards. The student is failed in the dissertation evaluation in the semester in which the dissertation examination is conducted. However, the revised dissertation may be re-submitted for a second and final attempt at passing the examination subject to the conditions specified by the DDC. The re-submission shall take place within a period not exceeding 24 weeks from the date of the decision of the DDC. The DDC must specify in the examination report whether they require (a) re-submission of the revised dissertation without oral examination or (b) full re-examination of the revised dissertation including the oral defense.
Fail	That the candidate be not recommended for the award of PhD and no further submission is permitted. The candidate must then be terminated from the PhD program.

The final, corrected copy of the dissertation post-examination and endorsement of the student's Main Advisor, Co-Advisor(s) and DDC members must be submitted to the Associate Dean for Graduate Studies at the relevant College and subsequently to the AVP of Graduate Studies for approval.

Internships

Internships provide an important opportunity for Khalifa University graduate students to experience a unique facility or specialization offered by an academic institution, research centre or company. Internship experiences can enhance the research students undertake at Khalifa University and facilitate real world applications. Students gain professional experience by interacting with potential research partners and employers, as well as an understanding of the skills needed in different industry sectors. Internship students will promote Khalifa University as a world class institution among government and industry entities in the UAE and all over the world. Students who demonstrate promising potential for independent work and whose research topic lends itself to external collaboration may be considered for an internship.

Internship Guidelines

All registered graduate students can apply for an internship during their studies at Khalifa University. Internships are optional and subject to approval. The following general guidelines apply:

- Students must be in good academic standing to be eligible to apply for an internship.
- Students must have the permission of their Main Advisor prior to pursuing an internship.
- An internship must not interfere with the student's academic studies, research and teaching duties, thus it is normally undertaken during the summer, for a period not exceeding 3 months. Students may apply for a longer internship period and any such request will be subject to approval.
- Students may not sign any agreement with a host organization until their internship application is approved by Khalifa University. The approval process includes review of all agreement documents.
- Students may not simultaneously accept employment from Khalifa University or any other organization.
- Based on approval from Khalifa University, the student may accept compensation from the host organization for internship expenses such as travel, accommodation, visa, etc. Depending on the financial arrangements made with the host, the student may not be eligible to receive a stipend from Khalifa University during the internship period.
- Pursuing an internship will not extend the duration of the student's scholarship.
- The internship will not be noted on the student's academic transcript.

Before the Internship

- The student must consult his/her Main Advisor and secure his/her support before pursuing an internship. The Main Advisor may assist the student in identifying a suitable host organization, if necessary.
- The student must obtain a formal letter from the host organization detailing the terms of the internship, including duration and any financial benefits offered to the student.
- The student must complete the Internship Application Form, obtain the approval of the Main Advisor, Department Chair, Associate AVP of Graduate Studies at the relevant College and submit it to GSO with supporting documentation. The student's participation in the internship is confirmed once approval is received from GSO and student's Banner record is updated, as appropriate.
- Applications for Research-Based internship should include the scope of planned work, a list of tasks to be conducted and expected outcomes. The Main Advisor must provide a letter of support stating how the intended internship will benefit and enhance the student's research at Khalifa University.
- Once the internship assignment is approved, the student should register for thesis/dissertation credits for the relevant semester.

During the Internship

- The student must maintain active communication with his/her Main Advisor and provide regular updates on the progress of the internship.
- The student is encouraged to keep a personal log covering the work carried out at the host institution to facilitate writing the final report that will be submitted to the Graduate Studies Office and the Main Advisor upon completion of the internship period.
- The student must behave in the utmost professional

manner, be a good ambassador for Khalifa University and adhere to the regulations and guidelines of the host organization.

- For Research-Based internships, the Main Advisor should maintain direct communication with the student's advisor at the host organization.

After the Internship

- The student must submit a detailed report to the Graduate Studies Office on the activities carried out during the internship, endorsed by the student's advisor at the host organization and Main Advisor at Khalifa University. The report must be signed by a representative from the host organization to confirm approval for publication.
- The Main Advisor will evaluate the student's work as part of research performance and incorporate the evaluation in the thesis/dissertation grade for the relevant semester.

Types of Internships

Research-Based

This internship provides students with experience in a research laboratory at a research-intensive international institution or research centre. The work undertaken during this internship must be relevant to the student's research at Khalifa University. It is the responsibility of the Main Advisor to monitor the student's progress during the internship.

Industry-Based

This internship provides students with an opportunity to gain experience in industry. Such activity may include collecting data, building case studies and obtaining a deeper understanding of the application area of the research topic or problem.

Course-Based

This internship allows students to attend a specialized graduate-level course available at a high-ranking international institution. Students must obtain the approval of their Advisor(s), the Associate Dean for Graduate Studies at the relevant College and the AVP of Graduate Studies prior to registering for courses outside Khalifa University. Students wishing to transfer credit for courses completed during an internship must adhere to Khalifa University policy *ACA 3270 Transfer Credit and Advance Standing.*

Application Procedure

The Graduate Studies Office (GSO) manages the internship application and approval process for graduate students. Internship applications are assessed on the basis of student's academic merit, quality of the application and the perceived benefit to the student's program of study. Internships may be sought with existing Khalifa University partner institutions, industry entities, or through ad hoc links with leading international universities and research centres.

Graduate Assistantships

Students holding a Khalifa University full-time scholarship will provide service of up to 12 hours per week during the academic semester, as detailed in the relevant scholarship contract. Service may include, but is not limited to, activities such as course work and lab supervision as assigned by the University. Students perform their assigned duties under the active tutelage and supervision of a faculty member. These appointments do not carry faculty status or other faculty rights or responsibilities.

Master's Students

Students pursuing a Master's qualification may be responsible for tasks related to the instruction of students and may support the faculty by:

- Preparing for class sections and/or laboratories;
- Presenting material in a classroom or lab setting;
- Facilitating group discussions and team-based learning;
- Offering technical support;
- Assisting with conduct and evaluation of assessment tasks; and
- Holding regular office hours.

These responsibilities will not generally extend to the instructional content of a course, the selection of student assignments, planning of examinations, determining the term grade for students or the instruction of an entire course.

Graduate full-time students engaged in Master's level studies at Khalifa University who assume substantial research responsibilities may aid the research of an investigator or a member of faculty on a research project or program. Graduate students are required to adhere to all University policies addressing research.

PhD Students

Graduate students at the Doctoral level may have an opportunity to gain substantial teaching experience and may be given primary charge and responsibility for a course (with the mentorship of a faculty member), including:

- Preparation and/or development of course material;
- Teaching at undergraduate level;
- Preparing for examinations and proctoring;
- Evaluating and grading assessment tasks; and
- Holding regular office hours and counseling students to improve their academic performance.

A graduate student is never responsible for assigning final grades. Graduate full-time students engaged in doctoral level studies at Khalifa University who assume substantial research responsibilities may provide high-level, experienced research support to an investigator or a member of faculty on a research project or program. Graduate students are required to adhere to all University policies addressing research.

Student Rights and Responsibilities

Academic Integrity

Khalifa University is committed to the principles of truth and academic honesty. It is the responsibility of all university community members – students, faculty, staff and administration alike – to promote academic integrity through active deterrence and reporting of violations. Every student admitted to KU is expected to fully comply with the university's Academic Integrity Policy and understand his/her rights and responsibilities *(ACA 3500 Academic Integrity, STL 5410 Student Code of Conduct, STL 5420 Student Rights and Responsibilities).* Admission to Khalifa University and registration in a course constitute an affirmation and acknowledgement by the student of his/her responsibility to abide by the terms and conditions of the academic integrity policy in its entirety. For policies and processes concerning the College of Medicine and Health Sciences, please refer to the *CMHS Medical Student Handbook.*

Student Academic Rights

Every enrolled student has the right to access and receive quality education.

- KU is obliged to provide students with information on available funds and financial aid.
- KU is obliged to uphold and preserve its students' rights to exercise principles of academic freedom.
- KU is obliged to advise on and provide sufficient course information to permit students to make informed course selections.
- KU is obliged to make each course outline available to students including (but not limited to):
    - A description of the topics to be considered in the course.
    - Objectives and learning outcomes.
    - A list of all required readings and other materials, a description of the means of evaluation to be used in the course, the instructor's office hours, and locations for office appointments.
- Instructors are obliged to clearly communicate the learning outcomes and assessment tools to students.
- Instructors are obliged to provide a fair and reasonable evaluation of a student's performance in a course, with evaluation measures reflecting the content of the course.
- The students have the right to a fair and impartial assessment of their performance.
- Subject to reasonable administrative arrangements and provided that a request is made by a student within a reasonable time after the notification of a decision, students have the right to appeal an academic decision.

Student Responsibilities

The policy on student responsibilities to the University, the faculty and fellow students includes The Honor Code of Conduct. Modelled after the "Fundamental Standard" established at Stanford University in 1896, the Khalifa University statement of student conduct applies to all students in the University community. This statement is as follows:

> *"Whether engaging in university activities or engaging in their lives outside the University, students at the Khalifa University of Science and Technology are expected to show respect for order, morality, personal honor and the rights of others as is demanded of good citizens. This includes conforming to applicable laws and respect at all times for the cultural norms and expectations of the society we live in. Failure to do this will be sufficient cause for removal from the University."*

More specifically, student responsibilities include:

- Abiding by all academic policies and procedures, and adhering to the academic integrity policy (including work ethics, attendance, etc.).
- Conforming to all non-academic administrative rules and regulations (including those related to health, safety and environment).
- Conducting oneself in accordance with the Student Code of Conduct.
- Respect the norms of UAE society and behave in a way that does not offend cultural sensitivities (see *STL 5410 Student Code of Conduct*).

- Observe decency in conduct and behavior, whether the student is on campus or off campus (see *STL 5410 Student Code of Conduct*).
- Adhere to the appearance appropriate to university students. Give special attention to clothing and cleanliness. Ensure that clothes do not conflict with public morals (see *STL 5430 Student Dress Code*).
- Abide by all academic policies and procedures and conform to all non-academic administrative rules and regulations.
- Complete his/her academic program. This includes being familiar with KU Catalogs, maintaining good academic standing, and meeting all other degree requirements.
- Abide by KU attendance policy (see *ACA 3555 Student Attendance (Graduate Programs)*).
- Maintain communication with KU and keep accurate student information including current address, home address, telephone number and e-mail address etc.
- Keep their ID card with them at all times and present it on demand to university personnel.
- Participate in campus and community life in a manner that will reflect credit upon the student and the university.
- Be punctual in attending lectures, labs, workshops and events.
- Be an active listener while in any educational setting and avoid any disruption.
- Maintain the cleanliness and tidiness of KU facilities.
- Refrain from using, circulating or displaying pamphlets, leaflets or posters in KU premises without prior approval.
- Assume responsibility of all resources such as apparatus, equipment, computer, books and other provided materials.
- Refrain from using any university computer for games or other purposes not related to the educational programs.
- Park only in the designated areas. Students are not allowed to use the parking area designated for faculty and staff.
- Be fully responsible for personal property. KU shall bear no responsibility for any lost or missing items.
- Consume food only in designated dining facilities. Food, tableware and utensils cannot be removed without permission.
- Refrain from engaging in spreading rumors or making false accusations.
- In case of a fire alarm, follow the instructions of the safety and security staff and leave KU premises as quickly as possible.
- Respect payment deadlines.
- Irrespective of religion or nationality, behave and dress in a modest manner. Harassment or intimidation of students will not be tolerated and students should report any such cases to the Student Services Office.

Confidentiality and Privacy of Student Records

Khalifa University creates and maintains a variety of records for prospective, current and former students. Documents submitted by students become the property of the university including, but not limited to application/enrollment forms, school certificates, academic or other transcripts and English language test scores. University faculty and staff are permitted to access a student's academic record only when necessary to the performance of their assigned duties and responsibilities.

Current and former students, their guardians and/or sponsors have access to the student's academic records upon written request to the Registrar's Office and provision of valid identification in accordance with *ACA 3850 Confidentiality and Privacy of Student Records* policy. Other parties may be given limited access to student academic records as follows:

- Organizations, their employees, agents and/or representatives authorized to act on the University's behalf or providing a service or function for or on behalf of the University may have access such as may reasonably be considered necessary to the service or function.
- Government and other authorized officials including accrediting bodies.
- To comply with a judicial order.
- Other institutions to which a student is transferring;

- Organizations conducting educational studies, on the condition that no personally identifiable information is released, or is released only in aggregate form.
- University employees, agents or representatives investigating a suspected security breach or conduct violation.
- Emergency personnel where there is a health or safety concern.

A student, guardian, or sponsor has the right to request changes to the content of the student's education record if the content is considered to be inaccurate, misleading, or in violation of the student's privacy or other rights. Such a request should be submitted in writing to the Registrar's Office.

Academic Integrity Code

The academic community, like all communities, functions best when all its members treat one another with honesty, fairness, respect, and trust. Khalifa University expects high standards of scholarship and integrity from all members of its community. To accomplish its mission of providing an optimal educational environment and developing leaders of society, the University promotes the assumption of personal responsibility and integrity and prohibits all forms of academic dishonesty. The purpose of education is to develop a student's ability to think logically and to express himself/ herself accurately.

Members of the University community are expected to carry out their work with intellectual honesty and professional integrity, adhering to the highest standards of ethical behavior consistent with the codes of conduct set down by relevant professional societies. Unethical behavior is not worthy of members of the University community and will be dealt with severely. Academic dishonesty in any form undermines the very foundations of higher education and will not be tolerated by the University. The most common form of academic dishonesty is plagiarism. Other forms of academic dishonesty are described in the sections below.

Plagiarism

Plagiarism is the act of representing another's words or ideas as one's own or failing to give appropriate credit to outside sources of information in any academic assignment, exercise, examination, project, presentation, report.

Forms of Plagiarism

- Word-for-word copying of someone else's work, in whole or in part, without acknowledgment, whether that work be a magazine article, a portion of a book, a newspaper piece, another student's paper, or any other composition not one's own. Any such use of another's work must be acknowledged by:
  - Enclosing all such copied portions in quotation marks; and/or
  - Providing a complete reference to the original source either in the body of one's work or in a note. As a general rule, one should make very little use of quoted matter in papers, project reports and assignments.
- An unacknowledged paraphrasing of the structure and language of another person's work. Changing a few words of another's composition, omitting a few sentences, or changing their order does not constitute original composition and therefore can be given no credit. If such borrowing or paraphrasing is ever necessary, the source must be indicated by appropriate reference.
- Writing a work based solely on the ideas of another person. Even though the language is not the same, if the thinking is clearly not one's own, then the person has committed plagiarism. If, for example, in writing a work a person reproduces the structure and progression of ideas in an essay one has read, or a speech one has heard, the person, in this case, is not engaging his/her own mind and experience enough to claim credit for writing his/her own composition.

In summary plagiarism includes, but is not limited to:

- Using published work without referencing (the most common);
- Copying coursework;
- Collaborating with any other person when the work is supposed to be individual;
- Taking another person's computer file/program;
- Submitting another person's work as one's own;
- The use of unacknowledged material published on the web;
- Purchase of model assignments from whatever source; or
- Copying another person's results.

Avoiding Plagiarism

To avoid plagiarism, a student must give credit whenever he or she uses:

- Another person's idea, opinion, or theory;
- Any facts, statistics, graphs, drawings, any pieces of information that are not common knowledge;
- Quotations of another person's actual spoken or written words; or
- Paraphrase of another person's spoken or written words.

Direct quotations should be put in "inverted commas", and referenced. Paraphrased or edited versions should be acknowledged and referenced.

Identification and Analysis of Plagiarism Guidelines

It is University policy that electronically-submitted coursework produced by students be regularly submitted to suitable plagiarism-detection software for the identification and analysis of possible plagiarism. The University holds a site license for reputable plagiarism-detection software and makes available to all teaching staff relevant access to the software. It is mandatory that all teaching staff use such software for all major student assignments and final project reports. Plagiarism is deemed to have occurred if the plagiarism score is equal to or greater than 15%, after all individual instances of scores of 2% or less are discounted. All coursework items that achieve a plagiarism score equal to or greater than 15% (after all individual instances of scores of 2% or less are discounted) will be awarded zero grades. The only faculty member who may submit a coursework item for a particular course to a plagiarism-detection software program is the assigned instructor for that course. No other academic course member should submit any coursework item that relates to another faculty member's assigned course.

Other Forms of Academic Dishonesty

Cheating

Using or attempting to use unauthorized materials and/or assistance in any academic assignment, exercise, examination, project, presentation, report, etc. This includes the possession of a mobile phone or any other unauthorized electronic devices during a test or an examination.

Collusion

Collusion includes cooperation of student(s) with faculty or staff personnel in securing confidential information/material (tests, examinations, etc.); bribery by student(s) to change examination grades and/or grade point average(s); cooperative efforts by student(s) and student assistant(s) to gain access to examinations or answers to examinations for distribution; seeking, obtaining, possessing, or giving to another person an examination or portions of an examination (not yet given), without permission of the instructor.

Fabrication of Data

Falsifying or inventing research, citations, or any information on any academic assignment, exercise, examination, project, presentation, report, etc.

Falsifying Signatures

Forging monograms, imprimaturs and other forms of authorization or identification – whether handwritten, electronic or otherwise – on official forms or documents, attendance lists or any academic assignment, exercise, examination, project, presentation, report, etc.

Falsification of Results

This means the alteration, modification, or misrepresentation of results (including selective inclusion or exclusion of results).

Recycling

Recycling is the submission of one's previous work to count as new work. For example, submission of a student's work that has previously counted in another unit of study is not allowed, unless explicitly authorized by the faculty members of both study units. In such case, students must reference their previous work.

Sabotage

Destruction of, or deliberate inhibition of, the progress of another student's work related to a course is considered sabotage and is viewed as academically dishonest. This includes the destruction or hiding of shared resources such as library materials and computer software and hardware to tampering with another person's laboratory experiments.

Procedure and Penalties for Academic Misconduct

Academic Dishonesty - Minor Violations

If an instructor suspects that a student has committed a minor violation, he/she should meet with the student to discuss the allegation. The meeting must take place within three working days from when the alleged violation was identified. If the instructor determines that no academic violation has occurred, the matter is dropped. If the instructor determines that a minor violation has occurred, he/she shall:

- Apply a sanction, if any, in accordance with KU policy *ACA 3500 Academic Integrity* (see also "Possible Sanctions for Academic Dishonesty Violations" below).
- Notify the student, the instructor's Department Chair and the relevant College Dean in writing, detailing the violation and sanction applied (if any) within five working days from when the meeting with the student(s) took place.
- The instructor's department chair will notify the Office of the Registrar about the violation, which will be recorded in the student's file. Following a second minor violation, the student's file will be referred by the Office of the Registrar to the Academic Integrity Council (AIC) for evaluation and recommendation of further sanctions.

Academic Dishonesty - Major Violations

If an instructor suspects that a student has committed a major violation, he/she should meet with the student to discuss the allegation. The meeting must take place within three working days from when the alleged violation was identified. If the instructor determines that no academic violation has occurred, the matter is dropped. If the instructor determines that a major violation has occurred, he/she shall:

- Notify the student, the instructor's Department Chair, and the relevant College Dean in writing, detailing the violation within five working days from when the meeting with the student(s) took place.
- The student will be notified in writing of the incident in question and the policy violation(s) under consideration. The notice (typically sent via email) will be delivered sufficiently in advance of the hearing to afford a reasonable opportunity to prepare a presentation and have access to the case file.
- The student's case file will be referred to the referred by the instructor's department chair through the relevant college to the Academic Integrity Council (AIC) within five (5) working days.
- The student's file will be automatically referred to the Judicial Officer (or designee) who will review the case, gather the evidence and present it, in writing, to the Academic Integrity Council (AIC).
- Upon submission of the case to the AIC,
  - The AIC will hold a meeting with the Judicial Officer (or designee) and, if necessary, the student and/or instructor for the purpose of examining the evidence and questioning any witnesses or relevant parties.
  - The student shall have the right to be assisted by an advocate. The advocacy role may be assigned to an academic advisor or counselor. External attorneys are not permitted to be involved in any grievance or appeal case.
  - The committee may consult the university legal assessors or an expert (e.g. medical, psychological, etc.) for advice regarding any evidentiary issue.
  - Based on the evidence, if the AIC decides that the student has committed an academic violation, they will recommend an appropriate sanction. The AIC may recommend any sanction in accordance with KU policy *ACA 3500 Academic Integrity* (see also "Possible Sanctions for Academic Dishonesty Violations" below).
  - The AIC submits a full report, including the recommended sanction, to the Provost (or designee) for a final decision. Such decision will be communicated to the Registrar's Office. Where the Provost (or designee) determines to impose a sanction other than that recommended by the AIC, written justification shall be provided to the AIC.
  - The Registrar's Office will communicate the final decision to the student, the instructor, the Department Chair, the relevant College Dean and the Graduate Studies Office.

During an Academic Dishonesty Investigation

A student under investigation for violation of this policy document may not withdraw from the course in question. A student may not graduate as long as any alleged violation of the Academic Integrity Policy remains unresolved. Non-availability of any of the concerned parties will not hinder the continuation of the investigation. Students may seek advice about the policy and the associated procedures from the advisor.

Possible Sanctions for Academic Dishonesty Violations

Sanctions for academic dishonesty are applied based on the severity of the violation:

- *Requirement to attend scheduled developmental workshops on relevant topics*

Opportunistic cheating in assignments, exercises, examinations, projects, presentations, reports, etc. that have a limited effect on a student's course grade.

- *Reduced grade or 0 for the work*

Opportunistic cheating in assignments, exercises, examinations, projects, presentations, reports, etc. that have a limited effect on a student's course grade.

- *Reduction in course grade by one letter grade*

Premeditated cheating in assignments, exercises, examinations, projects, presentations, reports, etc. that have a limited effect on a student's course grade.

- *XF or reduction in grade for the course*

Opportunistic cheating in assignments, exercises, examinations, projects, presentations, reports, etc. that have a significant effect on a student's course grade.

- *Suspension for one semester and an XF for the course*

Premeditated cheating in assignments, exercises, examinations, projects, presentations, reports, etc. that have a significant effect on a student's course grade.

- *Expulsion from KU*

Premeditated and/or repeated cheating in assignments, exercises, examinations, projects, presentations, reports, etc. that have a significant effect on a student's course grade.

- *Suspension from KU*

A student found guilty of academic dishonesty may be suspended for one or more semesters. The AIC recommends the length of suspension. Once imposed, the AIC recommends the effective date for suspension, which could be immediate. If suspended during an academic semester, the student will receive a grade of XF (Failure due to Academic Dishonesty) for the concerned course and a W for all remaining courses. KU will report the case to the student's guardian and/or sponsor.

Appeals

A student may, prior to graduation, appeal an XF grade recorded or other imposed sanction in accordance with *STL 5450 Student Grievances and Appeals.*

Records of Sanctions

All records of sanctions for all cases will be maintained in the student's file. In cases of major violations, KU will provide a record of sanction upon request from the guardian and/or sponsor (see *ACA 3850 Confidentiality and Privacy of Student Records*).

Student Grievances and Appeals

Khalifa University aims to provide a fair, equitable and productive learning environment for all its students that includes a variety of means by which student grievances are brought to consideration and subsequent resolution in a timely manner *(STL 5450 Student Grievances and Appeals).* A student has the right to appeal or file a grievance against academic or financial decisions or rulings, or a sanction resulting from a code of conduct violation. Students must follow the established procedures and adhere to time limits for filing a grievance or appeal. The University will issue an official written response. For policies and processes concerning the College of Medicine and Health Sciences, please refer to the *CMHS Medical Student Handbook.*

Appeals Procedure

In situations involving the appeal of a grade or an instructor imposed sanction related to a minor violation of the academic integrity policy, the student and instructor are encouraged to resolve the matter informally, amicably and promptly. Should the discussion fail to lead to resolution, the student may file an appeal with the relevant Department Chair. If the Department Chair, instructor and student are unable to resolve the issue, the student or Department Chair may further raise the appeal to the attention of the Dean of the College (or designee). In the case of an appeal of an instructor imposed sanction, the decision of the Dean of the College (or designee) will be final.

A student has the right to appeal a university imposed academic or non-academic sanction or a financial ruling subject to the following provisions:

- All appeals must be in writing and provide new information not considered previously.
- A student may appeal an officially recorded grade through submission of a "Grade Appeal" form to the Registrar's Office no later than the first day of classes of the next regular semester.
- All appeals of a sanction imposed by the Academic Integrity Council for an academic integrity violation must be submitted to the Registrar's Office within

five working days from the decision date. The Office of the Registrar will forward the case to the Graduate Studies Council, as appropriate.

- All appeals of a dismissal due to poor academic performance must be submitted to the Registrar's Office within five working days from the decision date. The Registrar's Office will forward the case to the Graduate Studies Council, as appropriate.
- All appeals of a sanction imposed by the Student Conduct Council for a code of conduct violation must be submitted to the Director of Student Services within five working days from the decision date. The Director will forward the case to the Graduate Studies Council, as appropriate.
- Financial appeals must be submitted to the Graduate Financial Appeals Committee, before the end of the semester from the financial action was applied.
- Appeals may result in the application of a lesser, identical or more severe sanction or grade.
- The recommendation of the Graduate Studies Council and Graduate Financial Appeals Committees final.
- The outcome of an appeal will be provided to the student in writing by the Registrar's Office or Graduate Studies Office and a copy of the final decision placed in the student's file.

Student Life and Services

Student Services is the department that fosters the intellectual, social, ethical, and personal development of students, preparing them to become engaged and constructive members of a diverse, dynamic, and global society within and out of the university. The department advocates students' needs, facilitates student involvement, and encourages students to accept responsibilities of membership in a campus community to explore personal interests through clubs, associations and focus groups. Additionally, there is strong emphasis on various health, safety and fitness programs, as well as recreational and educational activities. The *KU Student Handbook* provides further details on the activities and support provided by the Student Services department. For policies and processes concerning the College of Medicine and Health Sciences, please refer to the *CMHS Medical Student Handbook.*

Student Life

Student Life is committed to enriching the University's campus life by offering students an opportunity to take the initiative and assume leadership roles through student groups such as Student Council, clubs, and associations. Students are closely involved in organizing extracurricular activities, major and minor events. The aim is to promote a campus climate that enhances students' educational, physical, social, and emotional well-being and create a collaborative, caring, and participatory work environment.

Co-Education

The University maintains a multicultural and multi-structural educational environment that offers both an integrated and segregated education experience. All members of the community affirm the norms of UAE society and behave in ways that respects cultural sensitivities. All students, whether male or female, have access to equal educational opportunities and facilities.

Student Housing

University Residences offer an environment where students from different parts of the country and international destinations have the chance to meet and learn from one another. The University provides separate residential quarters for male and female students.

Student housing consists of single and double-shared furnished apartment-style buildings, varying in capacity between rooms. Sas Al Nakhl (SAN) Campus and Masdar City Residences are for male students, while Umm Lulu Complex (near SAN Campus) and Masdar City Residences are for female students. All housing facilities are managed by on-site staff and a security team.

Students are encouraged to refer to the Postgraduate Residence Guidebooks for further information.

Student Transportation

The University provides a range of transportation services for students:

- Daily shuttle bus service between the University campuses and Residences.
- Weekend transportation for students living in the university accommodation, subject to online registration. Transportation fees are set according to the University payment guidelines.
- Transportation to external events such as field, recreational, and ad hoc trips upon official requests by the concerned department.

Student Success

The Student Success Department provides services and experiences which allow each student to develop their capacity to achieve academic success, as well as meaningful personal and professional growth. The department focuses on the key areas of student guidance, and student engagement and development. Under the key areas, students are offered counseling services, academic and non-academic workshops, volunteering engagements, and the opportunity to develop social entrepreneurial competencies.

Counseling Services

Counselling provides support and intervention services to assist Khalifa University students personally and academically. A dedicated team of qualified counselors work to contribute to students' university experience in a trustworthy, confidential, and private atmosphere where students can share their concerns in a non-judgmental and welcoming environment.

All counseling sessions are held to a high level of confidentiality and are governed by KU Policy *STL 5510 Student Counseling.*

The counselors are available to support the students with academic Issues (low GPA, probation, attendance problems, test anxiety…), personal difficulties (stress, family conflicts, depression…), and social issues (difficulty making friends, problems with roommates…). The services are offered through individual counseling, consultation, group counseling, and workshops covering various topics catered to the needs of the students. Counseling services also assist students with special needs by offering special accommodations, to ensure they have access to educational opportunities equal to their fellow students. All students are encouraged to schedule an appointment with the counselor through the email.

Special Needs Services

Students, irrespective of any special need, have a right to equal access to education, resources, and facilities at the university. Students with documented special needs are entitled to reasonable accommodation within the available resources. Students are assured of the confidentiality of their special needs documentation.

The services provided include information on accessibility, identification of accommodations, filing of medical reports, and liaison with faculty and staff in establishing accommodations (e.g. equipment, tests, note-taking, etc.) and the provision of auxiliary aids when required. Please refer to *ACA 5200 Special Needs Students* for additional information.

Career Services

Khalifa University assists students in career planning and securing appropriate employment through provision of career related activities and professional services that follow best practices and meet the needs of students, alumni, and employers (refer to *STL 5520 Career Services*). Career Services are available from first registration and aim to help students develop career plans and goals, become employment ready and build relationships with employers. Students can develop effective study habits, discover personal learning styles, understand the importance of managing time, explore personal values and interests, as well as attend workshops on resume writing, interview preparation and networking skills. KU has a visible presence in the market as one of the first universities to cover the job demands of engineers in various industries, including clean technology and renewable energy.

KU Alumni Association Council

Mission Statement

The Khalifa University (KU) Alumni Association (KUAA) is set up to position KU as a leading global academic and research University and to place KU alumni at the forefront of the global local and global community focusing on facilitating a robust between alumni, current KU students, KU faculty, and collaborative network consisting of KU graduates, KU administration, and other relevant stakeholders.

Alumni Relations Charter/Mandate

Within the KUAA, comprised of all KU graduates, a KUAA Council (KUAAC) has been selected to serve this office and will be liaising with administration in order to engage, inform, and create a mutually beneficial platform for interaction with key stakeholders (including industry, academia, global leaders) in the UAE and abroad.

Student Council

Khalifa University strongly believes in students' active participation in the governance of the institute. Every student on campus, undergraduate or graduate, is eligible to serve on the Student Council.

The purpose of the Student Council is to provide a platform that promotes interaction between students and the University body. The Student Council works closely with Student Services to foster a spirit of community, understanding, and harmony throughout the campuses. The work of the Council also aims to promote student advocacy, leadership skills and contributes to enriching campus life. The Student Council encourages active participation in university governance, events, committee representation, student town hall meetings, and many student activities.

All KU students in good academic standing are eligible to run for office.

Student Council Objectives

- To liaise between students, faculty, and administration.
- To work on behalf of the interests and needs of the students.
- To improve the intellectual, cultural, and social character of the campus.
- To work with the Student Services Office (SSO) to set up events and activities.
- To assist in the formation and success of student clubs.
- To empower students at both levels to foster a living-learning sustainable community.
- To develop their leadership skills.
- To play an active and central role in the co-curricular life of the University.

Student Conduct

The Student Services Office is responsible for reviewing all alleged violations of non-academic student conduct. Non-academic offenses are related to behaviors that disrupt the life of the University community and include, but are not limited to, the following categories:

- Disruption of teaching or other University activities including administrative processes.
- Unauthorized entry and/or presence on University property.
- Threat, damage, and destruction of University property or the property of other members of the University community.
- Physical abuse, harassment, and dangerous activities.
- Possession of stolen property.
- Unauthorized or fraudulent use of University facilities, equipment or services.
- Misuse of library and information technology resources.
- Any behavior or appearance deemed by UAE or the University norms to be offensive to the culture.
- Behaviors deemed to be unacceptable may lead to a variety of sanctions up to and including student dismissal from the University. The University Student Handbook and website details University policies and procedures regarding student conduct regulations, hearings and sanctions.

Dress Code

All students are required to adhere to the University dress code when on campus or representing the University off-campus (see KU Policy *STL 5430 Dress Code*).

Student Code of Conduct

Every member of the University community is required to follow the principles of decency, modesty and propriety in their behavioral conduct and dress in line with the spirit of UAE cultural norms and religious traditions when on campus or representing the University off-campus. To this end, all students must comply with the conventions and regulations of University life established to maintain order, protect individuals and property, and fulfill the University's mission and purpose. It is the students' responsibility to familiarize themselves with the Code of Conduct and adhere to it *(STL 5410 Student Code of Conduct).*

Campus Access

All KU students are eligible to access University facilities during official working hours. All students must carry their Student ID with them at all times while on campus. This includes entering and exiting the University, attending classes, and using campus facilities and other designated spaces. Students with a valid University parking sticker are eligible to bring their vehicles on campus, subject to specific campus conditions and regulations. Access to laboratories and other specialized facilities, and after-hours access, require special advance permissions as stipulated by KU policy *STL 5710 Campus Access for Students.*

Center for Teaching and Learning (CTL)

Graduate Student Support Services

The Center for Teaching and Learning (CTL) at Khalifa University is committed to providing academic and instructional support services to graduate students. To uphold this commitment and to enrich the teaching and research experiences of the students, CTL offers structured training and workshop opportunities for post-graduate students.

Teaching Certificate for Teaching Assistants

To encourage best practices in teaching and learning, CTL offers a 10-week online training course which focuses on the development of knowledge, skills and understanding in the key aspects of teaching and learning. The course consists of modules of various collaborative and reflective activities with emphasis on professional growth and reflective engagements with other practitioners. In recognition of personal strive and devotion to growth and development, CTL awards those who complete the course with end of course certificates.

Academic Writing Workshop Series

Given the importance of effective written communication, especially in the area of research and scholarship, CTL offers an academic writing workshops series, which aims at enhancing students' research and writing skills. The workshops are driven by the need for creating a graduate culture that focuses on scholarship, healthy debates, and effective written communication.

List of Faculty

A

Abbas, Elrashid, PhD,

Omdurman Islamic University, 2007; Senior Lecturer of Social Sciences

Abbas, Manzar, PhD,

University of Chinese Academy of Science, 2017; Assistant Professor of Chemistry

Abdelhady, Ahmed, PhD,

The University of Manchester, 2011; Assistant Professor of Chemistry

Abdeljabbar, Alrazi, PhD,

University of South Florida, 2012; Associate Professor of Mathematics

Abdellah, Marwa, PhD,

University of Waterloo, 2015; Assistant Professor of Chemistry

Abderrahmane, Hamid, PhD,

Concordia University, 2009; Associate Professor of Mechanical and Nuclear Engineering

Abdul Samad, Yarjan, PhD,

Khalifa University, 2016; Assistant Professor of Aerospace Engineering

Abdul-latif, Zakariya, PhD

Framingham State University, 2014; Lecturer of General Education Unit

Abedrabbo, Sufian, PhD,

New Jersey Institute of Technology, 1998; Associate Professor of Physics

Abi Jaoude, Maguy, PhD,

University of Claude Bernard Lyon 1, 2011; Associate Professor of Chemistry

Abou Khousa, Mohammed, PhD,

Missouri University of Science and Technology, 2009; Associate Professor of Electrical Engineering and Computer Science

Abu Al Rub, Rashid, PhD,

Louisiana State University, 2004; Professor of Mechanical and Nuclear Engineering

Abu Haija, Mohammad, PhD,

Technical University of Berlin, 2006; Associate Professor of Chemistry

Abu-Nada, Eiyad, PhD,

New Mexico State University, 2001; Professor of Mechanical and Nuclear Engineering

Acquaye, Adolf, PhD,

Technological University, 2010; Associate Professor of Management Science and Engineering

Addad, Yacine, PhD,

University of Manchester, 2005; Associate Professor of Mechanical and Nuclear Engineering

Adem, Abdu, PhD,

Uppsala University, 1987; Professor of Pharmacology

Afgan, Imran, PhD,

University of Manchester, 2007; Associate Professor of Mechanical and Nuclear Engineering

Ajaj, Rafic, PhD,

Swansea University, 2013; Associate Professor of Aerospace Engineering

Al Ali, Khalid, PhD,

Tokyo University of Technology, 2014; Associate Professor of Chemical and Petroleum Engineering

Al Amoodi, Nahla, PhD,

University of Minnesota, 2016; Assistant Professor of Chemical and Petroleum Engineering

Al Arydah, Mo'tassem, PhD,

University of Ottawa, 2009; Assistant Professor of

Mathematics

Al Bataineh, Mohammad, PhD,

The University of Texas, 2015; Assistant Professor of Molecular Biology and Genetics

Al Deaibes, Mutasim, PhD,

University of Manitoba, 42661; Assistant Professor of General Education Unit

Al Durra, Ahmed, PhD,

The Ohio State University, 2010; Professor of Electrical Engineering and Computer Science

Al Galib, Mayssa, PhD,

National Institute of Applied Sciences, 2016; Assistant Professor of Chemistry

Al Ghaferi, Amal, PhD,

University of Pittsburgh, 2006; Associate Professor of Mechanical and Nuclear Engineering

Al Hajaj, Ahmed, PhD,

Imperial College London, 2014; Assistant Professor of Chemical and Petroleum Engineering

Al Hajri, Ebrahim, PhD,

University of Maryland, 2009; Associate Professor of Mechanical and Nuclear Engineering

Al Hammadi, Yousof, PhD,

the University of Nottingham, 2010; Associate Professor of Electrical Engineering and Computer Science

Al Homouz, Dirar, PhD,

University of Houston, 2007; Associate Professor of Physics

Al Hosani, Khalifa, PhD,

The Ohio State University, 2011; Associate Professor of Electrical Engineering and Computer Science

Al Jaafari, Khaled, PhD,

Texas A and M University, 2016; Assistant Professor of Electrical Engineering and Computer Science

Al Kaabi, Ahmed, PhD,

Colorado School of Mines, 2015; Assistant Professor of Mechanical and Nuclear Engineering

Al Khaleel, Mohammad, PhD,

McGill University, 2007; Associate Professor of Mathematics

Al Khazraji, Saeed, PhD,

Case Western Reserve University, 2011; Professor of Chemical and Petroleum Engineering

Al Kobaisi, Mohammed, PhD,

Colorado School of Mines, 2010; Associate Professor of Chemical and Petroleum Engineering

Al Mahri, Badr, PhD,

RWTH Aachen University, 2021; Senior Lecturer of Chemical and Petroleum Engineering

Al Marzooqi, Faisal, PhD,

Masdar Institute of Science and Technology, 2015; Associate Professor of Chemical and Petroleum Engineering

Al Marzouqi, Hasan, PhD,

Georgia Institute of Technology, 2014; Assistant Professor of Electrical Engineering and Computer Science

Al Moosa, Nawaf, PhD,

Georgia Institute of Technology, 2014; Assistant Professor of Electrical Engineering and Computer Science

Al Qutayri, Mahmoud, PhD,

University of Bath, 1992; Professor of Electrical Engineering and Computer Science

Al Safar, Habiba, PhD,

University of Western Australia, 2011; Professor of Biomedical Engineering

Al Saraierh, Hassan, PhD,

The Senate of Memorial University of New foundland, 2007; Senior Lecturer of Chemistry

Al Shalabi, Emad, PhD,

University of Texas - Austin, 2014; Associate Professor of Chemical and Petroleum Engineering

Al Shehhi, Maryam, PhD,

Khalifa University, 2016; Assistant Professor of Civil Infrastructure and Environmental Engineering

Al Shehhi, Mohamed, PhD,

University of Maryland, 2009; Associate Professor of Mechanical and Nuclear Engineering

Al Shoaibi, Ahmed, PhD,

University of Colorado, 2008; Professor of Chemical and Petroleum Engineering

Al Sumaiti, Ameena, PhD,

University of South Florida, 2015; Associate Professor of Electrical Engineering and Computer Science

Alameri, Saeed, PhD,

Colorado School of Mines, 2015; Assistant Professor of Mechanical and Nuclear Engineering

Alameri, Waleed, PhD,

Colorado School of Mines, 2015; Associate Professor of Chemical and Petroleum Engineering

AlAwadi, Khaled, PhD,

University of Texas at Austin, 2012; Associate Professor of Civil Infrastructure and Environmental Engineering

Alazzam, Anas, PhD,

Concordia University, 2010; Associate Professor of Mechanical and Nuclear Engineering

AlBlooshi, Hanifa, PhD,

AE University, 2014; Assistant Professor of Chemical and Petroleum Engineering

AlBusaeedi, Abdulla, Masters,

University of Yarmouk, 1997; Senior Lecturer of Social Sciences

Aldweik, Arafat, PhD,

Cleveland State University, 2001; Professor of Electrical Engineering and Computer Science

Alefishat, Eman, PhD,

University of Nottingham, 2011; Associate Professor of Pharmacology

AlFantazi, Akram, PhD,

Queen's University, 1994; Professor of Chemical and Petroleum Engineering

AlHammadi, Ali, PhD,

Rice University, 2016; Assistant Professor of Chemical and Petroleum Engineering

AlHseinat, Emad, PhD,

University of Edinburgh, 2013; Associate Professor of Chemical and Petroleum Engineering

Ali, Amin, PhD,

Khartoum University, 2020; Senior Lecturer of Biology

Ali, Mohamed, PhD,

University of Michigan, 1997; Associate Professor of Mechanical and Nuclear Engineering

Ali, Mohammed, PhD,

University of Oxford, 2003; Professor of Earth Science

Ali, Nazar, PhD,

University of Bradford, 1991; Associate Professor of Electrical Engineering and Computer Science

AlKhateeb, Ashraf, PhD,

University of Notre Dame, 2010; Senior Lecturer of Aerospace Engineering

Allouch, Nouha, PhD,

UNIVERSITY OF GRENOBLE, 2013; Assistant Professor of Mechanical and Nuclear Engineering

Allred, Jessica, Masters,

City College of New York, 2011; Lecturer of General Education Unit

Almansoori, Ali, PhD,

Imperial College London, 2006; Professor of Chemical and Petroleum Engineering

Al-Omari, Basem, PhD,

Northumbria University, 2018; Assistant Professor of Epidemiology & Public Health

Aloum, Lujain, Masters,

University College London, 2018; Senior Lecturer of Pharmacology

AlSalami, Yousuf, PhD,

Khalifa University for Science and Technology, 2016; Assistant Professor of Electrical Engineering and Computer Science

Al-Sarairah, Eman, PhD,

University of Manchester, 2007; Senior Lecturer of Mathematics

Alsawalhi, Jamal, PhD,

Purdue University, 2014; Assistant Professor of Electrical Engineering and Computer Science

AlShehhi, Aamna, PhD,

Masdar Institute of Science and Technology, 2017; Assistant Professor of Biomedical Engineering

Alshudeifat, Mohammad, PhD,

New Mexico State University, 2010; Associate Professor of Aerospace Engineering

AlSuwaidi, Aisha, PhD,

University of Oxford, 2012; Associate Professor of Earth Science

Alsuwaidi, Mohammad, PhD,

Colorado School of Mines, 2015; Assistant Professor of Earth Science

Alteneiji, Ahmed, PhD,

Khalifa University for Science and Technology, 2014; Assistant Professor of Electrical Engineering and Computer Science

Alzaabi, Omar, PhD,

Pennsylvania State University, 2019; Assistant Professor of Electrical Engineering and Computer Science

Amer, Saed, PhD,

Tennessee State University, 2012; Senior Lecturer of Management Science and Engineering

Ameur, Ahmed, Masters,

University of Central Florida, 2003; Senior Lecturer of Mathematics

Andrew, Matthew, Masters,

Macquarie University, 2010; Lecturer of General Education Unit

Anjum, Dalaver, PhD,

University at Albany SUNY, 2002; Assistant Professor of Physics

Arafat, Hassan, PhD,

University of Cincinnati, 2000; Professor of Chemical and Petroleum Engineering

Arif, Muhammad, PhD,

Curtin University, 2017; Assistant Professor of Chemical and Petroleum Engineering

Ashraf, Syed, PhD,

North Carolina State University, 1999; Professor of Biology

Askar, Khalid, PhD,

University of Florida, 2014; Assistant Professor of Mechanical and Nuclear Engineering

Aung, U Zeyar, PhD,

National University of Singapore, 2006; Associate Professor of Electrical Engineering and Computer Science

Aynedjian, Hagop, Masters,

Université Paul Sabatier – Toulouse III, 2005; Senior Lecturer of Physics

Ayoub, Mohammed, PhD,

University of Paris Saclay, 2003; Associate Professor of Biology

B

Babula, Michael, PhD,

University of London, 2006; Assistant Professor of Social Sciences

Banat, Fawzi, PhD,

McGill University, 1995; Professor of Chemical and

Petroleum Engineering

Barada, Hassan, PhD,

Louisiana State University, 1989; Professor of Electrical Engineering and Computer Science

Barkat, Braham, PhD,

Queensland University of Technology, 2000; Associate Professor of Electrical Engineering and Computer Science

Barsoum, Imad, PhD,

Royal Institute of Technology, 2008; Associate Professor of Mechanical and Nuclear Engineering

Bassous, Jad, Masters,

Ecole Nationale des Ponts et Chaussées, 1996; Senior Lecturer of Mathematics

Basten, Stuart, PhD,

University of Cambridge, 2008; Professor of Social Sciences

Batic, Davide, PhD,

University of Regensburg, 2005; Associate Professor of Mathematics

Beig, Balanthi, PhD,

INn Institute of Science, 2004; Associate Professor of Electrical Engineering and Computer Science

Belhaj, Hadi, PhD,

Dalhousie University, 2004; Associate Professor of Chemical and Petroleum Engineering

Bentahar, Jamal, PhD,

Laval University, 2005; Visiting Professor of Electrical Engineering and Computer Science

Berrouk, Abdallah, PhD,

The University of Manchester, 2007; Associate Professor of Mechanical and Nuclear Engineering

Bildsten, Meriem, Masters,

Uppsala University of Sweden, 2015; Senior Lecturer of Chemistry

Boiko, Igor, PhD,

Tulsa State University, 2009; Professor of Electrical Engineering and Computer Science

Bouchaala, Fateh, PhD,

University of Western Brittany, 2008; Assistant Professor of Earth Science

Bowman, Melanie, Masters,

University of Canberra, 2014; Lecturer of Management Science and Engineering

Bradley, Curtis, PhD,

Rice University, 1997; Associate Professor of Physics

Bsoul, Labeeb, PhD,

McGill University, 2003; Professor of Social Sciences

Burkett, Theodore, PhD,

University of Exeter, 2017; Senior Lecturer of General Education Unit

Butt, Haider, PhD,

University of Cambridge, 2012; Professor of Mechanical and Nuclear Engineering

C

Cannon, Brendon, PhD,

University of Utah, 2009; Assistant Professor of Social Sciences

Cantwell, Wesley, PhD,

Imperial College London, 1985; Professor of Aerospace Engineering

Ceriani, Andrea, PhD,

University of Pavia, 2000; Associate Professor of Earth Science

Chan, Vincent, PhD,

University of Pennsylvania, 1997; Professor of Biomedical Engineering

Chandrasekar, Srinivasakannan, PhD,

Annamalai University Tamil Nadu, 1993; Professor of Chemical and Petroleum Engineering

Chatzileontiadis, Leontios, PhD,

Aristotle University of Thessaloniki, 1997; Professor of Biomedical Engineering

Chen, Wei, PhD,

Chinese Academy of Sciences, 2012; Lecturer of Social Sciences

Chiesa, Matteo, PhD,

Norwegian University of Science and Technology, 2002; Professor of Mechanical and Nuclear Engineering

Choi, Daniel, PhD,

University of California, 2000; Associate Professor of Mechanical and Nuclear Engineering

Chrysikopoulos, Constantinos, PhD,

Stanford University, 1991; Professor of Civil Infrastructure and Environmental Engineering

Consigli, Giorgio, PhD,

University of Essex, 1998; Associate Professor of Mathematics

Corridon, Peter, PhD,

INna University, 2013; Assistant Professor of Physiology and Immunology

D

Dalton, David, Masters,

University of Sheffield, 1994; Senior Lecturer of General Education Unit

Damiani, Ernesto, PhD,

Università degli Studi di Milano, 1994; Professor of Electrical Engineering and Computer Science

Das, Gobind, PhD,

Università degli Studio di Trento, 2004; Associate Professor of Physics

Daw Elbait, Gihan, PhD,

Technischen Universitat Dresden, 2009; Senior Lecturer of Biology

Decarlis, Alessandro, PhD,

University degli Studi di Torino, 2006; Assistant Professor of Earth Science

Dermott, Mary, Masters,

National University of Ireland, 1983; Lecturer of Chemistry

Dias, Jorge, PhD,

University of Coimbra, 1994; Professor of Electrical Engineering and Computer Science

Dib, Khaled, PhD,

North Dakota State University, 1999; Senior Lecturer of Mathematics

Dimassi, Zakia, PhD,

The American University of Beirut, 2007; Assistant Professor of Pediatrics

Dimmitt, Nicholas, PhD,

University of Southern California, 1994; Associate Professor of Management Science and Engineering

Ding, Zhiguo, PhD,

University of London, 2005; Professor of Electrical Engineering and Computer Science

Domingues, Maria, PhD,

University of Aveiro, 2014; Assistant Professor of Biomedical Engineering

Dumee, Ludovic, PhD,

Victoria University, 2012; Assistant Professor of Chemical and Petroleum Engineering

Dutykh, Denys, PhD,

ENS Cachan, 2007; Associate Professor of Mathematics

E

Eissa, Shimaa, PhD,

University of Quebec, 2015; Assistant Professor of Chemistry

Ekpo, Okobi, PhD,

University of Pretoria, 2008; Assistant Professor of Anatomy and Cellular Biology

El Fadel, Mutasem, PhD,

Stanford University, 1991; Professor of Civil Infrastructure and Environmental Engineering

El Fouly, Tarek, PhD,

University of Waterloo, 2008; Associate Professor of Electrical Engineering and Computer Science

El Gamal, Glenda, PhD,

University of New England, 2018; Senior Lecturer of General Education Unit

El Khasawneh, Bashar, PhD,

University of Illinois at Urbana-Champaign, 1998; Associate Professor of Mechanical and Nuclear Engineering

El Khazali, Reyad, PhD,

Purdue University, 1992; Associate Professor of Electrical Engineering and Computer Science

El Kork, Nayla, PhD,

Universite de Lyon, 2009; Associate Professor of Physics

El Moursi, Mohamed, PhD,

University of New Brunswick, 2005; Professor of Electrical Engineering and Computer Science

El Rich, Marwan, PhD,

École Polytechnique de Montréal, 2005; Associate Professor of Mechanical and Nuclear Engineering

El Sadaany, Ehab, PhD,

University of Waterloo, 1998; Professor of Electrical Engineering and Computer Science

El Sokary, Wael, Masters,

University of Maryland Baltimore County, 2003; Lecturer of General Education Unit

Elayna, Imad, Masters,

University of Texas at San Antonio, 2002; Senior Lecturer of Mathematics

ElBassioni, Khaled, PhD,

the State University of New Jersey, 2002; Professor of Electrical Engineering and Computer Science

Elfadel, Ibrahim, PhD,

Massachusetts Institute of Technology, 1993; Professor of Electrical Engineering and Computer Science

El-Jammal, Hussam, Masters,

University of Arkansas, 1998; Senior Lecturer of Physics

El-Kadi, Mirella, PhD,

University of Lausanne, 1993; Associate Professor of Chemistry

Elmaarry, Mohamed, PhD,

Goettingen University, 2011; Associate Professor of Earth Science

Eveloy, Valerie, PhD,

Dublin City University, 2003; Professor of Mechanical and Nuclear Engineering

Everett, Dean, PhD,

University of London, 2007; Professor of Pathology and Infectious Disease

F

Fantino, Elena, PhD,

Universita degli Studi di Padova, 2001; Associate Professor of Aerospace Engineering

Fatt, Yap, PhD,

Nanyang Technological University, 2007; Associate Professor of Mechanical and Nuclear Engineering

Fernandes, Ryan, PhD,

University of Kentucky, 1991; Associate Professor of Mathematics

Fernandez, Maria, PhD,

Universidad de Sevilla, 1995; Professor of Chemical and Petroleum Engineering

Foulon, Francois, PhD,

Universite Paris, 1990; Professor of Mechanical and Nuclear Engineering

Francis, Diana, PhD,

Sorbonne Universities Paris, 2009; Assistant Professor of

Earth Science

G

Gabor, Adriana, PhD,

University of Twente, 2002; Associate Professor of Mathematics

Gacesa, Marko, PhD,

University of Connecticut, 2010; Assistant Professor of Physics

Galadari, Abdulla, PhD,

University of Aberdeen, 2013; Associate Professor of Social Sciences

Gardi, Alessandro, PhD,

RMIT University, 2017; Assistant Professor of Aerospace Engineering

Garvey, Kevin, Masters,

University of Surrey, 1998; Lecturer of General Education Unit

Gebrehiwot, Berihu, PhD,

University of Milan, 2010; Assistant Professor of Mathematics

Ghosh, Bisweswar, PhD,

Nagpur University, 1995; Associate Professor of Chemical and Petroleum Engineering

Giaralis, Agathoklis, PhD,

Rice University, 2008; Associate Professor of Civil Infrastructure and Environmental Engineering

Gkousis, Dimitrios, PhD,

University of California, 1986; Professor of Mechanical and Nuclear Engineering

Goharzadeh, Afshin, PhD,

University of Le Havre, 2001; Associate Professor of Mechanical and Nuclear Engineering

Goonetilleke, Ravindra, PhD,

State University of New York, 1990; Professor of Management Science and Engineering

Griffiths, Steven, PhD,

Massachusetts Institute of Technology, 2002; Professor of Practice of Chemical and Petroleum Engineering

Guha, Partha, PhD,

Oxford University, 1996; Professor of Mathematics

Gupta, Vinay, PhD,

Maharshi Dayanand Saraswati University Ajmer, 1997; Assistant Professor of Physics

H

Habbal, Kheirat, PhD,

The American University of Beirut, 2012; Assistant Professor of Family Medicine

Hamdan, Hamdan, PhD,

University of Arkansas for Medical Sciences, 2012; Assistant Professor of Physiology and Immunology

Harid, Noureddine, PhD,

University of Wales, 1991; Associate Professor of Electrical Engineering and Computer Science

Haroun, Mohamed, PhD,

University of Southern California, 2009; Associate Professor of Chemical and Petroleum Engineering

Hasan, Shadi, PhD,

Concordia University, 2011; Associate Professor of Chemical and Petroleum Engineering

Hasheem, Nabee, Masters,

Bangalore University, 1983; Senior Lecturer of Physics

Hassan, Jamal, PhD,

University of Waterloo, 2006; Associate Professor of Physics

Hassan, Shabir, PhD,

Zurich University, 2015; Assistant Professor of Biology

Hassen, Halah, Masters,

Mount Sinai School of Medicine, 1995; Associate Professor of Practice of Medicine

Hatzikirou, Haralampos, PhD,

Tu Dresden, 2009; Associate Professor of Mathematics

Henschel, Andreas, PhD,

Massachusetts Institute of Technology, 2010; Associate Professor of Electrical Engineering and Computer Science

Hjouj, Fawaz, PhD,

SIUC, 2013; Senior Lecturer of Mathematics

Hughes, Michael, PhD,

University of Wales, 1995; Professor of Biomedical Engineering

Hussain, Irfan, PhD,

University of Siena, 2016; Assistant Professor of Mechanical and Nuclear Engineering

I

Ibrahim, Saleh, PhD,

University of Helsinki, 1993; Professor of Physiology and Immunology

Islam, MD Didarul, PhD,

University of the Ryukyus, 2007; Associate Professor of Mechanical and Nuclear Engineering

J

James, Joann, PhD,

University of Bath, 2021; Senior Lecturer of General Education Unit

Janajreh, Isam, PhD,

Virginia Tech University, 1998; Professor of Mechanical and Nuclear Engineering

Javed, Sajid, PhD,

Kyungpook National University, 2017; Assistant Professor of Electrical Engineering and Computer Science

Jayaraman, Raja, PhD,

Texas Tech University, 2008; Associate Professor of Management Science and Engineering

Jelinek, Herbert, PhD,

University of Sydney, 2019; Associate Professor of Biomedical Engineering

Jimaa, Shihab, PhD,

Loughborough University, 1989; Associate Professor of Electrical Engineering and Computer Science

Jouini, Mohamed, PhD,

University of Bordeaux, 2009; Associate Professor of Mathematics

Junior, Mauro, PhD,

University of Arizona, 1992; Professor of Physics

K

Kappos, Andreas, PhD,

Aristotle University of Thessaloniki, 1986; Professor of Civil Infrastructure and Environmental Engineering

Karki, Hamad, PhD,

Tokyo University of Technology, 2008; Associate Professor of Mechanical and Nuclear Engineering

Kashir, Junaid, PhD,

Oxford University, 2012; Associate Professor of Biology

Khadkikar, Vinod, PhD,

École de technologie supérieure, 2008; Professor of Electrical Engineering and Computer Science

Khalaf, Kinda, PhD,

Ohio State University, 1998; Associate Professor of Biomedical Engineering

Khaleel, Maryam, PhD,

University of Minnesota, 2015; Assistant Professor of Chemical and Petroleum Engineering

Khalfan, Malik, PhD,

Loughborough University, 2001; Associate Professor of Management Science and Engineering

Khamsi, Mohamed, PhD,

University of Paris 6, 1987; Professor of Mathematics

Khan, Kamran, PhD,

Texas A and M University, 2011; Associate Professor of Aerospace Engineering

Khandoker, Ahsan, PhD,

Muroran Institute of Technology, 2004; Professor of Biomedical Engineering

Khonji, Majid, PhD,

University of Leeds, 2015; Assistant Professor of Electrical Engineering and Computer Science

Khraibi, Ali, PhD,

University of Mississippi, 1984; Professor of Physiology and Immunology

Kim, Jang, PhD,

University of Sydney, 1991; Professor of Mechanical and Nuclear Engineering

Kim, Nam Woon, PhD,

Texas University, 1993; Professor of Management Science and Engineering

Kim, Tae, PhD,

Duke University, 2007; Associate Professor of Civil Infrastructure and Environmental Engineering

Kirane, Mokhtar, PhD,

Pierre and Marie Curie University, 1983; Professor of Mathematics

Kishida, Tadahiro, PhD,

University of California, 2008; Associate Professor of Civil Infrastructure and Environmental Engineering

Kitapbayev, Yerkin, PhD,

The University of Manchester, 2014; Assistant Professor of Mathematics

Kohli, Nupur, PhD,

Aston University, 2015; Assistant Professor of Biomedical Engineering

Kourakis, Ioannis, PhD,

Universite Libre de Bruxelles Belgium, 2002; Professor of Mathematics

Koyi, Hemin, PhD,

Upsala University, 1989; Professor of Earth Science

Kui, Cheng, PhD,

The University of New South Wales, 2011; Associate Professor of Chemical and Petroleum Engineering

Kusmartsev, Fedor, PhD,

Landau Institute for Theoretical Physics, 1983; Professor of Physics

Kyritsis, Dimitrios, PhD,

Princeton University, 1998; Professor of Mechanical and Nuclear Engineering

L

Laadhari, Aymen, PhD,

University of Grenoble, 2011; Assistant Professor of Mathematics

Lee, Sung, PhD,

Texas A and M University, 2005; Associate Professor of Biomedical Engineering

Lehtonen, Erkko, Masters,

Tampere University of Technology, 1998; Assistant Professor of Mathematics

Liao, Kin, PhD,

Uni. of Illinois at Urbana, 1998; Professor of Aerospace Engineering

Liatsis, Panagiotis, PhD,

University of Manchester, 2002; Professor of Electrical Engineering and Computer Science

Loke, Show Pau, PhD,

UNIVERSITY PUTRA MALAYSIA, 2012; Professor of Chemical and Petroleum Engineering

Luckachan, Gisha, PhD,

Cochin University of Science and Technology (CUSAT), 2006; Lecturer of Chemistry

M

Maalej, Nabil, PhD,

University of Wisconsin - Madison, 1994; Associate Professor of Physics

Maalouf, Maher, PhD,

University of Oklahoma, 2009; Associate Professor of Management Science and Engineering

Mao, Samuel, PhD,

University of California, 2000; Professor of Practice of Mechanical and Nuclear Engineering

Martin, Neville, Masters,

Newcastle Upon Tyne Polytechnic, 1984; Lecturer of Mathematics

Mayyas, Ahmad, PhD,

Clemson University, 2012; Assistant Professor of Management Science and Engineering

Meribout, Mahmoud, PhD,

University of Technology of Compiegne, 1994; Professor of Electrical Engineering and Computer Science

Mettu, Srinivas, PhD,

Lehigh University, 2012; Assistant Professor of Chemical and Petroleum Engineering

Mezher, Toufic, PhD,

George Washington University, 1992; Professor of Management Science and Engineering

Mizouni, Rabeb, PhD,

Concordia University, 2007; Associate Professor of Electrical Engineering and Computer Science

Mohamad, Akbar, PhD,

IIT Madras, 2011; Assistant Professor of Chemistry

Mohamed, Sharmarke, PhD,

University College London, 2011; Associate Professor of Chemistry

Mohammad, Baker, PhD,

University of Texas at Austin, 2008; Professor of Electrical Engineering and Computer Science

Mohideen, Mohamed, PhD,

University of St.Andrews, 2011; Assistant Professor of Chemistry

Moran, Valentine, Masters,

Heriot-Watt University, 2001; Senior Lecturer of Management Science and Engineering

Moreeno, Mariam, Masters,

Marquette University, 1984; Lecturer of Mathematics

Mughrabi, Asma, Masters,

University of JO, 2005; Senior Lecturer of Mathematics

Muhaidat, Sami, PhD,

University of Waterloo, 2006; Professor of Electrical Engineering and Computer Science

Muschert, Glenn, PhD,

University of Colorado, 2002; Professor of Social Sciences

Mylonakis, George, PhD,

State University of New York at Buffalo, 1995; Professor of Civil Infrastructure and Environmental Engineering

N

Nader, Moni, PhD,

University of Sherbrooke, 2005; Associate Professor of Physiology and Immunology

Nashef, Enas, PhD,

University of South Carolina, 2004; Professor of Chemical and Petroleum Engineering

Nayfeh, Ammar, PhD,

Stanford University, 2006; Associate Professor of Electrical Engineering and Computer Science

Nogueira, Ricardo, PhD,

Pierre et Marie Curie University, 2004; Professor of Chemical and Petroleum Engineering

Nwayhed, Nadia, Masters,

The American Unviersity of Beirut, 2008; Lecturer of Mathematics

O

Okorie, Idika, PhD,

University of Manchester, 2020; Senior Lecturer of Mathematics

Omar, Mohammad, PhD,

University of Kentucky, 2004; Professor of Management Science and Engineering

Osman, Wael, PhD,

Tokyo University, 2014; Assistant Professor of Biology

Ossa, Frantz, PhD,

University of Poitiers, 2010; Assistant Professor of Earth Science

O'Sullivan, Siobhan, PhD,

University College Cork, 2000; Assistant Professor of Molecular Biology and Genetics

Otrok, Hadi, PhD,

Concordia University, 2008; Professor of Electrical Engineering and Computer Science

Oueis, Emilia, PhD,

University of Rouven, 2013; Assistant Professor of Chemistry

Oulhaj, Abderrahim, PhD,

Universite Catholique De Louvain, 2003; Associate Professor of Epidemiology & Public Health

P

Palmisano, Giovanni, PhD,

University of Palermo, 2008; Professor of Chemical and Petroleum Engineering

Pappa, Anna-Maria, PhD,

Ecole des Mines de St. Etienne, 2017; Assistant Professor of Biomedical Engineering

Parezanovic, Vladimir, PhD,

Ecole Polytechnique – ParisTech, 2011; Assistant Professor of Aerospace Engineering

Passamani Zubelli, Jorge, PhD,

University of California, 1989; Professor of Mathematics

Patole, Shashikant, PhD,

Sungkyunkwan University, 2010; Associate Professor of Physics

Pitsalidis, Charalampos, PhD,

Aristotle University of Thessaloniki, 2014; Assistant Professor of Physics

Polychronopoulou, Kyriaki, PhD,

University of Cyprus, 2005; Professor of Mechanical and Nuclear Engineering

Porcu, Emilio, PhD,

Trinity College, 2004; Professor of Mathematics

Puthal, Deepak, PhD,

University of Technology Sydney, 2017; Assistant Professor of Electrical Engineering and Computer Science

Q

Qattan, Issam, PhD,

Northwestern University, 2005; Associate Professor of Physics

Qurashi, Ahsan, PhD,

Chonbuk National University Jeonju, 2008; Associate Professor of Chemistry

R

Rahman, MD, PhD,

The University of New South Wales, 2002; Associate Professor of Chemical and Petroleum Engineering

Rahmani, Mohamed, PhD,

Universite Paris 7 Denis Diderot, 1999; Professor of Molecular Biology and Genetics

Rai, Muhammad, PhD,

Free University of Berlin, 2008; Assistant Professor of Anatomy and Cellular Biology

Raja, Aamir, PhD,

University of Canterbury, 2013; Assistant Professor of Physics

Rajasekaran, Senthil, PhD,

Sri Ramachandra Medical College, 2004; Professor of Medicine

Randelovic, Dragana, PhD,

University of NIS, 2008; Lecturer of Civil Infrastructure and Environmental Engineering

Rao, Sanjeev, PhD,

University of Auckland, 2009; Assistant Professor of Aerospace Engineering

Renda, Federico, PhD,

Scuola Superiore Sant'Anna, 2014; Associate Professor of Mechanical and Nuclear Engineering

Rezeq, Moh'D, PhD,

University of Ottawa, 2002; Associate Professor of Physics

Riahi, Mohamed, PhD,

Pierre et Marie Curie University, 2012; Assistant Professor of Mathematics

Richards, Selena, PhD,

University of Hull, 2008; Assistant Professor of Chemistry

Rios Torres, Ramon, PhD,

University of Barcelona, 2000; Professor of Chemistry

Rodriguez, Jorge, PhD,

University of Santiago de Compostela, 2006; Associate Professor of Chemical and Petroleum Engineering

Rossiter, Ashley, PhD,

University of Exeter, 2014; Associate Professor of Social Sciences

S

Sabatini, Roberto, PhD,

University of Nottingham, 2017; Professor of Aerospace Engineering

Sajini, Abdulrahim, PhD,

University of Cambridge, 2016; Assistant Professor of Biomedical Engineering

Sakhnini, Mohammad, PhD,

University of Exerter, 2014; Senior Lecturer of General Education Unit

Salah, Khaled, PhD,

Illinois Institute of Technology, 2000; Professor of Electrical Engineering and Computer Science

Saleh, Hani, PhD,

University of Texas at Austin, 2009; Associate Professor of Electrical Engineering and Computer Science

Sanduleanu, Mihai, PhD,

University of Twente, 1999; Associate Professor of Electrical Engineering and Computer Science

Schiffer, Andreas, PhD,

University of Oxford, 2014; Associate Professor of Mechanical and Nuclear Engineering

Seghier, Mohamed, PhD,

Joseph fourier University of Grenoble, 2000; Professor of Biomedical Engineering

Semiz, Sabina, PhD,

The University of British Columbia, 2001; Professor of Molecular Biology and Genetics

Seneviratne, Seneviratne, PhD,

Virginia Tech, 1994; Professor of Mechanical and Nuclear Engineering

Sengodan, Sivaprakash, PhD,

Ulsan National Institute of Science and Technology, 2015; Assistant Professor of Mechanical and Nuclear Engineering

Shakfa, Mohammad, PhD,

Technische University Braunschweig, 2015; Assistant Professor of Physics

Shanti, Aya, Masters,

Khalifa University, 2019; Lecturer of Biology

Sharif, Bayan, PhD,

University of Ulster, 1988; Professor of Electrical Engineering and Computer Science

Shariff, Mohd, PhD,

University of Newcastle Upon Tyne, 1985; Professor of Mathematics

Shaya, Janah, PhD,

University De Nice, 2016; Assistant Professor of Chemistry

Sheehan, David, PhD,

Trinity College Dublin, 1985; Professor of Chemistry

Shetty, Dinesh, PhD,

Seoul National University, 2011; Assistant Professor of Chemistry

Shoufan, Abdulhadi, PhD,

Technische Universitaet Darmstadt, 2007; Associate Professor of Electrical Engineering and Computer Science

Sim, Li-Chen, PhD,

University of Oxford, 2005; Assistant Professor of Social Sciences

Simsekler, Mecit, PhD,

University of Cambridge, 2014; Associate Professor of Management Science and Engineering

Singh, Nirpendra, PhD,

INn Institute of Technology Roorkee, 2007; Assistant Professor of Physics

Singh, Shakti, PhD,

Purdue University, 2010; Senior Lecturer of Electrical Engineering and Computer Science

Siraki, Arby Ted, PhD,

University of Ottawa, 2013; Assistant Professor of General Education Unit

Sleptchenko, Andrei, PhD,

University of Twente, 2002; Associate Professor of Management Science and Engineering

Sofotasios, Paschalis, PhD,

University of Leeds, 2011; Associate Professor of Electrical Engineering and Computer Science

Steuber, Thomas, PhD,

University of Cologne, 1989; Professor of Earth Science

Stitou, Samira, Masters,

University of Toronto, 1998; Lecturer of Mathematics

Stouraitis, Athanasios, PhD,

University of Florida, 1986; Professor of Electrical Engineering and Computer Science

Subhi, Enaam, Masters,

INna University, 2002; Senior Lecturer of General Education Unit

Subhiyyah, Hazim, Masters,

Northeastern University, 1999; Senior Lecturer of Physics

Susanto, Hadi, PhD,

University of Twente, 2006; Professor of Mathematics

Svetinovic, Davor, PhD,

Delft University of Technology, 2009; Associate Professor of Electrical Engineering and Computer Science

Swei, Sean, PhD,

Purdue University, 1993; Professor of Practice of Aerospace Engineering

T

Taha, Kamal, PhD,

University of Texas at Arlington, 2010; Associate Professor of Electrical Engineering and Computer Science

Tajdin, Mustapha, PhD,

University of al-Qarawiyyin, 2000; Assistant Professor of Social Sciences

Tardy, Blaise, PhD,

The University of Melbourne, 2015; Assistant Professor of Chemical and Petroleum Engineering

Temouri, Yama, PhD,

Aston University, 2008; Associate Professor of Management Science and Engineering

Thoudam, Satyendra, PhD,

Radboud University, 2012; Assistant Professor of Physics

U

Umar, Abdullahi, PhD,

University of St.Andrews, 1992; Professor of Mathematics

Umer, Rehan, PhD,

University of Auckland, 2009; Professor of Aerospace Engineering

V

Vahdati, Nader, PhD,

University of California Davis, 1989; Associate Professor of Mechanical and Nuclear Engineering

Van Vliet, Arjen, PhD,

Universitat Hamburg, 2014; Assistant Professor of Physics

Viegas, Jaime, PhD,

University of Porto, 2010; Associate Professor of Electrical Engineering and Computer Science

Werghi, Naoufel, PhD,

University of Strasbourg, 1996; Professor of Electrical Engineering and Computer Science

Wijeweera, Albert, PhD,

University of Tennessee, 2004; Associate Professor of Management Science and Engineering

Wollenberg, Alexander, PhD,

National University of Singapore, 2011; Assistant Professor of Management Science and Engineering

Y

Yates, Athol, PhD,

The Australian National University, 2011; Associate Professor of Social Sciences

Yeun, Chan, PhD,

University of London, 2000; Associate Professor of Electrical Engineering and Computer Science

Yildiz, Ibrahim, PhD,

University of Miami, 2008; Associate Professor of Chemistry

Yong, Kong, PhD,

National University of Singapore, 2002; Associate Professor of Electrical Engineering and Computer Science

Young, David, Masters,

University of Limerick, 2001; Senior Lecturer of General Education Unit

Yousef, Ahmed, PhD,

University of Western Ontario, 2009; Associate Professor of Biology

Z

Zahawi, Bashar, PhD,

Newcastle University, 1988; Professor of Electrical Engineering and Computer Science

Zaki, Wael, PhD,

Ecole Polytechnique, 2006; Professor of Mechanical and Nuclear Engineering

Zalloua, Pierre A., PhD,

University of California, 1996; Professor of Molecular Biology and Genetics

Zein El din, Hatem, PhD,

University of Waterloo, 2006; Professor of Electrical Engineering and Computer Science

Zemerly, Mohamed, PhD,

University of Birmingham, 1989; Associate Professor of Electrical Engineering and Computer Science

Zhang, Tiejun, PhD,

City University of Hong Kong, 2008; Professor of Mechanical and Nuclear Engineering

Zhao, Ruikun, PhD,

University of East Anglia, 2013; Senior Lecturer of Chemistry

Zheng, Lianxi, PhD,

University of Hong Kong, 2001; Professor of Mechanical and Nuclear Engineering

Zhou, Bing, PhD,

University of Adelaide, 1998; Associate Professor of Earth Science

Zikkos, Elias, PhD,

University of Cyprus, 2005; Senior Lecturer of Mathematics

Zou, Linda, PhD,

Monash University, 1998; Professor of Civil Infrastructure and Environmental Engineering

Zweiri, Yahya, PhD,

University of London, 2003; Professor of Aerospace Engineering

College of Science

MA in International and Civil Security

About the Program

Security is the insurance policy of the nation. The 21st century combines the promise of great progress with the resurgence of old dangers and the emergence of new ones. Those dangers include terrorism, warfare, weapons of mass destruction, tropical cyclones and large-scale industrial accidents. Some of these dangers are rooted in technology, others in society, and still others in nature itself. Attaining the strategic vision of the UAE will require deep understanding of those threats and hazards, and the knowledge and skills to address them. The Master of Arts in International and Civil Security (MA ICS) is a unique program that will prepare students to become leaders in this field. The MA ICS is a part-time program open to UAE National students who are working in or want to work in the field of security.

Program Educational Objectives

The objectives of the MA in International and Civil Security program are to:

1. Provide current and future security professionals with sophisticated knowledge of the UAE, regional and global security environment.
2. Provide current and future security professionals with the skills to produce, analyze and apply security-related research.
3. Apply higher education and research toward enhancing UAE, regional, and international security.

Learning Outcomes

MA in International and Civil Security graduates will have demonstrated:

1. Sophisticated knowledge of the international, national, and regional security environment, to include the relevant theories and history of conflict.
2. Sophisticated knowledge of natural and human caused threats to international, national, regional, and civil security.
3. An understanding of the relationships between and within the different levels of government and the private sector relative to international, national, regional and civil security.
4. Sophisticated knowledge of offensive and defensive technologies relevant to international, national, regional, and civil security.
5. The quantitative and qualitative research and analysis skills needed to contribute to the security field as practitioners, researchers and educators.
6. The written and verbal skills needed to effectively communicate within the fields of international and civil security.
7. The organizational skills needed to contribute to the security field as practitioners, researchers and educators.
8. The skills to apply appropriate technologies to support national, international, and civil security.
9. Ability to integrate and effectively utilize the theoretical frameworks, knowledge, and skills necessary for contributing to international, national, and civil security.

Program Structure and Requirements

Overall Program Structure

The MA ICS program is equivalent to 30 credit hours, distributed as follows: 12 credit hours of Program Core courses, 6 credit hours of Program Elective courses and 12 credit hours of Master's Workshop and Thesis. The core courses cover basic dimensions of both civil security and the broader security context in which civil security planning and policy must occur. Upon completion of the core coursework, students must take an additional two elective courses The elective courses may be in one of two tracks: Civil Security or Regional Security.

Program Component	Credit Hours
Program Core (4 courses)	12
Program Electives (2 courses)	6
Master's Workshop and Thesis	12
Total	**30**

Program Requirements

Students seeking the degree of MA in International and Civil Security must successfully complete 30 credit hours as specified in the program requirements detailed below, with a minimum CGPA of 3.0. Course selection should be made in consultation with the student's Academic Advisor. All courses have a credit rating of three credits each, except the Master's Thesis.

Program Core (12 credit hours)

Students must complete the core courses listed below.

Core Courses

IICS 601	Introduction to International Relations and Security Issues	3
IICS 602	Introduction to Civil Security	3
IICS 603	Social Science Research Methods	3
IICS 604	Regional Security and the Terrorist Threat	3

Program Electives (6 credit hours)

Students must select two courses from the list below.

Elective Courses

IICS 621	Technology and International Security	3
IICS 622	Technology and Civil Security	3
IICS 623	Regional Security Challenges and Policy Options	3
IICS 624	Creating Integrated Civil Security	3
IICS 625	Globalization and Middle East Security	3
IICS 626	Comparative Civil Security Systems	3
IICS 645	Policy Analysis	3
IICS 646	Intelligence and National Security	3
IICS 647	Exercise Design and Technology	3
IICS 648	The Changing Nature of War and Conflict	3
IICS 649	Cybersecurity and its Implications for Statecraft	3
IICS 690	Critical Infrastructure Protection Design	3
IICS 691	Nuclear Security	3
IICS 692	Computer and Network Security	3
IICS 693	Wireless Network and Mobile Security	3
IICS 694	Information Security Management	3

Thesis Workshop and Master's Thesis (12 credit hours)

Students must enroll in the Thesis Workshop after passing a minimum of six courses (18 credit hours), including the four core courses. The Thesis Workshop is a pre-requisite for the Master's Thesis and must be successfully completed before the student can register for thesis credits.

Workshop (3 credit hours)

IICS 698	Thesis Workshop	3

Students must complete a Master's Thesis that involves creative, social science research-oriented work within the field of civil or international security, under direct supervision of a full-time faculty advisor from the Institute of International and Civil Security, and at least one other full-time faculty who acts as a co-advisor. The outcome of research should demonstrate the synthesis of information into knowledge in a form that may be used by others. The research findings must be documented in a formal thesis and defended successfully in a viva voce examination.

Thesis (9 credit hours)

IICS 699	Master's Thesis	9

Study Plan

Students must consult with their respective advisors on the courses that they will enroll in, the required pre-requisites, and the thesis topic selection. The program is offered on a part-time basis only. The credit load is normally 6 credits during a regular semester as well as the summer term.

Students can only register for thesis credits after successfully completing a minimum of 9 credits of the core courses of the master's program they are enrolled in. It is to be noted that the minimum pass grade for graduate courses is a "C" letter grade. Students should consult the Graduate Catalog to learn about the graduate programs, the grading system, graduation requirements, and other pertinent matters.

A typical study plan for students enrolled in the MA ICS is shown below.

Typical Study Plan for Part-Time Students

	Semester 1	Semester 2
Year 1	• Program Core Course 1 • Program Core Course 2	• Program Core Course 3 • Program Core Course 4
Year 2	• Elective Course 1 • Thesis Workshop	• Elective Course 2 • Master's Thesis
Year 3	• Master's Thesis	

MSc in Applied Mathematics

About the Program

The degree of Master of Science in Applied Mathematics (MSc in Applied Mathematics) is awarded for successfully completing the requirements of a program of study, which includes taught courses and a thesis. The thesis is an independent investigation of specialized areas within the general field of Applied Mathematics.

The MSc in Applied Mathematics gives candidates the opportunity to deepen their knowledge in the broad field of Applied Mathematics and contribute to the process of discovery and knowledge creation through the conduct of original research. Candidates for this degree are taught and supervised by experienced faculty and are expected to demonstrate initiative in their approach and innovation in their work. In addition to successfully completing the taught course, candidates prepare and present a thesis on their chosen research area. Research may be undertaken on several topics corresponding to the areas of focus identified by the University.

Program Educational Objectives

The educational objectives of the MSc in Applied Mathematics program are to produce graduates who will be able to:

1. Advance professionally and be recognized as leaders in their chosen areas within the broad field of Applied Mathematics
2. Master solid analytical, quantitative and computational skills where Mathematics and Statistics play a key role
3. Apply their technical expertise to address the critical needs of society in a creative, ethical, and innovative manner
4. Further develop their knowledge and skills through graduate education or professional schools

Learning Outcomes

Students graduating with the MSc in Applied Mathematics will be able to:

1. Identify, formulate, and solve mathematical problems through knowledge and understanding of advanced mathematical concepts and computing
2. Critically evaluate emerging technologies and assess how they can be applied to different practical problems
3. Demonstrate the ability to advance his/her own knowledge and understanding through independent learning
4. Conduct and document research as well as defend such research results
5. Function in teams and communicate effectively
6. Conduct themselves in a professional and ethical manner

Program Structure and Requirements

The MSc in Applied Mathematics program consists of a minimum of 30 credit hours. The required program credits are distributed as follows: 12 credits of Program Core courses, 9 credits of Program Elective courses, and 9 credits of Applied Mathematics Master's Thesis work. Students will be expected to discuss their selection of the elective courses with the Program Coordinator/Supervisor to ensure that it is coherent and supports their thesis topic. The table below presents a summary of the MSc in Applied Mathematics degree program structure and requirements. All the MSc in Applied Mathematics program courses, with the exception of the Master's Thesis, have a credit rating of three credits each.

Program Component	Credit Hours
Program Core	12
Program Electives	9
Master's Thesis	9
Total	**30**

Program Requirements

Students seeking the degree of MSc in Applied Mathematics must successfully complete a minimum 30 credit hours as specified in the program requirements detailed below, with a minimum CGPA of 3.0. Course selection should be made in consultation with the student's main adviser. All courses have a credit rating of three credits each, except the Master's Thesis.

Program Core (12 credit hours)

The MSc in Applied Mathematics degree program core requires a minimum of 12 credits, consisting of the four courses, which are 3 credits each. The core courses are listed below.

Core Courses

MATH 621	Measure Theory	3
MATH 622	Real Analysis	3
MATH 605	Analytical Foundations of Risk and Optimization	3
MATH 606	Differential Equations	3

Program Electives (9 credit hours)

Students must complete a minimum of 9 credits of electives from the list of courses given below. Students can also select one elective course (3 credits) from other offered MSc programs at KU, subject to the approval of their research advisor and the Associate Dean for Graduate Studies.

Elective Courses

MATH 603	Multivariate Data Analysis	3
MATH 610	Model Estimation	3
MATH 611	Quantitative Tools for Data Science	3
MATH 612	Computational Methods and Optimization in Finance	3
MATH 613	Financial Risk and Portfolio Management	3
MATH 614	Factor Models with Machine Learning	3
MATH 615	Abstract Algebra	3
MATH 616	Linear Algebra and Optimization	3
MATH 617	Numerical Solutions of Differential Equations	3
MATH 618	Mathematical Biology	3
MATH 619	Mathematical Methods for High-Dimensional and Discrete Data with Machine Learning Applications	3
MATH 620	Advanced Statistical Inference	3
MATH 623	Health Data Science	3
MATH 624	Space-Time Data Science	3
MATH 626	Financial Derivatives and Risk Management	3
MATH 630	Research Methods in Science	3

Masters Thesis (9 credit hours)

A student must complete a master's thesis that involves creative research-oriented work within the broad field of Applied Mathematics, under the direct supervision of the main adviser, who must be a full-time faculty in the Department of Mathematics and at least one other full-time faculty who acts as co-adviser. The research findings must be documented in a formal thesis and defended successfully in a viva voce examination. Furthermore, the research should lead to publishable quality scholarly articles.

Thesis

MATH 699	Master's Thesis	9

Study Plan

Students must consult with their respective advisors on the courses that they will enroll in, the required pre-requisites, and the thesis topic selection. Full-time graduate students must register for 9 to 12 credits, including thesis credits, during a regular semester (Fall and Spring) and a maximum of 6 credits during a Summer term. In the case of part-time students, the credit load is normally 6 credits during a regular semester as well as the summer term.

Students can only register for thesis credits after successfully completing a minimum of 9 credits of the core courses of the master's program they are enrolled in. It is to be noted that the minimum pass grade for graduate courses is a "C" letter grade. Students should consult the Graduate Catalog to learn about the graduate programs, the grading system, graduation requirements, and other pertinent matters.

A typical study plan for students enrolled in the MSc in Applied Mathematics is shown below.

Typical Study Plan for Full-Time Students

Semester 1	**(Fall)**	•Seminar in Research Methods•Program Core Course 1 • Program Core Course 2 •Program Core Course 3 • Program Core Course 4
Semester 2	**(Spring)**	•Elective Course 1•Elective Course 2 •Elective Course 3 •Master's Thesis
Semester 3	**(Summer)**	•Master's Thesis

Typical Study Plan for Part-Time Students

	Semester 1	**Semester 2**
Year 1	•Seminar in Research Methods•Program Core Course 1 •Program Core Course 2	• Elective Course 1• Elective Course 2
Year 2	•Program Core Course 3•Program Core Course 4	•Elective Course 3•Master's Thesis
Year 3	•Master's Thesis	

MSc in Applied Chemistry

About the Program

The MSc in Applied Chemistry is awarded to candidates who successfully complete the academic courses and research thesis requirements of the program. The program is intended for candidates with a bachelor's degree in chemistry or other related specialization. The program's typical length is four semesters, with the first three semesters requiring the completion of a combination of course work and thesis work, and the final semester only requiring thesis work and writing. The program is designed to give candidates an opportunity to enhance their knowledge of chemistry and develop research expertise and skills in instrumentation and methodology that will prepare them for careers in applied chemistry or to pursue a doctorate degree.

Program Educational Objectives

The objectives of the MSc in Applied Chemistry program are to:

1. Provide a pool of highly trained professionals who can utilize their acquired knowledge in applied chemistry and skills in instrumentation and methods to contribute to the technical and research expertise of their employer.

2. Prepare graduates with outstanding educational skills and knowledge in applied chemistry and related areas to further their career aspirations.

3. Prepare students with effective communication and teamwork skills in areas related to applied chemistry to function successfully in their careers.

4. Provide students with sufficient expertise in applied chemistry to design and develop innovative solutions to complex scientific problems in the oil and gas industry.

5. Provide students with a quality education in applied chemistry in an academic environment committed to excellence and innovation that fosters leadership, professionalism and life-long learning and successful careers.

Learning Outcomes

Upon completion of the Master of Science in Applied Chemistry, the graduates will:

1. Be able to apply advanced concepts of fundamental and applied chemistry to the formulation and solution of complex problems in the oil and gas and related industries.

2. Develop and potentially publish the results of their research in peer-reviewed journals.

3. Have sufficient experience to successfully begin a PhD program in applied chemistry in a recognized university.

4. Be equipped with the knowledge and skills in applied chemistry to meet requirements of appropriate job opportunities at chemical companies.

Program Structure and Requirements

Overall Program Structure

The MSc ACHE program is equivalent to 30 credit hours, distributed as follows: 12 credit hours of Core courses, 9 credit hours of Program Elective courses and 9 credit hours of Master's Thesis. The components of the program are summarized in the table below.

Program Component	Credit Hours
Program Core	12
Program Electives	9
Master's Thesis	9
Total	**30**

Program Requirements

Students seeking the degree of MSc in Applied Chemistry must successfully complete 30 credit hours as specified in the program requirements detailed below, with a minimum CGPA of 3.0. Course selection should be made in consultation with the student's Main Advisor.

Program Core (12 credit hours)

Students must complete the core courses listed below.

Core Courses

CHEM 625	Applied Organic Chemistry & Instrumental Analysis	3
CHEM 655	Petroleum Production & Process Chemistry	3
CHEM 668	Corrosion Science & Advanced Physical Chemistry	3
CHEM 670	Polymers & Nanomaterials Chemistry	3

Program Electives (9 credit hours)

One elective course can be selected from other relevant graduate programs. Selection of elective courses should be made in consultation with the research supervisor and requires written approval from the Department Chair or designee.

Elective Courses

CHEM 620	Computational Chemistry	3
CHEM 623	Applied Inorganic Chemistry	3
CHEM 630	Advanced Industrial Catalysis	3
CHEM 640	Advanced Organometallics & Applications	3
CHEM 650	Spectrochemical Studies	3
CHEM 660	Environmental Science & Water Technology	3
CHEM 665	Fuels & Alternative Energy Sources	3
CHEM 666	Construction Chemicals & Green Chemicals	3

Master's Thesis (9 credit hours)

Students must complete a Master's Thesis that involves creative, research-oriented work within the field of applied chemistry, under direct supervision of a full-time faculty advisor from the Chemistry Department, and at least one other full-time faculty who acts as a co-advisor. The outcome of research should demonstrate the synthesis of information into knowledge in a form that may be used by others. The research findings must be documented in a formal thesis and defended successfully in a viva voce examination.

Thesis

CHEM 699	Master of Science Thesis	9

Study Plan

Students must consult with their respective advisors on the courses that they will enroll in, the required pre-requisites, and the thesis topic selection. Full-time graduate students must register for 9 to 12 credits, including thesis credits, during a regular semester (Fall and Spring) and a maximum of 6 credits during a Summer term. In the case of part-time students, the credit load is normally 6 credits during a regular semester as well as the summer term.

Students can only register for thesis credits after successfully completing a minimum of 9 credits of the core courses of the master's program they are enrolled in. It is to be noted that the minimum pass grade for graduate courses is a "C" letter grade. Students should consult the Graduate Catalog to learn about the graduate programs, the grading system, graduation requirements, and other pertinent matters.

A typical study plan for students enrolled in the MSc ACHE is shown below.

Typical Study Plan for Full-Time Students

Semester 1 (Fall)	•Seminar in Research Methods•Program Core Course 1 • Program Core Course 2 •Program Core Course 3 • Program Core Course 4
Semester 2 (Spring)	•Elective Course 1•Elective Course 2 •Elective Course 3 •Master's Thesis
Semester 3 (Summer)	•Master's Thesis

Typical Study Plan for Part-Time Students

	Semester 1	**Semester 2**
Year 1	•Seminar in Research Methods•Program Core Course 1 •Program Core Course 2	• Elective Course 1• Elective Course 2
Year 2	•Program Core Course 3•Program Core Course 4	•Elective Course 3•Master's Thesis
Year 3	•Master's Thesis	

MSc in Medical Physics

About the Program

The Master of Science in Medical Physics (MSc MEPH) combines in-depth knowledge and practical experience to educate and train qualified medical physicists in the areas of diagnostic imaging, radiation therapy, nuclear medicine and radiation protection. The program aims at fulfilling the needs of the country for competent medical physics practitioners. Students will utilize modelling, computer simulation and experimental techniques as tools to analyze and understand different phenomena and processes. Graduates of the MSc will have acquired the advanced level of knowledge and experience to assume a career in hospitals, in industry and government, as well as continuing their studies to the Doctorate level.

Program Educational Objectives

The objectives of the MSc in Medical Physics program are to produce graduates who:

1. Advance professionally and are recognized as leaders in their career.
2. Apply their technical expertise to address the needs of society in critical, creative, ethical, and innovative manner.
3. Further develop their knowledge and skills through graduate education and professional schools.

Learning Outcomes

MSc in Medical Physics graduates will be able to:

1. Apply medical physics knowledge, including core medical physics concepts and topics relating to the methods and techniques of clinical practice and research for the prevention, diagnosis, and safe treatment of human disease.
2. Solve medical physics problems individually and collaboratively involving the integration of knowledge including basic and applied physics, mathematics, biological and physics sciences; development of theoretical solutions; use of various concept representations, computational methods, simulations, and experimental tests.
3. Demonstrate skills related to posing new questions and solving problems in research, clinical, and industrial settings, including problem solving, troubleshooting, experimental skills, coding and software use, data processing and analysis.
4. Organize and communicate about scientific and technical concepts for different audiences and contexts using various and appropriate communication methods and modalities.
5. Develop familiarity with basic workplace concepts, issues, practices, professional conduct, and life skills, including ethical conduct and actions that are required of medical physicists.

Program Structure and Requirements

Overall Program Structure

The MSc MEPH program consists of a minimum 30 credit hours, distributed as follows:

Program Component	**Credit Hours**
Program Core	21
Master's Thesis	9
Total	**30**

Program Requirements

Students seeking the degree of MSc in Medical Physics must successfully complete a minimum 30 credit hours as specified in the program requirements detailed below, with a minimum CGPA of 3.0. Course selection should be made in consultation with the student's Main Advisor.

Program Core (21 credit hours)

Students must complete the core courses listed below.

Core Courses		
MEPH 620	Radiation Biology and Research Methods and Ethics	3
MEPH 630	Radiological Physics and Radiation Protection	3
MEPH 640	Physics of Radiotherapy	3
MEPH 650	Physics of Diagnostic Imaging	4
MEPH 660	Non-Ionizing Radiation Imaging	2
MEPH 680	Physics of Nuclear Medicine	3
MEPH 600/BMED 600	Physiological Systems	3

Master's Thesis (9 credit hours)

Students must complete a Master's Thesis that involves creative, research-oriented work within the field of medical physics, under direct supervision of a full-time faculty advisor from the Physics Department, and at least one other full-time faculty who acts as a co-advisor. The outcome of research should demonstrate the synthesis of information into knowledge in a form that may be used by others. The research findings must be documented in a formal thesis and defended successfully in a viva voce examination.

Thesis		
MEPH 699	Medical Physics Master's Thesis	9

Study Plan

Students must consult with their respective advisors on the courses that they will enroll in, the required pre-requisites, and the thesis topic selection. Full-time graduate students must register for 9 to 12 credits, including thesis credits, during a regular semester (Fall and Spring) and a maximum of 6 credits during a Summer term. In the case of part-time students, the credit load is normally 6 credits during a regular semester as well as the summer term.

Students can only register for thesis credits after successfully completing a minimum of 9 credits of the core courses of the master's program they are enrolled in. It is to be noted that the minimum pass grade for graduate courses is a "C" letter grade. Students should consult the Graduate Catalog to learn about the graduate programs, the grading system, graduation requirements, and other pertinent matters.

MSc in Molecular Life Sciences

About the Program

The MSc in Molecular Life Sciences (MMLS) program contributes to Khalifa University's desire to become a center of excellence in science, engineering, and medicine within the region and beyond. The program supports the University's alignment with the Abu Dhabi Economic Vision 2030 plan through the provision of internationally excellent education and student experience in Science, resulting in highly skilled Science professionals, capable of transferring state-of-the-art technologies in priority sectors of industry, business and government.

The program aims to offer comprehensive theoretical and practical knowledge of Molecular Life Sciences to students interested in pursuing careers in life sciences or medicine-related fields. It will graduate students who are critical thinkers with the ability to use their scientific knowledge to solve problems in life sciences and to effectively communicate them various stakeholders.

Program Educational Objectives

A few years after completing the program, the graduates will:

1. Create and critically evaluate current knowledge in life sciences in order to propose and plan new and creative approaches to solve research challenges with effective dissemination of the results to a variety of

audiences;

2. Work to the highest professional and ethical standards in an area of life sciences and develop their individual academic, professional and career skills;
3. Keep abreast of the latest developments in life sciences that contribute to the advancement of knowledge for the benefit of society.

Program Learning Outcomes

Upon completion of the program, students will be able to:

1. Examine and explain fundamental and advanced knowledge and research methods in life sciences, with emphasis on cellular and molecular biology.
2. Retrieve, analyze and critique published scientific data.
3. Plan, design, and conduct scientific experiments in biological sciences to address a specific question, independently and safely.
4. Analyze and interpret results following highest ethical, scientific, and professional standards.
5. Communicate effectively scientific results orally and in written forms to diverse audiences.

Program Structure and Requirements

Program Structure

The normal length of the program is 30 credit hours. To be recommended for graduation with an MSc in Molecular Life Sciences, students must satisfactorily complete the courses in the specified categories as set out as follows - at least 15 credit hours of BIOL courses (12 credit hours of core required courses and at least 3 credits hours of BIOL electives), 6 credit hours of additional electives, as well as 9 credit hours of thesis research. Additionally, students have to submit a written thesis which is evaluated by the examination committee, as well as satisfactorily defend their thesis research in a viva format.

Program Component	**Credit Hours**
Program Core	12
Electives	9
Thesis Research	9
Total	**30**

Program Requirements

Students seeking the degree of MSc in Molecular Life Sciences must successfully complete 30 credit hours as specified in the program requirements detailed below, with a minimum CGPA of 3.0. Course selection should be made in consultation with the student's Main Advisor.

Program Core (12 credit hours)

Students must complete the core courses listed below.

Core Courses

BIOL 601	Research Methods in Biosciences	3
BIOL 695	Graduate Seminar 1	1
BIOL 696	Graduate Seminar 2	1
BIOL 602	Advanced Cell and Molecular Biology	3
BIOL 603	Experimental techniques in Molecular Life Sciences	4

Program Electives (9 credit hours)

Students must complete 9 credit hours of electives (of which at least 3 credits hours of BIOL electives, and up to 6 credit hours of additional electives)

Program Elective Courses

BIOL 610	Protein Biochemistry	3
BIOL 620	Cell Signaling and Cancer Biology	3
BIOL 630	Applied Biotechnology	3
BIOL 640	Advanced Virology	3
BIOL 650	Molecular Endocrinology and Metabolic Diseases	3

Elective Courses from Other Departments

BMED 611	Clinical Pathology	3

BMED 612	Molecular Genetics & Genome Technologies	3
BMED 640	Biomaterials for Drug Delivery	3
BMED 634	Algorithms in Bioinformatics	3

Master's Thesis

Students must complete a master's Thesis that involves creative, research-oriented work within the field of Molecular Life Sciences, under direct supervision of a full-time faculty advisor from the Biology Department, and at least one other full-time faculty who acts as a co-advisor. The outcome of research should demonstrate the synthesis of information into knowledge in a form that may be used by others. The research findings must be documented in a formal thesis and defended successfully in a viva voce examination.

Thesis Research

BIOL 699	Thesis Research	9

Study Plan

Students must consult with their respective advisors on the courses that they will enroll in, the required pre-requisites, and the thesis topic selection. Full-time graduate students must register for 9 to 12 credits, including thesis credits, during a regular semester (Fall and Spring) and a maximum of 6 credits during a Summer term. In the case of part-time students, the credit load is normally 6 credits during a regular semester as well as the summer term.

Students can only register for thesis credits after successfully completing a minimum of 9 credits of the core courses of the master's program they are enrolled in. It is to be noted that the minimum pass grade for graduate courses is a "C" letter grade. Students should consult the Graduate Catalog to learn about the graduate programs, the grading system, graduation requirements, and other pertinent matters.

A typical study plan for students enrolled in the MSc in Molecular Life Sciences is shown below.

Typical Study Plan for Full-Time Students

Semester 1 (Fall)	•Seminar in Research Methods•Program Core Course 1 • Program Core Course 2 •Program Core Course 3 • Program Core Course 4
Semester 2 (Spring)	•Elective Course 1•Elective Course 2 •Elective Course 3 •Master's Thesis
Semester 3 (Summer)	•Master's Thesis

Typical Study Plan for Part-Time Students

	Semester 1	**Semester 2**
Year 1	•Seminar in Research Methods•Program Core Course 1 •Program Core Course 2	• Elective Course 1• Elective Course 2
Year 2	•Program Core Course 3•Program Core Course 4	•Elective Course 3•Master's Thesis
Year 3	•Master's Thesis	

MSc in Petroleum Geosciences

About the Program

Geoscience is the study of the Earth, the oceans, the atmosphere and the Earth's place in the solar system. Geoscientists explore the world around them to address some of the biggest challenges facing society, including securing energy, water and mineral resources, exploring climate change, the environment and natural hazards (volcanoes, landslides and flooding). The Master of Science in Petroleum Geosciences (MSc PGEG) gives students a variety of research opportunities that include studies of both earth surface and deep processes, including geological hazards, environmental geoscience, sedimentology/facies analysis, micropaleontology, bio- and chemo- stratigraphy, seismology, petrology, tectonics, geophysics, and geochemistry.

Program Educational Objectives

The objectives of the MSc in Petroleum Geosciences program are to:

1. Provide graduates with an outstanding education and the research skills required to further their careers.
2. Prepare graduates for further education in PhD programs.
3. Provide the oil and gas industry with highly educated personnel who can utilize their technical knowledge and skills to increase value of petroleum assets and to develop petroleum industry business opportunities.
4. Advance the technological skill base of E & P sponsor companies, the UAE, and the regional oil and gas industry.
5. Raise the overall educational environment of the UAE through publication of scholarly work.

Learning Outcomes

MSc in Petroleum Geosciences graduates will:

1. Be able to successfully apply advanced and current concepts and methods of the geosciences to formulate and solve complex petroleum geosciences problems.
2. Be able to plan and complete a research project within a reasonable time frame by integrating knowledge and methods from different disciplines of the petroleum geosciences and using appropriately selected research methods.
3. Demonstrate an ability to communicate complex scientific problems in oral and written forms in English appropriate to the petroleum and broad energy industry.
4. Demonstrate self-direction and time management when working independently.
5. Work effectively and professionally in multidisciplinary teams, as a member and a leader.
6. Be able to manage and analyze complex ethical issues.

Program Structure and Requirements

Overall Program Structure

The MSc PGEG program consists of a minimum 35 credit hours, distributed as follows: 15 credit hours of Program Core courses, 8 credit hours of Program Elective courses and 12 credit hours of Master's Thesis. The components of the program are summarized in the table below.

Program Component	**Credit Hours**
Program Core (3 courses)	12
Graduate Seminar I	1
Graduate Seminar II	1
Technical and Scientific Writing	1
Program Electives (2 courses)	8
Master's Thesis	12
Total	**35**

Program Requirements

Students seeking the degree of MSc in Petroleum Geosciences must successfully complete a minimum 35 credit hours as specified in the program requirements detailed below, with a minimum CGPA of 3.0. Course selection should be made in consultation with the student's Main Advisor.

Program Core (15 credit hours)

Students must complete the core courses listed below.

Core Courses		
PGEG 611	Carbonate Reservoir Petrology	4
PGEG 612	Sequence Stratigraphy of Carbonate Systems	4
PGEG 613	Advanced Reservoir Characterization	4
PGEG 695	Graduate Seminar I	1
PGEG 696	Graduate Seminar II	1
COMM 601	Technical and Scientific Writing	1

Program Electives (8 credit hours)

Students must select two courses from the list below. Subject to approval, elective courses can be taken from ERTH 700-level courses offered in the Petroleum Geosciences PhD program or other relevant graduate programs at KU.

Elective Courses

PGEG 623	Remote Sensing for Earth Sciences Applications and GIS	3
PGEG 689	Special Topics in Petroleum Geosciences	4
PEEG 630	Advanced Reservoir Engineering	3
PEEG 650	Advanced Petroleum Economics	3

Master's Thesis (12 credit hours)

Students must complete a Master's Thesis that involves creative, research-oriented work within the field of petroleum geosciences, under direct supervision of a full-time faculty advisor from the Petroleum Geosciences Department, and at least one other full-time faculty who acts as a co-advisor. The outcome of research should demonstrate the synthesis of information into knowledge in a form that may be used by others. The research findings must be documented in a formal thesis and defended successfully in a viva voce examination.

Thesis

PGEG 699	Master'sThesis	9

Study Plan

Students must consult with their respective advisors on the courses that they will enroll in, the required pre-requisites, and the thesis topic selection. Full-time graduate students must register for 9 to 12 credits, including thesis credits, during a regular semester (Fall and Spring) and a maximum of 6 credits during a Summer term. In the case of part-time students, the credit load is normally 6 credits during a regular semester as well as the summer term.

Students can only register for thesis credits after successfully completing a minimum of 9 credits of the core courses of the master's program they are enrolled in. It is to be noted that the minimum pass grade for graduate courses is a "C" letter grade. Students should consult the Graduate Catalog to learn about the graduate programs, the grading system, graduation requirements, and other pertinent matters.

A typical study plan for students enrolled in the MSc PGEG is shown below.

Typical Study Plan for Full-Time Students

Semester 1 (Fall)	•Seminar in Research Methods•Program Core Course 1 • Program Core Course 2 •Program Core Course 3 • Program Core Course 4
Semester 2 (Spring)	•Elective Course 1•Elective Course 2 •Elective Course 3 •Master's Thesis
Semester 3 (Summer)	•Master's Thesis

Typical Study Plan for Part-Time Students

	Semester 1	**Semester 2**
Year 1	•Seminar in Research Methods•Program Core Course 1 •Program Core Course 2	• Elective Course 1• Elective Course 2
Year 2	•Program Core Course 3•Program Core Course 4	•Elective Course 3•Master's Thesis
Year 3	•Master's Thesis	

PhD in Earth Sciences (with MSc Degree)

About the Program

The PhD in Earth Sciences builds on Khalifa University's internationally leading research activity in science, engineering, and medicine. It supports the University's alignment with the Abu Dhabi Economic Vision 2030 plan through the provision of internationally excellent education and student experience in Earth Sciences, producing highly skilled science professionals capable of transferring state-of-the-art technologies to priority sectors of industry, business and government. The aim of the PhD in Earth Sciences program is to produce graduates who are able to conduct independent research in Earth Sciences at the highest levels of originality and quality. The degree will be awarded to students who demonstrate a range of advanced knowledge and skills at the forefront of Earth Sciences and who complete an independent investigation of a novel specialist topic in order to present a dissertation addressing a problem in cutting edge research. Candidates for the degree will be supervised by teams of experienced researchers.

Program Educational Objectives

The objectives of the PhD in Earth Sciences program are to produce graduates who have the ability to:

1. Synthesize and critically evaluate complex current knowledge in the Earth Sciences in order to plan and implement new and creative approaches so as to generate new knowledge and solve research challenges with effective dissemination of the results to a variety of audiences;
2. Work to the highest professional and ethical standards in an area of Earth Sciences and develop their individual academic, professional and career skills; and
3. Keep abreast of the latest developments in Earth Sciences that contribute to the advancement of knowledge for the benefit of society.

Learning Outcomes

Upon successful completion of the PhD in Earth Sciences, a graduate will be able to:

1. Demonstrate and critically analyze comprehensive, deep and overarching knowledge that is at the frontier of recent developments in Earth Sciences.
2. Conduct and defend original independent research that creates significant new knowledge in Earth Sciences of publishable quality that leads to scholarly articles or other intellectual outputs.
3. Analyze and critically evaluate the uses and limitations of diverse methodologies and techniques for solving problems in Earth Sciences research, leading to informed and valid judgements.
4. Select and deploy advanced experimental and related skills to investigate and solve complex problems in Earth Sciences research.
5. Communicate effectively and professionally, in written and oral forms as appropriate, the major tenets of areas of Earth Sciences and their individual specializations to a variety of audiences.
6. Demonstrate a commitment to safe, responsible and ethical behavior in all research and professional activities.
7. Reflect upon their role(s) in their research specialization and in the wider research community to ensure that they take responsibility for their own development and that of peer groups and networks.

Program Structure and Requirements

Overall Program Structure

The PhD in Earth Sciences consists of a minimum 60 credit hours, distributed as follows: 24 credit hours of coursework, 36 credit hours of PhD Dissertation, two zero credit PhD Seminar courses, as well as PhD Written Qualifying and PhD Research Proposal Examinations. The components of the program are summarized in the table below.

Program Component	**Credit Hours**
Program Core (1 course)	3
Research Seminar I	0
Research Seminar II	0
PhD Written Qualifying Examination	0
PhD Research Proposal Examination	0
Program Electives	21
PhD Research Dissertation	36
Total	**60**

Program Requirements

Students seeking the degree of PhD in Earth Sciences must successfully complete a minimum 60 credit hours as specified in the program requirements detailed below, with a minimum CGPA of 3.0. Course selection should be made in consultation with the student's Main Advisor. Students who may have previously taken PhD level courses during their MSc at KU are not allowed to repeat those courses during their PhD. All courses listed below have a credit rating of three credits each, except for PhD Research Seminar, Written Qualifying Exam, Research Proposal Exam, and the PhD Research Dissertation.

Program Core (3 credit hours)

Students must complete the core courses listed below.

Core Courses

SCIE 701	Research Methods in Science	3

SCIE 702	Research Seminar I	0
SCIE 703	Research Seminar II	0
SCIE 795	PhD Written Qualifying Examina	0
SCIE 796	PhD Research Proposal Examinat	0

Program Electives (21 credit hours)

Students must complete a total of seven elective courses. Program electives are listed below.

Program Elective Courses

ERTH 701	Petroleum Systems	3
ERTH 711	Carbonate Petrology and Stratigraphy	3
ERTH 713	Rock Physics	4
ERTH 714	Seismic Interpretation in Petroleum Exploration and Production	3
ERTH 715	Seismic Modelling and Imaging	4
ERTH 718	Biogeochemical Cycles	3
ERTH 719	Deformation and Structures of Sedimentary Rocks	3
ERTH 720	Organic Geochemistry	3
ERTH 721	Sedimentary Basins Analysis	4
ERTH 723	Isotope Geochemistry of Sedimentary Systems	3
ERTH 793	Special Topics in Earth Science	4
ERTH 750	Earth's Paleoclimate	3
ERTH 751	Geology of the Solar System	3
ERTH 752	Plate Tectonics & Geodynamics	3
ERTH 753	Field Geology of the UAE	3
ERTH 754	Environm& Eng Geophysics	3
ERTH 755	Remote Sensing Earth& Plan Sci	3
ERTH 724	Clastic Sedimentology and Depositional Systems	
ERTH 756	Climate & Atmospheric Dynamics	3
ERTH 757	Global Change, Nat Haz & Disas	3
ERTH 758	Phys & Chem of Solar System	3
ERTH 759	Astrobiology	3

*Subject to approval of the Main Advisor and the Program Coordinator, up to two electives (6 credits) may be taken from outside the student's department and **ONLY** chosen from the list below, if these courses support the student's dissertation topic.*

Elective Courses from Other Departments

Chemistry

CHEM 711	Recent Developments in Inorganic Chemistry	3
CHEM 712	Recent Developments in Organic Chemistry	3
CHEM 714	Recent Developments in Analytical Chemistry	3
CHEM 716	Recent Developments in Environmental Chemistry	3

Mathematics

MATH 706	Modern Statistical Predictionand Data Mining	3
MATH 707	Nonlinear Optimization	3
MATH 708	Partial Differential Equations	3

Physics

PHYS 707	Advanced Solid State Physics	3
PHYS 708	Theoretical Astroparticle Physics	3
PHYS 709	Experimental Techniques in Astroparticle Physics	3
PHYS 710	Planetary Astrophysics	3
PHYS 712	Atomic and Molecular Physics for Space Scientists	3

Chemical Engineering

CHEG 720	Modelling and Engineering of Microbial Environmental Bioprocesses	3

Civil Engineering

CIVE 703	Groundwater Hydrology	3
CIVE 707	Environmental Remote Sensing and Satellite Image Processing	3
CIVE 719	Climate Dynamics	3

Mechanical Engineering

MEEN 782	Materials Characterization Techniques	3
MSEN 712	Imaging of Materials: Scanning Electron Microscopy and X-ray Microanalysis	3

Petroleum Engineering

PEEG 730	Fluid Flow and Transport Processes in Porous Media	3

PhD Research Dissertation (36 credit hours)

Students must complete a Dissertation that involves creative, research-oriented work within the field of Earth

Sciences, under direct supervision of a full-time faculty advisor from the Earth Sciences Department, and at least one other full-time faculty who acts as a co-advisor. The outcome of research should demonstrate the synthesis of information into knowledge in a form that may be used by others. The research findings must be documented in a formal dissertation and defended successfully in a viva voce examination.

Dissertation

SCIE 799	PhD Thesis Dissertation	36

Study Plan

A typical study plan for students enrolled in the PhD in Earth Sciences is shown below.

Typical Study Plan for Full-Time Students

	Semester 1	**Semester 2**
Year 1	• Program Core Course 1 • Elective Course 1 • Elective Course 2 • Elective Course 3	• Elective Course 4 • Elective Course 5 • Elective Course 6 • PhD Research Dissertation
Year 2	• Elective Course 7 • PhD Written Qualifying Examination • PhD Research Dissertation	• Research Seminar I • PhD Research Proposal Examination • PhD Research Dissertation
Year 3	• PhD Research Dissertation	• Research Seminar II • PhD Research Dissertation
Year 4	• PhD Research Dissertation	• PhD Research Dissertation

PhD in Earth Sciences (with only BSc Degree)

Introduction

This program is to be offered by the Department of Earth Sciences, College of Science (CoS) at Khalifa University of Science and Technology, Abu Dhabi.

The PhD in Earth Sciences builds on Khalifa University's internationally leading research activity in science, engineering, and medicine. It supports the University's alignment with the Abu Dhabi Economic Vision 2030 plan through the provision of internationally excellent education and student experience in Earth Sciences, producing highly skilled science professionals capable of transferring state-of-the-art technologies to priority sectors of industry, business and government. The aim of the PhD in Earth Sciences program is to produce graduates who are able to conduct independent research in Earth Sciences at the highest levels of originality and quality. The degree will be awarded to students who demonstrate a range of advanced knowledge and skills at the forefront of Earth Sciences and who complete an independent investigation of a novel specialist topic in order to present a dissertation addressing a problem in cutting edge research. Candidates for the degree will be supervised by teams of experienced researchers.

The PhD in Earth Sciences through the Bachelor-to-Doctorate Direct Admission is a 72 credit programs. There are 36 credits of taught courses and 36 credits of research aimed at producing a thesis describing an independent research project in a novel scientific topic. The program builds on Khalifa University's internationally leading research activity in science, engineering, and medicine.

The CAA recently approved Bachelor-to-Doctorate direct admission. Therefore, all students admitted directly to the PhD in Earth Sciences program with only a bachelor degree will follow the program structure and the typical study plan below.

Program Educational Objectives

The objectives of the PhD in Earth Sciences program are to produce graduates who have the ability to:

1. Synthesize and critically evaluate complex current knowledge in the Earth Sciences in order to plan and implement new and creative approaches so as to generate new knowledge and solve research challenges with effective dissemination of the results to a variety of audiences;

2. Work to the highest professional and ethical standards in an area of Earth Sciences and develop their individual academic, professional and career skills; and

3. Keep abreast of the latest developments in Earth Sciences that contribute to the advancement of

knowledge for the benefit of society.

Learning Outcomes

Upon successful completion of the PhD in Earth Sciences, a graduate will be able to:

1. Demonstrate and critically analyze comprehensive, deep and overarching knowledge that is at the frontier of recent developments in Earth Sciences.
2. Conduct and defend original independent research that creates significant new knowledge in Earth Sciences of publishable quality that leads to scholarly articles or other intellectual outputs.
3. Analyze and critically evaluate the uses and limitations of diverse methodologies and techniques for solving problems in Earth Sciences research, leading to informed and valid judgements.
4. Select and deploy advanced experimental and related skills to investigate and solve complex problems in Earth Sciences research.
5. Communicate effectively and professionally, in written and oral forms as appropriate, the major tenets of areas of Earth Sciences and their individual specializations to a variety of audiences.
6. Demonstrate a commitment to safe, responsible and ethical behavior in all research and professional activities.
7. Reflect upon their role(s) in their research specialization and in the wider research community to ensure that they take responsibility for their own development and that of peer groups and networks.

Program Structure and Requirements

Overall Program Structure

The PhD in Earth Sciences consists of a minimum 72 credit hours, distributed as follows: 36 credit hours of coursework, 36 credit hours of PhD Dissertation, two zero credit PhD Seminar courses, as well as PhD Written Qualifying and PhD Research Proposal Examinations. The components of the program are summarized in the table below.

Category	**Credit Hours**
Core Courses	21
Technical Electives	15
SCIE 702 PhD Research Seminar I	0
SCIE 703 PhD Research Seminar II	0
SCIE 795 PhD Written Qualifying Exam	0
SCIE 796 PhD Research Proposal Exam	0
PhD Research Dissertation	36
Total	**72**

All the courses that the students will take are at PhD level. The students will only be able to attempt SCIE 795 PhD Written Qualifying Exam (WQE) after successfully completing a minimum of 27 credits of formal coursework.

Program Requirements

Students seeking the degree of PhD in Earth Sciences must successfully complete a minimum 72 credit hours as specified in the program requirements detailed below, with a minimum CGPA of 3.0. Course selection should be made in consultation with the student's Main Advisor. All courses listed below have a credit rating of three credits each, except for PhD Research Seminar, Written Qualifying Exam, Research Proposal Exam, and the PhD Research Dissertation.

Program Core (21 credit hours)

Students must complete the core courses listed below.

Core Courses

SCIE 701	Research Methods in Science	3
ERTH 750	Earth's Paleoclimate	3
ERTH 751	Geology of the Solar System	3
ERTH 752	Plate Tectonics & Geodynamics	3
ERTH 753	Field Geology of the UAE	3
ERTH 754	Environm& Eng Geophysics	3
ERTH 755	Remote Sensing Earth& Plan Sci	3

Program Electives (15 credit hours)

Students must complete a total of five elective courses. Program electives are listed below.

Program Elective Courses

ERTH 701	Petroleum Systems	3
ERTH 711	Carbonate Petrology and Stratigraphy	3
ERTH 713	Rock Physics	4
ERTH 714	Seismic Interpretation in Petroleum Exploration and Production	3
ERTH 715	Seismic Modelling and Imaging	4
ERTH 718	Biogeochemical Cycles	3
ERTH 719	Deformation and Structures of Sedimentary Rocks	3
ERTH 720	Organic Geochemistry	3
ERTH 721	Sedimentary Basins Analysis	4
ERTH 723	Isotope Geochemistry of Sedimentary Systems	3
ERTH 724	Clastic Sedimentology and Depositional Systems	
ERTH 756	Climate & Atmospheric Dynamics	3
ERTH 757	Global Change, Nat Haz & Disas	3
ERTH 758	Phys & Chem of Solar System	3
ERTH 759	Astrobiology	3
ERTH 793	Special Topics in Earth Science	4

Subject to approval of the Main Advisor and the Program Coordinator, up to two electives (6 credits) may be taken from outside the student's department and ***ONLY*** *chosen from the list below, if these courses support the student's dissertation topic.*

Elective Courses from Other Departments

Chemistry

CHEM 711	Recent Developments in Inorganic Chemistry	3
CHEM 712	Recent Developments in Organic Chemistry	3
CHEM 714	Recent Developments in Analytical Chemistry	3
CHEM 716	Recent Developments in Environmental Chemistry	3

Mathematics

MATH 706	Modern Statistical Predictionand Data Mining	3
MATH 708	Partial Differential Equations	3

Physics

PHYS 707	Advanced Solid State Physics	3
PHYS 708	Theoretical Astroparticle Physics	3
PHYS 709	Experimental Techniques in Astroparticle Physics	3
PHYS 710	Planetary Astrophysics	3
PHYS 712	Atomic and Molecular Physics for Space Scientists	3

Chemical Engineering

CHEG 720	Modelling and Engineering of Microbial Environmental Bioprocesses	3

Civil Engineering

CIVE 703	Groundwater Hydrology	3
CIVE 707	Environmental Remote Sensing and Satellite Image Processing	3
CIVE 719	Climate Dynamics	3

Mechanical Engineering

MEEN 782	Materials Characterization Techniques	3
MSEN 712	Imaging of Materials: Scanning Electron Microscopy and X-ray Microanalysis	3

Petroleum Engineering

PEEG 730	Fluid Flow and Transport Processes in Porous Media	3

PhD Research Dissertation (36 credit hours)

Students must complete a Dissertation that involves creative, research-oriented work within the field of Earth Sciences, under direct supervision of a full-time faculty advisor from the Earth Sciences Department, and at least one other full-time faculty who acts as a co-advisor. The outcome of research should demonstrate the synthesis of information into knowledge in a form that may be used by others. The research findings must be documented in a formal dissertation and defended successfully in a viva voce examination.

Dissertation

SCIE 799	PhD Thesis Dissertation	36

Study Plan

A typical study plan for students enrolled in the PhD in Earth Sciences is shown below.

All courses in the study plan are 3 credit hours each. PhD Research Seminar I & II are zero credit each.

Typical Study Plan for Full-Time Students

- SCIE 701 Research Methods in Science
- Core Course 1
- Core Course 2
- Core Course 3

- Core Course 4
- Core Course 5
- Core Course 6

- Technical Elective 1
- Technical Elective 2
- SCIE 799 PhD Research Dissertation

- SCIE 799 PhD Research Dissertation
- SCIE *795 PhD Written Qualifying Exam*

- Technical Elective 3
- SCIE 702 PhD Research Seminar I
- SCIE 799 PhD Research Dissertation

- Technical Elective 4
- SCIE 799 PhD Research Dissertation
- SCIE *796 PhD Research Proposal Exam*

- Technical Elective 5
- SCIE 799 PhD

- SCIE 703 PhD Research Seminar II
-

Research Dissertation	SCIE 799 PhD Research Dissertation
• SCIE 799 PhD Research Dissertation	• SCIE 799 PhD Research Dissertation
	• *Final Doctoral Dissertation Exam*

PhD in Chemistry (with MSc Degree)

About the Program

The PhD in Chemistry (PhD CHEM) builds on Khalifa University's internationally leading research activity in science, engineering, and medicine. It supports the University's alignment with the Abu Dhabi Economic Vision 2030 plan through the provision of internationally excellent education and student experience in Chemistry, producing highly skilled science professionals capable of transferring state-of-the-art technologies to priority sectors of industry, business and government. The aim of the PhD in Chemistry program is to produce graduates who are able to conduct independent research in Chemistry at the highest levels of originality and quality. The degree will be awarded to students who demonstrate a range of advanced knowledge and skills at the forefront of Chemistry and who complete an independent investigation of a novel specialist topic in order to present a dissertation addressing a problem in cutting edge research. Candidates for the degree will be supervised by teams of experienced researchers.

Program Educational Objectives

The objectives of the PhD in Chemistry program are to produce graduates who have the ability to:

1. Synthesize and critically evaluate complex current knowledge in the chemical sciences in order to plan and implement new and creative approaches so as to generate new knowledge and solve research challenges with effective dissemination of the results to a variety of audiences;
2. Work to the highest professional and ethical standards in an area of chemical sciences and develop their individual academic, professional and career skills; and
3. Keep abreast of the latest developments in chemistry that contribute to the advancement of knowledge for the benefit of society.

Learning Outcomes

Upon successful completion of the PhD in Chemistry, a graduate will be able to:

1. Demonstrate and critically analyze comprehensive, deep and overarching knowledge that is at the frontier of recent developments in chemical sciences.
2. Conduct and defend original independent research that creates significant new knowledge in chemical sciences of publishable quality that leads to scholarly articles or other intellectual outputs.
3. Analyze and critically evaluate the uses and limitations of diverse methodologies and techniques for solving problems in chemical research, leading to informed and valid judgements.
4. Select and deploy advanced experimental and related skills to investigate and solve complex problems in chemical research.
5. Communicate effectively and professionally, in written and oral forms as appropriate, the major tenets of areas of chemistry and their individual specializations to a variety of audiences.
6. Demonstrate a commitment to safe, responsible and ethical behavior in all research and professional activities.
7. Reflect upon their role(s) in their research specialization and in the wider research community to ensure that they take responsibility for their own development and that of peer groups and networks.

Program Structure and Requirements

Overall Program Structure

The PhD in Chemistry consists of a minimum 60 credit hours, distributed as follows: 24 credit hours of coursework, 36 credit hours of PhD Dissertation, two zero credit PhD Seminar courses, as well as PhD Written Qualifying and PhD Research Proposal Examinations. The components of the program are summarized in the table below.

Program Component	**Credit Hours**
Program Core (2 courses)	6
Research Seminar I	0
Research Seminar II	0
PhD Written Qualifying Examination	0
PhD Research Proposal Examination	0
Program Electives	18
PhD Research Dissertation	36
Total	**60**

Program Requirements

Students seeking the degree of PhD in Chemistry must successfully complete a minimum 60 credit hours as specified in the program requirements detailed below, with a minimum CGPA of 3.0. Course selection should be made in consultation with the student's Main Advisor. All courses listed below have a credit rating of three credits each, except for PhD Research Seminar, Written Qualifying Exam, Research Proposal Exam, and the PhD Research Dissertation.

Program Core (6 credit hours)

Students must complete the core courses listed below.

Core Courses

CHEM 701	Methods and Techniques in Chemical research	3
SCIE 701	Research Methods in Science	3
SCIE 702	Research Seminar I	0
SCIE 703	Research Seminar II	0
SCIE 795	PhD Written Qualifying Examina	0
SCIE 796	PhD Research Proposal Examinat	0

Program Electives (18 credit hours)

Students must complete a total of six elective courses. Program electives are listed below.

Program Elective Courses

CHEM 711	Recent Developments in Inorganic Chemistry	3
CHEM 712	Recent Developments in Organic Chemistry	3
CHEM 713	Recent Advances in Physical Chemistry	3
CHEM 714	Recent Developments in Analytical Chemistry	3
CHEM 715	Recent Developments in Nanochemistry	3
CHEM 716	Recent Developments in Environmental Chemistry	3
CHEM 717	Advanced topics in Biochemistry	3
CHEM 719	Adv in Energy Storage Material	3
CHEM 720	Adv Topics in Theoretical Chem	3
CHEM 721	Green Analytical & Bioanalytic	3
CHEM 722	Adv Topics in Organic Chem	3
CHEM 723	Advanced Polymer Chemistry	3
CHEM 799	Entrepreneurship in Chemistry-Science	3

*Subject to approval of the Main Advisor and the Program Coordinator, up to two electives (6 credits) may be taken from outside the student's department and **ONLY** chosen from the list below, if these courses support the student's dissertation topic.*

Elective Courses from Other Departments

Mathematics

MATH 705	Mechanics of interacting particles	3
MATH 707	Nonlinear Optimization	3
MATH 708	Partial Differential Equations	3
MATH 777	Mathematical Models for Biology and Epidemiology	3

Earth Sciences

ERTH 720	Organic Geochemistry	3
ERTH 723	Isotope Geochemistry of Sedimentary Systems	3

Physics

PHYS 702	Advanced Quantum Mechanics	3
PHYS 705	Nanophysics and Nanotechnology	3
PHYS 707	Advanced Solid State Physics	3

Biomedical Engineering

BMED 716	Medical Device Innovation	3

Chemical Engineering

CHEG 700	Sustainable Desalination Processes	3
CHEG 703	Applied nanotechnology	3
CHEG 710	Kinetics and Mechanisms	3
CHEG 750	Molecular Thermodynamics	3
CHEG 770	Heterogeneous Catalysis	3

Civil Engineering

CIVE 720	Nanotechnology in Water Purification	3

Electrical Engineering

ECCE 781	The Physics of Solar Cells	3

Mechanical Engineering

MSEN 712	Imaging of Materials: Scanning Electron Microscopy and X-ray Microanalysis	3
MSEN 715	Advanced Imaging of Materials: Transmission Electron Microscopy	3
MSEN 750	HighEfficiency Silicon Solar Cells: Designs and Technologies	3
MEEN 782	Materials Characterization Techniques	3
MEEN 792	Advanced Nanomaterials and Their Mechanical Applications	3

PhD Research Dissertation (36 credit hours)

Students must complete a Dissertation that involves creative, research-oriented work within the field of chemistry, under direct supervision of a full-time faculty advisor from the Chemistry Department, and at least one other full-time faculty who acts as a co-advisor. The outcome of research should demonstrate the synthesis of information into knowledge in a form that may be used by others. The research findings must be documented in a formal dissertation and defended successfully in a viva voce examination.

Dissertation

SCIE 799	PhD Thesis Dissertation	36

Study Plan

A typical study plan for students enrolled in the PhD in Chemistry is shown below.

Typical Study Plan for Full-Time Students

	Semester 1	**Semester 2**
Year 1	• Program Core Course 1 • Program Core Course 2 • Elective Course 1 • Elective Course 2	• Elective Course 3 • Elective Course 4 • Elective Course 5 • PhD Research Dissertation
Year 2	• Elective Course 6 • PhD Written Qualifying Examination • PhD Research Dissertation	• Research Seminar I • PhD Research Proposal Examination • PhD Research Dissertation
Year 3	• PhD Research Dissertation	• Research Seminar II • PhD Research Dissertation
Year 4	• PhD Research Dissertation	• PhD Research Dissertation

PhD in Chemistry (with only BSc Degree)

Introduction

The Ph.D. in Chemistry (Ph.D. CHEM) builds on Khalifa University's internationally leading research activity in science, engineering, and medicine. It supports the University's alignment with the Abu Dhabi Economic Vision 2030 plan through the provision of internationally excellent education and student experience in Chemistry, producing highly skilled science professionals capable of transferring state-of-the-art technologies to priority sectors of industry, business, and government. The aim of the Ph.D. in Chemistry program is to produce graduates who are able to conduct independent research in Chemistry at the highest levels of originality and quality. The degree will be awarded to students who demonstrate a range of advanced knowledge and skills at the forefront of Chemistry and who complete an independent investigation of a novel specialist topic in order to present a dissertation addressing a problem in cutting-edge research. Candidates for the degree will be supervised by teams of experienced researchers. The PhD CHEM program has four thematic areas which include Advanced Materials and Sustainable Chemistry, Physical and Computational Chemistry, Environmental and Green Chemistry, and Polymer and

Applied Organic Chemistry.

Program Educational Objectives

The objectives of the PhD in Chemistry program are to produce graduates who have the ability to:

1. Synthesize and critically evaluate complex current knowledge in the chemical sciences in order to plan and implement new and creative approaches so as to generate new knowledge and solve research challenges with effective dissemination of the results to a variety of audiences;
2. Work to the highest professional and ethical standards in an area of chemical sciences and develop their individual academic, professional and career skills; and
3. Keep abreast of the latest developments in chemistry that contribute to the advancement of knowledge for the benefit of society.

Learning Outcomes

Upon successful completion of the PhD in Chemistry, a graduate will be able to:

1. Demonstrate and critically analyze comprehensive, deep and overarching knowledge that is at the frontier of recent developments in chemical sciences.
2. Conduct and defend original independent research that creates significant new knowledge in chemical sciences of publishable quality that leads to scholarly articles or other intellectual outputs.
3. Analyze and critically evaluate the uses and limitations of diverse methodologies and techniques for solving problems in chemical research, leading to informed and valid judgements.
4. Select and deploy advanced experimental and related skills to investigate and solve complex problems in chemical research.
5. Communicate effectively and professionally, in written and oral forms as appropriate, the major tenets of areas of chemistry and their individual specializations to a variety of audiences.
6. Demonstrate a commitment to safe, responsible and ethical behavior in all research and professional activities.
7. Reflect upon their role(s) in their research specialization and in the wider research community to ensure that they take responsibility for their own development and that of peer groups and networks.

Program Structure and Requirements

Overall Program Structure

Category	**Credit Hours**
Core Courses	12
Technical Electives	24
SCIE 702 PhD Research Seminar I	0
SCIE 703 PhD Research Seminar II	0
SCIE 795 PhD Written Qualifying Exam	0
SCIE 796 PhD Research Proposal Exam	0
PhD Research Dissertation	36
Total	**72**

All the courses that the students will take are at PhD level. The students will only be able to attempt SCIE PhD Written Qualifying Exam (WQE) after successfully completing a minimum of 27 credits of formal coursework.

Program Requirements

Students seeking the degree of PhD in Chemistry must successfully complete a minimum 72 credit hours as specified in the program requirements detailed below, with a minimum CGPA of 3.0. Course selection should be made in consultation with the student's Main Advisor. All courses listed below have a credit rating of three credits each, except for PhD Research Seminar, Written Qualifying Exam, Research Proposal Exam, and the PhD Research Dissertation.

Program Core (12 credit hours)

Students must complete SCIE 701 Research Methods in Science in addition to 9 credits from the list of technical courses below.

Core Courses

SCIE 701	Research Methods in Science	3

CHEM 701	Methods and Techniques in Chemical research	3
CHEM 704	Electrochemistry & Corrosion S	3
CHEM 705	Synthesis & Reaction Mechanism	3

Program Electives (24 credit hours)

Students must complete a total of eight elective courses (24 credits) from the list of program elective courses below.

Program Elective Courses

CHEM 711	Recent Developments in Inorganic Chemistry	3
CHEM 712	Recent Developments in Organic Chemistry	3
CHEM 713	Recent Advances in Physical Chemistry	3
CHEM 714	Recent Developments in Analytical Chemistry	3
CHEM 715	Recent Developments in Nanochemistry	3
CHEM 716	Recent Developments in Environmental Chemistry	3
CHEM 717	Advanced topics in Biochemistry	3
CHEM 719	Adv in Energy Storage Material	3
CHEM 720	Adv Topics in Theoretical Chem	3
CHEM 721	Green Analytical & Bioanalytic	3
CHEM 722	Adv Topics in Organic Chem	3
CHEM 723	Advanced Polymer Chemistry	3
CHEM 799	Entrepreneurship in Chemistry-Science	3

Subject to approval of the Main Advisor and the Program Coordinator, up to two electives (6 credits) may be taken from outside the student's department and **ONLY** chosen from the list below, if these courses support the student's dissertation topic.

Elective Courses from Other Departments

Mathematics

MATH 705	Mechanics of interacting particles	3
MATH 707	Nonlinear Optimization	3
MATH 708	Partial Differential Equations	3
MATH 777	Mathematical Models for Biology and Epidemiology	3

Earth Sciences

ERTH 720	Organic Geochemistry	3
ERTH 723	Isotope Geochemistry of Sedimentary Systems	3

Physics

PHYS 702	Advanced Quantum Mechanics	3
PHYS 705	Nanophysics and Nanotechnology	3
PHYS 707	Advanced Solid State Physics	3

Biomedical Engineering

BMED 716	Medical Device Innovation	3

Chemical Engineering

CHEG 703	Applied nanotechnology	3
CHEG 710	Kinetics and Mechanisms	3
CHEG 750	Molecular Thermodynamics	3
CHEG 770	Heterogeneous Catalysis	3
CHEG 700	Sustainable Desalination Processes	3
	Or	
CIVE 714	Sustainable Desalination Processes	3

Civil Engineering

CIVE 720	Nanotechnology in Water Purification	3

Electrical Engineering

ECCE 781	The Physics of Solar Cells	3

Mechanical Engineering

MSEN 712	Imaging of Materials: Scanning Electron Microscopy and X-ray Microanalysis	3
MSEN 715	Advanced Imaging of Materials: Transmission Electron Microscopy	3
MSEN 750	HighEfficiency Silicon Solar Cells: Designs and Technologies	3
MEEN 781	Materials Selection in Mechanical Design	3
MEEN 782	Materials Characterization Techniques	3
MEEN 792	Advanced Nanomaterials and Their Mechanical Applications	3

PhD Research Dissertation (36 credit hours)

Students must complete a Dissertation that involves creative, research-oriented work within the field of chemistry, under direct supervision of a full-time faculty advisor from the Chemistry Department, and at least one other full-time faculty who acts as a co-advisor. The outcome of research should demonstrate the synthesis of information into knowledge in a form that may be used by others. The research findings must be documented in a formal dissertation and defended successfully in a viva voce examination.

Dissertation

SCIE 799	PhD Thesis Dissertation	36

Study Plan

A typical study plan for students enrolled in the PhD in Chemistry is shown below.

All courses in the study plan are 3 credit hours each. PhD Research Seminar I & II are zero credit each.

Typical Study Plan for Full-Time Students

	Semester 1	Semester 2
Year 1	• SCIE 701 Research Methods in Science • Core Course 1 • Core Course 2 • Core Course 3	• Technical Elective 1 • Technical Elective 2 • Technical Elective 3
Year 2	• Technical Elective 4 • Technical Elective 5 • SCIE 799 PhD Research Dissertation	• SCIE 799 PhD Research Dissertation • SCIE *795 PhD Written Qualifying Exam*
Year 3	• Technical Elective 6 • SCIE 702 PhD Research Seminar I • SCIE 799 PhD Research Dissertation	• Technical Elective 7 • SCIE 799 PhD Research Dissertation • SCIE *796 PhD Research Proposal Exam*
Year 4	• Technical Elective 8 • SCIE 799 PhD	• SCIE 703 PhD Research Seminar II •

	Research Dissertation	SCIE 799 PhD Research Dissertation
Year 5	• SCIE 799 PhD Research Dissertation	• SCIE 799 PhD Research Dissertation • *Final Doctoral Dissertation Exam*

PhD in Mathematics (with MSc Degree)

About the Program

The PhD in Mathematics (PhD MATH) builds on Khalifa University's internationally leading research activity in science, engineering, and medicine. It supports the University's alignment with the Abu Dhabi Economic Vision 2030 plan through the provision of internationally excellent education and student experience in Mathematics, producing highly skilled science professionals capable of transferring state-of-the-art technologies to priority sectors of industry, business and government. The aim of the PhD in Mathematics program is to produce graduates who are able to conduct independent research in Mathematics at the highest levels of originality and quality. The degree will be awarded to students who demonstrate a range of advanced knowledge and skills at the forefront of Mathematics and who complete an independent investigation of a novel specialist topic in order to present a dissertation addressing a problem in cutting edge research. Candidates for the degree will be supervised by teams of experienced researchers.

Program Educational Objectives

The objectives of the PhD in Mathematics program are to produce graduates who have the ability to:

1. Synthesize and critically evaluate complex current knowledge in the Mathematical sciences in order to plan and implement new and creative approaches so as to generate new knowledge and solve research challenges with effective dissemination of the results to a variety of audiences;
2. Work to the highest professional and ethical standards in an area of Mathematical sciences and develop their individual academic, professional and career skills; and
3. Keep abreast of the latest developments in Mathematics that contribute to the advancement of knowledge for the benefit of society.

Learning Outcomes

Upon successful completion of the PhD in Mathematics, a graduate will be able to:

1. Demonstrate and critically analyze comprehensive, deep and overarching knowledge that is at the frontier of recent developments in Mathematical sciences.
2. Conduct and defend original independent research that creates significant new knowledge in Mathematical sciences of publishable quality that leads to scholarly articles or other intellectual outputs.
3. Analyze and critically evaluate the uses and limitations of diverse methodologies and techniques for solving problems in Mathematical research, leading to informed and valid judgements.
4. Select and deploy advanced experimental and related skills to investigate and solve complex problems in Mathematical research.
5. Communicate effectively and professionally, in written and oral forms as appropriate, the major tenets of areas of Mathematics and their individual specializations to a variety of audiences.
6. Demonstrate a commitment to safe, responsible and ethical behavior in all research and professional activities.
7. Reflect upon their role(s) in their research specialization and in the wider research community to ensure that they take responsibility for their own development and that of peer groups and networks.

Study Plan

A typical study plan for students enrolled in the PhD in Mathematics is shown below.

Typical Study Plan for Full-Time Students

	Semester 1	Semester 2
Year 1	• Program Core Course 1 • Elective Course 1 • Elective Course 2 • Elective Course 3	• Elective Course 4 • Elective Course 5 • Elective Course 6 • PhD Research Dissertation
Year 2	• Elective Course 7 • PhD Written Qualifying Examination • PhD Research Dissertation	• Research Seminar I • PhD Research Proposal Examination • PhD Research Dissertation
Year 3	• PhD Research Dissertation	• Research Seminar II • PhD Research Dissertation
Year 4	• PhD Research Dissertation	• PhD Research Dissertation

PhD in Mathematics (with only BSc Degree)

Introduction

This program is to be offered by the Department of Mathematics, College of Science (CoS) at Khalifa University of Science and Technology, Abu Dhabi.

The aim of the PhD in Mathematics programme is to produce graduates who can conduct independent research in Mathematical sciences at the highest levels of originality and quality. The degree will be awarded to students who demonstrate a range of advanced knowledge and skills at the forefront of Mathematics and who complete an independent investigation of a novel specialist topic to present a thesis addressing a problem in cutting edge research. Candidates for the degree will be supervised by teams of experienced researchers.

The PhD in Mathematics through the Bachelor-to-Doctorate Direct Admission is a full-time, 72 credit programs. There are 36 credits of taught courses and 36 credits of research aimed at producing a thesis describing an independent research project in a novel scientific topic. The program builds on Khalifa University's internationally leading research activity in science, engineering, and medicine. It supports the University's alignment with the Abu Dhabi Economic Vision 2030 plan through the provision of internationally excellent education and student experience in Mathematics, producing highly skilled science professionals capable of transferring state-of-the-art technologies to priority sectors of industry, business, and government.

The CAA recently approved Bachelor-to-Doctorate direct admission. Therefore, all students admitted directly to the PhD in Mathematics program with only a bachelor degree will follow the program structure and the typical study plan below.

Program Educational Objectives

The objectives of the PhD in Mathematics program are to produce graduates who have the ability to:

1. Synthesize and critically evaluate complex current knowledge in the Mathematical sciences in order to plan and implement new and creative approaches so as to generate new knowledge and solve research challenges with effective dissemination of the results to a variety of audiences;

2. Work to the highest professional and ethical standards in an area of Mathematical sciences and develop their individual academic, professional and career skills; and

3. Keep abreast of the latest developments in Mathematics that contribute to the advancement of knowledge for the benefit of society.

Learning Outcomes

Upon successful completion of the PhD in Mathematics, a graduate will be able to:

1. Demonstrate and critically analyze comprehensive, deep and overarching knowledge that is at the frontier of recent developments in Mathematical sciences.

2. Conduct and defend original independent research that creates significant new knowledge in Mathematical sciences of publishable quality that leads to scholarly articles or other intellectual outputs.

3. Analyze and critically evaluate the uses and limitations of diverse methodologies and techniques for solving problems in Mathematical research,

leading to informed and valid judgements.

4. Select and deploy advanced experimental and related skills to investigate and solve complex problems in Mathematical research.
5. Communicate effectively and professionally, in written and oral forms as appropriate, the major tenets of areas of Mathematics and their individual specializations to a variety of audiences.
6. Demonstrate a commitment to safe, responsible and ethical behavior in all research and professional activities.
7. Reflect upon their role(s) in their research specialization and in the wider research community to ensure that they take responsibility for their own development and that of peer groups and networks.

Study Plan

A typical study plan for students enrolled in the PhD in Mathematics is shown below.

All courses in the study plan are 3 credit hours each. PhD Research Seminar I & II are zero credit each.

Typical Study Plan for Full-Time Students

• SCIE 701 Research Methods in Science • Core Course 1 • Core Course 2 • Core Course 3	• Technical Elective 1 • Technical Elective 2 • Technical Elective 3
• Technical Elective 4 • Technical Elective 5 • SCIE 799 PhD Research Dissertation	• SCIE 799 PhD Research Dissertation • SCIE *795 PhD Written Qualifying Exam*
• Technical Elective 6 • SCIE 702 PhD Research Seminar I • SCIE 799 PhD Research Dissertation	• Technical Elective 7 • SCIE 799 PhD Research Dissertation • SCIE *796 PhD Research Proposal Exam*
• Technical Elective 8 • SCIE 799 PhD	• SCIE 703 PhD Research Seminar II •

Research Dissertation	SCIE 799 PhD Research Dissertation
• SCIE 799 PhD Research Dissertation	• SCIE 799 PhD Research Dissertation
	• *Final Doctoral Dissertation Exam*

PhD in Molecular Life Sciences (with MSc Degree)

The PhD in Molecular Life Sciences (MOLS) program contributes to Khalifa University's desire to become a center of excellence in science, engineering, and medicine within the region and beyond. The program supports the University's alignment with the Abu Dhabi Economic Vision 2030 plan through the provision of internationally excellent education and student experience in Science, resulting in highly skilled Science professionals, capable of transferring state-of-the-art technologies in priority sectors of industry, business and government.

The program aims to offer comprehensive theoretical and practical knowledge of Molecular Life Sciences to students interested in pursuing careers in life sciences or medicine-related fields. It will graduate students who are critical thinkers with the ability to use their scientific knowledge to solve problems in life sciences and to effectively communicate them various stakeholders.

Program Educational Objectives

A few years after completing the program, the graduates will:

1. Critically evaluate current knowledge in life sciences fields and propose, plan, and execute new and creative strategies to solve research challenges, with effective dissemination of the results to a variety of audiences;
2. Work to the highest professional and ethical standards in an area of life sciences to create new knowledge and develop their individual academic, professional and career skills;
3. Stay well-informed of the latest developments in life sciences so as to contribute to the advancement of knowledge for the benefit of society.

Program Learning Outcomes

Upon completion of the program, students will be able to:

1. Demonstrate and critically analyze comprehensive, deep and overarching knowledge that is at the frontier of recent developments in molecular life sciences.
2. Conduct and defend original independent research that creates significant new knowledge in biological and life sciences of publishable quality that leads to scholarly articles or other intellectual outputs.
3. Analyze and critically evaluate the uses and limitations of diverse methodologies and techniques for solving problems in biological research, leading to informed and valid judgements.
4. Select and deploy advanced experimental and related skills to investigate and solve complex problems in life science research.
5. Communicate effectively and professionally, in written and oral forms as appropriate, the major tenets of areas of life sciences and their individual specializations to a variety of audiences.
6. Demonstrate a commitment to safe, responsible and ethical behavior in all research and professional activities.
7. Reflect upon their role(s) in their research specialization and in the wider research community to ensure that they take responsibility for their own development and that of peer groups and networks.

Program Structure and Requirements

Overall Program Structure

The normal length of the program is 60 credit hours. To be recommended for graduation with an PhD in Molecular Life Sciences, students must satisfactorily complete formal courses in the specified categories as set out as follows – 9 credit hours of core required courses and 15 credit hours of electives (of which at least 9 credits hours must be BIOL electives, and up to 6 credit hours of additional electives).

The curriculum also requires 36 credit hours of thesis research. Additionally, students have to submit a written thesis which is evaluated by the examination committee, as well as satisfactorily defend their thesis research in a viva format.

Program Component	**Credit Hours**
Program Core	9
Electives	15
PhD Thesis Research	36
Total	**60**

Program Requirements

Students seeking the degree of PhD in Molecular Life Sciences must successfully complete a minimum 60 credit hours as specified in the program requirements detailed below, with a minimum CGPA of 3.0. Course selection should be made in consultation with the student's Main Advisor.

Program Core (9 credit hours)

Students must complete the core courses listed below.

Core Courses

SCIE 701	Research Methods in Science	3
BIOL 795	Graduate Seminar I	1
BIOL 796	Graduate Seminar II	1
BIOL 797	Graduate Seminar III	1
BIOL 701	Advanced Techniques in Molecular Life Sciences	3

Program Electives (15 credit hours)

Students must complete 15 credit hours of electives (of which at least 9 credits hours must be BIOL electives, and up to 6 credit hours of additional electives).

Program Elective Courses

BIOL 710	Recent Advances in Protein Biochemistry	3
BIOL 720	Recent Advances in Cell Signaling and Cancer Biology	3
BIOL 730	Recent Advances in Biotechnology	3
BIOL 740	Recent Advances in Virology	3
BIOL 750	Recent Advances in Endocrinology	3
BIOL 760	Recent Advances in Clinical Microbiology	3

Elective Courses from Other Departments

BMED 711	Biomolecular and Cellular Engineering	3
BMED 720	Biophysical Engineering of Cellular Systems	3
CHEM 714	Recent Developments in Analytical Chemistry	3
CHEM 715	Recent Developments in Nanochemistry	3
CHEM 716	Recent Developments in Environmental Chemistry	3
CHEM 717	Advanced topics in Biochemistry	3

Thesis Research (36 credit hours)

Students must complete a Dissertation that involves creative, research-oriented work within the field of Molecular Life Sciences, under direct supervision of a full-time faculty advisor from the Biology Department, and at least one other full-time faculty who acts as a co-advisor. The outcome of research should demonstrate the synthesis of information into knowledge in a form that may be used by others. The research findings must be documented in a formal dissertation and defended successfully in a viva voce examination.

Thesis Research

BIOL 799	Thesis Research	36

Study Plan

A typical study plan for students enrolled in the PhD in Molecular Life Sciences is shown below.

Typical Study Plan for Students

Semester 1	Semester 2
• SCIE 701 Research Methods in Science • BIOL 701 Advanced Techniques in Molecular Life Sciences • Elective 1 • Elective 2	• BIOL 795 Graduate Seminar 1 • Elective 3 • Elective 4 • Elective 5 • BIOL 799 Thesis Research
Semester 3	**Semester 4**
• BIOL 796 Graduate Seminar 2 • SCIE 795 PhD Written Qualifying Examination • BIOL 799 Thesis Research	• SCIE 796 PhD Research Proposal Examination • BIOL 799 Thesis Research
Semester 5	**Semester 6**
• BIOL 799 Thesis Research	• BIOL 797 Graduate Seminar 3 • BIOL 799 Thesis Research
Semester 7	**Semester 8**
• BIOL 799 Thesis Research	• BIOL 799 Thesis Research

PhD in Molecular Life Science (with BSc only)

The PhD in Molecular Life Sciences (MOLS) program contributes to Khalifa University's desire to become a center of excellence in science, engineering, and medicine within the region and beyond. The program supports the University's alignment with the Abu Dhabi Economic Vision 2030 plan through the provision of internationally excellent education and student experience in Science, resulting in highly skilled Science professionals, capable of transferring state-of-the-art technologies in priority sectors of industry, business and government.

The program aims to offer comprehensive theoretical and practical knowledge of Molecular Life Sciences to students interested in pursuing careers in life sciences or medicine-related fields. It will graduate students who are critical thinkers with the ability to use their scientific knowledge to solve problems in life sciences and to effectively communicate them various stakeholders.

Program Educational Objectives

A few years after completing the program, the graduates will:

1. Critically evaluate current knowledge in life sciences fields and propose, plan, and execute new and creative strategies to solve research challenges, with effective dissemination of the results to a variety of audiences;
2. Work to the highest professional and ethical standards in an area of life sciences to create new knowledge and develop their individual academic, professional and career skills;
3. Stay well-informed of the latest developments in life sciences so as to contribute to the advancement of knowledge for the benefit of society.

Program Learning Outcomes

Upon completion of the program, students will be able to:

1. Demonstrate and critically analyze comprehensive, deep and overarching knowledge that is at the frontier of recent developments in molecular life sciences.
2. Conduct and defend original independent research that creates significant new knowledge in biological

and life sciences of publishable quality that leads to scholarly articles or other intellectual outputs.

3. Analyze and critically evaluate the uses and limitations of diverse methodologies and techniques for solving problems in biological research, leading to informed and valid judgements.
4. Select and deploy advanced experimental and related skills to investigate and solve complex problems in life science research.
5. Communicate effectively and professionally, in written and oral forms as appropriate, the major tenets of areas of life sciences and their individual specializations to a variety of audiences.
6. Demonstrate a commitment to safe, responsible and ethical behavior in all research and professional activities.
7. Reflect upon their role(s) in their research specialization and in the wider research community to ensure that they take responsibility for their own development and that of peer groups and networks.

Program Structure and Requirements

Overall Program Structure

This BSc-to-PhD program IN Molecular Life Sciences program (also called Direct Entry PhD) is a 72 credit hours degree program with at least 36 credit hours of courses - 15 credit hours of required courses (core) and 21 credit hours of electives, as listed below. The program also has 36 credit hours of thesis research.

Therefore, all students admitted directly to the PhD in Molecular Life Sciences program with only a bachelor degree will follow the program structure and the typical study plan below.

Category	**Credit Hours**
Program Core	15
Electives	21
PhD Research Dissertation	36
Total	**72**

Program Requirements

Students seeking the degree of PhD in Molecular Life Sciences must successfully complete a minimum 72 credit hours as specified in the program requirements detailed below, with a minimum CGPA of 3.0. Course selection should be made in consultation with the student's Main Advisor. All the courses that the students will take are at PhD level. The students will only be able to attempt SCIE 795 PhD Written Qualifying Exam (WQE) after successfully completing a minimum of 27 credits of formal coursework.

Program Core (15 credit hours)

Students must complete the core courses listed below.

Core Courses

SCIE 701	Research Methods in Science	3
BIOL 795	Graduate Seminar I	1
BIOL 796	Graduate Seminar II	1
BIOL 797	Graduate Seminar III	1
BIOL 701	Advanced Techniques in Molecular Life Sciences	3
BIOL 730	Recent Advances in Biotechnology	3
BIOL 700	Molecular Life Sciences Laboratory Rotation	3

Program Electives (21 credit hours)

Students must complete 21 credit hours of electives (of which at least 15 credits hours must be BIOL electives, and up to 6 credit hours of additional electives).

Program Elective Courses

BIOL 710	Recent Advances in Protein Biochemistry	3
BIOL 720	Recent Advances in Cell Signaling and Cancer Biology	3
BIOL 740	Recent Advances in Virology	3
BIOL 750	Recent Advances in Endocrinology	3
BIOL 760	Recent Advances in Clinical Microbiology	3
BIOL 790	Recent Advances in Drug Development and Delivery	3

Elective Courses from Other Departments

BMED 711	Biomolecular and Cellular Engineering	3
BMED 720	Biophysical Engineering of Cellular Systems	3

CHEM 714	Recent Developments in Analytical Chemistry	3
CHEM 715	Recent Developments in Nanochemistry	3
CHEM 716	Recent Developments in Environmental Chemistry	3
CHEM 717	Advanced topics in Biochemistry	3

PhD Research Dissertation (36 credit hours)

Students must complete a Dissertation that involves creative, research-oriented work within the field of Molecular Life Sciences, under direct supervision of a full-time faculty advisor from the Biology Department, and at least one other full-time faculty who acts as a co-advisor. The outcome of research should demonstrate the synthesis of information into knowledge in a form that may be used by others. The research findings must be documented in a formal dissertation and defended successfully in a viva voce examination.

Thesis Research

BIOL 799	Thesis Research	36

Study Plan

A typical study plan for students enrolled in the BSc-PhD in Molecular Life Sciences is shown below.

Typical Study Plan for Students

Semester 1	**Semester 2**
• BIOL 700 Lab Rotation • SCIE 701 Research Methods in Science • BIOL 701 Adv techniques in Mol Life Sciences • BIOL 730 Recent Advances in Biotechnology	• BIOL 795 Graduate Seminar 1 • Elective 1 • Elective 2 • Elective 3 • BIOL 799 Thesis Research
Semester 3	**Semester 4**
• BIOL 796 Graduate Seminar 2 • BIOL 799 Thesis Research • Elective 4 • Elective 5	• SCIE795 PhD Written Qualifying Examination • BIOL 799 Thesis Research • Elective 6 • Elective 7
Semester 5	**Semester 6**
• BIOL 799 Thesis Research • SCIE796 PhD Research Proposal Examination	• BIOL 797 Graduate Seminar 3 • BIOL 799 Thesis Research
Semester 7	**Semester 8**
•	•

BIOL 799 Thesis Research	BIOL 799 Thesis Research
Semester 9	**Semester 10**
• BIOL 799 Thesis Research	• BIOL 799 Thesis Research • PhD Research Dissertation Examination

PhD in Physics (with MSc Degree)

About the Program

The PhD in Physics (PhD PHYS) builds on Khalifa University's internationally leading research activity in science, engineering, and medicine. It supports the University's alignment with the Abu Dhabi Economic Vision 2030 plan through the provision of internationally excellent education and student experience in Physics, producing highly skilled science professionals capable of transferring state-of-the-art technologies to priority sectors of industry, business and government. The aim of the PhD in Physics program is to produce graduates who are able to conduct independent research in Physical sciences at the highest levels of originality and quality. The degree will be awarded to students who demonstrate a range of advanced knowledge and skills at the forefront of Physics and who complete an independent investigation of a novel specialist topic in order to present a dissertation addressing a problem in cutting edge research. Candidates for the degree will be supervised by teams of experienced researchers.

Program Educational Objectives

The objectives of the PhD in Physics program are to produce graduates who have the ability to:

1. Synthesize and critically evaluate complex current knowledge in the Physical sciences in order to plan and implement new and creative approaches so as to generate new knowledge and solve research challenges with effective dissemination of the results to a variety of audiences;
2. Work to the highest professional and ethical standards in an area of Physical sciences and develop their individual academic, professional and career skills; and
3. Keep abreast of the latest developments in Physics that contribute to the advancement of knowledge for the benefit of society.

Learning Outcomes

Upon successful completion of the PhD in Physics, a graduate will be able to:

1. Demonstrate and critically analyze comprehensive, deep and overarching knowledge that is at the frontier of recent developments in Physical sciences.
2. Conduct and defend original independent research that creates significant new knowledge in Physical sciences of publishable quality that leads to scholarly articles or other intellectual outputs.
3. Analyze and critically evaluate the uses and limitations of diverse methodologies and techniques for solving problems in Physical research, leading to informed and valid judgements.
4. Select and deploy advanced experimental and related skills to investigate and solve complex problems in Physical research.
5. Communicate effectively and professionally, in written and oral forms as appropriate, the major tenets of areas of Physics and their individual specializations to a variety of audiences.
6. Demonstrate a commitment to safe, responsible and ethical behavior in all research and professional activities.
7. Reflect upon their role(s) in their research specialization and in the wider research community to ensure that they take responsibility for their own development and that of peer groups and networks.

Program Structure and Requirements

Overall Program Structure

The PhD in Physics consists of a minimum 60 credit hours, distributed as follows: 24 credit hours of coursework, 36 credit hours of PhD Dissertation, two zero credit PhD Seminar courses, as well as PhD Written Qualifying and PhD Research Proposal examinations. The components of the program are summarized in the table below.

Program Component	Credit Hours
Program Core (1 course)	3
Research Seminar I	0
Research Seminar II	0
PhD Written Qualifying Examination	0
PhD Research Proposal Examination	0
Program Electives	21
PhD Research Dissertation	36
Total	**60**

Program Requirements

Students seeking the degree of PhD in Physics must successfully complete a minimum 60 credit hours as specified in the program requirements detailed below, with a minimum CGPA of 3.0. Course selection should be made in consultation with the student's Main Advisor. All courses listed below have a credit rating of three credits each, except for PhD Research Seminar, Written Qualifying Exam, Research Proposal Exam, and the PhD Research Dissertation.

Program Core (3 credit hours)

Students must complete the core courses listed below.

Core Courses

SCIE 701	Research Methods in Science	3
SCIE 702	Research Seminar I	0
SCIE 703	Research Seminar II	0
SCIE 795	PhD Written Qualifying Examina	0
SCIE 796	PhD Research Proposal Examinat	0

Program Electives (21 credit hours)

Students must complete a total of seven elective courses. Program electives are listed below.

Program Elective Courses

PHYS 701	Advanced Computational Physics	3
PHYS 702	Advanced Quantum Mechanics	3
PHYS 703	Molecular Biophysics	3
PHYS 704	Advanced Electromagnetic Theory	3
PHYS 705	Nanophysics and Nanotechnology	3
PHYS 706	Quantum Field Theory	3
PHYS 707	Advanced Solid State Physics	3
PHYS 708	Theoretical Astroparticle Physics	3
PHYS 709	Experimental Techniques in Astroparticle Physics	3
PHYS 710	Planetary Astrophysics	3
PHYS 711	Quantum Transport and Optics	3
PHYS 712	Atomic and Molecular Physics for Space Scientists	3
PHYS 713	Electron Microscopy for Materials Characterization	3

*Subject to approval of the Main Advisor and the Program Coordinator, up to two electives (6 credits) may be taken from outside the student's department and **ONLY** chosen from the list below, if these courses support the student's dissertation topic.*

Elective Courses from Other Departments

Chemistry

CHEM 713	Recent Advances in Physical Chemistry	3
CHEM 715	Recent Developments in Nanochemistry	3

Mathematics

MATH 705	Mechanics of interacting particles	3
MATH 708	Partial Differential Equations	3
MATH 709	Probability and Stochastic Processes	3

Chemical Engineering

CHEG 703	Applied nanotechnology	3

Electrical Engineering

ECCE 778	Physics and Manufacturability of Advanced Micro and Nano Devices	3
ECCE 781	The Physics of Solar Cells	3

Mechanical Engineering

MEEN 782	Materials Characterization Techniques	3
MEEN 792	Advanced Nanomaterials and Their Mechanical Applications	3
MSEN 712	Imaging of Materials: Scanning Electron Microscopy and X-ray Microanalysis	3

PhD Research Dissertation (36 credit hours)

Students must complete a Dissertation that involves creative, research-oriented work within the field of physics, under direct supervision of a full-time faculty advisor from the Physics Department, and at least one other full-time faculty who acts as a co-advisor. The outcome of research should demonstrate the synthesis of information into knowledge in a form that may be used by others. The research findings must be documented in a formal dissertation and defended successfully in a viva voce examination.

Dissertation

SCIE 799	PhD Thesis Dissertation	36

Study Plan

A typical study plan for students enrolled in the PhD in Physics is shown below.

Typical Study Plan for Full-Time Students

	Semester 1	**Semester 2**
Year 1	• Program Core Course 1 • Elective Course 1 • Elective Course 2 • Elective Course 3	• Elective Course 4 • Elective Course 5 • Elective Course 6 • PhD Research Dissertation
Year 2	• Elective Course 7 • PhD Written Qualifying Examination • PhD Research Dissertation	• Research Seminar I • PhD Research Proposal Examination • PhD Research Dissertation
Year 3	• PhD Research Dissertation	• Research Seminar II • PhD Research Dissertation
Year 4	• PhD Research Dissertation	• PhD Research Dissertation

PhD in Physics (with only BSc Degree)

Introduction

The PhD in Physics (PhD PHYS) builds on Khalifa University's internationally leading research activity in science, engineering, and medicine. It supports the University's alignment with the Abu Dhabi Economic Vision 2030 plan through the provision of internationally excellent education and student experience in Physics, producing highly skilled science professionals capable of transferring state-of-the-art technologies to priority sectors of industry, business and government. The aim of the PhD in Physics program is to produce graduates who are able to conduct independent research in Physical sciences at the highest levels of originality and quality. The degree will be awarded to students who demonstrate a range of advanced knowledge and skills at the forefront of Physics and who complete an independent investigation of a novel specialist topic in order to present a dissertation addressing a problem in cutting edge research. Candidates for the degree will be supervised by teams of experienced researchers.

The CAA recently approved Bachelor-to-Doctorate direct admission. Therefore, all students admitted directly to the PhD in Physics program with only a bachelor degree will follow the program structure and the typical study plan below.

Program Educational Objectives

The objectives of the PhD in Physics program are to produce graduates who have the ability to:

1. Synthesize and critically evaluate complex current knowledge in the Physical sciences in order to plan and implement new and creative approaches so as to generate new knowledge and solve research challenges with effective dissemination of the results to a variety of audiences;

2. Work to the highest professional and ethical standards in an area of Physical sciences and develop their individual academic, professional and career skills; and

3. Keep abreast of the latest developments in Physics that contribute to the advancement of knowledge for the benefit of society.

Learning Outcomes

Upon successful completion of the PhD in Physics, a graduate will be able to:

1. Demonstrate and critically analyze comprehensive, deep and overarching knowledge that is at the frontier of recent developments in Physical sciences.

2. Conduct and defend original independent research that creates significant new knowledge in Physical sciences of publishable quality that leads to scholarly articles or other intellectual outputs.

3. Analyze and critically evaluate the uses and limitations of diverse methodologies and techniques

for solving problems in Physical research, leading to informed and valid judgements.

4. Select and deploy advanced experimental and related skills to investigate and solve complex problems in Physical research.
5. Communicate effectively and professionally, in written and oral forms as appropriate, the major tenets of areas of Physics and their individual specializations to a variety of audiences.
6. Demonstrate a commitment to safe, responsible and ethical behavior in all research and professional activities.
7. Reflect upon their role(s) in their research specialization and in the wider research community to ensure that they take responsibility for their own development and that of peer groups and networks.

Program Structure and Requirements

Overall Program Structure

The PhD in Physics consists of a minimum 72 credit hours, distributed as follows: 36 credit hours of coursework, 36 credit hours of PhD Dissertation, two zero credit PhD Seminar courses, as well as PhD Written Qualifying and PhD Research Proposal examinations. The components of the program are summarized in the table below.

Category	**Credit Hours**
Core Courses	12
Technical Electives	24
SCIE 702 PhD Research Seminar I	0
SCIE 703 PhD Research Seminar II	0
SCIE 795 PhD Written Qualifying Exam	0
SCIE 796 PhD Research Proposal Exam	0
PhD Research Dissertation	36
Total	**72**

All the courses that the students will take are at PhD level. The students will only be able to attempt SCIE PhD Written Qualifying Exam (WQE) after successfully completing a minimum of 27 credits of formal coursework.

Program Requirements

Students seeking the degree of PhD in Physics must successfully complete a minimum 72 credit hours as specified in the program requirements detailed below, with a minimum CGPA of 3.0. Course selection should be made in consultation with the student's Main Advisor. All courses listed below have a credit rating of three credits each, except for PhD Research Seminar, Written Qualifying Exam, Research Proposal Exam, and the PhD Research Dissertation.

Program Core (12 credit hours)

Students must complete the core courses listed below.

Core Courses

SCIE 701	Research Methods in Science	3
PHYS 715	Electromagnetism	3
PHYS 716	Advanced Statistical Mechanics	3
PHYS 717	Quantum Mechanics	3

Program Electives (24 credit hours)

Students must complete a total of eight elective courses (24 credits). Program electives are listed below.

Program Elective Courses

PHYS 701	Advanced Computational Physics	3
PHYS 702	Advanced Quantum Mechanics	3
PHYS 703	Molecular Biophysics	3
PHYS 704	Advanced Electromagnetic Theory	3
PHYS 705	Nanophysics and Nanotechnology	3
PHYS 706	Quantum Field Theory	3
PHYS 707	Advanced Solid State Physics	3
PHYS 708	Theoretical Astroparticle Physics	3
PHYS 709	Experimental Techniques in Astroparticle Physics	3
PHYS 710	Planetary Astrophysics	3
PHYS 711	Quantum Transport and Optics	3
PHYS 712	Atomic and Molecular Physics for Space Scientists	3
PHYS 713	Electron Microscopy for Materials Characterization	3

*Subject to approval of the Main Advisor and the Program Coordinator, up to two electives (6 credits) may be taken from outside the student's department and **ONLY** chosen from the list below, if these courses support the student's dissertation topic.*

Elective Courses from Other Departments

Chemistry		
CHEM 713	Recent Advances in Physical Chemistry	3
CHEM 715	Recent Developments in Nanochemistry	3
Mathematics		
MATH 705	Mechanics of interacting particles	3
MATH 708	Partial Differential Equations	3
MATH 709	Probability and Stochastic Processes	3
Chemical Engineering		
CHEG 703	Applied nanotechnology	3
Electrical Engineering		
ECCE 778	Physics and Manufacturability of Advanced Micro and Nano Devices	3
ECCE 781	The Physics of Solar Cells	3
Mechanical Engineering		
MEEN 782	Materials Characterization Techniques	3
MEEN 792	Advanced Nanomaterials and Their Mechanical Applications	3

PhD Research Dissertation (36 credit hours)

Students must complete a Dissertation that involves creative, research-oriented work within the field of physics, under direct supervision of a full-time faculty advisor from the Physics Department, and at least one other full-time faculty who acts as a co-advisor. The outcome of research should demonstrate the synthesis of information into knowledge in a form that may be used by others. The research findings must be documented in a formal dissertation and defended successfully in a viva voce examination.

Dissertation		
SCIE 799	PhD Thesis Dissertation	36

Study Plan

A typical study plan for students enrolled in the PhD in Physics is shown below.

All courses in the study plan are 3 credit hours each. PhD Research Seminar I & II are zero credit each.

Typical Study Plan for Full-Time Students

- SCIE 701 Research Methods in Science
- Core Course 1
- Core Course 2
- Core Course 3

- Technical Elective 1
- Technical Elective 2
- Technical Elective 3

- Technical Elective 4
- Technical Elective 5
- SCIE 799 PhD Research Dissertation

- SCIE 799 PhD Research Dissertation
- SCIE *795 PhD Written Qualifying Exam*

- Technical Elective 6
- SCIE 702 PhD Research Seminar I
- SCIE 799 PhD Research Dissertation

- Technical Elective 7
- SCIE 799 PhD Research Dissertation
- SCIE *796 PhD Research Proposal Exam*

- Technical Elective 8
- SCIE 799 PhD Research Dissertation

- SCIE 703 PhD Research Seminar II
- SCIE 799 PhD Research Dissertation

- SCIE 799 PhD Research Dissertation

- SCIE 799 PhD Research Dissertation
- SCIE 799 PhD Research Dissertation
- *Final Doctoral Dissertation Exam*

College of Engineering

MSc in Aerospace Engineering

About the Program

The Master of Science in Aerospace Engineering (MSc AERO) gives candidates the opportunity to deepen their knowledge in the broad field of Aerospace Engineering and contribute to the process of discovery and knowledge creation through the conduct of original research. Candidates for this degree are taught and supervised by experienced faculty and are expected to demonstrate initiative in their approach and innovation in their work. In addition to successfully completing the taught course component of the program, candidates prepare and present a thesis on their chosen area. Research may be undertaken in several topics corresponding to the areas of focus identified by the University.

Program Educational Objectives

The objectives of the MSc in Aerospace Engineering program are to produce graduates who:

1. Advance professionally and be recognized as leaders in their respective careers in Aerospace Engineering in industry, government, and academia.
2. Apply their technical expertise to address the needs of society in a critical, creative, ethical, and innovative manner to solve problems related to Aerospace Engineering that are locally and globally relevant.
3. Further develop their knowledge and skills through graduate education and professional schools.

Learning Outcomes

MSc in Aerospace Engineering graduates will be able to:

1. Identify, formulate, and solve advanced Aerospace Engineering problems through the application of modern tools and techniques and advanced knowledge of mathematics and engineering science.
2. Acquire knowledge of contemporary issues in the field of Aerospace Engineering and develop an aptitude for innovation and entrepreneurship.
3. Design and conduct experiments, as well as analyze, interpret data and make decisions.
4. Conduct research and document and defend the research results.
5. Function in teams and communicate effectively.
6. Conduct themselves in a professional and ethical manner.

Program Structure and Requirements

Overall Program Structure

The MSc AERO program is equivalent to 30 credit hours, distributed as follows: 12 credit hours of Program Core courses, 9 credit hours of Program Elective courses and 9 credit hours of Master's Thesis. The components of the program are summarized in the table below.

Program Component	**Credit Hours**
Seminar in Research Methods	0
Program Core	12
Program Electives	9
Master's Thesis	9
Total	**30**

Program Requirements

Students seeking the degree of MSc in Aerospace Engineering must successfully complete 30 credit hours as specified in the program requirements detailed below, with a minimum CGPA of 3.0. Course selection should be made in consultation with the student's Main Advisor. All courses have a credit rating of three credits each, except the Seminar in Research Methods and the Master's Thesis.

Program Core (12 credit hours)

Students must complete the core courses listed below.

Core Courses		
ENGR 695	Seminar in Research Methods	0
ENGR 606	Advanced Engineering Mathematics	3
AERO 620	Advanced Aerodynamics	3
AERO 630	Aerospace Materials and Structures	3
AERO 640	Advanced Flight Dynamics and Control	3

Program Electives and Concentrations (9 credit hours)

Students must select three courses from the list below. Subject to approval of the Main Advisor, students can select up to two elective courses (6 credit hours) from other MSc programs in the College of Engineering at KU.

Program Elective Courses

AERO 611	Combustion Theory and Applications	3
AERO 612	Advanced Viscous Flow Analysis	3
AERO 621	Boundary Layer Analysis	3
AERO 622	Structural Dynamics and Aeroelasticity	3
AERO 623	Experimental Methods in Aerodynamics	3
AERO 631	Mechanics of Composite Materials	3
AERO 632	Advanced Composite Materials Manufacturing	3
AERO 650	Space Systems Engineering	3
AERO 651	Space Systems Design Project I	1
AERO 652	Space Systems Design Project II	2
AERO 653	Space Propulsion	3
AERO 654	Astrodynamics and Mission Analysis	3
AERO 660	Aerospace Navigation and Guidance Systems	3
AERO 694	Selected Topics in Aerospace Engineering	4
ENGR 602	Engineering Numerical Methods	3

Concentration in Space Systems and Technology

The program offers an optional concentration in Space Systems and Technology. Students choosing this concentration are expected to attain the following concentration specific learning outcomes:

1. Demonstrate proficiency in space systems analysis and design.
2. Acquire skills in advanced satellite development, assembly, integration and testing.

In addition to program specific core courses, students who opt for the concentration in Space Systems and Technology must complete a minimum of three courses (9 credit hours) from the list below and a thesis within the domain of the concentration. The concentration will be specified on the student's official transcript. *(AERO 650, AERO 651, and AERO 652: Indicates required courses for the concentration).*

Concentration Courses

AERO 650	Space Systems Engineering	3
AERO 651	Space Systems Design Project I	1
AERO 652	Space Systems Design Project II	2
AERO 653	Space Propulsion	3
AERO 654	Astrodynamics and Mission Analysis	3

Master's Thesis (minimum 9 credit hours)

Students must complete a Master's Thesis that involves original, creative, research-oriented work within the broad field of aerospace engineering, under direct supervision of a faculty advisor from the Aerospace Engineering Department, and at least one other full-time faculty who acts as a co-advisor. The research findings must be documented in a formal thesis and defended successfully in a viva voce examination. Furthermore, the research should lead to publishable quality scholarly articles.

Thesis

AERO 699	Master's thesis	9

Study Plan

Students must consult with their respective advisors on the courses that they will enroll in, the required pre-requisites, and the thesis topic selection. Full-time graduate students must register for 9 to 12 credits, including thesis credits, during a regular semester (Fall and Spring) and a maximum of 6 credits during a Summer term. In the case of part-time students, the credit load is normally 6 credits during a regular semester as well as the summer term.

Students can only register for thesis credits after successfully completing a minimum of 9 credits of the core courses of the master's program they are enrolled in. It is to be noted that the minimum pass grade for graduate courses is a "C" letter grade. Students should consult the Graduate Catalog to learn about the graduate programs, the grading system, graduation requirements, and other pertinent matters.

A typical study plan for students enrolled in the MSc AERO is shown below.

Typical Study Plan for Full-Time Students

Semester 1 (Fall)	• Seminar in Research Methods • Program Core Course 1 • Program Core Course 2 • Program Core Course 3 • Program Core Course 4
Semester 2 (Spring)	• Elective Course 1 • Elective Course 2 • Elective Course 3 • Master's Thesis
Semester 3 (Summer)	• Master's Thesis

Typical Study Plan for Part-Time Students

	Semester 1	**Semester 2**
Year 1	• Seminar in Research Methods • Program Core Course 1 • Program Core Course 2	• Elective Course 1• Elective Course 2
Year 2	• Program Core Course 3• Program Core Course 4	• Elective Course 3• Master's Thesis
Year 3	• Master's Thesis	

MSc in Biomedical Engineering

About the Program

The Master of Science in Biomedical Engineering (MSc BMED) program encompasses the following main characteristics:

- Advanced Biomedical Engineering
- Clinical and Molecular Diagnostic and Therapeutic Systems
- Healthcare Innovation, Leadership and Management
- Specialized professional courses, such as Biosensors: Fundamentals and Applications, Advanced Biosignal Processing, Advanced Rehabilitation Engineering, Deep Learning for Biomedical and Health Informatics, as well as the important Healthcare Leadership, Innovation and Management courses.

The degree caters to recent graduates who would like to pursue a Master's qualification before going to industry, enrolling in a professional program, such as medicine, or continuing their graduate studies at the PhD level. The program also targets practicing engineers under full-time employment who wish to advance their knowledge base and enhance their career progression prospects.

Program Educational Objectives

The objectives of the MSc in Biomedical Engineering program are to produce graduates who:

1. Are able to apply their training on the interface of engineering, medicine and science in an ethical, creative, and innovative manner to solve problems related to health and healthcare that are locally and globally relevant.
2. Are recognized as leaders in their respective careers in biomedical engineering in industry, hospitals and clinical practice, government, and academia.
3. Engage in life-long learning by continuing their education in graduate or professional schools or through career development and professional training.

Learning Outcomes

MSc in Biomedical Engineering graduates will be able to:

1. Identify, formulate, and solve advanced biomedical engineering and science problems and apply current engineering and science tools and techniques.
2. Conduct interdisciplinary research; design and conduct experiments, manage, analyze, interpret data and disseminate research results.
3. Function in team environments and communicate effectively with engineering, medical and science stakeholders and communities.
4. Acquire knowledge of contemporary issues in the fields of biomedical engineering, science and medicine and develop an aptitude for innovation and

entrepreneurship.

5. Understand and apply professional and ethical standards in local and global frameworks.

Program Structure and Requirements

Overall Program Structure

The MSc BMED program consists of a minimum 30 credit hours, distributed as follows: 12 credit hours of Program Core courses, 9 credit hours of Program Elective courses, 9 credit hours of Master's Thesis and a zero credit Research Methods course. The components of the program are summarized in the table below.

Program Component	Credit Hours
Seminar in Research Methods	0
Program Core	12
Program Electives	9
Master's Thesis	9
Total	**30**

Program Requirements

Students seeking the degree of MSc in Biomedical Engineering must successfully complete a minimum 30 credit hours as specified in the program requirements detailed below, with a minimum CGPA of 3.0. Course selection should be made in consultation with the student's Main Advisor. All courses have a credit rating of three credits each, except the Seminar in Research Methods and the Master's Thesis.

Program Core (12 credit hours)

Students must complete the core courses listed below.

Core Courses

ENGR 695	Seminar in Research Methods	0
BMED 600	Physiological Systems	3
BMED 601	Experimental Biochemistry	3
BMED 602	Innovation and Creativity in Technology Organizations	3
BMED 603	Multivariate Statistics and Data Analysis	3

Program Electives (9 credit hours)

Students must select any three elective courses from the list below. Subject to Main Advisor approval, up to two elective courses (6 credit hours) can be taken from other MSc programs in the College of Engineering at KU.

Program Elective Courses

BMED 611	Clinical Pathology	3
BMED 612	Molecular Genetics & Genome Technologies	3
BMED 620	Cognitive and Computational Neuroscience	3
BMED 621	Applied Neuroscience and Engineering	3
BMED 630	Deep Learning for Biomedical and Health Informatics	3
BMED 631	Advanced Biosignal Processing	3
BMED 632	Physiological Control Systems	3
BMED 633	Advanced Rehabilitation Engineering	3
BMED 634	Algorithms in Bioinformatics	3
BMED 635	Healthcare Information Systems	3
BMED 640	Biomaterials for Drug Delivery	3
BMED 641	Biosensors: Fundamentals and A	3
BMED 694	Selected Topics in Biomedical Engineering	3
ENGR 602	Engineering Numerical Methods	3

Master's Thesis (minimum 9 credit hours)

Students must complete a Master's Thesis that involves creative, research-oriented work within the broad field of biomedical engineering, under the direct supervision of a full-time faculty advisor from the Biomedical Engineering Department, and at least one other full-time faculty who acts as a co-advisor. The outcome of research should demonstrate the synthesis of information into knowledge in a form that may be used by others. The research findings must be documented in a formal thesis and defended successfully in a viva voce examination. Furthermore, the research should lead to publishable quality scholarly articles.

Thesis

BMED 699	Master's Thesis	9

Study Plan

Students must consult with their respective advisors on the courses that they will enroll in, the required pre-requisites, and the thesis topic selection. Full-time graduate students must register for 9 to 12 credits, including thesis credits, during a regular semester (Fall and Spring) and a maximum of 6 credits during a Summer term. In the case of part-time students, the credit load is normally 6 credits during a regular semester as well as the summer term.

Students can only register for thesis credits after successfully completing a minimum of 9 credits of the core courses of the master's program they are enrolled in. It is to be noted that the minimum pass grade for graduate courses is a "C" letter grade. Students should consult the Graduate Catalog to learn about the graduate programs, the grading system, graduation requirements, and other pertinent matters.

A typical study plan for students enrolled in the MSc BMED is shown below.

Typical Study Plan for Full-Time Students

Semester 1	**(Fall)**	• Seminar in Research Methods • Program Core Course 1 • Program Core Course 2 • Program Core Course 3 • Program Core Course 4
Semester 2	**(Spring)**	• Elective Course 1 • Elective Course 2 • Elective Course 3 • Master's Thesis
Semester 3	**(Summer)**	• Master's Thesis

Typical Study Plan for Part-Time Students

	Semester 1	**Semester 2**
Year 1	•Seminar in Research Methods•Program Core Course 1 •Program Core Course 2	• Elective Course 1• Elective Course 2
Year 2	•Program Core Course 3•Program Core Course 4	•Elective Course 3•Master's Thesis
Year 3	•Master's Thesis	

MSc in Chemical Engineering

About the Program

The Master of Science in Chemical Engineering (MSc CHEG) is an exciting research-led program, with a wide range of courses and a significant research component that provides an in-depth grounding in the various aspects of the broad field of chemical engineering. The program is delivered by experienced international faculty who are actively engaged in cutting-edge research. The MSc CHEG provides excellent training for those aiming to pursue a career in industry and academia as well as research and development. Moreover, within the MSc CHEG program, two concentrations are optionally introduced. They are, Food Process Engineering and Technology (FPET) concentration, as well as Metallurgical Engineering (METE) concentration.

Program Educational Objectives

The objectives of the MSc in Chemical Engineering program are to produce graduates who:

1. Advance professionally and are recognized as leaders in their chosen fields.
2. Apply their technical expertise to address the needs of society in critical, creative, ethical, and innovative manner.
3. Further develop their knowledge and skills through graduate education and professional schools.

Learning Outcomes

MSc in Chemical Engineering graduates will be able to:

1. Demonstrate advanced knowledge of sciences (mathematics, physics, chemistry) and engineering.
2. Understand and carry out safe and economic design of chemical engineering processes and systems fulfilling environmental and societal constraints.
3. Design and conduct theoretical and/or experimental work, as well as analyze and interpret data.
4. Identify, formulate, analyze and solve chemical engineering problems by applying knowledge of

chemical engineering concepts.

5. Use computational and process simulation tools necessary for chemical engineering practice.
6. Communicate effectively and professionally in English (both oral and in writing).
7. Function autonomously and take responsibility for managing professional practices, work, processes or systems. Demonstrate an awareness and understanding of contemporary environmental and social issues in the regional and global context.
8. Inculcate a passion for life-long learning and self-education; learn from experiences gained in different contexts and apply new knowledge and skills into practice; demonstrate professional integrity and ethical responsibility.
9. Take responsibility and act to formulate creative solutions to complex problems.

Program Structure and Requirements

Overall Program Structure

The MSc CHEG consists of a minimum 30 credit hours, distributed as follows: 12 credit hours of Program Core courses, 9 credit hours of Program Elective courses, 9 credit hours of Master's Thesis and a zero credit Research Methods course. Students may organize the selection of elective courses relevant to the Master's Thesis topic with the consent of the Main Advisor. The components of the program are summarized in the table below.

Program Component	Credit Hours
Seminar in Research Methods	0
Program Core	12
Program Electives	9
Master's Thesis	9
Total	**30**

Program Requirements

Students seeking the degree of MSc in Chemical Engineering must successfully complete a minimum 30 credit hours as specified in the program requirements detailed below, with a minimum CGPA of 3.0. Course selection should be made in consultation with the student's Main Advisor. All courses have a credit rating of three credits each, except the Seminar in Research Methods and the Master's Thesis.

Program Core (12 credit hours)

Students must complete the core courses listed below.

Core Courses

ENGR 695	Seminar in Research Methods	0
CHEG 610	Advanced Chemical Reaction Engineering	3
CHEG 620	Mathematical Methods in Chemical Engineering	3
CHEG 630	Advanced Chemical Engineering Thermodynamics	3
CHEG 640	Transport Phenomena	3

Program Electives and Concentrations (9 credit hours)

Students must select three courses from the list below. Subject to approval of the Main Advisor, students can also select up to two elective courses (6 credit hours) from other MSc programs in the College of Engineering at KU.

Program Elective Courses

CHEG 604	Desalination	3
CHEG 606	Wastewater Treatment Engineering	3
CHEG 611	Polymer Reaction Engineering	3
CHEG 621	Numerical Methods in Chemical Engineering	3
CHEG 622	Process Simulation and Optimization	3
CHEG 623	Systems Engineering	3
CHEG 631	Statistical Thermodynamics	3
CHEG 641	Multiphase Flow	3
CHEG 642	Separation Processes	3
CHEG 643	Colloids and Interfacial Science	3
CHEG 644	Consequence analysis of chemical releases	3
CHEG 651	Combustion and Air Pollution Control	3
CHEG 652	Advanced Process Control	3
CHEG 653	Sustainable Energy Conversion Processes	3
CHEG 654	Chemical Process Safety	3
CHEG 655	Air Quality Management	3
CHEG 656	Experimental Design	3
CHEG 657	Materials Engineering and Corrosion	3
CHEG 658	Polymer Properties and Processing	3
CHEG 659	Engineering Design for Process Safety	3
CHEG 694	Selected Topics in Chemical Engineering	3

Concentration in Food Process Engineering and Technology (FPET)

The MSc CHEG program offers an optional concentration in Food Process Engineering and Technology. Students choosing this concentration are expected to attain the following concentration specific learning outcomes:

1. Apply the knowledge of food science and engineering in the processing, preservation, and packaging of nutritious and high-quality food products while meeting food safety standards and regulations.

2. Demonstrate an understanding of the advanced and emerging technologies for food processing operations, quality control, and farming along with their impact on the environment.

In addition to program specific core courses, students who opt for the concentration in Food Process Engineering and Technology must complete a minimum of three courses (9 credit hours) from the list below and a thesis within the domain of the concentration. The concentration will be specified on the student's official transcript.

Concentration Courses

CHEG 660	Food Engineering and Science	3
CHEG 661	Food Preservation and Packaging	3
CHEG 662	Food Safety and Legislation	3
CHEG 663	Food Systems Engineering	3
CHEG 664	Enzymes in Food Engineering	3
CHEG 665	Farming Technologies for Arid Climate	3

Concentration in Metallurgy Engineering (METE)

The MSc CHEG program offers an optional concentration in Metallurgy Engineering. Students choosing this concentration are expected to attain the following concentration specific learning outcomes:

1. Assess the application of the principles involved in mineral processing and chemical extraction of metals.

2. Assess the application of the principles that support microstructure, properties, behavior of metals and alloys to design and produce advanced metals and alloys.

3. Demonstrate an ability to describe and apply international best practice standards in minerals engineering, metallurgical methods and technologies.

In addition to program specific core courses, students who opt for the concentration in Metallurgy Engineering must complete a minimum of three courses (9 credit hours) from the list below and a thesis within the domain of the concentration. The concentration will be specified on the student's official transcript. *(CHEG 670: Indicates required courses for the concentration).*

Concentration Courses

CHEG 670	Advanced Extractive Metallurgy	3
CHEG 671	Advanced Physical Metallurgy	3
CHEG 672	Materials Characterization	3
CHEG 673	Phase Transformations in Metals	3
CHEG 657	Materials Engineering and Corrosion	3

Master's Thesis (minimum 9 credit hours)

Students must complete a Master's Thesis that involves creative, research-oriented work within the broad field of chemical engineering, under the direct supervision of a full-time faculty advisor from the Chemical and Petroleum Engineering Department, and at least one other full-time faculty who acts as a co-advisor. The outcome of research should demonstrate the synthesis of information into knowledge in a form that may be used by others. The research findings must be documented in a formal thesis and defended successfully in a viva voce examination. Furthermore, the research should lead to publishable quality scholarly articles.

Thesis

CHEG 699	Master's Thesis	9

Study Plan

Students must consult with their respective advisors on the courses that they will enroll in, the required pre-requisites, and the thesis topic selection. Full-time graduate students must register for 9 to 12 credits, including thesis credits, during a regular semester (Fall and Spring) and a maximum of 6 credits during a Summer term. In the case of part-time students, the credit load is normally 6 credits during a regular semester as well as the summer term.

Students can only register for thesis credits after successfully completing a minimum of 9 credits of the core courses of the master's program they are enrolled in. It is to be noted that the minimum pass grade for graduate courses is a "C" letter grade. Students should consult the Graduate Catalog to learn about the graduate programs, the grading system, graduation requirements, and other pertinent matters.

A typical study plan for students enrolled in the MSc CHEG is shown below.

Typical Study Plan for Full-Time Students

Semester 1 (Fall)	• Seminar in Research Methods• Program Core Course 1 • Program Core Course 2 • Program Core Course 3 • Program Core Course 4
Semester 2 (Spring)	• Elective Course 1• Elective Course 2 • Elective Course 3 • Master's Thesis
Semester 3(Summer)	• Master's Thesis

Typical Study Plan for Part-Time Students

	Semester 1	Semester 2
Year 1	• Seminar in Research Methods• Program Core Course 1 • Program Core Course 2	• Elective Course 1• Elective Course 2
Year 2	• Program Core Course 3• Program Core Course 4	• Elective Course 3• Master's Thesis
Year 3	• Master's Thesis	

A typical study plan for students enrolled in the MSc CHEG with Food Process Engineering and Technology (FPET) concentration or Metallurgy Engineering (METE) concentration is as follows.

Typical Study Plan for Full-Time Students

Semester 1 (Fall)	• Seminar in Research Methods• Program Core Course 1 • Program Core Course 2 • Program Core Course 3 • Program Core Course 4
Semester 2(Spring)	• Concentration Elective Course 1• Concentration Elective Course 2 • Concentration Elective Course 3 • Master's Thesis
Semester 3(Summer)	• Master's Thesis

Typical Study Plan for Part-Time Students

	Semester 1	Semester 2
Year 1	• Seminar in Research Methods• Program Core Course 1 • Program Core Course 2	• Concentration Elective Course 1• Concentration Elective Course 2
Year 2	• Program Core Course 3• Program Core Course 4	• Concentration Elective Course 3• Master's Thesis
Year 3	• Master's Thesis	

MSc in Civil and Infrastructural Engineering

About the Program

The Master of Science in Civil and Infrastructural Engineering (MSc CIVE) is an exciting research-led program, with a wide range of courses and a significant research component that provides an in-depth grounding in the various aspects of the broad field of civil engineering. The program is delivered by experienced international faculty and candidates for this degree are expected to demonstrate initiative and innovation in their work.

Program Educational Objectives

The objectives of the MSc in Civil and Infrastructural Engineering program are to produce graduates who:

1. Are able to apply their training on the interface of engineering and science in an ethical, creative and innovative manner to solve problems related to civil and infrastructural engineering that are locally and globally relevant.
2. Are recognized as leaders in their respective careers in civil and infrastructural engineering in industry, government and academia.
3. Engage in life-long learning by continuing their education by enrolling in PhD programs or through career development and professional training.

Learning Outcomes

MSc in Civil and Infrastructural Engineering graduates will be able to:

1. Identify, formulate, and solve advanced civil and infrastructural engineering problems and apply current engineering and science tools and techniques.
2. Conduct interdisciplinary research and design, conduct experiments, manage, analyze, interpret data and disseminate research results.
3. Function in team environments and communicate effectively with engineering and science stakeholders and communities.
4. Acquire knowledge of contemporary issues in the fields of civil and infrastructural engineering.
5. Understand and apply professional and ethical standards in local and global frameworks.

Program Structure and Requirements

Overall Program Structure

The MSc CIVE consists of a minimum 30 credit hours, distributed as follows: 12 credit hours of Program Core courses, 9 credit hours of Program Elective courses, 9 credit hours of Master's Thesis and a zero credit Research Methods course. Students may organize the selection of elective courses relevant to the Master's Thesis topic with the consent of the Main Advisor. The components of the program are summarized in the table below.

Program Component	**Credit Hours**
Seminar in Research Methods	0
Program Core	12
Program Electives	9
Master's Thesis	9
Total	**30**

Program Requirements

Students seeking the degree of MSc in Civil and Infrastructural Engineering must successfully complete a minimum 30 credit hours as specified in the program requirements detailed below, with a minimum CGPA of 3.0. Course selection should be made in consultation with the student's Main Advisor. All courses have a credit rating of three credits each, except the Seminar in Research Methods and the Master's Thesis.

Program Core (12 credit hours)

Students must complete the core courses listed below.

Core Courses

ENGR 695	Seminar in Research Methods	0
CIVE 630	Tensors Algebra & Applications	3
CIVE 631	Dynamic Response of Civil Engineering Constructions	3
CIVE 632	Highrise Building Design	3
CIVE 650	Construction Cost Estimating	3

Program Electives (9 credit hours)

Students must select three courses from the list below. Subject to approval of the Main Advisor, students can also select up to two elective courses (6 credit hours) from other MSc programs in the College of Engineering at KU.

Program Elective Courses

CIVE 634	Design of Civil Engineering Structures for Fire Protection	3
CIVE 635	Railway Geotechnics	3
CIVE 636	Wind Effects on Structures	3
CIVE 637	Pavement Monitoring & Rehabilitation	3
CIVE 638	Transportation Systems	3
CIVE 640	Soil Structure Interaction	3
CIVE 641	Coastal Engineering	3
CIVE 651	Sustainable Building Construction	3
CIVE 652	Construction Safety	3
CIVE 694	Selected Topics in Civil &	3

Infrastructural Engineering

Master's Thesis (minimum 9 credit hours)

Students must complete a Master's Thesis that involves creative, research-oriented work within the broad field of civil/infrastructural engineering, under the direct supervision of a full-time faculty advisor from the Civil Infrastructure and Environmental Engineering Department, and at least one other full-time faculty who acts as a co-advisor. The outcome of research should demonstrate the synthesis of information into knowledge in a form that may be used by others. The research findings must be documented in a formal thesis and defended successfully in a viva voce examination. Furthermore, the research should lead to publishable quality scholarly articles.

Thesis

CIVE 699	Master's Thesis	9

Study Plan

Students must consult with their respective advisors on the courses that they will enroll in, the required pre-requisites, and the thesis topic selection. Full-time graduate students must register for 9 to 12 credits, including thesis credits, during a regular semester (Fall and Spring) and a maximum of 6 credits during a Summer term. In the case of part-time students, the credit load is normally 6 credits during a regular semester as well as the summer term.

Students can only register for thesis credits after successfully completing a minimum of 9 credits of the core courses of the master's program they are enrolled in. It is to be noted that the minimum pass grade for graduate courses is a "C" letter grade. Students should consult the Graduate Catalog to learn about the graduate programs, the grading system, graduation requirements, and other pertinent matters.

A typical study plan for students enrolled in the MSc CIVE is shown below.

Typical Study Plan for Full-Time Students

Semester 1 (Fall)	• Seminar in Research Methods• Program Core Course 1 • Program Core Course 2 • Program Core Course 3 • Program Core Course 4
Semester 2 (Spring)	• Elective Course 1• Elective Course 2 • Elective Course 3 • Master's Thesis
Semester 3 (Summer)	• Master's Thesis

Typical Study Plan for Part-Time Students

	Semester 1	**Semester 2**
Year 1	• Seminar in Research Methods• Program Core Course 1 • Program Core Course 2	• Elective Course 1 • Elective Course 2
Year 2	• Program Core Course 3 • Program Core Course 4	• Elective Course 3• Master's Thesis
Year 3	• Master's Thesis	

MSc in Computational Data Science

About the Program

The Master of Science in Computational Data Science (MSc CODS) combines computer science algorithms and statistical techniques to analyze and understand the information hidden in big data, such as those generated by financial and health services, so as to optimize and grow the various economic sectors, devise strategies and enable leaders to make data-driven decisions. MSc CODS program equips graduates with the knowledge and skills to join data and technology intensive industries, including but not limited to investments and finance, telecommunications, national security, healthcare, energy, manufacturing, and utilities.

Program Educational Objectives

The educational objectives of the M.Sc. in Computational Data Science program are to produce graduates who will be able to:

1. Advance professionally and be recognized as leaders in their chosen areas within the broad field of computational data science.
2. Apply their technical expertise to address the critical needs of society in a creative, ethical, and innovative manner.
3. Further develop their knowledge and skills through graduate education or professional schools.

Learning Outcomes

Students graduating with the M.Sc. in Computational Data Science will be able to:

1. Identify, formulate, and solve computational data science problems through knowledge and understanding of advanced computing and mathematical concepts.
2. Critically evaluate emerging data analysis technologies and assess how they can be applied to different types and amounts of data.
3. Design and program complex computer software for various computational data science applications using state-of-the-art tools and techniques.
4. Conduct research and document and defend the research results.
5. Function in teams and communicate effectively.
6. Conduct themselves in a professional and ethical manner

Program Structure and Requirements

Overall Program Structure

The MSc CODS program consists of a minimum of 30 credit hours distributed as follows: 12 credit hours of Program Core courses, 9 credit hours of Program Elective courses, 9 credit hours of Master's Thesis and a zero credit Research Methods course. The components of the program are summarized in the table below.

Program Component	**Credit Hours**
Seminar in Research Methods	0
Program Core	12
Program Electives	9
Master's Thesis	9
Total	**30**

Program Requirements

Students seeking the degree of MSc in Computational Data Science must successfully complete a minimum 30 credit hours as specified in the program requirements detailed below, with a minimum CGPA of 3.0. Course selection should be made in consultation with the student's Main Advisor. All courses have a credit rating of three credits each, except the Seminar in Research Methods and the Master's Thesis.

Program Core (12 credit hours)

Students must complete the core courses listed below.

Core Courses

ENGR 695	Seminar in Research Methods	0
CODS 608	Distributed Sys and Cloud Comp	3
CODS 610	Model Estimation	3
CODS 620	Advanced Statistical Inference	3
CODS 622	Data Science with Machine Learning	3

Program Electives and Concentrations (9 credit hours)

Students must select three courses from the list below. Subject to approval of the Main Advisor and the Associate Dean for Graduate Studies, students can select one elective course (3 credit hours) from the MSc in Computer Science or the MSc in Electrical and Computer Engineering programs at KU.

Program Elective Courses

CODS 612	Computational Methods and Optimization in Finance	3
CODS 623	Health Data Science	3
CODS 624	Space-Time Data Science	3
CODS 626	Financial Derivatives and Risk Management	3
CODS 630	Advanced Computer Networks	3
CODS 631	Blockchain Fundamentals and Applications	3
CODS 634	Artificial Intelligence	3

CODS 635	Deep Learning Systems Design	3
CODS 636	Introduction to High Performance Computing	3
CODS 637	GPU Programming	3
CODS 640	Financial Cyber Security	3
CODS 641	Natural Language Proc. & Info. Retrieval	3
CODS 642	Database Systems Concepts and Design	3
CODS 643	Mobile and Pervasive Computing	3
CODS 644	Data Science for Business Applications	3
CODS 645	Financial Machine Learning	3
CODS 650	Data Processing and Visualization	3
CODS 694	Selected Topics in Computational Data Science	3

Concentration in Computational Systems

The MSc CODS program offers an optional concentration in Computational Systems. Students choosing this concentration are expected to attain the following concentration specific learning outcomes:

1. Demonstrate proficiency in analysis and design of major aspects of computational systems for data science applications.

In addition to program specific core courses, students who opt for the concentration in Computational Systems must complete a minimum of three courses (9 credit hours) from the list below and a thesis within the domain of the concentration. The concentration will be specified on the student's official transcript.

Concentration Courses

CODS 630	Advanced Computer Networks	3
CODS 631	Blockchain Fundamentals and Applications	3
CODS 635	Deep Learning Systems Design	3
CODS 636	Introduction to High Performance Computing	3
CODS 637	GPU Programming	3
CODS 642	Database Systems Concepts and Design	3
CODS 643	Mobile and Pervasive Computing	3

Concentration in Data Analytics

The MSc CODS program offers an optional concentration in Data Analytics. Students choosing this concentration are expected to attain the following concentration specific learning outcomes:

1. Apply advanced data analytic techniques to a range of application domains.

In addition to program specific core courses, students who opt for the concentration in Data Analytics must complete a minimum of three courses (9 credit hours) from the list below and a thesis within the domain of the concentration. The concentration will be specified on the student's official transcript.

Concentration Courses

CODS 623	Health Data Science	3
CODS 624	Space-Time Data Science	3
CODS 635	Deep Learning Systems Design	3
CODS 640	Financial Cyber Security	3
CODS 641	Natural Language Proc. & Info. Retrieval	3
CODS 644	Data Science for Business Applications	3
CODS 645	Financial Machine Learning	3
CODS 650	Data Processing and Visualization	3

Master's Thesis (minimum 9 credit hours)

Students must complete a Master's Thesis that involves creative, research-oriented work within the field of computational data science, under direct supervision of a faculty advisor from the Electrical Engineering and Computer Science Department or the Mathematics Department, and at least one other full-time faculty who acts as a co-advisor. The outcome of research should demonstrate the synthesis of information into knowledge in a form that may be used by others. The research findings must be documented in a formal thesis and defended successfully in a viva voce examination. Furthermore, the research should lead to publishable quality scholarly articles.

Thesis

CODS 699	Master's Thesis	9

Study Plan

Students must consult with their respective advisors on the courses that they will enroll in, the required pre-requisites, and the thesis topic selection. Full-time graduate students must register for 9 to 12 credits, including thesis credits, during a regular semester (Fall and Spring) and a maximum of 6 credits during a Summer term. In the case of part-time students, the credit load is normally 6 credits during a regular semester as well as the summer term.

Students can only register for thesis credits after successfully completing a minimum of 9 credits of the core courses of the master's program they are enrolled in. It is to be noted that the minimum pass grade for graduate courses is a "C" letter grade. Students should consult the Graduate Catalog to learn about the graduate programs, the grading system, graduation requirements, and other pertinent matters.

A typical study plan for students enrolled in the MSc CODS is shown below.

Typical Study Plan for Full-Time Students

Semester 1 (Fall)	• Seminar in Research Methods • Program Core Course 1 • Program Core Course 2 • Program Core Course 3 • Program Core Course 4
Semester 2	• Elective Course 1• Elective Course 2 • Elective Course 3 • Master's Thesis
Semester 3 (Summer)	• Master's Thesis

Typical Study Plan for Part-Time Students

	Semester 1	**Semester 2**
Year 1	• Seminar in Research Methods• Program Core Course 1 • Program Core Course 2	• Elective Course 1 • Elective Course 2
Year 2	• Program Core Course 3 • Program Core Course 4	• Elective Course 3• Master's Thesis
Year 3	• Master's Thesis	

MSc in Computer Science

About the Program

The Master of Science in Computer Science (MSc COSC) follows an in-depth, balanced approach to both fundamental and advanced aspects of Computer Science such as Algorithms, Software Engineering, Artificial Intelligence and Data Science. A wide variety of courses will offer opportunities to specialize on state-of-the-art competencies such as Data Mining, Machine Learning, Information Security and Bioinformatics.

Program Educational Objectives

The objectives of the MSc in Computer Science program are to produce graduates who:

1. Advance professionally and be recognized as leaders in their chosen fields.

2. Apply their technical expertise to address the needs of society in critical, creative, ethical, and innovative manner.

3. Further develop their knowledge and skills through graduate education and professional schools.

Learning Outcomes

MSc in Computer Science graduates will be able to:

1. Identify, formulate, and solve advanced computer and information systems problems through the application of modern tools as well as techniques and advanced knowledge of mathematics and science.

2. Acquire knowledge of contemporary issues in the field of computer science.

3. Design and conduct experiments, as well as analyze and interpret data and make decisions.

4. Conduct research and document and defend the research results.

5. Function on teams and communicate effectively.

6. Conduct themselves in a professional and ethical manner.

Program Structure and Requirements

Overall Program Structure

The MSc COSC program is equivalent to 30 credit hours, distributed as follows: 12 credit hours of Program Core courses, 9 credit hours of Program Elective courses and 9 credit hours of Master's Thesis. The components of the program are summarized in the table below.

Program Component	**Credit Hours**
Seminar in Research Methods	0
Program Core	12
Program Electives	9
Master's Thesis	9
Total	**30**

Program Requirements

Students seeking the degree of MSc in Computer Science must successfully complete 30 credit hours as specified in the program requirements detailed below, with a minimum CGPA of 3.0. Course selection should be made in consultation with the student's Main Advisor. All courses have a credit rating of three credits each, except the Seminar in Research Methods and the Master's Thesis.

Program Core (12 credit hours)

Students must complete the core courses listed below.

Core Courses

ENGR 695	Seminar in Research Methods	0

Select at least one Engineering Mathematics Core course from the list below:

ENGR 602	Engineering Numerical Methods	3
ENGR 605	Systems Optimization	3

Select at least three COSC Core courses from the list below:

COSC 602	Software Engineering	3
COSC 604	Artificial Intelligence	3
COSC 607	Algorithm Design Techniques	3
COSC 608	Distributed Systems and Cloud Computing	3
COSC 632	Advanced Operating Systems	3

Program Electives and Concentrations (9 credit hours)

Students must select three courses from the list below, or from any core courses listed above that are not used to meet the Program Core requirement. Subject to approval of the Main Advisor, students can select up to two elective courses (6 credit hours) from other MSc programs in the College of Engineering at KU.

Program Elective Courses

COSC 603	Multi-agent Systems	3
COSC 605	Strategic Requirements Engineering	3
COSC 606	Machine Learning	3
COSC 620	Algorithms in Bioinformatics	3
COSC 621	Data Science	3
COSC 631	Blockchain Fundamentals and Applications	3
COSC 635	Deep Learning System Design	3
COSC 636	Human Computer Interaction	3
COSC 637	Parallel Programming	3
COSC 638/CSEC 638	Artificial Intelligence Techniques for Cyber-Security	3
COSC 694	Selected Topics in Computer Science	3

Concentration in Artificial Intelligence

The MSc COSC program offers an optional concentration in Artificial Intelligence. In addition to program specific core courses, students who opt for the Artificial Intelligence concentration must complete a minimum of three courses (9 credit hours) from the list below and a thesis in the general domain of artificial intelligence. The concentration will be specified on the student's official transcript.

Concentration Courses

COSC 603	Multi-agent Systems	3
COSC 606	Machine Learning	3

COSC 621	Data Science	3
COSC 635	Deep Learning System Design	3
COSC 638/CSEC 638	Artificial Intelligence Techniques for Cyber-Security	3

Master's Thesis (minimum 9 credit hours)

Students must complete a Master's Thesis that involves creative, research-oriented work within the field of computing and information systems, under direct supervision of a faculty advisor from the Electrical Engineering and Computer Science Department, and at least one other full-time faculty who acts as a co-advisor. The outcome of research should demonstrate the synthesis of information into knowledge in a form that may be used by others. The research findings must be documented in a formal thesis and defended successfully in a viva voce examination. Furthermore, the research should lead to publishable quality scholarly articles.

Thesis

COSC 699	Master's Thesis	9

Study Plan

Students must consult with their respective advisors on the courses that they will enroll in, the required pre-requisites, and the thesis topic selection. Full-time graduate students must register for 9 to 12 credits, including thesis credits, during a regular semester (Fall and Spring) and a maximum of 6 credits during a Summer term. In the case of part-time students, the credit load is normally 6 credits during a regular semester as well as the summer term.

Students can only register for thesis credits after successfully completing a minimum of 9 credits of the core courses of the master's program they are enrolled in. It is to be noted that the minimum pass grade for graduate courses is a "C" letter grade. Students should consult the Graduate Catalog to learn about the graduate programs, the grading system, graduation requirements, and other pertinent matters.

A typical study plan for students enrolled in the MSc COSC is shown below.

Typical Study Plan for Full-Time Students

Semester 1 (Fall)	• Seminar in Research Methods • Program Core Course 1 • Program Core Course 2 • Program Core Course 3 • Program Core Course 4
Semester 2	• Elective Course 1• Elective Course 2 • Elective Course 3 • Master's Thesis
Semester 3 (Summer)	• Master's Thesis

Typical Study Plan for Part-Time Students

	Semester 1	**Semester 2**
Year 1	• Seminar in Research Methods• Program Core Course 1 • Program Core Course 2	• Elective Course 1 • Elective Course 2
Year 2	• Program Core Course 3 • Program Core Course 4	• Elective Course 3• Master's Thesis
Year 3	• Master's Thesis	

MSc in Cyber Security

About the Program

The Master of Science in Cyber Security (MSc CSEC) program targets students with diverse backgrounds, including graduates of Computer Science, Computer Engineering, Electronic Engineering, Communication Engineering, Information Technology, Mathematics, or other pertinent specializations. The program is designed to develop the student's ability to think critically and make informed decisions when it comes to infrastructure attacks on company's hardware and software. Students will be trained in how to assess the level of risk within an enterprise and to improve its security.

Program Educational Objectives

The objectives of the MSc in Cyber Security program are to produce graduates who:

1. Advance professionally and be recognized as leaders in their field.

2. Apply their technical expertise to address the needs of society in critical, creative, ethical, and innovative manner.

3. Further develop their knowledge and skills through graduate education and professional schools.

Learning Outcomes

MSc in Cyber Security graduates will be able to:

1. Identify, formulate, and solve advanced Cyber Security problems through the application of modern tools and techniques and advanced knowledge of mathematics and science.

2. Acquire, review and integrate knowledge of contemporary issues in the field of Cyber Security, developing autonomous judgements.

3. Design and conduct experiments, taking responsibility of interpreting results and making decisions based on them.

4. Conduct research projects, document the research methodology and defend the project outcome.

5. Manage individual activities and lead team work in Cyber Security professional context.

6. Consistently and sensibly manage ethical issues emerging in professional activities.

Program Structure and Requirements

Overall Program Structure

The MSc CSEC consists of a minimum 30 credit hours, distributed as follows: 12 credit hours of Program Core courses, 9 credit hours of Elective courses, 9 credit hours of Master's Thesis and a zero credit Research Methods course. The components of the program are summarized in the table below.

Program Component	**Credit Hours**
Seminar in Research Methods	0
Program Core	12
Program Electives	9
Master's Thesis	9
Total	**30**

Program Requirements

Students seeking the degree of MSc in Cyber Security must successfully complete a minimum 30 credit hours as specified in the program requirements detailed below, with a minimum CGPA of 3.0. Course selection should be made in consultation with the student's Main Advisor. All courses have a credit rating of three credits each, except the Seminar in Research Methods and the Master's Thesis.

Program Core (12 credit hours)

Students must complete the core courses listed below.

Core Courses

ENGR 695	Seminar in Research Methods	0
CSEC 601	Cyber Physical Systems Security	3
CSEC 602	Modern Cryptography	3
CSEC 603	Secure Software Systems Engineering	3
CSEC 604	Cyber-security Threats and Mitigation	3

Program Electives (9 credit hours)

Students must select three courses from the list below. Subject to approval of the Main Advisor, students can select up to two elective courses (6 credit hours) from other MSc programs in the College of Engineering at KU.

Program Elective Courses

CSEC 615	Cloud and Mobile Digital Forensics	3
CSEC 618	Wireless Network and Mobile Security	3
CSEC 620	Social Engineering and Human Hacking	3
CSEC 621	Hardware and System Architecture Security	3
CSEC 622	Penetration Testing	3
COSC 638/CSEC 638	Artificial Intelligence Techniques for Cyber-Security	3
CSEC 640	Financial Cyber Security	3

CSEC 694	Selected Topics in Cyber Security	3

Master’s Thesis (minimum 9 credit hours)

Students must complete a Master’s Thesis that involves creative, research-oriented work within the broad field of Cyber Security, under the direct supervision of a full-time faculty advisor from the Electrical Engineering and Computer Science Department, and at least one other full-time faculty who acts as a co-advisor. The outcome of research should demonstrate the synthesis of information into knowledge in a form that may be used by others. The research findings must be documented in a formal thesis and defended successfully in a viva voce examination. Furthermore, the research should lead to publishable quality scholarly articles.

Thesis

CSEC 699	Master's Thesis	9

Study Plan

Students must consult with their respective advisors on the courses that they will enroll in, the required pre-requisites, and the thesis topic selection. Full-time graduate students must register for 9 to 12 credits, including thesis credits, during a regular semester (Fall and Spring) and a maximum of 6 credits during a Summer term. In the case of part-time students, the credit load is normally 6 credits during a regular semester as well as the summer term.

Students can only register for thesis credits after successfully completing a minimum of 9 credits of the core courses of the master’s program they are enrolled in. It is to be noted that the minimum pass grade for graduate courses is a “C” letter grade. Students should consult the Graduate Catalog to learn about the graduate programs, the grading system, graduation requirements, and other pertinent matters.

A typical study plan for students enrolled in the MSc CSEC is shown below.

Typical Study Plan for Full-Time Students

Semester 1 (Fall)	• Seminar in Research Methods• Program Core Course 1 • Program Core Course 2 • Program Core Course 3 • Program Core Course 4
Semester 2	• Elective Course 1• Elective Course 2 • Elective Course 3 • Master’s Thesis
Semester 3 (Summer)	• Master’s Thesis

Typical Study Plan for Part-Time Students

	Semester 1	**Semester 2**
Year 1	• Seminar in Research Methods• Program Core Course 1 • Program Core Course 2	• Elective Course 1 • Elective Course 2
Year 2	• Program Core Course 3 • Program Core Course 4	• Elective Course 3• Master’s Thesis
Year 3	• Master’s Thesis	

MSc in Electrical and Computer Engineering

About the Program

The Master of Science in Electrical and Computer Engineering (MSc ECE) is an exciting research-led program, with a wide range of courses and a significant research component that provides an in-depth grounding in the various aspects of the broad field of electrical and computer engineering. The program is delivered by experienced international faculty who are actively engaged in cutting-edge research. The MSc ECE program provides excellent training for those aiming to pursue a career in industry and academia as well as research and development.

Program Educational Objectives

The objectives of the MSc in Electrical and Computer Engineering program are to produce graduates who:

1. Advance professionally and are recognized as leaders in their chosen fields.
2. Apply their technical expertise to address the needs of society in critical, creative, ethical, and innovative manner.
3. Further develop their knowledge and skills through graduate education and professional schools.

Learning Outcomes

MSc in Electrical and Computer Engineering graduates will be able to:

1. Identify, formulate, and solve advanced electrical and computer engineering problems through the application of modern tools and techniques and advanced knowledge of mathematics and engineering science.
2. Acquire knowledge of contemporary issues in the field of electrical and computer engineering.
3. Design and conduct experiments, as well as analyze, interpret data, and make decisions.
4. Conduct research and document and defend the research results.
5. Function on teams and communicate effectively.
6. Conduct themselves in a professional and ethical manner.

Program Structure and Requirements

Overall Program Structure

The MSc ECE consists of a minimum 30 credit hours, distributed as follows: 12 credits of Program Core courses (including 3 credits of engineering mathematics courses), 9 credit hours of Program Elective courses, 9 credit hours of Master's Thesis. Students may organize the selection of elective courses and the thesis topic to follow a concentration. The concentration will be noted on the transcript and the diploma. The components of the program are summarized in the table below.

Program Component	**Credit Hours**
Seminar in Research Methods	0
Program Core	12
Program Electives	9
Master's Thesis	9
Total	**30**

Program Requirements

Students seeking the degree of MSc in Electrical and Computer Engineering must successfully complete a minimum 30 credit hours as specified in the program requirements detailed below, with a minimum CGPA of 3.0. Course selection should be made in consultation with the student's Main Advisor. All courses have a credit rating of three credits each, except the Seminar in Research Methods and the Master's Thesis.

Program Core (12 credit hours)

Students must complete the core courses listed below.

Core Courses

ENGR 695	Seminar in Research Methods	0

Select at least one Engineering Mathematics Core course from the list below:

ENGR 602	Engineering Numerical Methods	3
ENGR 605	Systems Optimization	3
ENGR 606	Advanced Engineering Mathematics	3

Select at least three ECCE Core courses from the list below:

ECCE 610	Digital Signal Processing	3
ECCE 620	Real-Time Embedded Systems	3
ECCE 623	Digital Systems Design with FPGA	3
ECCE 630	Advanced Computer Networks	3
ECCE 635	Deep Learning System Design	3
ECCE 650	Linear Systems	3
ECCE 660	Power System Analysis	3
ECCE 661	Power Electronics	3
ECCE 670	Micro/Nano Processing Technologies	3
ECCE 671	Fabrication of Nano Devices	3
ECCE 672	Integrated Microelectronic Devices	3

ECCE 671: If student has taken ECCE 495 Fabrication

course or equivalent.

Program Electives, Concentrations (9 credit hours)

Students must select any three elective courses from the list below, or from any core courses listed above that are not used to meet the Program Core requirement. Subject to approval of the Main Advisor, students can select up to two elective courses (6 credit hours) from other MSc programs in the College of Engineering at KU.

Program Elective Courses

COSC 604	Artificial Intelligence	3
COSC 606	Machine Learning	3
ECCE 612	Embedded Digital Signal and Image Processing	3
ECCE 621	Digital ASIC Design	3
ECCE 622	RF and Mixed-Signal Circuits Design	3
ECCE 625	Digital Integrated Circuits Design	3
ECCE 628	Computer Architecture	3
ECCE 629	Hardware Accelerators for Artificial Intelligence	3
ECCE 631	Blockchain Fundamentals & Applications	3
ECCE 632	Advanced Operating Systems	3
ECCE 633	Machine Vision and Image Understanding	3
ECCE 636	Human Computer Interaction	3
ECCE 637	Parallel Programming	3
ECCE 638/COSC 638/CSEC 638	Artificial Intelligence Techniques for Cyber-Security	3
ECCE 640	Communication Systems Design	3
ECCE 641	Wireless Communications Systems	3
ECCE 642	Broadband Communication Networks	3
ECCE 643	Radar Systems	3
ECCE 644	Radio Frequency Measurements	3
ECCE 645	Stochastic Processes, Detection, and Estimation	3
ECCE 652	Modeling and System Identification	3
ECCE 653	Advanced Digital Control Systems	3
ECCE 654	Adaptive Control	3
ECCE 655	Artificial Intelligence for Control Engineering	3
ECCE 656	Nonlinear Systems	3
ECCE 657	Sensors Systems	3
ECCE 658	Autonomous Robotic Systems	3
ECCE 659	Modeling and Control of Robotic Systems	3
ECCE 662	Electric Drives	3
ECCE 663	Distribution Systems Design and Operation	3
ECCE 664	Distributed Generation	3
ECCE 665	Electric Power Quality	3
ECCE 666	Power System Protection	3
ECCE 667	High Voltage Engineering	3
ECCE 668	Advanced Electric Machines	3
ECCE 669	Power System Operation	3
ECCE 670	Micro/Nano Processing Technologies	3
ECCE 671	Fabrication of Nano Devices	3
ECCE 672	Integrated Microelectronic Devices	3
ECCE 673	Secure Embedded System Design	3
ECCE 680	Fundamentals of Photonics	3
ECCE 681	Semiconductor Optoelectronic Devices	3
ECCE 694	Selected Topics in Electrical and Computer Engineering	3
ENGR 610	Risk, Reliability and Uncertainty in Engineering Systems	3

Master's Thesis (minimum 9 credit hours)

Students must complete a Master's Thesis that involves creative, research-oriented work within the broad field of ECE, under the direct supervision of a full-time faculty advisor from the Electrical Engineering and Computer Science Department, and at least one other full-time faculty who acts as a co-advisor. The outcome of research should demonstrate the synthesis of information into knowledge in a form that may be used by others. The research findings must be documented in a formal thesis and defended successfully in a viva voce examination. Furthermore, the research should lead to publishable quality scholarly articles.

Thesis

ECCE 699	Master's Thesis	9

Study Plan

Students must consult with their respective advisors on the courses that they will enroll in, the required pre-requisites, and the thesis topic selection. Full-time graduate students must register for 9 to 12 credits, including thesis credits, during a regular semester (Fall and Spring) and a maximum of 6 credits during a Summer term. In the case of part-time students, the credit load is normally 6 credits during a regular semester as well as the summer term.

Students can only register for thesis credits after successfully completing a minimum of 9 credits of the core courses of the master's program they are enrolled in. It is to be noted that the minimum pass grade for graduate courses is a "C" letter grade. Students should consult the Graduate Catalog to learn about the graduate programs, the grading system, graduation requirements, and other pertinent matters.

A typical study plan for students enrolled in the MSc ECE is shown below.

Typical Study Plan for Full-Time Students

Semester 1 (Fall)	• Seminar in Research Methods• Program Core Course 1 • Program Core Course 2 • Program Core Course 3 • Mathematics Core Course 1
Semester 2	• Elective Course 1• Elective Course 2 • Elective Course 3 • Master's Thesis
Semester 3 (Summer)	• Master's Thesis

Typical Study Plan for Part-Time Students

	Semester 1	Semester 2
Year 1	• Seminar in Research Methods• Program Core Course 1 • Program Core Course 2	• Elective Course 1 • Elective Course 2
Year 2	• Program Core Course 3• Mathematics Core Course 1	• Elective Course 3• Master's Thesis
Year 3	• Master's Thesis	

MSc in Engineering Systems and Management

About the Program

The Master of Science in Engineering Systems and Management (MSc ESM) is an interdisciplinary program that brings together experts in engineering, design, economics, management and policy to teach and undertake research into large-scale complex systems. The mission of the MSc ESM is to create corporate and government leaders that can effectively deal with global energy and sustainability challenges that involve large scale systems. MSc ESM graduates are trained in strategy, industrial operations, operations research, and systems thinking. As such, they will be ideally positioned to take leadership positions in the private or public sector and guide research and implementation of advanced technologies, and optimize the operations and design of complex systems.

Program Educational Objectives

The objectives of the MSc in Engineering and Systems Management program are to produce graduates who have an:

1. Ability to identify and respond to complex engineering systems problems (involving technical and socioeconomic components).

2. Ability to apply advanced systems analysis tools in a multi-disciplinary setting in order to bound, plan, analyze, design and implement solutions to engineering systems problems, while advancing

professionally and be recognized as leaders in their chosen fields.

3. Understanding of the complex interactions between the engineering system solutions and their implications on larger scale (regional, national, global) technological, economic, societal and environmental systems with a view on long-term sustainability.

4. Understanding of the value of technical and scientific scholarship, service to society, leadership and life-long learning required to further their career aspirations in support of the needs of the community.

Learning Outcomes

MSc in Engineering and Systems Management graduates will be able to:

1. Successfully apply appropriate combinations of advanced concepts of engineering, economics, system theory, management and policy to identify, formulate and address engineering systems problems, and acquire knowledge of contemporary issues in the field of engineering systems and management.

2. Successfully use advanced system analysis, operations research methodology, data management, and design tools (e.g. optimization, simulation, architecture, statistical analysis, surveys, applied principles and heuristics etc.) to design, develop, implement, integrate and improve systems and processes, and make educated objective decisions.

3. Understand and apply the relationships between the management tasks of planning, organization, leadership, control, and the human element in production, research, and service organizations along with an understanding of and dealing with the stochastic nature of organizational systems.

4. Assess the direct and indirect impact of engineering solutions on sustainable development (e.g., economic, environmental, and social factors) with a focus on engineering systems contemporary issues such as energy and health care delivery systems, while developing an aptitude for continuous improvement.

5. Use appropriate advanced methods to design, conduct and analyze experimental studies and manage data for engineering systems with a strong sociotechnical component.

6. Communicate effectively in written and oral form, both, individually and as a member of a multidisciplinary team, while conducting research, documenting and defending the research results.

Program Structure and Requirements

Overall Program Structure

The MSc ESM consists of a minimum 30 credit hours, distributed as follows: 12 credit hours of Program Core courses, 9 credit hours of Program Elective courses, 9 credit hours of Master's Thesis and a zero credit Research Methods course. Students may organize the selection of elective courses and the thesis topic to follow a concentration. The concentration will be noted on the transcript and the diploma. The components of the program are summarized in the table below.

Program Component	**Credit Hours**
Seminar in Research Methods	0
Program Core	12
Program Electives	9
Master's Thesis	9
Total	**30**

Program Requirements

Students seeking the degree of MSc in Engineering and Systems Management must successfully complete a minimum 30 credit hours as specified in the program requirements detailed below, with a minimum CGPA of 3.0. Course selection should be made in consultation with the student's Main Advisor. All courses have a credit rating of three credits each, except the Seminar in Research Methods and the Master's Thesis.

Program Core (12 credit hours)

Students must complete the core courses listed below.

Core Courses		
ENGR 695	Seminar in Research Methods	0
ESMA 603	Systems Optimization	3
ESMA 604	System Dynamics for Business Policy Or	3
ESMA 650	Cost Engineering	3
ESMA 605	System Project Management	3
ESMA 610	Business Analytics, Statistics for Engineering Systems	3

Program Electives, Concentrations (9 credit hours)

Students must select any three elective courses from the list below, or from any core courses listed above that are not used to meet the Program Core requirement. Subject to approval of the Main Advisor, students can select up to two elective courses (6 credit hours) from other MSc programs in the College of Engineering at KU.

Program Elective Courses

ESMA 601	System Architecture	3
ESMA 602	Product Design and Development	3
ESMA 607	Management and Entrepreneurship for Engineers	3
ESMA 608	Environmental Policy and Economics	3
ESMA 617	Innovation and Creativity in Technology Organizations	3
ESMA 618	Strategic Management of Technology and Innovation	3
ESMA 619	Advanced Quality Management System	3
ESMA 621	Production, Operations and Inventory Management	3
ESMA 623	Advanced Lean Manufacturing	3
ESMA 633	System Simulation: Modelling and Analysis	3
ESMA 641	Supply Chain, Logistics and Transportation Networks	3
ESMA 642	Global Supply Chain Management	3
ESMA 643	Warehousing and Distribution	3
ESMA 671	Healthcare Operations Management	3
ESMA 672	Lean Service Systems	3
ESMA 673	Healthcare Information Systems	3
ESMA 694	Selected Topics in Systems and Engineering Management	3

Concentration in Technology Management, Innovation and Entrepreneurship

The MSc ESM offers an optional concentration in Technology Management, Innovation and Entrepreneurship. This concentration allows students to conduct an in-depth study on managing the steps needed to translate new technologies into useful products and services. In addition to program specific core courses, students pursuing this concentration must successfully complete the courses listed below and a thesis in a field of research relevant to the general area of Technology Strategy, Management, Innovation and Entrepreneurship. The concentration will be specified on the student's diploma and official transcript.

Concentration Courses

ESMA 607	Management and Entrepreneurship for Engineers	3
ESMA 617	Innovation and Creativity in Technology Organizations	3
ESMA 618	Strategic Management of Technology and Innovation	3

Master's Thesis (minimum 9 credit hours)

Students must complete a Master's Thesis that involves creative, research-oriented work within the broad field of ESM, under the direct supervision of a full-time faculty advisor from the Industrial and Systems Engineering Department, and at least one other full-time faculty who acts as a co-advisor. The outcome of research should demonstrate the synthesis of information into knowledge in a form that may be used by others. The research findings must be documented in a formal thesis and defended successfully in a viva voce examination. Furthermore, the research should lead to publishable quality scholarly articles.

Thesis

ESMA 699	Master Thesis	9

Study Plan

Students must consult with their respective advisors on the courses that they will enroll in, the required pre-requisites, and the thesis topic selection. Full-time graduate students must register for 9 to 12 credits, including thesis credits, during a regular semester (Fall and Spring) and a maximum of 6 credits during a Summer term. In the case of part-time students, the credit load is normally 6 credits during a regular semester as well as the summer term.

Students can only register for thesis credits after successfully completing a minimum of 9 credits of the core courses of the master's program they are enrolled in. It is to be noted that the minimum pass grade for graduate courses is a "C" letter grade. Students should consult the Graduate Catalog to learn about the graduate programs, the grading system, graduation requirements, and other pertinent matters.

A typical study plan for students enrolled in the MSc ESM is shown below.

Typical Study Plan for Full-Time Students

Semester 1 (Fall)	• Seminar in Research Methods• Program Core Course 1 • Program Core Course 2 • Program Core Course 3 • Program Core Course 4
Semester 2 (Spring)	• Elective Course 1• Elective Course 2 • Elective Course 3 • Master's Thesis
Semester 3 (Summer)	• Master's Thesis

Typical Study Plan for Part-Time Students

	Semester 1	**Semester 2**
Year 1	• Seminar in Research Methods• Program Core Course 1 • Program Core Course 2	• Elective Course 1 • Elective Course 2
Year 2	• Program Core Course 3 • Program Core Course 4	• Elective Course 3• Master's Thesis
Year 3	• Master's Thesis	

MSc in Materials Science and Engineering

About the Program

The Master of Science in Materials Science and Engineering (MSc MSEN) is an exciting research-led program, with a wide range of courses and a significant research component that provides an in-depth grounding in the various aspects of the broad field of materials science engineering. The program is delivered by experienced international faculty who are actively engaged in cutting-edge research. The MSc MSEN program provides excellent training for those aiming to pursue a career in industry and academia as well as research and development.

Program Educational Objectives

The objectives of the MSc in Materials Science and Engineering program are to produce graduates who will:

1. Identify and address current and future needs in various aspects of materials and devices (both active and passive) for all sorts of applications towards a sustainable and improved human well-being.
2. Apply a multi-disciplinary approach to conceive, plan, design, and implement innovations and solutions to problems and challenges that involve materials and their properties and applications.
3. Determine the potential impact of materials-based technologies and innovations on the social, economic, environmental aspects.
4. Promote science-based engineering, technical scholarship, service to society, leadership, best practice, and life-long learning.

Learning Outcomes

MSc in Materials Science and Engineering graduates will be able to:

1. Apply advanced concepts of fundamental sciences and engineering to identify, formulate and solve complex materials and devices problems.
2. Design and develop materials, devices, systems, and processes to meet desired needs of society professionally and ethically.
3. Design and conduct experiments in the area of materials and/or devices, and analyze and interpret data.
4. Be continuously aware of contemporary issues and research opportunities/challenges in the field of materials engineering as related to energy and sustainability and engage in life-long learning in the field and in the fundamentals of other related disciplines.
5. Deploy advanced materials characterization techniques, skills, and modern scientific and engineering tools.
6. Communicate effectively in written and oral form,

both, individually and as a member of a multidisciplinary team.

Program Structure and Requirements

Overall Program Structure

The MSc MSEN consists of a minimum 30 credit hours, distributed as follows: 12 credit hours of Program Core courses, 9 credit hours of Elective courses, 9 credit hours of Master's Thesis and a zero credit Research Methods course. The components of the program are summarized in the table below.

Program Component	Credit Hours
Seminar in Research Methods	0
Program Core	12
Program Electives	9
Master's Thesis	9
Total	**30**

Program Requirements

Students seeking the degree of MSc in Materials Science and Engineering must successfully complete a minimum 30 credit hours as specified in the program requirements detailed below, with a minimum CGPA of 3.0. Course selection should be made in consultation with the student's Main Advisor. All courses have a credit rating of three credits each, except the Seminar in Research Methods and the Master's Thesis.

Program Core (12 credit hours)

Students must complete the core courses listed below.

Core Courses

ENGR 695	Seminar in Research Methods	0
MEEN 630	Advanced Engineering Mathematics	3
MSEN 607	Thermodynamics of Materials	3
MSEN 608	Kinetics of Materials	3
MSEN 623	Electrical, Optical and Magnetic Properties of Crystalline Materials	3

Program Electives and Concentrations (9 credit hours)

Students must select three courses from the list below. Subject to approval of the Main Advisor, students can select up to two elective courses (6 credit hours) from other MSc programs in the College of Engineering at KU.

Program Elective Courses

MSEN 605	Structure and Properties of Polymers	3
MSEN 606	Materials Processing and Manufacturing Technologies	3
MSEN 611	Photovoltaic Technologies: Materials, Devices and Systems	3
MSEN 612	Physics for Solid-State Application	3
MSEN 619	Crystallography and Diffraction	3
MSEN 621	Mechanical Properties of Materials	3
MSEN 622	Electrical, Optical and Magnetic Properties of Amorphous Materials	3
MSEN 624	Thermal Properties of Materials	3
MSEN 694	Selected Topics in Material Science and Engineering	3

Concentration in Space Systems and Technology

The program offers an optional concentration in Space Systems and Technology. Students choosing this concentration are expected to attain the following concentration specific learning outcomes:

1. Demonstrate proficiency in space systems analysis and design.
2. Acquire skills in advanced satellite development, assembly, integration and testing.

In addition to program specific core courses, students who opt for the concentration in Space Systems and Technology must complete a minimum of three courses (9 credit hours) from the list below and a thesis within the domain of the concentration. The concentration will be specified on the student's official transcript. *(AERO 650, AERO 651, and AERO 652: Indicates required courses for the concentration).*

Concentration Courses

AERO 650	Space Systems Engineering	3
AERO 651	Space Systems Design Project I	1
AERO 652	Space Systems Design Project II	2
AERO 653	Space Propulsion	3
AERO 654	Astrodynamics and Mission Analysis	3

Master's Thesis (minimum 9 credit hours)

Students must complete a Master's Thesis that involves creative, research-oriented work within the broad field of MSEN, under the direct supervision of a full-time faculty advisor from the Mechanical Engineering Department, and at least one other full-time faculty who acts as a co-advisor. The outcome of research should demonstrate the synthesis of information into knowledge in a form that may be used by others. The research findings must be documented in a formal thesis and defended successfully in a viva voce examination. Furthermore, the research should lead to publishable quality scholarly articles.

Thesis		
MSEN 699	Master's Thesis	9

Study Plan

Students must consult with their respective advisors on the courses that they will enroll in, the required pre-requisites, and the thesis topic selection. Full-time graduate students must register for 9 to 12 credits, including thesis credits, during a regular semester (Fall and Spring) and a maximum of 6 credits during a Summer term. In the case of part-time students, the credit load is normally 6 credits during a regular semester as well as the summer term.

Students can only register for thesis credits after successfully completing a minimum of 9 credits of the core courses of the master's program they are enrolled in. It is to be noted that the minimum pass grade for graduate courses is a "C" letter grade. Students should consult the Graduate Catalog to learn about the graduate programs, the grading system, graduation requirements, and other pertinent matters.

A typical study plan for students enrolled in the MSc MSEN is shown below.

Typical Study Plan for Full-Time Students

Semester 1 (Fall)	• Seminar in Research Methods • Program Core Course 1 • Program Core Course 2 • Program Core Course 3 • Program Core Course 4
Semester 2	• Elective Course 1• Elective Course 2 • Elective Course 3 • Master's Thesis
Semester 3 (Summer)	• Master's Thesis

Typical Study Plan for Part-Time Students

	Semester 1	**Semester 2**
Year 1	• Seminar in Research Methods• Program Core Course 1 • Program Core Course 2	• Elective Course 1 • Elective Course 2
Year 2	• Program Core Course 3 • Program Core Course 4	• Elective Course 3• Master's Thesis
Year 3	• Master's Thesis	

MSc in Mechanical Engineering

About the Program

The Master of Science in Mechanical Engineering (MSc MEEN) combines in-depth knowledge from core areas of mechanical engineering, including mechanics, thermodynamics, fluids, materials, manufacturing and controls. The integration of these core topics is essential for multidisciplinary threads, such as robotics, micro and nanotechnologies, production systems, and energy systems. Students will utilize modelling, computer simulation and advanced experimental techniques as tools to analyze and understand different phenomena and processes. Graduates of the MSc MEEN will have acquired the advanced level of knowledge needed to assume leading positions in industry and government, as well as continuing their studies to the Doctorate level.

Program Educational Objectives

The objectives of the MSc in Mechanical and Engineering program are to produce graduates who:

1. Advance professionally and be recognized as leaders in their chosen fields.
2. Apply their technical expertise to address the needs of society in critical, creative, ethical, and innovative manner.
3. Further develop their knowledge and skills through graduate education and professional schools.

Learning Outcomes

MSc in Mechanical Engineering graduates will be able to:

1. Identify, formulate, and solve advanced mechanical engineering problems through the application of modern tools and techniques and advanced knowledge of mathematics and engineering science.
2. Acquire knowledge of contemporary issues in the field of mechanical engineering.
3. Design and conduct experiments, as well as analyze, interpret data and make decisions.
4. Conduct research and document and defend the research results.
5. Function in teams and communicate effectively.
6. Conduct themselves in a professional and ethical manner.

Program Structure and Requirements

Overall Program Structure

The MSc MEEN consists of a minimum 30 credit hours, distributed as follows: 12 credit hours of Program Core courses, 9 credit hours of Elective courses, 9 credit hours of Master's Thesis and a zero credit Research Methods course. The components of the program are summarized in the table below.

Program Component	**Credit Hours**
Seminar in Research Methods	0
Program Core	12
Program Electives	9
Master's Thesis	9
Total	**30**

Program Requirements

Students seeking the degree of MSc in Mechanical Engineering must successfully complete a minimum 30 credit hours as specified in the program requirements detailed below, with a minimum CGPA of 3.0. Course selection should be made in consultation with the student's Main Advisor. All courses have a credit rating of three credits each, except the Seminar in Research Methods and the Master's Thesis.

Program Core (12 credit hours)

Students must complete the core courses listed below.

Core Courses

ENGR 695	Seminar in Research Methods	0
MEEN 630	Advanced Engineering Mathematics	3

Select at least three MEEN courses from the list below:

MEEN 601	Advanced Dynamics	3
MEEN 602	Advanced Vibrations	3
MEEN 603	Advanced Thermodynamics	3
MEEN 604	Advanced Fluid Mechanics	3
MEEN 605	Advanced Continuum Mechanics	3
MEEN 606	Advanced Mechanics of Solids and Materials	3
MEEN 607	Sustainable Energy	3

Program Electives, Concentrations (9 credit hours)

Students must select any three elective courses from the list below, or from any core courses listed above that are not used to meet the Program Core requirement. Subject to approval of the Main Advisor, up to two elective courses (6 credit hours) can be taken from other MSc programs in the College of Engineering at KU.

Program Elective Courses

MEEN 610	Applied Finite Element Analysis	3
MEEN 611	Combustion Theory and Applications	3
MEEN 612	Advanced Viscous Flow	3

	Analysis		
MEEN 613	Advanced Heat Transfer	3
MEEN 614	Advanced Energy Conversion	3
MEEN 615	Multiphase Flow Engineering	3
MEEN 616	Solar Thermal Analysis, Design and Testing	3
MEEN 617	Fuel Cell Systems	3
MEEN 618	Computational Fluid Dynamics and Fire Modeling	3
MEEN 619	Fire Dynamics Laboratory	3
MEEN 620	Measurements and Instrumentation	3
MEEN 621	Feedback Control	3
MEEN 622	Control System Theory and Design	3
MEEN 623	Introduction To Hydrodynamic Stability	3
MEEN 631	Fatigue and Fracture of Engineering Materials	3
MEEN 632	Micro/Nanotechnology and Applications	3
MEEN 633	Advanced Manufacturing Processes	3
MEEN 656	Nonlinear Systems	3
MEEN 659	Modeling and Control of Robotic Systems	3
MEEN 663	Theory and Design of Digital Control Systems	3
MEEN 681	Materials Selection in Mechanical Design	3
MEEN 694	Selected Topics in Mechanical Engineering	3

Concentration in Space Systems and Technology

The program offers an optional concentration in Space Systems and Technology. Students choosing this concentration are expected to attain the following concentration specific learning outcomes:

1. Demonstrate proficiency in space systems analysis and design.
2. Acquire skills in advanced satellite development, assembly, integration and testing.

In addition to program specific core courses, students who opt for the concentration in Space Systems and Technology must complete a minimum of three courses (9 credit hours) from the list below and a thesis within the domain of the concentration. The concentration will be specified on the student's official transcript. *(AERO 650, AERO 651, and AERO 652: Indicates required courses for the concentration).*

Concentration Courses

AERO 650	Space Systems Engineering	3
AERO 651	Space Systems Design Project I	1
AERO 652	Space Systems Design Project II	2
AERO 653	Space Propulsion	3
AERO 654	Astrodynamics and Mission Analysis	3

Master's Thesis (minimum 9 credit hours)

Students must complete a Master's Thesis that involves creative, research-oriented work within the broad field of mechanical engineering, under the direct supervision of a full-time faculty advisor from the Mechanical and Nuclear Engineering Department, and at least one other full-time faculty who acts as a co-advisor. The outcome of research should demonstrate the synthesis of information into knowledge in a form that may be used by others. The research findings must be documented in a formal thesis and defended successfully in a viva voce examination. Furthermore, the research should lead to publishable quality scholarly articles.

Thesis

MEEN 699	Master's Thesis	9

Study Plan

Students must consult with their respective advisors on the courses that they will enroll in, the required pre-requisites, and the thesis topic selection. Full-time graduate students must register for 9 to 12 credits, including thesis credits, during a regular semester (Fall and Spring) and a maximum of 6 credits during a Summer term. In the case of part-time students, the credit load is normally 6 credits during a regular semester as well as the summer term.

Students can only register for thesis credits after successfully completing a minimum of 9 credits of the core courses of the master's program they are enrolled in. It is to be noted that the minimum pass grade for graduate courses is a "C" letter grade. Students should consult the Graduate Catalog to learn about the graduate programs, the grading system, graduation requirements, and other pertinent matters.

A typical study plan for students enrolled in the MSc MEEN is shown below.

Typical Study Plan for Full-Time Students

Semester 1 (Fall)	• Seminar in Research Methods • Program Core Course 1 • Program Core Course 2 • Program Core Course 3 • Program Core Course 4
Semester 2	• Elective Course 1• Elective Course 2 • Elective Course 3 • Master's Thesis
Semester 3 (Summer)	• Master's Thesis

Typical Study Plan for Part-Time Students

	Semester 1	**Semester 2**
Year 1	• Seminar in Research Methods• Program Core Course 1 • Program Core Course 2	• Elective Course 1 • Elective Course 2
Year 2	• Program Core Course 3 • Program Core Course 4	• Elective Course 3• Master's Thesis
Year 3	• Master's Thesis	

MSc in Nuclear Engineering

About the Program

The Master of Science in Nuclear Engineering (MSc NUCE) was established to support the UAE's peaceful nuclear energy program. Education in Nuclear Engineering is of paramount importance for the safe construction, operation, maintenance and eventual decommissioning of nuclear reactors. The MSc NUCE targets students with various backgrounds, such as graduates of Mechanical, Nuclear or Electrical and Computer Engineering, Physics, Chemistry, Material Science, Mathematics or other pertinent specializations. The program starts with common core courses that cover essential nuclear engineering topics, followed by a selection of specialization tracks that prepare students for project/thesis work and broaden their expertise in specific areas of nuclear technology. Students will also have the opportunity to complete a field trip component, which consists of carrying out a series of nuclear reactor experiments to consolidate theory lessons given in class as well as visiting selected nuclear facilities to gain an overall appreciation of nuclear energy technology. By necessity, the field trips will be undertaken overseas until such time that nuclear laboratories and facilities are available in the UAE. Applicants with insufficient prior academic background may be conditionally admitted and assigned remedial undergraduate courses.

Program Educational Objectives

The objectives of the MSc in Nuclear Engineering program are to produce graduates who:

1. Advance professionally and be recognized as leaders in their chosen fields.
2. Apply their technical expertise to address the needs of society in critical, creative, ethical, and innovative manner.
3. Further develop their knowledge and skills through graduate education and professional schools.

Learning Outcomes

MSc in Nuclear Engineering graduates will be able to:

1. Identify, formulate, and solve advanced Nuclear Engineering problems through the application of modern tools and techniques and advanced knowledge of mathematics and engineering science.
2. Acquire knowledge of contemporary issues and demonstrate an advanced level of understanding in the field of Nuclear Engineering.
3. Design and conduct experiments, as well as analyze, interpret data and make decisions.
4. Conduct research in a chosen area of specialization, document and defend the research results.
5. Function on teams in design, analysis and/or safety

and communicate effectively, both orally and in writing.

6. Understand legal, professional, regulatory and ethical responsibilities.

Program Structure and Requirements

Overall Program Structure

The MSc NUCE consists of a minimum 30 credit hours, distributed as follows: 12 credit hours of Program Core courses, 9 credit hours of Elective courses, 9 credit hours of Master's Thesis and a zero credit Research Methods course. The components of the program are summarized in the table below:

Program Component	Credit Hours
Seminar in Research Methods	0
Program Core	12
Program Electives	9
Master's Thesis	9
Total	**30**

Program Requirements

Students seeking the degree of MSc in Nuclear Engineering must successfully complete a minimum 30 credit hours as specified in the program requirements detailed below, with a minimum CGPA of 3.0. Course selection should be made in consultation with the student's Main Advisor. All courses have a credit rating of three credits each, except the Seminar in Research Methods and the Master's Thesis.

Program Core (12 credit hours)

Students must complete the core courses listed below.

Core Courses

ENGR 695	Seminar in Research Methods	0
NUCE 601	Thermal Hydraulics in Nuclear Systems	3
NUCE 602	Nuclear materials, Structural Integrity and Chemistry	3
NUCE 603	Nuclear Reactor Theory	3
NUCE 606	Radiation Measurement and Applications	3

Program Electives (9 credit hours)

Students must select any three elective courses from the list below. Subject to approval of the Main Advisor, up to two elective courses (6 credit hours) can be taken from other MSc programs in the College of Engineering at KU.

Program Elective Courses

NUCE 611	Nuclear Systems Design and Analysis	3
NUCE 612	Nuclear Safety and Probabilistic Safety	3
NUCE 613	Nuclear Fuel Cycle and Safeguards	3
NUCE 614	Nuclear Nonproliferation and Security	3
NUCE 621	Nuclear Instrumentation and Control	3
NUCE 622	Thermal Hydraulics Computations & Modelling	3
NUCE 623	Radiological Environmental Impact Assessment	3
NUCE 624	Radiation Damage and Nuclear Fuels	3
NUCE 625	Advanced Core Physics for Light Water Reactors	3

Master's Thesis (minimum 9 credit hours)

Students must complete a Master's Thesis that involves creative, research-oriented work within the broad field of nuclear engineering, under the direct supervision of a full-time faculty advisor from the Mechanical and Nuclear Engineering Department, and at least one other full-time faculty who acts as a co-advisor. The outcome of research should demonstrate the synthesis of information into knowledge in a form that may be used by others. The research findings must be documented in a formal thesis and defended successfully in a viva voce examination. Furthermore, the research should lead to publishable quality scholarly articles.

Thesis

NUCE 699	Master's Thesis	9

Study Plan

Students must consult with their respective advisors on the courses that they will enroll in, the required pre-requisites, and the thesis topic selection. Full-time graduate students must register for 9 to 12 credits, including thesis credits, during a regular semester (Fall and Spring) and a maximum of 6 credits during a Summer term. In the case of part-time students, the credit load is normally 6 credits during a regular semester as well as the summer term.

Students can only register for thesis credits after successfully completing a minimum of 9 credits of the core courses of the master's program they are enrolled in. It is to be noted that the minimum pass grade for graduate courses is a "C" letter grade. Students should consult the Graduate Catalog to learn about the graduate programs, the grading system, graduation requirements, and other pertinent matters.

A typical study plan for students enrolled in the MSc NUCE is shown below.

Typical Study Plan for Full-Time Students

Semester 1 (Fall)	• Seminar in Research Methods • Program Core Course 1 • Program Core Course 2 • Program Core Course 3 • Program Core Course 4
Semester 2	• Elective Course 1• Elective Course 2 • Elective Course 3 • Master's Thesis
Semester 3 (Summer)	• Master's Thesis

Typical Study Plan for Part-Time Students

	Semester 1	**Semester 2**
Year 1	• Seminar in Research Methods• Program Core Course 1 • Program Core Course 2	• Elective Course 1 • Elective Course 2
Year 2	• Program Core Course 3 • Program Core Course 4	• Elective Course 3• Master's Thesis
Year 3	• Master's Thesis	

MSc in Petroleum Engineering

About the Program

The Petroleum Engineering program seeks to become a leading international program in education, training, research and professional service dedicated to serving the competence, training and technology development needs of the petroleum industry. The Master of Science in Petroleum Engineering (MSc PEEG) is delivered by experienced international faculty who are actively engaged in cutting-edge research and provides excellent training for students aiming to pursue a career in industry and academia, as well as research and development.

Program Educational Objectives

The objectives of the MSc in Petroleum Engineering program are to:

1. Provide graduates with an outstanding education and the research skills and knowledge required to further their career aspirations.

2. Provide the regional and global oil and gas industry with a pool of highly educated personnel who can utilize their in-depth knowledge of petroleum engineering to better develop business opportunities.

3. Advance the technological profile of the UAE, and the regional and global oil and gas sector.

4. Address the needs of society in a critical, creative, ethical, and innovative manner.

Learning Outcomes

MSc in Petroleum Engineering graduates will be able to:

1. Demonstrate advanced knowledge of petroleum engineering concepts.
2. Apply advanced concepts of petroleum engineering science and mathematics to the formulation and solution of complex problems.
3. Use advanced techniques to design, simulate and conduct theoretical and experimental work.
4. Publish and present effectively research findings in international conferences and peer reviewed journals.
5. Demonstrate an awareness and understanding of contemporary issues related to fossil fuels and their role in the energy mix.
6. Participate in professional organizations and learn from experiences and engage in life-long learning.

Program Structure and Requirements

Overall Program Structure

The MSc PEEG consists of a minimum 30 credit hours, distributed as follows: 12 credit hours of Program Core courses, 9 credit hours of Elective courses, 9 credit hours of Master's Thesis and a zero credit Research Methods course. The components of the program are summarized in the table below.

Program Component	Credit Hours
Seminar in Research Methods	0
Program Core	12
Program Electives	9
Master's Thesis	9
Total	**30**

Program Requirements

Students seeking the degree of MSc in Petroleum Engineering must successfully complete a minimum 30 credit hours as specified in the program requirements detailed below, with a minimum CGPA of 3.0. Course selection should be made in consultation with the student's Main Advisor. All courses have a credit rating of three credits each, except the Seminar in Research Methods and the Master's Thesis.

Program Core (12 credit hours)

Students must complete the core courses listed below.

Core Courses

ENGR 695	Seminar in Research Methods	0
ENGR 602	Engineering Numerical Methods	3

Select at least three PEEG courses from the list below:

PEEG 610	Advanced Well Test Analysis	3
PEEG 620	Advanced Drilling Engineering	3
PEEG 630	Advanced Reservoir Engineering	3
PEEG 640	Well Performance Evaluation	3

Program Electives (9 credit hours)

Students must select three courses from the list below, or from any core courses listed above that are not used to meet the Program Core requirement. Subject to Main Advisor approval, up to two elective courses (6 credit hours) can be taken from other MSc programs in the College of Engineering at KU.

Program Elective Courses

PEEG 621	Underbalanced Drilling	3
PEEG 623	Well Stimulation	3
PEEG 631	Petroleum Reservoir Simulation	3
PEEG 632	Enhanced Oil Recovery	3
PEEG 641	Well Completion and Workover	3
PEEG 650	Advanced Petroleum Economics	3
PEEG 694	Selected Topics in Petroleum Engineering	3

Master's Thesis (minimum 9 credit hours)

Students must complete a Master's Thesis that involves creative, research-oriented work within the broad field of petroleum engineering, under the direct supervision of a full-time faculty advisor from the Chemical and Petroleum Engineering Department, and at least one other full-time faculty who acts as a co-advisor. The outcome of research should demonstrate the synthesis of information into knowledge in a form that may be used by others. The research findings must be documented in a formal thesis and defended successfully in a viva voce examination. Furthermore, the research should lead to publishable quality scholarly articles.

Thesis

PEEG 699	Master's Thesis	9

Study Plan

Students must consult with their respective advisors on the courses that they will enroll in, the required pre-requisites, and the thesis topic selection. Full-time graduate students must register for 9 to 12 credits, including thesis credits, during a regular semester (Fall and Spring) and a maximum of 6 credits during a Summer term. In the case of part-time students, the credit load is normally 6 credits during a regular semester as well as the summer term.

Students can only register for thesis credits after successfully completing a minimum of 9 credits of the core courses of the master's program they are enrolled in. It is to be noted that the minimum pass grade for graduate courses is a "C" letter grade. Students should consult the Graduate Catalog to learn about the graduate programs, the grading system, graduation requirements, and other pertinent matters.

A typical study plan for students enrolled in the MSc PEEG is shown below.

Typical Study Plan for Full-Time Students

Semester 1 (Fall)	• Seminar in Research Methods • Program Core Course 1 • Program Core Course 2 • Program Core Course 3 • Program Core Course 4
Semester 2	• Elective Course 1• Elective Course 2 • Elective Course 3 • Master's Thesis
Semester 3 (Summer)	• Master's Thesis

Typical Study Plan for Part-Time Students

	Semester 1	**Semester 2**
Year 1	• Seminar in Research Methods• Program Core Course 1 • Program Core Course 2	• Elective Course 1 • Elective Course 2
Year 2	• Program Core Course 3 • Program Core Course 4	• Elective Course 3• Master's Thesis
Year 3	• Master's Thesis	

MSc in Sustainable Critical Infrastructure

About the Program

The Master of Science in Sustainable Critical Infrastructure (MSc SCIN) program will be conducive to developing highly skilled researchers and workforce and attracting substantial government and industry interest. The academic program is designed to develop core capabilities, through the integration of coursework and research that is critical to the region.

Urban development will continue globally while the requirements for reducing its ecological footprint and carbon emissions in particular will be increasingly more aggressive. The Sustainable Critical Infrastructure (SCIN) Program aims at advancing research and education in integrated sustainable infrastructure development. The program is addressed to architects, urban planners and civil engineers, as well as engineers and building scientists interested in infrastructure planning.

The need for urban critical infrastructure development and maintenance will remain acute; as urbanization will be a continuing process, well into the middle of the century to accommodate the growing global population and migration waves. Infrastructures can be defined as "network[s] of independent man-made systems and processes that function collaboratively and synergistically to produce and distribute a continuous flow of essential goods and services." Typical critical infrastructure systems include:

- Transportation networks
- Logistics systems (including waste processing and reverse logistics),
- Buildings and urban components
- Energy generation and distribution systems
- Water supply and wastewater treatments systems,
- Information and communication technology (ICT) systems etc.

The efficiency and reliability of urban critical infrastructure affect many aspects of society that include the cost of food and consumer goods, health and safety of citizens, availability and reliability of power systems, reliability and speed of telecommunications, travel times. Critical infrastructures also affect the environment and natural resources.

Program Educational Objectives

The objectives of the MSc in Sustainable Critical Infrastructure program are to produce graduates who possess an:

1. Ability to design integrated urban infrastructure systems for new or existing developments with careful examination of environmental, social and financial requirements.
2. Ability to apply planning and design tools using multi-disciplinary inputs in order effectively generate and implement solutions to urban infrastructure problems.
3. Understanding of the complex interactions between infrastructure systems solutions and their implications on larger scale (regional, national, global) technological, economic, societal and environmental systems with a view on long-term sustainability.
4. Understanding of the value of technical and scientific scholarship, service to society, leadership and life-long learning required to further their career aspirations in support of the needs of the community.

Learning Outcomes

MSc in Sustainable Critical Infrastructure graduates will be able to:

1. Successfully apply advanced concepts of planning and engineering to identify, formulate and solve complex infrastructure planning problems, particularly as they pertain to sustainable urban infrastructure planning.
2. Successfully apply advanced concepts of infrastructure planning to the analysis, design and development of infrastructure projects, urban design, and transportation systems to meet societal needs.
3. Use advanced techniques, skills, and modern scientific and engineering software tools for planning professional practice.
4. Successfully develop integrated infrastructure plans that account for long term resource availability on one hand and the financial and social constraints on the other with a long-term sustainability objective.
5. Use an advanced approach to design and conduct surveys, and to analyze and interpret data.
6. Communicate effectively in written and oral form, both, individually and as a member of a multidisciplinary team, and thus to put forward the scientific findings at national and international levels successfully.

Program Structure and Requirements

Overall Program Structure

The MSc SCIN consists of a minimum 30 credit hours, distributed as follows: 12 credit hours of Program Core courses, 9 credit hours of Elective courses, 9 credit hours of Master’s Thesis and a zero credit Research Methods course. The components of the program are summarized in the table below.

Program Component	**Credit Hours**
Seminar in Research Methods	0
Program Core	12
Program Electives	9
Master’s Thesis	9
Total	**30**

Program Requirements

Students seeking the degree of MSc in Sustainable Critical Infrastructure must successfully complete a minimum 30 credit hours as specified in the program requirements detailed below, with a minimum CGPA of 3.0. Course selection should be made in consultation with the student’s Main Advisor. All courses have a credit rating of three credits each, except the Seminar in Research Methods and the Master's Thesis.

Program Core (12 credit hours)

Students must complete the core courses listed below.

Core Courses

ENGR 695	Seminar in Research Methods	0
ESMA 603	Systems Optimization Or	3
ESMA 610	Business Analytics, Statistics for Engineering Systems	3
SCIN 601	Transportation Systems Analysis: Demand and Economics	3
SCIN 602	Urban Design for Sustainability: Theory and Practice	3
SCIN 612	Sustainable Building Science: Fundamentals, Tools, and Applications	3

Program Electives (9 credit hours)

Students must select any three elective courses from the list below. Subject to Main Advisor approval, up to two elective courses (6 credit hours) can be taken from other MSc programs in the College of Engineering at KU.

Program Elective Courses

SCIN 603	Management of Infrastructure Systems	3
SCIN 604	Infrastructure Finance	3
SCIN 605	Planning Theory, Practice, and Ethics	3
SCIN 606	Geographic Information Systems	3
SCIN 607	Infrastructure and Development	3
SCIN 608	Urban Planning and Design Studio	3
SCIN 609	Comparative Land Use and Transportation Planning	3
SCIN 610	Public Transportation Systems	3
SCIN 611	Thermal Energy in Buildings	3
SCIN 612	Sustainable Building Science: Fundamentals, Tools, and Applications	3
SCIN 694	Selected Topics in Sustainable Critical Infrastructure	3

Master's Thesis (minimum 9 credit hours)

Students must complete a Master's Thesis that involves creative, research-oriented work within the broad field of sustainable critical infrastructure, under the direct supervision of a full-time faculty advisor from the Industrial and Systems Engineering Department, and at least one other full-time faculty who acts as a co-advisor. The outcome of research should demonstrate the synthesis of information into knowledge in a form that may be used by others. The research findings must be documented in a formal thesis and defended successfully in a viva voce examination. Furthermore, the research should lead to publishable quality scholarly articles.

Thesis

SCIN 699	Master's Thesis	9

Study Plan

Students must consult with their respective advisors on the courses that they will enroll in, the required pre-requisites, and the thesis topic selection. Full-time graduate students must register for 9 to 12 credits, including thesis credits, during a regular semester (Fall and Spring) and a maximum of 6 credits during a Summer term. In the case of part-time students, the credit load is normally 6 credits during a regular semester as well as the summer term.

Students can only register for thesis credits after successfully completing a minimum of 9 credits of the core courses of the master's program they are enrolled in. It is to be noted that the minimum pass grade for graduate courses is a "C" letter grade. Students should consult the Graduate Catalog to learn about the graduate programs, the grading system, graduation requirements, and other pertinent matters.

A typical study plan for students enrolled in the MSc SCIN is shown below.

Typical Study Plan for Full-Time Students

Semester 1 (Fall)	• Seminar in Research Methods • Program Core Course 1 • Program Core Course 2 • Program Core Course 3 • Program Core Course 4
Semester 2	• Elective Course 1• Elective Course 2 • Elective Course 3 • Master's Thesis
Semester 3 (Summer)	• Master's Thesis

Typical Study Plan for Part-Time Students

	Semester 1	**Semester 2**
Year 1	• Seminar in Research Methods• Program Core Course 1 • Program Core Course 2	• Elective Course 1 • Elective Course 2
Year 2	• Program Core Course 3 • Program Core Course 4	• Elective Course 3• Master's Thesis
Year 3	• Master's Thesis	

MSc in Water and Environmental Engineering

About the Program

The Master of Science in Water and Environmental Engineering (MSc WENV) aims to provide students with a comprehensive understanding of the challenges behind one of the foundations of sustainable development – ensuring sufficient and equitable access to clean water. Furthermore, the program gives students the opportunity to deepen their knowledge in one of two specialization tracks - *Water and Environmental Technologies* or *Water and Environmental Resources* - and contribute to the process of discovery and knowledge creation through the conduct of original research. Candidates for this degree are taught and supervised by experienced faculty and are expected to demonstrate initiative in their approach and innovation in their work.

Program Educational Objectives

The objectives of the MSc in Water and Environmental Engineering program are to produce graduates who will have an:

1. An ability to identify and address current and future societal problems related to water, waste, and the environment within a broader framework of sustainable development.
2. An ability to apply a multi-disciplinary approach to conceive, plan, design, and implement solutions to problems in the field of water and environmental engineering.
3. An understanding of the impact of solutions to water and environmental engineering problems in a global, economic, environmental, and societal systems context.
4. An understanding of the value of technical and scientific scholarship, service to society, leadership and lifelong learning required to further their career aspirations.

Learning Outcomes

MSc in Water and Environmental Engineering graduates will be able to:

1. Successfully apply advanced concepts of fundamental sciences and engineering to identify, formulate, and solve complex water and environmental engineering problems, and understand the impact of such solutions on sustainable development.
2. Successfully apply advanced concepts of water and environmental engineering and fundamental sciences to design, analyze, and develop technologies, processes or systems to meet desired needs of society, both, professionally and ethically.
3. Use an advanced and rigorous approach to the design and execution of experiments, and to the analysis and interpretation of experimental data.
4. Be knowledgeable of contemporary issues and research challenges/opportunities related to water and environmental engineering, and engage in lifelong learning to keep abreast of such issues.

5. Use advanced techniques, skills, and modern scientific and engineering tools for problems related to professional practice in the field of water and environmental engineering.

6. Communicate effectively and professionally in written and oral form, both, individually and as a member of a multidisciplinary team.

Program Structure and Requirements

Overall Program Structure

The MSc WENV consists of a minimum 30 credit hours, distributed as follows: 6 credit hours of Program Core courses, 15 credit hours of Elective courses, 9 credit hours of Master's Thesis and a zero credit Research Methods course. The components of the program are summarized in the table below.

Program Component	**Credit Hours**
Seminar in Research Methods	0
Program Core	6
Program Electives	15
Master's Thesis	9
Total	**30**

Program Requirements

Students seeking the degree of MSc in Water and Environmental Engineering must successfully complete a minimum 30 credit hours as specified in the program requirements detailed below, with a minimum CGPA of 3.0. Course selection should be made in consultation with the student's Main Advisor. All courses have a credit rating of three credits each, except the Seminar in Research Methods and the Master's Thesis.

Program Core (6 credit hours)

Students must complete the core courses listed below.

Core Courses

ENGR 695	Seminar in Research Methods	0
WENV 601	Chemicals in the Environment: Fate and Transport	3
WENV 622	Data Analysis for Environmental Modeling Or	3
CHEG 620	Mathematical Methods in Chemical Engineering	3

Program Electives (15 credit hours)

Students must select elective courses from the list below; Subject to approval of the Main Advisor, up to two elective courses (6 credit hours) can be taken from other MSc programs in the College of Engineering at KU.

Program Elective Courses

WENV 623	Global Climate Change: Impacts and Adaptation	3
WENV 694	Selected Topics in Water and Environmental Engineering	3
WENV 604	Desalination	3
WENV 606	Wastewater Treatment Engineering	3
WENV 602	Industrial Ecology	3
WENV 611	Hydrologic Analysis	3

Master's Thesis (minimum 9 credit hours)

Students must complete a Master's Thesis that involves creative, research-oriented work within the broad field of water and environmental engineering, under the direct supervision of a full-time faculty advisor from the Civil Infrastructure and Environmental Engineering Department or the Chemical and Petroleum Engineering Department, and at least one other full-time faculty who acts as a co-advisor. The outcome of research should demonstrate the synthesis of information into knowledge in a form that may be used by others. The research findings must be documented in a formal thesis and defended successfully in a viva voce examination. Furthermore, the research should lead to publishable quality scholarly articles.

Thesis

WENV 699	Master's Thesis	9

Study Plan

Students must consult with their respective advisors on the courses that they will enroll in, the required pre-requisites, and the thesis topic selection. Full-time graduate students must register for 9 to 12 credits, including thesis credits, during a regular semester (Fall and Spring) and a maximum of 6 credits during a Summer term. In the case of part-time students, the credit load is normally 6 credits during a regular semester as well as the summer term.

Students can only register for thesis credits after successfully completing a minimum of 9 credits of the core courses of the master's program they are enrolled in. It is to be noted that the minimum pass grade for graduate courses is a “C” letter grade. Students should consult the Graduate Catalog to learn about the graduate programs, the grading system, graduation requirements, and other pertinent matters.

A typical study plan for students enrolled in the MSc WENV is shown below.

Typical Study Plan for Full-Time Students

Semester 1 (Fall)	• Seminar in Research Methods • Program Core Course 1 • Program Core Course 2 • Track Core Course 1 • Track Core Course 2
Semester 2	• Elective Course 1• Elective Course 2 • Elective Course 3 • Master’s Thesis
Semester 3 (Summer)	• Master’s Thesis

Typical Study Plan for Part-Time Students

	Semester 1	**Semester 2**
Year 1	• Seminar in Research Methods • Program Core Course 1 • Program Core Course 2	• Elective Course 1• Elective Course 2
Year 2	• Track Core Course 1• Track Core Course 2	• Elective Course 3• Master’s Thesis
Year 3	• Master’s Thesis	

MEng in Health, Safety and Environmental Engineering

About the Program

The Master of Engineering in Health, Safety and Environmental Engineering (MEng HSEG) program is designed for educational preparation of two types of professionals:

- Engineering graduates who are currently working as engineers in industry and who intend to stay in that type of job, but who want to embed HSE in their engineering functions. These graduates will have diverse capabilities in the various aspects of HSE and will use this knowledge to manage risk as they devise optimal engineering and operational solutions within the constraints of regulatory mandates and best practices.
- Engineering graduates who wish to assume varying levels of HSE responsibilities in one or more aspects of a company’s HSE department/program. These graduates will have sufficient background to assume the role of a general HSE engineering practitioner/manager while possessing additional capabilities in any one of the offered HSE areas of concentrations.

Program Educational Objectives

The objectives of the MEng in Health, Safety and Environmental Engineering program are to produce graduates who:

1. Apply their scientific knowledge and engineering skills to develop innovative solutions to HSEG problems in occupational setting;
2. Advance professionally and are recognized as leaders in the HSEG field;
3. Communicate effectively regarding HSEG issues to management, employees and other stakeholders; and
4. Demonstrate knowledge of their ethical and professional responsibilities, as well as applicable standards and regulations.

Learning Outcomes

MEng in Health, Safety and Environmental Engineering graduates will have the ability to:

1. Anticipate, recognize, and evaluate hazardous conditions and work practices in business and industry;
2. Develop/implement engineering and administrative control strategies for identified hazardous conditions and work practices in business and industry;

3. Communicate effectively in written and oral forms at the level of professionals in HSEG positions;
4. Conduct themselves in a professional and ethical manner;
5. Function as members of teams working towards achieving solutions to defined problems; and
6. Demonstrate research skills relevant to the disciplines within HSEG.

Program Structure and Requirements

Overall Program Structure

The MEng in HSE Engineering program consists of a minimum 30 credit hours, distributed as follows: 12 credit hours of Program Core courses, 12 credits of program electives, 3 credits of free electives, 3 credits of HSEG graduate project (capstone course) and a zero credit Research Methods course. The components of the program are summarized in the table below.

Program Component	**Credit Hours**
Seminar in Research Methods	0
Program Core	12
Program Electives	12
Free Technical Elective	3
HSEG Graduate Project	3
Total	**30**

Program Requirements

Students seeking the degree of MEng in HSE Engineering must successfully complete a minimum of 30 credit hours as specified in the program requirements detailed below, with a minimum CGPA of 3.0. Course selection should be made in consultation with the student's Main Advisor. All courses have a credit rating of three credits each, except the Seminar in Research Methods.

Program Core (12 credit hours)

Students must complete the core courses listed below.

Core Courses

ENGR 695	Seminar in Research Methods	0
HSEG 601	Introduction to HSE Engineering	3
HSEG 602	Industrial Hygiene Engineering	3
HSEG 605	System Safety Engineering and Risk Management	3
HSEG 606	Fire Protection Engineering	3

Program Electives and Concentrations (12 credit hours)

Students must select any four elective courses from the list below, in consultation with their Main Advisor (NUCE courses are offered to UAE National and sponsored Saudi Arabia National students only):

Program Elective Courses

Fire Protection Engineering Concentration

Students wishing to complete an optional concentration in Fire Protection Engineering, must complete a minimum of four elective courses from the list below. The concentration will be noted on the student's official transcript, provided that the student fulfils the following requirements:

- Complete a minimum of four courses (12 credit hours) from the same concentration; and
- Complete a HSEG Graduate Project within the domain of the concentration.

Concentration Courses

MEEN 611	Combustion Theory and Applications	3
MEEN 613	Advanced Heat Transfer	3
MEEN 618	Computational Fluid Dynamics and Fire Modeling	3
MEEN 619	Fire Dynamics Laboratory	3

Process Safety Engineering Concentration

Students wishing to complete an optional concentration in Process Safety Engineering, must complete a minimum of four elective courses from the list below. The concentration will be noted on the student's official transcript, provided that the student fulfils the following requirements:

- Complete a minimum of four courses (12 credit hours) from the same concentration; and
- Complete a HSEG Graduate Project within the domain of the concentration.

Concentration Courses

CHEG 644	Consequence analysis of chemical releases	3
CHEG 655	Air Quality Management	3
CHEG 659	Engineering Design for Process Safety	3
CHEG 651	Combustion and Air Pollution Control	3

Radiation Protection Engineering Concentration

Students wishing to complete an optional concentration in Radiation Protection Engineering, must complete a minimum of four elective courses from the list below. The concentration will be noted on the student's official transcript, provided that the student fulfils the following requirements:

- Complete a minimum of four courses (12 credit hours) from the same concentration; and
- Complete a HSEG Graduate Project within the domain of the concentration.

Concentration Courses

NUCE 606	Radiation Measurement and Applications	3
NUCE 607	Principles of Radiological Protection	3
NUCE 608	Radiological Protection in Planned Exposure Situations	3
NUCE 609	Radiological Protection in Existing and Emergency Exposure Situations	3
NUCE 615	Radiation Dosimetry	3
NUCE 616	Occupational Radiological Protections	3
NUCE 623	Radiological Environmental Impact Assessment	3
NUCE 625	Advanced Core Physics for Light Water Reactors	3

Free Technical Elective (3 credit hours)

Students can select any course from the Master's programs offered in the College of Engineering provided that they meet the prerequisites of that particular course.

Graduate Project (3 credit hours)

Students must complete the individual capstone project.

Project

HSEG 697	HSEG Graduate Project	3

Study Plan

A typical study plan for students enrolled in the MEng in HSE Engineering is shown below.

Typical Study Plan for Full-Time Students

	Semester 1	**Semester 2**
Year 1	• Seminar in Research Methods• Program Core Course 1 • Program Core Course 2 • Program Core Course 3	• Program Core Course 4• Program Elective Course 1 • Program Elective Course 2
Year 2	• Program Elective Course 3• Program Elective Course 4 • Free Technical Elective	• Graduate Project

Typical Study Plan for Part-Time Students

	Semester 1	**Semester 2**
Year 1	• Seminar in Research Methods• Program Core Course 1 • Program Core Course 2	• Program Elective Course 1• Program Elective Course 2
Year 2	• Program Core Course 3• Program Core Course 4	• Program Elective Course 3• Program Elective Course 4
Year 3	• Free Technical Elective• Graduate Project	

PhD in Engineering

About the Program

The Doctor of Philosophy in Engineering (PhD ENGR) is awarded to candidates who successfully complete a program of advanced courses in engineering and conduct independent research of a specialized area within their selected discipline. Students are expected to seek novel solutions that advance the boundaries of engineering knowledge, demonstrate initiative in their approach and innovation in their work. PhD candidates prepare and present a dissertation on their chosen area. Research may be undertaken in a variety of topics corresponding to the areas of focus identified by the University. Candidates applying to the program may opt for a PhD in Engineering with a concentration in one of the engineering areas listed below. The concentration will be specified on the student's diploma and official transcript.

• Aerospace Engineering
• Biomedical Engineering
• Chemical Engineering
• Civil Infrastructure and Environmental Engineering
• Electrical and Computer Engineering
• Engineering Systems and Management
• Material Science and Engineering
• Mechanical Engineering
• Nuclear Engineering
• Petroleum Engineering
• Robotics

Selecting a concentration is not mandatory and students who prefer to pursue a multidisciplinary form of research have the option to complete a multidisciplinary PhD in Engineering (i.e. with no one specialization). If this option is selected, only the title of the degree will be stated on the diploma and transcript of the student.

Program Educational Objectives

Program Educational Objectives are broad statements that describe the career and professional accomplishments that graduates are expected to attain within few years of graduation. The PhD in Engineering program aims to produce graduates with the disciplinary preparation and ability to:

1. Synthesize scientific and technical engineering knowledge to identify, formulate and solve research challenges, and effectively disseminate the results to a variety of audiences.
2. Work across multiple disciplines and develop their individual academic, professional and career focus.
3. Keep abreast of the latest advances in science and engineering that contribute to the advancement of knowledge for the benefit of society.

Learning Outcomes

Students graduating with a PhD in Engineering will have the ability to:

1. Demonstrate appropriate breadth and depth of knowledge that is at the frontier of their disciplines and areas of specialization.
2. Conduct and defend original independent research that results in significant contributions to knowledge in the field and leads to publishable quality scholarly articles.
3. Understand and value diverse methodologies and techniques for solving critical problems in research.
4. Verify, justify and evaluate the various aspects of the solution to a complex engineering problem.
5. Communicate effectively and professionally, in written and oral forms, the major tenets of their field and their work to a variety of audiences.
6. Demonstrate a commitment to ethical behavior in research and professional activities.
7. Contribute effectively in multidisciplinary collaborative environments.

Admission Requirements

In addition to satisfying the University general admission requirements, applicants for the PhD in Engineering must demonstrate that they have the appropriate technical background. Disciplines acceptable for admission to each of the PhD in Engineering concentrations include, but are not limited to, the ones listed below.

PhD Concentration	Engineering Discipline	
Aerospace Engineering	Aerospace/Aeronautical Engineering Mechanical/Mechatronics Engineering	Electrical and Computer Engineering/Science
Biomedical Engineering	Biomedical Engineering Bio-Engineering/Science Mechanical/Mechatronics Engineering	Aerospace/Aeronautical Engineering Electrical and Computer Engineering/Science
Chemical Engineering	Chemical Engineering Biomedical Engineering Civil and Environmental Engineering Materials Engineering/Science	Mechanical/Mechatronics Engineering Nuclear Engineering Industrial Systems Engineering Petroleum Engineering
Civil Infrastructure and Environmental Engineering	Civil Infrastructural Engineering Environmental Engineering Mechanical Engineering Materials Engineering/Science Chemical Engineering	Applied Mathematics Computer Science Bio-Sciences Chemistry
Electrical and Computer Engineering	Electrical/Electronic Engineering Communication Engineering Computer Engineering Computer Science Software Engineering Information Technology	Mechatronics Robotics Material Engineering/Science Applied Mathematics Applied Physics
Engineering Systems and Management	Industrial Engineering Systems Engineering Electrical Engineering Computer Engineering Civil and Environmental Engineering Architectural Engineering Aerospace/Aeronautical Engineering	Mechanical Engineering Materials Engineering/Science Nuclear Engineering Chemical Engineering Applied Mathematics Computer Science Bio-Sciences
Material Science and Engineering	Materials Engineering/Science Mechanical/Mechatronics Engineering Aerospace/Aeronautical Engineering Civil and Environmental Engineering	Chemical Engineering Nuclear Engineering Industrial Systems Engineering
Mechanical Engineering	Mechanical/Mechatronics Engineering Aerospace/Aeronautical Engineering Civil and Environmental Engineering Chemical Engineering	Materials Engineering/Science Nuclear Engineering Industrial Systems Engineering
Nuclear Engineering	Nuclear Engineering Mechanical/Mechatronics Engineering Aerospace/Aeronautical Engineering Electrical and Computer Engineering/Science	Chemical Engineering Engineering/Medical Physics Materials Engineering/Science
Petroleum Engineering	Petroleum Engineering Chemical Engineering Applied Mathematics Hydrology Geophysics,	Geology Engineering Civil Engineering Aerospace Engineering Nuclear Engineering
Robotics	Robotics	Materials

Mechanical/Mechatronics Engineering	Engineering/Science
Aerospace/Aeronautical Engineering	Nuclear Engineering
Biomedical Engineering	Electrical and Computer Engineering/Science
	Information Technology
	Computer Science

Mathematics Requirements

Mathematics is an integral element of all engineering disciplines. Therefore, the PhD in Engineering program will assess the mathematical background of the students at the admissions stage and require admitted students to pass at least two PhD level courses with a substantial mathematical component as explained below.

1. The admissions committee will assess the mathematical background of all students applying for the PhD in Engineering, taking into account mathematics courses completed at Master's and undergraduate levels, along with the mathematical skills essential for the particular PhD concentration the student would like to pursue. Depending on the committee's assessment, the student may be conditionally admitted subject to successful completion of one or two courses from an approved list of graduate-level mathematics courses. Credits from these courses do not count toward fulfillment of the PhD degree requirements and do not contribute to the student's CGPA calculation. The current list of approved graduate-level mathematics courses is:

2. All students must complete a minimum of 6 credit hours of PhD level technical elective courses with a substantial mathematics component. These courses count towards the PhD degree program taught course credit hour requirement and contribute to the graduation CGPA. The current PhD level courses with a substantial mathematics component are listed below (NUCE courses are offered to UAE National and sponsored Saudi Arabia National students only).

PhD Technical Electives with Substantial Mathematical Component

Course List

AERO 701	Nonlinear Structural Dynamics	4
AERO 703	Numerical Methods in Aerofluids	4
AERO 711	Fracture Mechanics and Fatigue	3
AERO 761	Advanced Process Dynamics and Control	3
AERO 764	Optimal Control	3
BMED 711	Biomolecular and Cellular Engineering	3
BMED 712	Rehabilitation and Augmentation of Human Movement	3
BMED 713	Advanced Physiological Systems	3
BMED 716	Medical Device Innovation	3
BMED 720	Biophysical Engineering of Cellular Systems	3
BMED 725	Computational Systems Biology of Cancer	3
CHEG 700	Sustainable Desalination Processes	3
CHEG 705	Membrane Technology	3
CHEG 708	Phase Equilibria	3
CHEG 710	Kinetics and Mechanisms	3
CHEG 720	Modelling and Engineering of Microbial Environmental Bioprocesses	3
CHEG 745	Multicomponent Mass Transfer	3
CHEG 750	Molecular Thermodynamics	3
CHEG 760	Non-Equilibrium Thermodynamics	3
CHEG 765	Computational Fluid Dynamics for Chemical Engineers	3
CHEG 790	Dynamic Behavior of Process Systems	3
CIVE 707	Environmental Remote Sensing and Satellite Image Processing	3
CIVE 719	Climate Dynamics	3
CIVE 721	Aquatic Chemistry	3
CIVE 750	Non-Linear Mechanics of Construction Materials	3
CIVE 751	Non-Linear FE Analysis of Civil Engineering Structures	3
ECCE 701	Power System Modelling and	3

	Control	
ECCE 703	Embedded Generation Operation and Control	3
ECCE 706	Power Quality and FACTS Devices	3
ECCE 710	Analysis of Power Systems Over-voltages and Transients	3
ECCE 711	Advanced Power System Grounding and Safety	3
ECCE 714	Application of Heuristic Optimization Techniques to Power Systems	3
ECCE 721	Analog Mixed Signal Design Techniques	3
ECCE 722	Numerical Simulation of Circuits and Systems	3
ECCE 732	Machine Learning and Applicatications	3
ECCE 733	High Speed Computer Arithmetic	3
ECCE 734	Advanced Computer Architecture	3
ECCE 735	Advanced Computer Vision Paradigms	3
ECCE 738	High Performance Computing	3
ECCE 741	Advanced Digital Communications	3
ECCE 742	Advanced Concepts in Stochastic Processes, Detection, and Estimation Theory	3
ECCE 743	Broadband Communication Systems	3
ECCE 744	Optical Wireless Communication System	3
ECCE 751	Discontinuous Control Systems	3
ECCE 752	Nonlinear Control	3
ECCE 753	Computational Prototyping of Dynamical Systems	3
ECCE 754	Computational Prototyping of Partial Differential Equations	3
ECCE 755	Cognitive Robotics	4
ECCE 756	Robotic Perception	4
ECCE 757	Control of Robotic Systems	3
ECCE 772	Advanced Microsystem Design	3
ECCE 773	Photonic Materials and Metamaterials Design for Engineers	3
ECCE 774	Advanced Photonic Integrated Circuits	3
ESMA 701	Advanced Systems	3
	Optimization	
ESMA 710	Times Series Analysis Modeling and Prediction	3
ESMA 711	Advanced Business Analytics	3
ESMA 720	Advanced Production and Operations Management	3
ESMA 721	Stochastic Processes and Applications	3
ESMA 730	Complex Network Analysis	3
ESMA 781	Modeling Urban Systems Energy Flow	3
MEEN 701/AERO 711	Fracture Mechanics and Fatigue	3
MEEN 702	Damage Mechanics of Solids and Structures	3
MEEN 703	Linear and Nonlinear Finite Element Methods	3
MEEN 704	Computational Inelasticity	3
MEEN 705/MSEN 705	Micromechanics of Materials	3
MEEN 706	Theory of Plasticity	3
MEEN 720/MSEN 720	Statistical Thermodynamics	
MEEN 721	Computational Fluid Mechanics	3
MEEN 722	Non-Newtonian Fluid Dynamics	3
MEEN 723/AERO 723	Advanced Combustion	3
MEEN 724	Advanced Modeling of Cooling Systems	3
MEEN 725	Multiphase Flow in Porous Media	3
MEEN 741	Advanced Conduction and Radiation Heat Transfer	3
MEEN 742	Advanced Convection Heat Transfer	3
MEEN 743	Micro-Nano Energy Transport	3
MEEN 744	Interfacial Transport and Phase Change Heat Transfer	3
MEEN 761	Advanced Process Dynamics and Control	3
MEEN 762	Analysis and Simulation of Mechatronics Systems	3
MEEN 764	Optimal Control	3
MEEN 765	Acoustics and Noise Control	3
MEEN 767	Control of Robotic Systems	3
MSEN 701	Electrochemical Processes and Devices	3
MSEN 710	Advanced Solid State Physics	3
MSEN 730	Science and Engineering of Thin Films, Surfaces and Interfaces	3

MSEN 740	Advances in Investigation of Intermolecular and Surface Forces	3
NUCE 701	Advanced Computational Methods of Particle Transport	3
NUCE 702	Nuclear Systems and Materials/Accident analysis	3
NUCE 704	The Reactor Core Design Analysis for light water reactors	3
NUCE 705	Nuclear Criticality Safety Assessment	3
PEEG 723	Stimulation of Conventional and Unconventional Reservoirs	3
PEEG 730	Fluid Flow and Transport Processes in Porous Media	3
PEEG 732	Hybrid Enhanced Oil Recovery	3
PEEG 733	Miscible Gas Flooding	3
PEEG 746	Emerging Well Construction Technology	3
PEEG 747	Horizontal and Multilateral Drilling and Completion	3
PEEG 749	Characterization and Modelling of Unconventional Reservoirs	3
PEEG 752	Simulation of Naturally Fractured Reservoirs	3

Program Structure and Requirements (with MSc Degree)

Overall Program Structure

The PhD ENGR consists of a minimum 60 credit hours, distributed as follows: 3 credit hours of Program Core courses, 21 credit hours of Program Technical Elective courses, 36 credit hours of Dissertation research and two zero credit PhD Research Seminar courses. The technical background of the student will be assessed by a Written Qualifying Examination (WQE), followed by a Research Proposal Examination (RPE) which the student must successfully complete in order to progress further in the program. The components of the PhD program are summarized in the table below.

Program Component	**Credit Hours**
Research Methods in Engineering	3
PhD Research Seminar I	0
PhD Research Seminar II	0
Written Qualifying Examination (WQE)	0
Research Proposal Examination (RPE)	0
Program Electives	21
PhD Research Dissertation	36
Total	**60**

Program Requirements

Students seeking the degree of PhD in Engineering must successfully complete a minimum 60 credit hours as specified in the program requirements detailed below, with a minimum CGPA of 3.0. Course selection should be made in consultation with the student's Main Advisor and must be aligned to the chosen area(s) of research. All courses have a credit rating of three credits each, except the PhD Research Seminar, Written Qualifying Exam, Research Proposal Exam, and the PhD Dissertation.

Program Core (3 credit hours)

Students must complete the core courses listed below.

Core Courses

ENGR 701	Research Methods in Engineering	3
ENGR 703	PhD Research Seminar I	0
ENGR 704	PhD Research Seminar II	0
ENGR 795	PhD Written Qualifing Examination	0
ENGR 796	PhD Research Proposal Examination	0

Program Electives and Concentrations (21 credit hours)

Students must complete a minimum of seven technical elective courses from the list below. At least two of these electives (6 credit hours) must be PhD level courses with a substantial mathematical component, as outlined in the 'Mathematics Requirements' section above.

Subject to the approval of the dissertation Main Advisor, up to two elective courses (6 credit hours) can be taken from relevant MSc programs in the College of Engineering at KU to help the student bridge a knowledge gap that will support his/her research. The student must not have taken the same or similar MSc level courses to satisfy the requirements of his/her Master's degree. A copy of the student's MSc transcript must be provided when a request is made to take MSc level courses.

Students wishing to complete a PhD in Engineering with a concentration in a given area, must select at least four (12 credit hours) of the seven technical elective courses from one of the groups listed below. All selected concentration courses must be at PhD level. The concentration will be noted on the student's diploma and official transcript provided that the student fulfills the following requirements:

- Complete a minimum of four PhD level courses (12 credit hours) from the same concentration; and
- Complete a PhD research dissertation within the domain of the concentration.

The PhD elective courses are listed below under the various engineering concentration fields supported by the program. Students must take into account the above points when choosing their electives.

Aerospace Engineering

Concentration Field Courses

AERO 701	Nonlinear Structural Dynamics	4
AERO 702	Advanced Composite Materials and Structures	3
AERO 703	Numerical Methods in Aerofluids	4
AERO 711	Fracture Mechanics and Fatigue	3
AERO 712	Damage Mechanics of Solids and Structures	3
AERO 723	Advanced Combustion	3
AERO 761	Advanced Process Dynamics and Control	3
AERO 764	Optimal Control	3
AERO 765	Advanced Orbit Design for Planetary Missions	3
AERO 794	Selected Topics in Aerospace Engineering	4

Biomedical Engineering

Concentration Field Courses

BMED 711	Biomolecular and Cellular Engineering	3
BMED 712	Rehabilitation and Augmentation of Human Movement	3
BMED 713	Advanced Physiological Systems	3
BMED 716	Medical Device Innovation	3
BMED 720	Biophysical Engineering of Cellular Systems	3
BMED 725	Computational Systems Biology of Cancer	3
BMED 794	Selected Topics in Biomedical Engineering	4

Chemical Engineering

Concentration Field Courses

CHEG 700	Sustainable Desalination Processes	3
CHEG 703	Applied nanotechnology	3
CHEG 705	Membrane Technology	3
CHEG 708	Phase Equilibria	3
CHEG 710	Kinetics and Mechanisms	3
CHEG 712	Physical and Chemical Treatment of Waters	3
CHEG 715	Biological Wastewater Treatment	3
CHEG 720	Modelling and Engineering of Microbial Environmental Bioprocesses	3
CHEG 730	Experimental Techniques and Instrumentation	3
CHEG 735	Electrochemical Engineering	3
CHEG 745	Multicomponent Mass Transfer	3
CHEG 750	Molecular Thermodynamics	3
CHEG 760	Non-Equilibrium Thermodynamics	3
CHEG 765	Computational Fluid Dynamics for Chemical Engineers	3
CHEG 770	Heterogeneous Catalysis	3
CHEG 790	Dynamic Behavior of Process Systems	3
CHEG 794	Selected Topics in Chemical Engineering	3

Civil Infrastructure and Environmental Engineering

Concentration Field Courses

CIVE 703	Groundwater Hydrology	3
CIVE 707	Environmental Remote Sensing and Satellite Image Processing	3
CIVE 712	Remediation Engineering	3
CIVE 714	Sustainable Desalination Processes	3
CIVE 717	Membrane Technology	3
CIVE 718	Advanced Topics in Applied Environmental Chemistry	3
CIVE 719	Climate Dynamics	3

CIVE 720	Nanotechnology in Water Purification	3
CIVE 721	Aquatic Chemistry	3
CIVE 722	Solid and Hazardous Waste Management	3
CIVE 730	Public Transit Operations and Planning	3
CIVE 750	Non-Linear Mechanics of Construction Materials	3
CIVE 751	Non-Linear FE Analysis of Civil Engineering Structures	3
CIVE 755	Geotechnical Natural Hazards Mitigation	3
CIVE 756	Chemo-mechanical Modelling & Design of Flexible Pavements	3
CIVE 760	Construction Procurement Management	3
CIVE 761	Productivity Improvement in Construction	3
CIVE 762	Advanced Building Information Modeling	3
CIVE 794	Selected Topics in Civil Infrastructural and Environmental Engineering	3

Electrical and Computer Engineering

Concentration Field Courses

ECCE 701	Power System Modelling and Control	3
ECCE 703	Embedded Generation Operation and Control	3
ECCE 706	Power Quality and FACTS Devices	3
ECCE 710	Analysis of Power Systems Over-voltages and Transients	3
ECCE 711	Advanced Power System Grounding and Safety	3
ECCE 714	Application of Heuristic Optimization Techniques to Power Systems	3
ECCE 721	Analog Mixed Signal Design Techniques	3
ECCE 722	Numerical Simulation of Circuits and Systems	3
ECCE 723	High Speed Communication Circuits	3
ECCE 730	Advanced Deep Learning	3
ECCE 731	Distributed Computing	3
ECCE 732	Machine Learning and Applications	3
ECCE 733	High Speed Computer Arithmetic	3
ECCE 734	Advanced Computer Architecture	3
ECCE 735	Advanced Computer Vision Paradigms	3
ECCE 736	Advanced Topics LoT and Blockchain	3
ECCE 737	Network and Information Security	3
ECCE 738	High Performance Computing	3
ECCE 741	Advanced Digital Communications	3
ECCE 742	Advanced Concepts in Stochastic Processes, Detection, and Estimation Theory	3
ECCE 743	Broadband Communication Systems	3
ECCE 744	Optical Wireless Communication System	3
ECCE 751	Discontinuous Control Systems	3
ECCE 752	Nonlinear Control	3
ECCE 753	Computational Prototyping of Dynamical Systems	3
ECCE 754	Computational Prototyping of Partial Differential Equations	3
ECCE 755	Cognitive Robotics	4
ECCE 756	Robotic Perception	4
ECCE 762	Voltage Source Converters	3
ECCE 771	Advanced Integrated Circuits Technology	3
ECCE 772	Advanced Microsystem Design	3
ECCE 773	Photonic Materials and Metamaterials Design for Engineers	3
ECCE 774	Advanced Photonic Integrated Circuits	3
ECCE 778	Physics and Manufacturability of Advanced Micro and Nano Devices	3
ECCE 781	The Physics of Solar Cells	3
ECCE 794	Selected Topics in Electrical and Computer Engineering	4

Engineering Systems and Management

Concentration Field Courses

ESMA 701	Advanced Systems Optimization	3
ESMA 710	Times Series Analysis Modeling and Prediction	3
ESMA 711	Advanced Business Analytics	3
ESMA 720	Advanced Production and	3

	Operations Management	
ESMA 721	Stochastic Processes and Applications	3
ESMA 722	Technology strategy	3
ESMA 730	Complex Network Analysis	3
ESMA 740	Sustainable Development: Theory & Policy	3
ESMA 741	Advanced Modeling for Energy Planning	3
ESMA 742	Energy Economics, Finance and Policy	3
ESMA 743	Engineering for Energy and Poverty Solutions	3
ESMA 780	Advanced Urbanism: Urban Design Ideals and Action	3
ESMA 781	Modeling Urban Systems Energy Flow	3
ESMA 794	Selected Topics in Engineering Systems and Management	3

Material Science and Engineering

Concentration Field Courses

MSEN 701	Electrochemical Processes and Devices	3
MSEN 710	Advanced Solid State Physics	3
MSEN 712	Imaging of Materials: Scanning Electron Microscopy and X-ray Microanalysis	3
MSEN 715	Advanced Imaging of Materials: Transmission Electron Microscopy	3
MSEN 730	Science and Engineering of Thin Films, Surfaces and Interfaces	3
MSEN 740	Advances in Investigation of Intermolecular and Surface Forces	3
MSEN 750	HighEfficiency Silicon Solar Cells: Designs and Technologies	3
MSEN 760	Thin Film Solar Cells: From Design to Applications	3
MSEN 794	Selected Topics in Materials Science and Engineering	3

Mechanical Engineering

Concentration Field Courses

MEEN 701/AERO 711	Fracture Mechanics and Fatigue	3
MEEN 702	Damage Mechanics of Solids and Structures	3
MEEN 703	Linear and Nonlinear Finite Element Methods	3
MEEN 704	Computational Inelasticity	3
MEEN 705/MSEN 705	Micromechanics of Materials	3
MEEN 706	Theory of Plasticity	3
MEEN 721	Computational Fluid Mechanics	3
MEEN 722	Non-Newtonian Fluid Dynamics	3
MEEN 723/AERO 723	Advanced Combustion	3
MEEN 724	Advanced Modeling of Cooling Systems	3
MEEN 725	Multiphase Flow in Porous Media	3
MEEN 741	Advanced Conduction and Radiation Heat Transfer	3
MEEN 742	Advanced Convection Heat Transfer	3
MEEN 743	Micro-Nano Energy Transport	3
MEEN 744	Interfacial Transport and Phase Change Heat Transfer	3
MEEN 745	Concentrated Solar Power and Thermal Energy Storage	3
MEEN 761	Advanced Process Dynamics and Control	3
MEEN 762	Analysis and Simulation of Mechatronics Systems	3
MEEN 764	Optimal Control	3
MEEN 765	Acoustics and Noise Control	3
MEEN 766	MEMS Theory and Applications	3
MEEN 782	Materials Characterization Techniques	3
MEEN 792	Advanced Nanomaterials and Their Mechanical Applications	3
MEEN 794	Selected Topics in Mechanical Engineering	3

Nuclear Engineering

Concentration Field Courses

NUCE 701	Advanced Computational Methods of Particle Transport	3
NUCE 702	Nuclear Systems and Materials/Accident analysis	3
NUCE 703	Aging Management of Nuclear Materials	3
NUCE 704	The Reactor Core Design Analysis for light water reactors	3

NUCE 705	Nuclear Criticality Safety Assessment	3
NUCE 794	Selected Topics in Nuclear Engineering	3

Petroleum Engineering

Concentration Field Courses

PEEG 723	Stimulation of Conventional and Unconventional Reservoirs	3
PEEG 730	Fluid Flow and Transport Processes in Porous Media	3
PEEG 732	Hybrid Enhanced Oil Recovery	3
PEEG 733	Miscible Gas Flooding	3
PEEG 746	Emerging Well Construction Technology	3
PEEG 747	Horizontal and Multilateral Drilling and Completion	3
PEEG 749	Characterization and Modelling of Unconventional Reservoirs	3
PEEG 752	Simulation of Naturally Fractured Reservoirs	3
PEEG 794	Selected Topics in Petroleum Engineering	3

Robotics

Concentration Field Courses

ECCE 732	Machine Learning and Applications	3
ECCE 735	Advanced Computer Vision Paradigms	3
ECCE 755	Cognitive Robotics	4
ECCE 756	Robotic Perception	4
MEEN 761	Advanced Process Dynamics and Control	3
MEEN 762	Analysis and Simulation of Mechatronics Systems	3
MEEN 764	Optimal Control	3
MEEN 765	Acoustics and Noise Control	3
MEEN 767	Control of Robotic Systems	3

PhD Research Dissertation (minimum 36 credit hours)

Students must complete a PhD Research Dissertation that involves novel, creative, research-oriented work under the direct supervision of at least one full-time faculty advisor from the College of Engineering, and at least one other full-time faculty who acts as a co-advisor. The Main Advisor of a student who opts for a PhD with a concentration must be a faculty member in the Department offering that particular concentration. The outcome of research should demonstrate the synthesis of information into knowledge in a form that may be used by others. The research findings must be documented in a formal Dissertation and defended successfully in a viva voce examination. Furthermore, the research must lead to publishable quality scholarly journal articles.

Dissertation

ENGR 799	PhD Research Dissertation	48

Topical Areas for Written Qualifying Examination (WQE)

Achieving PhD candidacy is contingent upon successfully passing a two-stage qualifying examination which is composed of a Written Qualifying Exam (WQE), followed by a Research Proposal Examination (RPE). For further details, please refer to the **"PhD Research Milestones"** section of this catalog.

The primary objective of the PhD Written Qualifying Exam (WQE) is to ensure that students pursuing a Doctoral degree in a particular concentration have graduate level understanding of the fundamentals of that concentration and evaluates the student's ability to apply them to solve problems in **three topical exam areas.** The syllabi for the topical exam areas are taken from undergraduate courses in the College of Engineering at Khalifa University.

Students must register for the PhD WQE in Banner before the end of the Add/Drop period of the semester in which they plan to take the exams. The student must choose three exam topical areas from an approved list, in consultation with his/her Main Advisor. Students enrolled in the PhD with a concentration must select at least two of the three topical areas from the list specific to their concentration. Students pursuing a multidisciplinary PhD must select topical areas relevant to their particular fields of research.

The exams are coordinated by the Associate Dean for Graduate Studies and the Chair of the relevant Department (or designee) and held twice per year over a one-week period. The duration of each exam is three hours. A minimum score of 73 percent is required to pass the exam for each topical area. Failing any topical area of the WQE will result in the student failing the entire WQE and placing him/her on Academic Probation Level 1. A failed WQE can be retaken only once and passed upon the next offering. If the student repeats the WQE, then he/she will be required only to retake the exams in the topical areas that he/she failed during the WQE at the first attempt. The student may opt to retake the exams in topical areas other than those he/she failed in at the first attempt. PhD students who fail the WQE at the second attempt will be placed on

Academic Probation Level 2 and will be subject to dismissal from the PhD program.

The list of topical exam areas for each of the PhD in Engineering concentrations and their corresponding undergraduate course syllabi are given below. This list is subject to change.

Aerospace Engineering

Topical Exam Area: Aerodynamics

AERO 335	Aerodynamics I	4
AERO 336	Aerodynamics II	3

Topical Exam Area: Aerospace Materials and Manufacturing

AERO 320	Aerospace Materials	3
AERO 415	Aerospace Materials Manufacturing	3

Topical Exam Area: Astronautics

AERO 465	Space Dynamics and Control	3
AERO 485	Spacecraft Design	3
AERO 495	Special Topics in Aerospace Engineering	3

Topical Exam Area: Dynamics and Control

AERO 201	Engineering Dynamics	3
AERO 350	Dynamic Systems and Control	4
AERO 450	Flight Dynamics and Stability	3

Topical Exam Area: Mechanics of Solids and Structures

AERO 225	Mechanics of Solids	4
AERO 321	Aerospace Structures	3

Topical Exam Area: Thermodynamics and Propulsion

AERO 240	Thermofluids for Aerospace Engineering	4
AERO 440	Aerospace Propulsion	3

Biomedical Engineering

Topical Exam Area: Biochemistry

CHEG 210	Introduction to Biochemical Engineering	3

Topical Exam Area: Biomaterial Sciences and Engineering

BMED 411	Biomaterials	4

Topical Exam Area: Biomechanics

BMED 321	Mechanics for Biomedical Engineers	4
BMED 322	Functional Biomechanics	4

Topical Exam Area: Biomedical Signals

BMED 352	Fundamentals of Biomedical Signal Processing	4

Topical Exam Area: Genomics

BMED 413	Application of Bio-molecular Tools	3

Topical Exam Area: Molecular Biology

BMED 341	Molecular Cell Biology	4

Topical Exam Area: Physiology and Anatomy

BMED 211	Human Anatomy	4
BMED 212	Physiological Systems & Modeling II	4

Topical Exam Area: Transport Phenomena

BMED 331	Biotransport Phenomena	3

Chemical Engineering

Topical Exam Area: Chemical Engineering Thermodynamics

CHEG 230	Chemical Engineering Thermodynamics I	3
CHEG 332	Chemical Engineering Thermodynamics II	3

Topical Exam Area: Mass Transport Phenomena

CHEG 324	Mass Transfer	3
CHEG 485	Separation Processes	4

Topical Exam Area: Momentum and Heat Transport Phenomena

CHEG 232	Fluid Mechanics	4
CHEG 335	Heat Transfer	4

Topical Exam Area: Reaction Engineering

CHEG 443	Reaction Engineering	4

Topical Exam Area: Chemical Engineering Process Control

CHEG 412	Process Dynamics & Control	4

Civil Infrastructure and Environmental Engineering

Topical Exam Area: Atmospheric Pollution

CIVE 469	Air Pollution Control	3

Topical Exam Area: Behavior and Analysis of Structures

CIVE 225	Mechanics of Solids	4
CIVE 340	Behavior and Analysis of Structures	3

Topical Exam Area: Building Design

CIVE 341	Design of Steel Structures	3
CIVE 442	Design of Concrete Structures	3

Topical Exam Area: Construction Project Management

CIVE 332	Fundamentals of Construction Engineering & Management	3
CIVE 484	Project Planning, Scheduling and Control	3

Topical Exam Area: Environmental Engineering

CIVE 370	Introduction to Environmental Engineering	4

Topical Exam Area: Fluid Mechanics

CIVE 335	Fluid Mechanics	4

Topical Exam Area: Geotechnical and Foundation Engineering

CIVE 338	Geotechnical Engineering	4
CIVE 470	Foundation Engineering	4

Topical Exam Area: Hydrology

CIVE 465	Water Resources Management	3

Topical Exam Area: Pavement Engineering

CIVE 472	Pavements Design and Maintenance	3

Topical Exam Area: Transportation Engineering

CIVE 380	Transportation Engineering	3

Topical Exam Area: Water and Wastewater Treatment Technologies

CIVE 463	Water and Wastewater Treatment Technologies	3

Electrical and Computer Engineering

Topical Exam Area: Algorithms and Computing Theory

COSC 301	Automata, Computability, and Complexity	3
COSC 310	Data Structures	3
COSC 312	Design and Analysis of Algorithms	3

Topical Exam Area: Artificial Intelligence

COSC 330	Introduction to Artificial Intelligence	3
COSC 430	Data Analytics	3
ECCE 454	Artificial Intelligence	3

Topical Exam Area: Communication Systems

ECCE 360	Communication Systems	4
ECCE 362	Digital Communications I	3
ECCE 460	Wireless Communications	3

Topical Exam Area: Computer Architecture

ECCE 350	Computer Architecture and Organization	3
ECCE 450	Embedded Systems	3

Topical Exam Area: Computer and Network Security

ECCE 444	Computer Security	3
ECCE 446	Network Security	3

Topical Exam Area: Computer Systems

COSC 410	Parallel and Distributed Computing	3
ECCE 354	Operating Systems	3
ECCE 356	Computer Networks	4
ECCE 448	Cloud Infrastructure and Services	3

Topical Exam Area: Control Systems

ECCE 323	Feedback Control Systems	4
ECCE 428	Modern Control Systems	3
ECCE 429	Digital Control Systems	3

Topical Exam Area: Digital System Design

ECCE 408	Digital Systems Design	3
ECCE 410	VLSI Systems Design	3

Topical Exam Area: Electromagnetic Waves and Propagation

ECCE 320	Applied Electromagnetics	3
ECCE 470	Antennas and Propagation	3

Topical Exam Area: Electronic Devices and Circuits

ECCE 312	Electronic Circuits & Devices	4
ECCE 411	Analog Integrated Circuits Design	3

Topical Exam Area: Integrated Microelectronic Devices and Technology

ECCE 326	Introduction to Semiconductor Devices	4
ECCE 495	Special Topics in Electrical and Computer Engineering	3

Topical Exam Area: Power Electronics

ECCE 423	Power Electronics	3

Topical Exam Area: Power Systems and Electrical Machines

ECCE 322	Electrical Machines	4
ECCE 421	Power System Analysis	3
ECCE 425	Power System Stability and Control	3

Topical Exam Area: Signal Processing

ECCE 302	Signals and Systems	3

ECCE 402	Digital Signal Processing	3

Topical Exam Area: Software Engineering

ECCE 330	System Analysis & Software Design	3
ECCE 438 COSC 452	Software Architecture	3

Engineering Systems and Management

Topical Exam Area: Applied Statistics and Quality Control

ISYE 311	Quality & Reliability Engineering	4
ISYE 431	Time Series Forecasting	3
MATH 242	Introduction to Probability and Statistics	3

Topical Exam Area: Engineering Economics

ISYE 200	Engineering Economic Analysis	3
ISYE 362	Systems Project Management	3
BUSS 201	Fundamentals of Accounting and Finance	3

Topical Exam Area: Operations Research and Optimization

ISYE 251	Operations Research 1	4
ISYE 430	Supply Chain and Logistics	4
ISYE 451	Operations Research 2	3

Topical Exam Area: Production and Facilities Planning

ISYE 341	Simulation Modeling and Analysis	4
ISYE 351	Production and Operations Management	3
ISYE 475	Facilities Planning and Warehousing	4

Material Science and Engineering

Topical Exam Area: Synthesis and Characterization of Materials

MEEN 225	Engineering Materials	4
MEEN 423	Physical Metallurgy	3

Topical Exam Area: Thermal and Mechanical Properties of Materials

MEEN 325	Mechanics of Solids	4
MEEN 343	Heat Transfer	4

Topical Exam Area: Thermodynamics and Kinetics of Materials

MEEN 240	Thermodynamics	3
CHEG 324	Mass Transfer	3

Mechanical Engineering

Topical Exam Area: Control and Mechatronics

MEEN 356	Computer-Controlled Systems	4
MEEN 484	Mechatronics	3

Topical Exam Area: Dynamics and Vibrations

MEEN 201	Engineering Dynamics	3
MEEN 350	Dynamic Systems and Vibration	3

Topical Exam Area: Engineering Mathematics

MATH 204	Linear Algebra	3

Topical Exam Area: Fluid Mechanics and Heat Transfer

MEEN 335	Fluid Mechanics	4
MEEN 343	Heat Transfer	4

Topical Exam Area: Solid Mechanics and Strength of Materials

MEEN 325	Mechanics of Solids	4
MEEN 420	Materials: Strength & Fracture	3

Topical Exam Area: Thermodynamics

MEEN 240	Thermodynamics	3
MEEN 441	Applied Thermodynamics	3

Nuclear Engineering

Topical Exam Area: Reactor Systems Design and Analysis

NUCE 303	Mechanics & Thermal-hydraulics Principles for Nuclear Engineering	3
NUCE 401	Introduction to Nuclear Reactor Physics	3
NUCE 402	Introduction to Nuclear Systems and Operation	3

Topical Exam Area: Nuclear Material Science Engineering

NUCE 303	Mechanics & Thermal-hydraulics Principles for Nuclear Engineering	3
NUCE 401	Introduction to Nuclear Reactor Physics	3

Topical Exam Area: Radiation Safety in the Environment

NUCE 301	Radiation Science & Health Physics	3
NUCE 401	Introduction to Nuclear Reactor Physics	3

Petroleum Engineering

Topical Exam Area: Reservoir Engineering

PEEG 331	Reservoir Engineering I	3
PEEG 334	Reservoir Engineering II	4

Topical Exam Area: Drilling Engineering

PEEG 322	Drilling Engineering I	3
PEEG 326	Drilling Engineering II	3

Topical Exam Area: Production Engineering

PEEG 442	Surface Production Facilities	3
PEEG 443	Production System Design and Analysis	3

Robotics

Topical Exam Area: Control and Mechatronics

MEEN 356	Computer-Controlled Systems	4
MEEN 484	Mechatronics	3

Topical Exam Area: Signal Processing

ECCE 302	Signals and Systems	3
ECCE 402	Digital Signal Processing	3

Topical Exam Area: Computer Architecture and Networks

ECCE 350	Computer Architecture and Organization	3
ECCE 356	Computer Networks	4
ECCE 450	Embedded Systems	3

Study Plan

Typical study plans for full-time and part-time students enrolled on the PhD in Engineering program are shown below. Each student must select the technical elective courses in consultation with her/his advisor.

Typical Study Plan for Full-Time Students

- ENGR 701 Research Methods in Engineering
- Technical Elective 1
- Technical Elective 3
- ENGR 799PhDResearch Dissertation
- Technical Elective 2
- ENGR 795 PhDWritten Qualifying Exam (WQE)
- Technical Elective 4
- Technical Elective 5
- Technical Elective 6
- ENGR 799PhDResearch Dissertation
- ENGR 799 PhD Research Dissertation
- ENGR 796 PhD Research Proposal Examination (RPE)
- Technical Elective 7
- ENGR 703 PhD Research Seminar I
- ENGR 704PhDResearch Seminar II
- ENGR 799PhDResearch Dissertation
- ENGR 799 PhD Research Dissertation
- ENGR 799 PhD Research
- ENGR 799PhDResearch Dissertation

Dissertation

- PhD Research Dissertation Examination

Typical Study Plan for Part-Time Students

• ENGR 701 Research Methods in Engineering • Technical Elective 1	• Technical Elective 2 • Technical Elective 3
• Technical Elective 4 • ENGR 799 PhD Research Dissertation	• ENGR 799PhDResearch Dissertation • ENGR 795 PhDWritten Qualifying Exam (WQE)
• Technical Elective 5 • ENGR 799 PhD Research Dissertation	• ENGR 799PhDResearch Dissertation • ENGR 796 PhD Research Proposal Examination (RPE)
• Technical Elective 6	• Technical Elective 7
• ENGR 703 PhD Research Seminar I • ENGR 799 PhD Research Dissertation	• ENGR 799PhDResearch Dissertation
• ENGR 704 PhD	•

Research Seminar II	ENGR 799PhDResearch Dissertation
• ENGR 799 PhD Research Dissertation	
• ENGR 799 PhD Research Dissertation	• ENGR 799PhDResearch Dissertation
	• PhDResearch Dissertation Examination

Program Structure and Requirements (with only BSc Degree)

Overall Program Structure

The PhD ENGR consists of a minimum 72 credit hours, distributed as follows: 12 credit hours of Program Core courses, 24 credit hours of Program Technical Elective courses, 36 credit hours of Dissertation research and two zero credit PhD Research Seminar courses. The technical background of the student will be assessed by a Written Qualifying Examination (WQE), followed by a Research Proposal Examination (RPE) which the student must successfully complete in order to progress further in the program. The components of the PhD program are summarized in the table below.

Category	Credit Hours
Core Courses	12
Technical Electives	24
ENGR 703 PhD Research Seminar I	0
ENGR 704 PhD Research Seminar II	0
ENGR 795 PhD Written Qualifying Exam	0
ENGR 796 PhD Research Proposal Exam	0
PhD Research Dissertation	36
Total	**72**

All the courses that the students will take are at PhD level. The students will only be able to attempt ENGR 795 PhD Written Qualifying Exam (WQE) after successfully completing a minimum of 27 credits of formal coursework.

Program Requirements

Students seeking the degree of PhD in Engineering must successfully complete a minimum 72 credit hours as specified in the program requirements detailed below, with a minimum CGPA of 3.0. Course selection should be made in consultation with the student's Main Advisor and must be aligned to the chosen area(s) of research. All courses have a credit rating of three credits each, except the PhD Research Seminar, Written Qualifying Exam, Research Proposal Exam, and the PhD Dissertation.

Program Core (12 credit hours)

Students must complete the core courses listed below.

Aerospace Engineering - Core Courses

Concentration Core Courses

ENGR 701	Research Methods in Engineering	3
AERO 781	Advanced Aerodynamics	3
AERO 782	Adv Aerospace Materials & Stru	3
AERO 783	Advanced Flight Mechanics	3
AERO 784	Adv Space Systems Engineering	3

Biomedical Engineering - Core Courses

Concentration Core Courses

ENGR 701	Research Methods in Engineering	3
BMED 781	Adv Multivariate Data Analysis	3
BMED 782	Advanced Physiological Systems	3
BMED 720	Biophysical Engineering of Cellular Systems	3
BMED 725	Computational Systems Biology of Cancer	3

Chemical Engineering - Core Courses

Concentration Core Courses

ENGR 701	Research Methods in Engineering	3
CHEG 781	Adv Math Methods in Chem Eng	3
CHEG 782	Adv Chem Eng Thermodynamics	3
CHEG 783	Adv Chemical Reaction Engineer	3

Civil Infrastructure and Environmental Engineering - Core Courses

Concentration Core Courses

ENGR 701	Research Methods in Engineering	3
CIVE 782	Adv Soil-Structure Interaction	3
CIVE 783	Advanced Building Construction	3
CIVE 784	Adv Transportation Systems	3

Electrical and Computer Engineering - Core Courses

Concentration Core Courses

ENGR 701	Research Methods in Engineering	3
COSC 781	Algorithm Design Techniques	3
ECCE 782	Linear Systems	3
ECCE 783	Power System Analysis	3
ECCE 784	Digital Signal Processing	3
ECCE 785	Digital ASIC Design	3
ECCE 786	Integrated Microelectronic Dev	3
ECCE 787	Deep Learning Systems Design	3
ECCE 788	Advanced Computer Networks	3

Engineering Systems and Management - Core Courses

Concentration Core Courses

ENGR 701	Research Methods in Engineering	3
ESMA 783	Advanced Cost Engineering	3
ESMA 784	Optimization for Eng Systems	3
ESMA 785	Business Analytics for Eng	3

	Sys	

Material Science and Engineering - Core Courses

Concentration Core Courses

ENGR 701	Research Methods in Engineering	3
MSEN 781	Adv Thermodyn & Thermostat Mat	3
MSEN 783	Elec,Opt & Magnetic Prop Mater	3
MSEN 784	Adv Phys of Solid-State Apps	3
MSEN 785	Phenomenological & Atomistic K	3

Mechanical Engineering - Core Courses

Concentration Core Courses

ENGR 701	Research Methods in Engineering	3
MEEN 783	Adv Dynamics and Applications	3
MEEN 784	Advanced Control System	3
MEEN 785	Adv Mechanics of Solid Materia	3
MEEN 786	Adv Fluid Mech of Incompressib	3

Nuclear Engineering - Core Courses

Concentration Core Courses

ENGR 701	Research Methods in Engineering	3
NUCE 781	Adv Therm Hydraulics in NUCE	3
NUCE 782	Adv Nuc Mats,Struc Integ& Chem	3
NUCE 783	Nuclear Reactor Theory	3

Petroleum Engineering - Core Courses

Concentration Core Courses

ENGR 701	Research Methods in Engineering	3
PEEG 781	Well Pressure Transient Analys	3
PEEG 782	Adv Character & Reservoir Eng	3
PEEG 783	Adv Well Performance Evaluatio	3

Robotics - Core Courses

Concentration Core Courses

ENGR 701	Research Methods in Engineering	3
ECCE 784	Digital Signal Processing	3
ECCE 787	Deep Learning Systems Design	3
MEEN 784	Advanced Control System	3

Program Electives and Concentrations (24 credit hours)

Students must complete a minimum of seven technical elective courses from the list below. At least two of these electives (6 credit hours) must be PhD level courses with a substantial mathematical component, as outlined in the 'Mathematics Requirements' section above.

Students wishing to complete a PhD in Engineering with a concentration in a given area, must select at least four (12 credit hours) of the seven technical elective courses from one of the groups listed below. All selected concentration courses must be at PhD level. The concentration will be noted on the student's diploma and official transcript provided that the student fulfills the following requirements:

- Complete a minimum of four PhD level courses (12 credit hours) from the same concentration; and
- Complete a PhD research dissertation within the domain of the concentration.

The PhD elective courses are listed below under the various engineering concentration fields supported by the program. Students must take into account the above points when choosing their electives.

Aerospace Engineering

Concentration Field Courses

AERO 701	Nonlinear Structural Dynamics	4
AERO 702	Advanced Composite Materials and Structures	3
AERO 703	Numerical Methods in Aerofluids	4
AERO 711	Fracture Mechanics and Fatigue Or	3
MEEN 701/AERO 711	Fracture Mechanics and Fatigue	3
AERO 712	Damage Mechanics of Solids and Structures Or	3
MEEN 702	Damage Mechanics of Solids	3

	and Structures	
AERO 723	Advanced Combustion Or	3
MEEN 723/AERO 723	Advanced Combustion	3
AERO 761	Advanced Process Dynamics and Control Or	3
MEEN 761	Advanced Process Dynamics and Control	3
AERO 764	Optimal Control Or	3
MEEN 764	Optimal Control	3
AERO 765	Advanced Orbit Design for Planetary Missions	3
AERO 794	Selected Topics in Aerospace Engineering	4

Biomedical Engineering

Concentration Field Courses

BMED 711	Biomolecular and Cellular Engineering	3
BMED 712	Rehabilitation and Augmentation of Human Movement	3
BMED 713	Advanced Physiological Systems	3
BMED 716	Medical Device Innovation	3
BMED 725	Computational Systems Biology of Cancer	3
BMED 794	Selected Topics in Biomedical Engineering	4

Chemical Engineering

Concentration Field Courses

CHEG 700	Sustainable Desalination Processes Or	3
CIVE 714	Sustainable Desalination Processes	3
CHEG 703	Applied nanotechnology	3
CHEG 705	Membrane Technology Or	3
CIVE 717	Membrane Technology	3
CHEG 708	Phase Equilibria	3
CHEG 710	Kinetics and Mechanisms	3
CHEG 712	Physical and Chemical Treatment of Waters	3
CHEG 715	Biological Wastewater Treatment	3
CHEG 720	Modelling and Engineering of Microbial Environmental Bioprocesses	3
CHEG 730	Experimental Techniques and Instrumentation	3
CHEG 735	Electrochemical Engineering	3
CHEG 745	Multicomponent Mass Transfer	3
CHEG 750	Molecular Thermodynamics	3
CHEG 760	Non-Equilibrium Thermodynamics	3
CHEG 765	Computational Fluid Dynamics for Chemical Engineers	3
CHEG 770	Heterogeneous Catalysis	3
CHEG 790	Dynamic Behavior of Process Systems	3
CHEG 794	Selected Topics in Chemical Engineering	3

Civil Infrastructure and Environmental Engineering

Concentration Field Courses

CIVE 703	Groundwater Hydrology	3
CIVE 707	Environmental Remote Sensing and Satellite Image Processing	3
CIVE 712	Remediation Engineering	3
CIVE 714	Sustainable Desalination Processes Or	3
CHEG 700	Sustainable Desalination Processes	3
CIVE 717	Membrane Technology Or	3
CHEG 705	Membrane Technology	3
CIVE 718	Advanced Topics in Applied Environmental Chemistry	3
CIVE 719	Climate Dynamics	3
CIVE 720	Nanotechnology in Water Purification	3
CIVE 721	Aquatic Chemistry	3
CIVE 722	Solid and Hazardous Waste Management	3
CIVE 730	Public Transit Operations and Planning	3
CIVE 750	Non-Linear Mechanics of Construction Materials	3

CIVE 751	Non-Linear FE Analysis of Civil Engineering Structures	3
CIVE 755	Geotechnical Natural Hazards Mitigation	3
CIVE 756	Chemo-mechanical Modelling & Design of Flexible Pavements	3
CIVE 760	Construction Procurement Management	3
CIVE 761	Productivity Improvement in Construction	3
CIVE 762	Advanced Building Information Modeling	3
CIVE 794	Selected Topics in Civil Infrastructural and Environmental Engineering	3

Electrical and Computer Engineering

Concentration Field Courses

ECCE 701	Power System Modelling and Control	3
ECCE 703	Embedded Generation Operation and Control	3
ECCE 706	Power Quality and FACTS Devices	3
ECCE 710	Analysis of Power Systems Over-voltages and Transients	3
ECCE 711	Advanced Power System Grounding and Safety	3
ECCE 714	Application of Heuristic Optimization Techniques to Power Systems	3
ECCE 721	Analog Mixed Signal Design Techniques	3
ECCE 722	Numerical Simulation of Circuits and Systems	3
ECCE 723	High Speed Communication Circuits	3
ECCE 731	Distributed Computing	3
ECCE 732	Machine Learning and Applications	3
ECCE 733	High Speed Computer Arithmetic	3
ECCE 734	Advanced Computer Architecture	3
ECCE 735	Advanced Computer Vision Paradigms	3
ECCE 736	Advanced Topics LoT and Blockchain	3
ECCE 737	Network and Information Security	3
ECCE 738	High Performance Computing	3
ECCE 741	Advanced Digital Communications	3
ECCE 742	Advanced Concepts in Stochastic Processes, Detection, and Estimation Theory	3
ECCE 743	Broadband Communication Systems	3
ECCE 744	Optical Wireless Communication System	3
ECCE 751	Discontinuous Control Systems	3
ECCE 752	Nonlinear Control	3
ECCE 753	Computational Prototyping of Dynamical Systems	3
ECCE 754	Computational Prototyping of Partial Differential Equations	3
ECCE 755	Cognitive Robotics	4
ECCE 756	Robotic Perception	4
ECCE 762	Voltage Source Converters	3
ECCE 771	Advanced Integrated Circuits Technology	3
ECCE 772	Advanced Microsystem Design	3
ECCE 773	Photonic Materials and Metamaterials Design for Engineers	3
ECCE 774	Advanced Photonic Integrated Circuits	3
ECCE 778	Physics and Manufacturability of Advanced Micro and Nano Devices	3
ECCE 781	The Physics of Solar Cells	3
ECCE 794	Selected Topics in Electrical and Computer Engineering	4

Engineering Systems and Management

Concentration Field Courses

ESMA 701	Advanced Systems Optimization	3
ESMA 710	Times Series Analysis Modeling and Prediction	3
ESMA 711	Advanced Business Analytics	3
ESMA 720	Advanced Production and Operations Management	3
ESMA 721	Stochastic Processes and Applications	3
ESMA 722	Technology strategy	3
ESMA 730	Complex Network Analysis	3
ESMA 740	Sustainable Development: Theory & Policy	3
ESMA 741	Advanced Modeling for Energy Planning	3
ESMA 742	Energy Economics, Finance	3

	and Policy	
ESMA 743	Engineering for Energy and Poverty Solutions	3
ESMA 780	Advanced Urbanism: Urban Design Ideals and Action	3
ESMA 781	Modeling Urban Systems Energy Flow	3
ESMA 794	Selected Topics in Engineering Systems and Management	3

Material Science and Engineering

Concentration Field Courses

MSEN 701	Electrochemical Processes and Devices	3
MSEN 710	Advanced Solid State Physics	3
MSEN 712	Imaging of Materials: Scanning Electron Microscopy and X-ray Microanalysis	3
MSEN 715	Advanced Imaging of Materials: Transmission Electron Microscopy	3
MSEN 730	Science and Engineering of Thin Films, Surfaces and Interfaces	3
MSEN 740	Advances in Investigation of Intermolecular and Surface Forces	3
MSEN 750	HighEfficiency Silicon Solar Cells: Designs and Technologies	3
MSEN 760	Thin Film Solar Cells: From Design to Applications	3
MSEN 794	Selected Topics in Materials Science and Engineering	3

Mechanical Engineering

Concentration Field Courses

MEEN 701/AERO 711	Fracture Mechanics and Fatigue	3
	Or	
AERO 711	Fracture Mechanics and Fatigue	3
MEEN 702	Damage Mechanics of Solids and Structures	3
	Or	
AERO 712	Damage Mechanics of Solids and Structures	3
MEEN 703	Linear and Nonlinear Finite Element Methods	3
MEEN 704	Computational Inelasticity	3
MEEN 705/MSEN 705	Micromechanics of Materials	3
MEEN 706	Theory of Plasticity	3
MEEN 721	Computational Fluid Mechanics	3
MEEN 722	Non-Newtonian Fluid Dynamics	3
MEEN 723/AERO 723	Advanced Combustion	3
	Or	
AERO 723	Advanced Combustion	3
MEEN 724	Advanced Modeling of Cooling Systems	3
MEEN 725	Multiphase Flow in Porous Media	3
MEEN 741	Advanced Conduction and Radiation Heat Transfer	3
MEEN 742	Advanced Convection Heat Transfer	3
MEEN 743	Micro-Nano Energy Transport	3
MEEN 744	Interfacial Transport and Phase Change Heat Transfer	3
MEEN 745	Concentrated Solar Power and Thermal Energy Storage	3
MEEN 761	Advanced Process Dynamics and Control	3
	Or	
AERO 761	Advanced Process Dynamics and Control	3
MEEN 762	Analysis and Simulation of Mechatronics Systems	3
MEEN 763	Theory and design of digital control systems	3
MEEN 764	Optimal Control	3
	Or	
AERO 764	Optimal Control	3
MEEN 765	Acoustics and Noise Control	3
MEEN 766	MEMS Theory and Applications	3
MEEN 781	Materials Selection in Mechanical Design	3
MEEN 782	Materials Characterization Techniques	3
MEEN 791	Inference and Estimation from Models and Data	3

MEEN 792	Advanced Nanomaterials and Their Mechanical Applications	3
MEEN 794	Selected Topics in Mechanical Engineering	3

Nuclear Engineering

Concentration Field Courses

NUCE 701	Advanced Computational Methods of Particle Transport	3
NUCE 702	Nuclear Systems and Materials/Accident analysis	3
NUCE 703	Aging Management of Nuclear Materials	3
NUCE 704	The Reactor Core Design Analysis for light water reactors	3
NUCE 705	Nuclear Criticality Safety Assessment	3
NUCE 794	Selected Topics in Nuclear Engineering	3

Petroleum Engineering

Concentration Field Courses

PEEG 723	Stimulation of Conventional and Unconventional Reservoirs	3
PEEG 730	Fluid Flow and Transport Processes in Porous Media	3
PEEG 732	Hybrid Enhanced Oil Recovery	3
PEEG 733	Miscible Gas Flooding	3
PEEG 746	Emerging Well Construction Technology	3
PEEG 747	Horizontal and Multilateral Drilling and Completion	3
PEEG 749	Characterization and Modelling of Unconventional Reservoirs	3
PEEG 752	Simulation of Naturally Fractured Reservoirs	3
PEEG 794	Selected Topics in Petroleum Engineering	3

Robotics

Concentration Field Courses

ECCE 732	Machine Learning and Applicications	3
ECCE 735	Advanced Computer Vision Paradigms	3
ECCE 755	Cognitive Robotics	4
ECCE 756	Robotic Perception	4
MEEN 761	Advanced Process Dynamics and Control	3
	Or	
AERO 761	Advanced Process Dynamics and Control	3
MEEN 762	Analysis and Simulation of Mechatronics Systems	3
MEEN 763	Theory and design of digital control systems	3
MEEN 764	Optimal Control	3
	Or	
AERO 764	Optimal Control	3
MEEN 765	Acoustics and Noise Control	3
MEEN 767	Control of Robotic Systems	3
	Or	
ECCE 757	Control of Robotic Systems	3

PhD Research Dissertation (minimum 36 credit hours)

Students must complete a PhD Research Dissertation that involves novel, creative, research-oriented work under the direct supervision of at least one full-time faculty advisor from the College of Engineering, and at least one other full-time faculty who acts as a co-advisor. The Main Advisor of a student who opts for a PhD with a concentration must be a faculty member in the Department offering that particular concentration. The outcome of research should demonstrate the synthesis of information into knowledge in a form that may be used by others. The research findings must be documented in a formal Dissertation and defended successfully in a viva voce examination. Furthermore, the research must lead to publishable quality scholarly journal articles.

Dissertation

ENGR 799	PhD Research Dissertation	48

Topical Areas for Written Qualifying Examination (WQE)

Achieving PhD candidacy is contingent upon successfully passing a two-stage qualifying examination which is composed of a Written Qualifying Exam (WQE), followed by a Research Proposal Examination (RPE). For further details, please refer to the **"PhD Research Milestones"** section of this catalog.

The primary objective of the PhD Written Qualifying Exam (WQE) is to ensure that students pursuing a Doctoral degree in a particular concentration have graduate level understanding of the fundamentals of that concentration and evaluates the student's ability to apply them to solve problems in **three topical exam areas.** The syllabi for the topical exam areas are taken from undergraduate courses in the College of Engineering at Khalifa University.

Students must register for the PhD WQE in Banner before the end of the Add/Drop period of the semester in which they plan to take the exams. The student must choose three exam topical areas from an approved list, in consultation with his/her Main Advisor. Students enrolled in the PhD with a concentration must select at least two of the three topical areas from the list specific to their concentration. Students pursuing a multidisciplinary PhD must select topical areas relevant to their particular fields of research.

The exams are coordinated by the Associate Dean for Graduate Studies and the Chair of the relevant Department (or designee) and held twice per year over a one-week period. The duration of each exam is three hours. A minimum score of 73 percent is required to pass the exam for each topical area. Failing any topical area of the WQE will result in the student failing the entire WQE and placing him/her on Academic Probation Level 1. A failed WQE can be retaken only once and passed upon the next offering. If the student repeats the WQE, then he/she will be required only to retake the exams in the topical areas that he/she failed during the WQE at the first attempt. The student may opt to retake the exams in topical areas other than those he/she failed in at the first attempt. PhD students who fail the WQE at the second attempt will be placed on Academic Probation Level 2 and will be subject to dismissal from the PhD program.

The list of topical exam areas for each of the PhD in Engineering concentrations and their corresponding undergraduate course syllabi are given below. This list is subject to change.

Aerospace Engineering

Topical Exam Area: Aerodynamics

AERO 335	Aerodynamics I	4
AERO 336	Aerodynamics II	3

Topical Exam Area: Aerospace Materials and Manufacturing

AERO 320	Aerospace Materials	3
AERO 415	Aerospace Materials Manufacturing	3

Topical Exam Area: Astronautics

AERO 465	Space Dynamics and Control	3
AERO 485	Spacecraft Design	3
AERO 495	Special Topics in Aerospace Engineering	3

Topical Exam Area: Dynamics and Control

AERO 201	Engineering Dynamics	3
AERO 350	Dynamic Systems and Control	4
AERO 450	Flight Dynamics and Stability	3

Topical Exam Area: Mechanics of Solids and Structures

AERO 225	Mechanics of Solids	4
AERO 321	Aerospace Structures	3

Topical Exam Area: Thermodynamics and Propulsion

AERO 240	Thermofluids for Aerospace Engineering	4
AERO 440	Aerospace Propulsion	3

Biomedical Engineering

Topical Exam Area: Biochemistry

CHEG 210	Introduction to Biochemical Engineering	3

Topical Exam Area: Biomaterial Sciences and Engineering

BMED 411	Biomaterials	4

Topical Exam Area: Biomechanics

BMED 321	Mechanics for Biomedical Engineers	4
BMED 322	Functional Biomechanics	4

Topical Exam Area: Biomedical Signals

BMED 352	Fundamentals of Biomedical Signal Processing	4

Topical Exam Area: Genomics

BMED 413	Application of Bio-molecular Tools	3

Topical Exam Area: Molecular Biology

BMED 341	Molecular Cell Biology	4

Topical Exam Area: Physiology and Anatomy

BMED 211	Human Anatomy	4
BMED 212	Physiological Systems & Modeling II	4

Topical Exam Area: Transport Phenomena

BMED 331	Biotransport Phenomena	3

Chemical Engineering

Topical Exam Area: Chemical Engineering Thermodynamics

CHEG 230	Chemical Engineering Thermodynamics I	3
CHEG 332	Chemical Engineering Thermodynamics II	3

Topical Exam Area: Mass Transport Phenomena

CHEG 324	Mass Transfer	3
CHEG 485	Separation Processes	4

Topical Exam Area: Momentum and Heat Transport Phenomena

CHEG 232	Fluid Mechanics	4
CHEG 335	Heat Transfer	4

Topical Exam Area: Reaction Engineering

CHEG 443	Reaction Engineering	4

Topical Exam Area: Chemical Engineering Process Control

CHEG 412	Process Dynamics & Control	4

Civil Infrastructure and Environmental Engineering

Topical Exam Area: Atmospheric Pollution

CIVE 469	Air Pollution Control	3

Topical Exam Area: Behavior and Analysis of Structures

CIVE 225	Mechanics of Solids	4
CIVE 340	Behavior and Analysis of Structures	3

Topical Exam Area: Building Design

CIVE 341	Design of Steel Structures	3
CIVE 442	Design of Concrete Structures	3

Topical Exam Area: Construction Project Management

CIVE 332	Fundamentals of Construction Engineering & Management	3
CIVE 484	Project Planning, Scheduling and Control	3

Topical Exam Area: Environmental Engineering

CIVE 370	Introduction to Environmental Engineering	4

Topical Exam Area: Fluid Mechanics

CIVE 335	Fluid Mechanics	4

Topical Exam Area: Geotechnical and Foundation Engineering

CIVE 338	Geotechnical Engineering	4
CIVE 470	Foundation Engineering	4

Topical Exam Area: Hydrology

CIVE 465	Water Resources Management	3

Topical Exam Area: Pavement Engineering

CIVE 472	Pavements Design and Maintenance	3

Topical Exam Area: Transportation Engineering

CIVE 380	Transportation Engineering	3

Topical Exam Area: Water and Wastewater Treatment Technologies

CIVE 463	Water and Wastewater Treatment Technologies	3

Electrical and Computer Engineering

Topical Exam Area: Algorithms and Computing Theory

COSC 301	Automata, Computability, and Complexity	3
COSC 310	Data Structures	3
COSC 312	Design and Analysis of Algorithms	3

Topical Exam Area: Artificial Intelligence

COSC 330	Introduction to Artificial Intelligence	3
COSC 430	Data Analytics	3
ECCE 454	Artificial Intelligence	3

Topical Exam Area: Communication Systems

ECCE 360	Communication Systems	4
ECCE 362	Digital Communications I	3
ECCE 460	Wireless Communications	3

Topical Exam Area: Computer Architecture

ECCE 350	Computer Architecture and Organization	3
ECCE 450	Embedded Systems	3

Topical Exam Area: Computer and Network Security

ECCE 444	Computer Security	3
ECCE 446	Network Security	3

Topical Exam Area: Computer Systems

COSC 410	Parallel and Distributed Computing	3
ECCE 354	Operating Systems	3
ECCE 356	Computer Networks	4
ECCE 448	Cloud Infrastructure and Services	3

Topical Exam Area: Control Systems

ECCE 323	Feedback Control Systems	4

ECCE 428	Modern Control Systems	3
ECCE 429	Digital Control Systems	3

Topical Exam Area: Digital System Design

ECCE 408	Digital Systems Design	3
ECCE 410	VLSI Systems Design	3

Topical Exam Area: Electromagnetic Waves and Propagation

ECCE 320	Applied Electromagnetics	3
ECCE 470	Antennas and Propagation	3

Topical Exam Area: Electronic Devices and Circuits

ECCE 312	Electronic Circuits & Devices	4
ECCE 411	Analog Integrated Circuits Design	3

Topical Exam Area: Integrated Microelectronic Devices and Technology

ECCE 326	Introduction to Semiconductor Devices	4
ECCE 495	Special Topics in Electrical and Computer Engineering	3

Topical Exam Area: Power Electronics

ECCE 423	Power Electronics	3

Topical Exam Area: Power Systems and Electrical Machines

ECCE 322	Electrical Machines	4
ECCE 421	Power System Analysis	3
ECCE 425	Power System Stability and Control	3

Topical Exam Area: Signal Processing

ECCE 302	Signals and Systems	3
ECCE 402	Digital Signal Processing	3

Topical Exam Area: Software Engineering

ECCE 330	System Analysis & Software Design	3
ECCE 438	Software Architecture	3
COSC 452		

Engineering Systems and Management

Topical Exam Area: Applied Statistics and Quality Control

ISYE 311	Quality & Reliability Engineering	4
ISYE 431	Time Series Forecasting	3
MATH 242	Introduction to Probability and Statistics	3

Topical Exam Area: Engineering Economics

ISYE 200	Engineering Economic Analysis	3
ISYE 362	Systems Project Management	3
BUSS 201	Fundamentals of Accounting and Finance	3

Topical Exam Area: Operations Research and Optimization

ISYE 251	Operations Research 1	4
ISYE 430	Supply Chain and Logistics	4
ISYE 451	Operations Research 2	3

Topical Exam Area: Production and Facilities Planning

ISYE 341	Simulation Modeling and Analysis	4
ISYE 351	Production and Operations Management	3
ISYE 475	Facilities Planning and Warehousing	4

Material Science and Engineering

Topical Exam Area: Synthesis and Characterization of Materials

MEEN 225	Engineering Materials	4
MEEN 423	Physical Metallurgy	3

Topical Exam Area: Thermal and Mechanical Properties of Materials

MEEN 325	Mechanics of Solids	4
MEEN 343	Heat Transfer	4

Topical Exam Area: Thermodynamics and Kinetics of Materials

MEEN 240	Thermodynamics	3
CHEG 324	Mass Transfer	3

Mechanical Engineering

Topical Exam Area: Control and Mechatronics

MEEN 356	Computer-Controlled Systems	4
MEEN 484	Mechatronics	3

Topical Exam Area: Dynamics and Vibrations

MEEN 201	Engineering Dynamics	3
MEEN 350	Dynamic Systems and Vibration	3

Topical Exam Area: Engineering Mathematics

MATH 204	Linear Algebra	3

Topical Exam Area: Fluid Mechanics and Heat Transfer

MEEN 335	Fluid Mechanics	4
MEEN 343	Heat Transfer	4

Topical Exam Area: Solid Mechanics and Strength of Materials

MEEN 325	Mechanics of Solids	4
MEEN 420	Materials: Strength & Fracture	3

Topical Exam Area: Thermodynamics

MEEN 240	Thermodynamics	3
MEEN 441	Applied Thermodynamics	3

Nuclear Engineering

Topical Exam Area: Reactor Systems Design and Analysis

NUCE 303	Mechanics & Thermal-hydraulics Principles for Nuclear Engineering	3
NUCE 401	Introduction to Nuclear Reactor Physics	3
NUCE 402	Introduction to Nuclear Systems and Operation	3

Topical Exam Area: Nuclear Material Science Engineering

NUCE 303	Mechanics & Thermal-hydraulics Principles for Nuclear Engineering	3
NUCE 401	Introduction to Nuclear Reactor Physics	3

Topical Exam Area: Radiation Safety in the Environment

NUCE 301	Radiation Science & Health Physics	3
NUCE 401	Introduction to Nuclear Reactor Physics	3

Petroleum Engineering

Topical Exam Area: Reservoir Engineering

PEEG 331	Reservoir Engineering I	3
PEEG 334	Reservoir Engineering II	4

Topical Exam Area: Drilling Engineering

PEEG 322	Drilling Engineering I	3
PEEG 326	Drilling Engineering II	3

Topical Exam Area: Production Engineering

PEEG 442	Surface Production Facilities	3
PEEG 443	Production System Design and Analysis	3

Robotics

Topical Exam Area: Control and Mechatronics

MEEN 356	Computer-Controlled Systems	4
MEEN 484	Mechatronics	3

Topical Exam Area: Signal Processing

ECCE 302	Signals and Systems	3
ECCE 402	Digital Signal Processing	3

Topical Exam Area: Computer Architecture and Networks

ECCE 350	Computer Architecture and Organization	3
ECCE 356	Computer Networks	4
ECCE 450	Embedded Systems	3

Study Plan

A typical study plan for students enrolled in the PhD in Engineering is shown below. All courses in the study plan are 3 credit hours each. PhD Research Seminar I & II are zero credit each.

Typical Study Plan for Full-Time Students

- ENGR 701 Research Methods in Eng.
- Core Course 1
- Core Course 2
- Core Course 3

- Technical Elective 1
- Technical Elective 2
- Technical Elective 3

- Technical Elective 4
- Technical Elective 5
- ENGR 799 PhD Research Dissertation

- ENGR 799 PhD Research Dissertation
- *ENGR 795 PhD Written Qualifying Exam*

- Technical Elective 6
- ENGR 703 PhD Research Seminar I
- ENGR 799 PhD Research Dissertation

- Technical Elective 7
- ENGR 799 PhD Research Dissertation
- *ENGR 796 PhD Research Proposal Exam*

- Technical Elective 8
- ENGR 799 PhD Research Dissertation

- ENGR 703 PhD Research Seminar II
- ENGR 799 PhD Research Dissertation

- ENGR 799 PhD Research Dissertation
- ENGR 799 PhD Research Dissertation
- *Final Doctoral Dissertation Exam*

College of Medicine and Health Sciences

Doctor of Medicine

About the Program

The 4-year course of study leading to the Doctor of Medicine (MD) degree employs leading-edge learning and clinical experiences to enable students to gain the competencies expected of all physicians, with an emphasis on providing technology enhanced personalized, preventive and community care. The program prepares students for postgraduate study in any specialty, for licensure, and for future medical practice. KU's Doctor of Medicine program incorporates innovative curricular design that promotes scientific inquiry, critical thinking and comprehensive clinical expertise in preparing physicians to be life-long adaptive learners. Overall, the program evolves medical education in such a way as to prepare physicians for the next 20 years and beyond.

Program Educational Objectives

The goals of the Khalifa University CMHS Doctor of Medicine degree program are to:

1. Provide an integrated clinical and research experience in a singular postgraduate level medical education program;
2. Educate and inspire a diverse workforce of physicians who understand the needs of patients, are able to communicate across cultures, and collaborate with diverse teams;
3. Prepare physicians who are able to seamlessly integrate technology into areas such as personalized and preventative care, artificial intelligence, population health, augmented reality and nanotechnology;
4. Prepare medical students and residents to serve as specialty physicians and to practice evidence-based medicine in the healthcare and hospital systems of Abu Dhabi and the United Arab Emirates;
5. Attract and retain a diverse and talented faculty dedicated to providing outstanding medical education and supporting the professional development of medical students;
6. Respond to stakeholder and government needs for medical education leading to clinicians who can serve the healthcare needs of the United Arab Emirates; and
7. Be an essential contributor to the development and enhancement of the existing healthcare ecosystem of Abu Dhabi.

Program Learning Outcomes

The MD program learning outcomes are adapted from the Association of American Medical Colleges (AAMC) Physician Competency Reference Set (PCRS). Upon successful completion of the program, MD graduates will be able to:

1. Demonstrate knowledge of established and evolving biomedical, clinical, epidemiological and social-behavioral sciences, as well as the application of this knowledge to patient care.
2. Apply established and emerging bio-physical scientific principles fundamental to health care for patients and populations.
3. Make informed decisions about diagnostic and therapeutic interventions based on patient information and preferences, up-to-date scientific evidence, and clinical judgment.
4. Apply principles of epidemiological sciences to the identification of health problems, risk factors, treatment strategies, resources, and disease prevention/health promotion efforts for patients and populations.
5. Demonstrate interpersonal and communication skills that result in the effective exchange of information and collaboration with patients, their families, and health professionals.
6. Gather essential and accurate information about patients and their conditions through history-taking, physical examination, and the use of laboratory data, imaging, and other tests.
7. Develop and carry out patient management plans.
8. Provide appropriate referral of patients, including ensuring continuity of care throughout transitions between providers or settings, and following up on patient progress and outcomes.
9. Apply established and emerging principles of clinical sciences to diagnostic and therapeutic decision-making, clinical problem-solving, and other aspects of evidence-based health care.
10. Perform all medical, diagnostic, and surgical procedures considered essential for the area of practice.
11. Maintain comprehensive, timely, and legible medical records.
12. Provide patient-centered care that is compassionate, appropriate, and effective for the treatment of health problems and the promotion of health.
13. Contribute to the creation, dissemination, application, and translation of new health care knowledge and practices.

14. Demonstrate an awareness of and responsiveness to the larger context and system of health care, as well as the ability to call effectively on other resources in the system to provide optimal health care.
15. Analyze practice systematically using quality improvement methods, and implement changes with the goal of practice improvement.
16. Demonstrate the ability to utilize emerging technologies and to advance medical knowledge through research and innovation to improve the health of individuals and the community.
17. Demonstrate sensitivity, honesty, and compassion in difficult conversations, including those about death, end of life, adverse events, bad news, disclosure of errors, and other sensitive topics.
18. Demonstrate the qualities required to sustain lifelong personal and professional growth.
19. Apply principles of social-behavioral sciences to provision of patient care, including assessment of the impact of psychosocial and cultural influences on health, disease, care-seeking, care compliance, and barriers to and attitudes toward care.
20. Advocate for quality patient care and optimal patient care systems.
21. Counsel and educate patients and their families to empower them to participate in their care and enable shared decision making.
22. Demonstrate the ability to engage in an interprofessional team in a manner that optimizes safe, effective patient- and population-centered care
23. Demonstrate a commitment to carrying out professional responsibilities and an adherence to ethical principles.
24. Demonstrate the ability to investigate and evaluate one's care of patients, to appraise and assimilate scientific evidence, and to continuously improve patient care based on constant self-evaluation and lifelong learning.
25. Demonstrate accountability in one's conduct and performance in delivering health services, improving people's welfare, and protecting human rights.

Competency Domains

The four-year course of study leading to the Doctor of Medicine degree at Khalifa University is based on development of competencies across ten domains. These competencies provide a summary of what graduates of the program are expected to demonstrate in the workplace after graduation, as residents, fellows, and clinical practitioners. They are based on the needs of the program's constituencies. The ten domains are:

- Patient Care
- Knowledge for Practice
- Practice-Based Learning and Improvement
- Interpersonal and Communication Skills
- Professionalism
- Systems-Based Practice
- Inter-Professional Collaboration
- Personal and Professional Development
- Technology Enhanced Healthcare
- Social Accountability

Entrustable Professional Activities

Entrustable Professional Activities (EPAs) for Entering Residency provide expectations for both learners and teachers that include 13 activities that all medical students should be able to perform upon entering residency, regardless of their future career specialty. EPAs offer a practical approach to assessing competence in real-world settings. During your time as a student, your competency in performing the EPAs is documented in an e-portfolio that can be shared with residency directors to provide clear demonstration that you can successfully perform the activities required for entrance into residency. The 13 core EPAS are:

• EPA 1 Gather a history and perform a physical examination.

• EPA 2 Prioritize a differential diagnosis following a clinical encounter.

• EPA 3 Recommend and interpret common diagnostic and screening tests.

• EPA 4 Enter and discuss orders and prescriptions.

• EPA 5 Document a clinical encounter in the patient record.

• EPA 6 Provide an oral presentation of a clinical encounter.

• EPA 7 Form clinical questions and retrieve evidence to advance patient care.

• EPA 8 Give or receive a patient handover to transition care responsibility.

• EPA 9 Collaborate as a member of an inter-professional team.

• EPA 10 Recognize a patient requiring urgent or emergent care and initiate evaluation and management.

• EPA 11 Obtain informed consent for tests and/or procedures.

• EPA 12 Perform general procedures of a physician.

• EPA 13 Identify system failures and contribute to a culture of safety and improvement.

Program Structure and Requirements

Overall Program Structure

The MD degree curriculum integrates basic and clinical science instruction across four sequential periods of study designed to prepare the medical student for entry into any residency program and for the subsequent practice of medicine. Four longitudinal strands run throughout the program:

- Biomedical Science
- Clinical Medicine
- Medicine and Society
- Research, Technology and Innovation

The MD program is a full-time cohort-based program. The minimum period of study is four years from the date of first matriculation as a degree student, with a maximum period of study of six years. Study is considered to commence from first enrollment in degree courses as a fully admitted (matriculated) medical student. The duration of the entire program will never be less than 130 weeks. Courses and clerkships are delivered at the Main Campus medical program facilities of Khalifa University (Buildings A and B) and at affiliated hospitals and clinics.

Program Requirements

The learning pathway for the Doctor of Medicine degree is presented in Table 1. The curriculum is divided into four periods of study, comprising foundations of medicine (Period 1), integrated organ systems (Period 2), core clinical clerkships (Period 3), and advanced clinical rotations (Period 4). Coursework is multidisciplinary and features a case-based format in which biomedical sciences are delivered to the students in a clinical context. Clinical experiences in primary care and emergency settings begin in the first period of study with coordinated opportunities for practical application of basic knowledge, skills, and reasoning (the Clinical Medicine strand). Students participate in the Abu Dhabi health sector to engage with the community in a program to enhance medical and preventative health practices, the Balsam Community Health Learning Program (Balsam - Barnamij L-Ta‘leem Sehat al-Mujtama (بَلسمْ - برنامج لتعليم صحة المجتمع)).

Period 1 focuses on the study of the foundations of medicine. The period starts with Transitions I, which is an orientation to medical education and the practice of medicine. Students are welcomed into their learning community, meet with a learning specialist to identify their learning styles, and are introduced to the diverse educational pedagogies used in the MD program, such as team-based learning and the flipped classroom. The Biomedical Science strand covers foundational topics in molecular and cellular biology; human genetics; human anatomy, histology and embryology; physiology and immunology; pathology; microbiology and infectious disease; and, pharmacology and therapeutics. An introduction to clinical skills in the Clinical Medicine strand focuses on doctor–patient communication, history-taking, general physical examination skills and basic clinical procedures. Clinical skills training includes simulation, standardized patient, and real-world experiences, including half day preceptorship in primary-care clinics and emergency departments. Impeded within this strand are physicianship-focusesd sessions which introduce students to professional identity formation, medical professionalism and ethics, career selection, and personal health and wellness. The Medicine and Society strand introduces students to healthcare systems, social determinants of health, and the roles physicians hold in society. The strand also prepares students to participate in Balsam during Period 2 (explained below). During the Research, Technology and Innovation strand, students review the basics of medical research, human subjects research, epidemiology and biostatistics, and evidence-based medicine. Students undergo CITI training and are paired with a research mentor to identify a required research project which will continue throughout the four years of study.

Period 2 focuses on the in-depth study of human biology, disease, illness, and injury organized by the major organ-systems; specifically, the cardiovascular, respiratory, renal, integumentary, musculoskeletal, gastrointestinal, hematopoietic, lymphoreticular, endocrine, reproductive, nervous and behavioral systems. Clinical correlations tie the biomedical sciences to medical practice. In the Clinical

Medicine strand, students build upon their clinical skills by performing targeted histories and physical exams, developing differential diagnoses, and formulating evidenced-based diagnostic and therapeutic strategies. Within this strand, a set of physicianship-focusesd sessions are set to help students identify potential career pathways while continuing to explore their own personal and professional development. They also continue to participate in half-day rotations at outpatient clinics and emergency rooms. The Medicine and Society strand focuses on systems of care, healthcare policy and advocacy, medical jurisprudence, interprofessional healthcare, community-based healthcare, and end-of-life care. During Period 2, students begin their service-learning study with participation in the Balsam Community Health Learning Program (Balsam - Barnamij L-Ta‘leem Sehat al-Mujtama (برنامج لتعليم صحة المجتمع - بَلسمْ), a service-learning program that focuses on home-based healthcare. Students move forward with their research projects during Period 2.

<u>Period 3</u> begins the intensive clinical training phase and consists of eight (8) core clerkships: Surgery, Internal Medicine, Neurology, Medical Imaging, Family Medicine, Obstetrics and Gynecology, Pediatrics, and Psychiatry. All students take these same core clerkships although not in the same order. During these clerkships, students spend the majority of the week at affiliated hospitals and clinics, gaining experience in both inpatient and outpatient areas. They work with faculty clerkship directors and preceptors, residents, fellows, and other healthcare professionals. One day each week, students participate in formal lectures, case-based small group sessions and/or simulation training as part of the Medical Science in Clinical Practice course. These experiences provide students a third opportunity to integrate learning objectives from the core biomedical with the practice of clinical medicine. Students continue to participate in the Balsam Community Health Learning Program during Period 3, work or complete their required research project, build upon their clinical skills, and further explore career opportunities and pathways to specialty training through the three strands.

<u>Period 4</u> builds on the clerkship experiences and prepares students to enter their chosen field of specialization after graduation. All students must complete rotations in Emergency Medicine and Advanced Medicine and a Sub-Internship experience. Advanced Medicine (Internal Medicine, Obstetrics and Gynecology, Pediatrics, or Surgery) provides the students progressively greater responsibilities, while the Sub-internship rotation requires students to take on the role of intern under direct supervision by faculty, residents, and other healthcare providers. Additional six elective rotations give students the latitude to follow a pathway of emphasis, consistent with their long-term career goals, or to explore other areas of interest. The Clinical Medicine, Medicine and Society, and Research, Technology and Innovation continue to run through P4 where students work on finalizing requirements and projects related to these strands. At the end of Period 4, all students participate in a clinical medicine capstone that is intended to prepare them for their chosen residency.

Program Core

The curriculum includes required core content from the biomedical, behavioral, and socioeconomic sciences to support the medical student's mastery of contemporary scientific knowledge and concepts and the methods fundamental to applying them to the health of individuals and populations. The table below provides a list of core courses that are offered in the Doctor of Medicine program.

MD Program Curriculum Learning Pathway

Clinical Experience

The clinical experience is integral to the curriculum. Students begin clinical training (the Clinical Medicine strand) early in the first year by encountering basic medical conditions in outpatient settings; clinical training advances progressively to include exposure to more complex cases and conditions in hospital settings, and culminates in subinternship experiences. The Period 3 curriculum includes clinical experiences in both inpatient and ambulatory settings appropriate for the achievement of required clinical experiences. Each medical student participates in at least one clinical clerkship in a health care setting in which he/she works with resident physicians currently enrolled in an accredited program of graduate medical education.

Program Electives (Pathways)

Independent scholarship and broad elective opportunities in the fourth year encourage students to explore personal interests and build competency through pathways in preparation for advanced postgraduate study and practice in a specialty area. Differentiation in training occurs during Period 4 when students choose six electives (24 credits) and participate in an advanced medicine rotation, emergency medicine, and a subinternship (see Period 4 description above). Electives may be chosen from a list of choices within Khalifa University affiliated institutions or at other institutions locally, regionally, or internationally.

Required Courses

MDCM 900	Emergency Medicine	4
MDCM 901	Advanced Medicine	4
MDCM 903	Sub Internship	4
MDCM 904	Elective 1	4
MDCM 905	Elective 2	4
MDCM 906	Elective 3	4
MDCM 907	Elective 4	4
MDCM 908	Elective 5	4
MDCM 909	Elective 6	4
MDCM 999	Transitions V & Capstones	0

MDCM 901 and MDCM 903: Internal Medicine, Obstetrics and Gynecology, Pediatrics, or Surgery.

Study Plan

A typical study plan for a Doctor of Medicine degree student is shown below. The number of credits assigned for each course in Periods 1 and 2 is determined based on workload expectations: one credit is equivalent to approximately 15 hours of formal instruction. The total workload expectation per credit is equivalent to approximately 45 hours, including instruction, study, and assessments. A 3- to 4-hour laboratory, case-based, or clinic session is quantitatively equivalent to one formal instructional hour and presumes that the activity time includes most of the study or preparation normally associated with 1 hour of lecture. The limit for formal instruction during Periods 1 and 2 is 25 hours weekly, which results in a weekly workload of up to 75 hours.

Student workload during Periods 3 and 4 is designed to ensure an appropriate balance between formal teaching and service. All medical students rotating through clerkships, electives, and subinternships are required to comply with established limitations on duty hours. Duty hours should be limited to 80 hours per week, averaged over a 4-week period and inclusive of all in-house call activities. Continuous on-site duty, including in-house call, should not exceed 24 consecutive hours. Students may remain on duty for up to six additional hours to participate in didactic activities, transfer care of patients, conduct outpatient clinics, and maintain continuity of medical and surgical care. Students must be provided with one day in seven free from all educational and clinical responsibilities, averaged over a 4-week period and inclusive of call. Students must be provided adequate time for rest and personal activities. This should optimally be a 10-hour time period between all daily duty periods and after in-house call. Each student is expected to choose electives for Period 4 in consultation with her/his academic advisor, the Associate Dean for Clinical Affairs, Associate Dean for Academic Affairs, and Assistant Dean for Medical Education.

Period 1 (August – March)

Courses

Code	Course Title	Credits	Duration
MDPS 600	Transitions I	0	1 week
MDBS 601	Molecules, Genes and Cells	6	6 weeks
MDBS 602	Introduction to Anatomy	4	4 weeks
MDBS 603	Introduction to Physiology and Immunology	5	5 weeks
Winter Break: 2 Weeks			
MDBS 604	Pathology	3	3 weeks
MDBS 605	Microbiology and Infectious Diseases	3	3 weeks
MDBS 606	Pharmacology and Therapeutics	4	4 weeks
MDCM 600	Practice of Medicine I	8	26 weeks
MDMS 600	Medicine and Society I	3	26 weeks
MDRT 600	Research, Technology, and Innovation I	3	26 weeks
MDBS 607	Innovation and Entrepreneurship in Medicine	0	26 weeks

Period 1 Assessments

Spring Break: 1 Week

Period 2 (April – March)

Courses

Code	Course Title	Credits	Duration
MDBS 701	Cardiovascular and Respiratory Systems	6	6 weeks
MDBS 708	Renal System	3	3 weeks
MDBS 703	Integumentary System	2	2 weeks
Summer Break: 6 Weeks			
MDBS 704	Musculoskeletal System	3	3 weeks
MDBS 705	Gastrointestinal System	4	4 weeks
MDBS 702	Hematopoietic and Lymphoreticular Systems	3	3 weeks
MDBS 706	Endocrine System	3	3 weeks
MDBS 707	Reproductive System	3	3 weeks
Winter Break: 3 Weeks			
MDBS 709	Nervous System and Special Senses	6	6 weeks
MDBS 710	Behavioral Science	3	3 weeks
MDCM 700	Practice of Medicine II	8	38 weeks
MDMS 700	Medicine and Society II	3	38 weeks
MDRT 700	Research, Technology, and Innovation II	3	38 weeks
MDBS 607	Innovation and Entrepreneurship in Medicine	0	26 weeks

Period 2 Assessments

Spring Break: 1 Week

Period 3 (April – March)

Clerkships

Code	Course/Clerkship Title	Credits	Duration
MDPS 801	Transitions III	0	6 weeks
MDCM 801	Internal Medicine Clerkship	8	8 weeks
MDCM 802	Surgery Clerkship	8	8 weeks
MDCM 803	Medical Imaging Clerkship	4	4 weeks
MDCM 804	Neurology Clerkship	4	4 weeks

MDCM 805	Obstetrics and Gynecology Clerkship	6	6 weeks
MDCM 806	Pediatrics Clerkship	6	6 weeks
Winter Break: 3 Weeks			
MDCM 807	Psychiatry Clerkship	6	6 weeks
MDCM 808	Family Medicine Clerkship	6	6 weeks
MDBS 800	Medical Science in Clinical Practice	3	48 weeks
MDMS 800	Medicine and Society III	3	48 weeks
MDPS 800	Practice of Medicine	3	48 weeks
MDRT 800	Research, Technology, and Innovation III	3	48 weeks

Period 3 Assessments

Preparation for IFOM and Other Examinations Required for Application to Residency

Period 4 (April – May)

Advanced Clinical Rotations

Code	Clinical Rotation Title	Credits	Duration
MDCM 900	Emergency Medicine	4	4 weeks
MDCM 901	Advanced Medicine (Internal Medicine, Obstetrics and Gynecology, Pediatrics, or Surgery)	4	4 weeks
MDCM 903	Sub-Internship (Internal Medicine, Obstetrics and Gynecology, Pediatrics, or Surgery)	4	4 weeks
MDCM 904	Elective 1	4	4 weeks
MDCM 904	Elective 2	4	4 weeks
MDCM 904	Elective 3	4	4 weeks
MDCM 904	Elective 4	4	4 weeks
MDCM 905	Elective 5	4	4 weeks
MDCM 905	Elective 6	4	4 weeks
MDMS 900	Medicine and Society IV	3	38 weeks
MDPS 900	Physicianship IV	3	38 weeks
MDRT 900	Research, Technology, and Innovation IV	3	38 weeks
MDCM 999	Transitions V and Clinical Medicine Capstone	0	4 weeks

Courses

AERO - Aerospace Engineering

AERO 611 - Combustion Theory and Applications (3)

Combustion thermo-chemistry of different fuels, adiabatic flame temperature and combustion products composition, chemical kinetics and important combustion chemical mechanisms, ideal flow reactors, laminar premixed flames, diffusion flames including liquid droplet and solid particle combustion, turbulent premixed and non-premixed flames, pollutant emissions and control. All of the above are treated with emphasis on a wide variety of practical applications that motivate or relate to the various theoretical concepts and current research interests.

Offered: Fall.

AERO 620 - Advanced Aerodynamics (3)

This course aims at providing a graduate level understanding of the analytical treatment of incompressible aerodynamics. General and exact solutions of potential flow are revisited and expanded upon, fortifying the aerospace student's undergraduate knowledge and introducing students from other undergraduate tracks to the fundamentals of modern analytical aerodynamics. This knowledge is then built upon with the treatment of unsteady potential flow, the introduction to the laminar boundary layer solutions and the coupling between the external flow (potential flow) and the viscous flow in the boundary layer.

Offered: Fall.

AERO 621 - Boundary Layer Analysis (3)

Introduction to Boundary Layer concept, Review of Navier-Stokes Equations; Integral Equations and Solutions for Laminar Flows; Differential Equations of Motion for Laminar Flow; Exact and Numerical Solutions for Laminar, Incompressible Flows; Compressible Laminar Boundary Layers: Transformations, Exact and Numerical Solutions; Transition to Turbulent Flow: Re-Theta, Hydrodynamic Stability Theory, The eN method; Wall Bounded, Incompressible Turbulent Flows; Free Shear Flows: Jets and Wakes.

AERO 622 - Structural Dynamics and Aeroelasticity (3)

To develop an understanding and skills for performing an accurate dynamic analysis (time and frequency response, mode shapes and resonance frequencies) for dynamical structures that give the student a strong engineering sense for the real life applications. In addition, the course will give the student the ability of understanding the interaction between the elastic structure with the static and the aerodynamic forces that influence the aircraft performance and stability.

Offered: Fall.

AERO 623 - Experimental Methods in Aerodynamics (3)

This course is intended for graduate students who plan to perform experimental research in aerodynamics/fluid mechanics. Students will become familiar with major types of experimental facilities used in aerodynamics. They will be exposed to the theoretical background of distinct types of measurement techniques. Students will apply the data analysis techniques on real-life scientific data-sets, write a detailed report and give a presentation on their findings and conclusions. Practical demonstrations of available experimental techniques will be organized.

AERO 630 - Aerospace Materials and Structures (3)

Graduate level course with advanced treatment in aircraft structures and aerospace materials. Topics include loads on aircraft, functions of structural components, bending of beams with non-symmetrical cross-sections, bending and torsion of thin-walled structures, structural idealization, multi-cell beams, fuselage, tapered beams, Shear and bending analysis in thin walled laminated composite beams, and recent developments in aerospace materials.

Offered: Fall Spring.

AERO 631 - Mechanics of Composite Materials (3)

Graduate level course with advanced treatment in mechanics of composite materials. Topics include analysis and design of composite materials for aerospace structures, micromechanics, anisotropic elasticity, elastic behavior and strength of lamina, laminated plate theory, failure analysis of laminates, effects of temperature and humidity, interface mechanics, stress analysis methods for composite structures made of beams, laminates, sandwich plates, and thin shells, stability of composite structures, and experimental characterization of composite materials.

Offered: Spring.

AERO 632 - Advanced Composite Materials Manufacturing (3)

Graduate level course with advanced knowledge on composite materials and their manufacturing techniques. Principles of composites, various types of reinforcements, core materials, their properties and their interactions during composite manufacturing. Review of the manufacturing methods for composite materials with special emphasis on polymer matrix composites; analysis of fiber processing techniques, interfacial treatments, and composites fabrication methods; analytical treatment of process modeling including heat transfer, cure kinetics, resin flow, and residual stresses.

Offered: Fall.

AERO 640 - Advanced Flight Dynamics and Control (3)

Graduate level course with advanced treatment of flight dynamics and control. The course focuses on fixed-wing aircraft and introduces the flight mechanics aspects of rotary-wing aircraft. Topics include, longitudinal and lateral-directional flight motions, stability derivative expressions, effect of nonlinearity, flight under disturbances, flying and handling qualities, modern control theories relevant to flight dynamics, flight control strategies, stability augmentation systems, and autopilots/flight simulators.

Offered: Spring.

AERO 650 - Space Systems Engineering (3)

This course provides the fundamentals of space mission engineering. Starting from the physics of the space environment and orbital mechanics, it demonstrates how to develop the design of a space system from the initial mission objective, through requirements definition, concept development and trade-off. Then it analyses the main subsystems of a spacecraft: thermal, power, structures, mechanism, propulsion, attitude determination and control, communications, telemetry, tracking and command.

Offered: Fall Spring.

AERO 651 - Space Systems Design Project I (1)

This laboratory course provides hands-on formation on satellite subsystems, satellite integration and testing by means of an educational satellite and direct experience on systems modeling/development through a team project.

Corequisite: AERO650. Offered: Spring.

AERO 652 - Space Systems Design Project II (2)

This laboratory course builds on the work done in AERO 651 Space Systems Design Project I. It provides hands-on formation on satellite subsystems, satellite integration and testing by means of an educational satellite and direct experience on systems modeling/development through a team project.

Prerequisite: AERO 651.

AERO 653 - Space Propulsion (3)

The course focuses on rocket propulsion systems, their physics, their performance, their sizing and their mission design. Students are exposed to ideal rocket propulsion system performance prediction as well as the effects associated with deviations from ideal behavior. Propulsion system design is emphasized with a discussion on mission requirements, and launch analysis is included to enable complete sizing studies. The course provides an understanding of the thermo-fluid dynamic concepts underlying rocket space propulsion and their implications for launch vehicle and spacecraft system performance and design. Combustion and thermochemistry provide the theoretical foundations to understand chemical engines. Basics of electrical and electromagnetic thrusters are also taught.

Prerequisite: AERO 650.

AERO 654 - Astrodynamics and Mission Analysis (3)

This course elaborates the fundamental concepts of spaceflight orbital mechanics and introduces trajectory design for planet-centered and interplanetary missions. It starts with a short review of the two-body problem and introduces the design and characterization of planet-centered orbits in the presence of perturbations and related orbit transfer maneuvers. It provides the link between mission requirements and orbit planning. Then, it focuses on interplanetary trajectory design and gravity assist maneuvers. Eventually, it introduces to concepts of dynamical system theory applied to missions to and around the libration points of the circular restricted three-body problem and to trajectory design with low-thrust propulsion.

Prerequisite: AERO650. Offered: Fall Spring.

AERO 660 - Aerospace Navigation and Guidance Systems (3)

This course covers navigation and guidance technologies adopted in contemporary aerospace vehicles including remotely piloted and autonomous aerospace platforms.

These include navigation and guidance requirements, positioning and navigation techniques, navigation sensors, guidance schemes, trajectory optimization, and test and evaluation of navigation and guidance systems.

Offered: Fall.

AERO 694 - Selected Topics in Aerospace Engineering (4)

This course covers selected contemporary topics in aerospace engineering. The topics will vary from semester to semester depending on faculty availability and student interests. Proposed course descriptions are considered by the Department of Aerospace Engineering on an ad hoc basis and the course will be offered according to demand. The proposed course content will need to be approved by the Graduate Studies Committee. The Course may be repeated once with change of contents to earn a maximum of 6 credit hours.

Offered: Spring.

AERO 699 - Master's thesis (9)

In the Master's Thesis, the student is required to independently conduct original research-oriented work related to important aerospace engineering problems under the direct supervision of a main advisor, who must be a full-time faculty in the Aerospace Engineering Department, and at least one other full-time faculty who acts as co-advisor. The outcome of the research should demonstrate the synthesis of information into knowledge in a form that may be used by others and lead to publications in suitable journals/conferences. The student's research findings must be documented in a formal thesis and defended through a viva voce examination.

Corequisite: ENGR695. Offered: Fall Spring Summer.

AERO 701 - Nonlinear Structural Dynamics (4)

Basics of Linear Vibrations: Development of model nonlinear systems: Nonlinear Response Phenomena in Structural Vibratory Systems (combined lectures and student reading of current literature): Reduced Order Modeling for Nonlinear Multi-DOF Systems: Experimentation, data analysis, and simulation (combined lecturing and student reading of current literature).

Offered: Fall Spring.

AERO 702 - Advanced Composite Materials and Structures (3)

Introduction to fiber reinforced composites. Fibers and resin materials. Manufacturing techniques. Analysis of composite structures. Finite element analysis of composite structures. Lamina strength, Delamination, Fracture and failure. Sandwich composite beam. Woven and draped fabric composites. Multi-functional composites, heat and electrical conductivity. Fundamental concepts and principles of nanotechnology.

Offered: Fall Spring.

AERO 703 - Numerical Methods in Aerofluids (4)

Governing Equations. Computational Grids. Discrete Modeling. Numerical Solution of Elliptic Equations. Solution of 1-D, Unsteady Parabolic and Hyperbolic Equations. Solution of the 2-D, Unsteady Euler Equations. Boundary Condition Treatment.

Offered: Fall.

AERO 711 - Fracture Mechanics and Fatigue (3)

Concept of linear elastic fracture mechanics, stress intensity factor, Griffith energy balance, determination of the elastic field at a sharp crack tip, J integrals analysis, experimental determination of fracture toughness, elastic plastic fracture mechanics, fatigue crack growth, elastic-plastic crack tip fields, critical crack sizes and fatigue crack propagation rate prediction. Fracture mechanisms and fracture modes associated with failure of engineering materials.

Offered: Fall Spring.

AERO 712 - Damage Mechanics of Solids and Structures (3)

This course aims to teach students the basic mechanisms of damage (degradation) and fracture (cracking) and how to develop theoretical models and computational algorithms that can be used in simulating and understanding damage evolution, fracture, and ultimate failure of various engineering materials, composites, and structural systems and devices. Damage and fracture in various brittle and ductile materials and their engineering implications will be studied. Formulation of time-independent and time-dependent damage and fracture models taking into consideration linear and nonlinear material behavior will be discussed in this course. Modeling of damage and fracture due to various loading conditions (e.g., mechanical, thermal, chemical, electrical, fluid) will be presented. Also, the capabilities and limitations of well-known damage and fracture models for various applications will be assessed.

Offered: Fall.

AERO 723 - Advanced Combustion (3)

Extend the combustion theory and applications course and draws the connection between reactive flow, combustion fundamentals, combustion engineering, flames, and aerodynamics interactions. The main topics will focus on the following areas: Reactive flow transport phenomena, chemical kinetics, preferential-diffusion and flame stretch interaction, reaction mechanism reduction, combustion engineering, Biofuel combustion characterization, hydrodynamic and aerodynamic flame stability, oxygen enhanced combustion, combustion driven acoustics and vibration, fire dynamic simulation, combustion mechanisms in spark ignition and compression ignition engines, flamelet models for CFD combustion. A wide variety of practical models and applications related to the various concepts as well as experimental methods and diagnostics will be covered in lab and through literature survey.

AERO 761 - Advanced Process Dynamics and Control (3)

This course aims to provide multidisciplinary fundamentals and solid mathematical foundation of modern energy process systems engineering. It presents a systematic framework for physics-based and empirical dynamic process modeling, transient analysis, feedback control and optimization. This course is particularly dedicated to the most popular advanced control strategy in energy process industries - model predictive control (MPC). Other optimal control approaches are also introduced to deal with plant disturbances, uncertainties, nonlinearities, instabilities and constraints. This course emphasizes the use of advanced math tools to develop dynamic models and design advanced controllers for energy process systems.

Offered: Spring.

AERO 764 - Optimal Control (3)

This course is designed to teach students methods of optimal control and parameter estimation using Linear Quadratic Gaussian design approach, optimal control theory of non-deterministic systems, optimal control of nonlinear and time-varying systems with known inputs, as well as parameters and state estimation.

Offered: Fall Spring.

AERO 765 - Advanced Orbit Design for Planetary Missions (3)

This course provides the knowledge and tools to design spacecraft trajectories in the context of interplanetary and planetary missions. Starting from a review of Keplerian motion, it covers advanced methods to model gravity-assisted trajectories and design interplanetary transfers. It illustrates the techniques for numerical orbit propagation and the fundamentals of low-thrust trajectory optimization. Finally, it presents the concepts of modern dynamical system theory applied to missions to and around the libration points in the circular restricted-three body problem.

AERO 781 - Advanced Aerodynamics (3)

This course aims at providing a graduate level understanding of the analytical treatment of incompressible aerodynamics. General and exact solutions of potential flow are revisited and expanded upon, fortifying the aerospace student's undergraduate knowledge and introducing students from other undergraduate tracks to the fundamentals of modern analytical aerodynamics. This knowledge is then built upon with the treatment of unsteady potential flow, the introduction to the laminar boundary layer solutions and the coupling between the external flow (potential flow) and the viscous flow in the boundary layer.

AERO 782 - Adv Aerospace Materials & Stru (3)

Graduate level course with advanced treatment in aircraft structures and aerospace materials. Topics include loads on aircraft, functions of structural components, bending, torsion and shear of thin-walled structures, structural idealization, multi-cell beams, fuselage, tapered beams, Shear and bending analysis in thin walled laminated composite beams, and recent developments in aerospace materials.

AERO 783 - Advanced Flight Mechanics (3)

Graduate-level course with advanced treatment of flight dynamics and control. The course focuses on fixed-wing aircraft and introduces the flight mechanics aspects of rotary-wing aircraft. Topics include longitudinal and lateral-directional flight motions, stability derivative expressions, effect of nonlinearity, flight under disturbances, flying and handling qualities, modern control theories relevant to flight dynamics, flight control strategies, stability augmentation systems, and autopilots/flight simulators.

AERO 784 - Adv Space Systems Engineering (3)

This course aims at providing a graduate level understanding of space mission engineering. Starting from the physics of the space environment and orbital mechanics, it demonstrates how to develop the design of a space system from the initial mission objective, through requirements definition, concept development and trade-off. Then it analyses the main subsystems of a spacecraft: thermal, power, structures, mechanism, propulsion, attitude determination and control, communications, telemetry, tracking and command.

AERO 794 - Selected Topics in Aerospace Engineering (4)

This course covers selected contemporary topics in Aerospace engineering. The topics will vary from semester to semester depending on faculty availability and student interests. Proposed course descriptions are considered by the Department of Aerospace Engineering on an ad hoc basis and the course will be offered according to demand. The proposed course content will need to be approved by the Graduate Studies Committee. The Course may be repeated once with change of contents to earn a maximum of 6 credit hours.

Offered: Fall.

BIOL - Biology

BIOL 601 - Research Methods in Biosciences (3)

This course will provide students with a solid understanding of research methodology and their specific application to bioscience research. Topics covered include theory of research, bioethics, experimental design, analysis and interpretation of data, statistics, review and critique of primary bioscience literature, scientific writing with proper use of citations, and presenting scientific data to both life scientists and the general public. The course assessments will include in-class assignments, a semester exam, submission of a scientific writing assignment, and two in-class oral presentations.

Prerequisite: Graduate standing and enrollment in the MSc Molecular Biosciences program.

BIOL 602 - Advanced Cell and Molecular Biology (3)

This is an advanced graduate-level course biology that covers the classic and the contemporaneous concepts on the cell structure/organization, its dynamics and the key molecular mechanisms controlling cell function. The first part of the course consists of an overview of the major cellular structures and components and their function in cell communication, trafficking/transport/secretion, cell division/proliferation/survival/death, cell motility, and gene expression. The second part will be dedicated to the major cell signaling pathways controlling these aspects of the cell and their molecular components. Students will also be exposed to recent developments in the field, based on primary literature.

Prerequisite: Undergraduate course in microbiology or virology and graduate standing.

BIOL 603 - Experimental techniques in Molecular Life Sciences (4)

This course is devised to build the necessary experimental skillset for the students to be able to perform, analyze, and interpret scientific experiments in molecular life sciences. Importantly, the students will learn about the experimental techniques in 3 main domains: a) Computational methods and bioinformatics, b) techniques in different research themes that are protein-focused, and c) those that are based on the analysis of genetic material such as DNA and RNA. The course will also teach students the utility of experimental methods in microscopy that are used to determine and interpret certain outcomes in domains b) and c).

Prerequisite: Undergraduate course in Biology (any stream) + Graduate standing.

BIOL 610 - Protein Biochemistry (3)

This course provides a comprehensive understanding of proteins and different approaches cells use to regulate their activity. A significant portion of the course will focus on enzymes, their mechanism of action, steady-state kinetics and their inhibition. Different approaches used for protein purification as well as various analytical techniques, including immune-assays, to detect proteins will also be discussed.

Prerequisite: Undergraduate course in Biochemistry + Graduate standing.

BIOL 620 - Cell Signaling and Cancer Biology (3)

The course aims to provide an updated view and advanced knowledge of the molecular and cellular basis of cancer. This covers the different dysregulations of the cellular and molecular processes leading to carcinogenesis, tumor growth, and metastasis, including those controlling the cell cycle as well as the key cell signaling pathways. A special focus will be given to the major receptors and signaling proteins involved in the control of cell proliferation, survival, migration, and death (cell cycle checkpoints, tumor suppressors, cellular and viral oncogenes, apoptosis, immune checkpoints).

Prerequisite: Undergraduate course in Biology (any stream) + Graduate standing.

BIOL 630 - Applied Biotechnology (3)

This course is devised to introduce students to the wide variety of applications of biotechnology. Topics in enzymology, vaccinology, environment, and agriculture will be the main focus areas. Additionally, the students will get a sneak peek into biotech related entrepreneurship, intellectual property rights, patenting, and marketing.

Prerequisite: Undergraduate course in Biology (any stream) + Graduate standing.

BIOL 640 - Advanced Virology (3)

This course will allow students to advance their knowledge of molecular biology related to medically important viruses. The course will cover viral classification and the viral life cycle processes (entry, host interaction/immune evasion, and replication). It is designed to provide students a deep understanding of these processes by exploring detailed examples provided by different viruses. In addition, the course will also other important aspects of virology including modern viral diagnostic methods, viral evolution in persistent viruses (such as HIV, influenza and coronaviruses), antivirals, and the use of viruses as biotechnology tools. Course assessments will include a midterm, final exam and short presentation aimed at educating the general public.

Prerequisite: Undergraduate course in microbiology or virology and graduate standing.

BIOL 650 - Molecular Endocrinology and Metabolic Diseases (3)

This course introduces current understanding and critical evaluation of metabolic and endocrine health. The course discusses the molecular basis of selected hormones production, signaling, and metabolic functions. It also discuss pathophysiological factors, both molecular and acquired, that lead to a variety of metabolic diseases and their associated co-morbidities. These disorders include diabetes mellitus, obesity, and a variety of cardiovascular diseases.

Prerequisite: BSc in Biology (any stream) + Graduate standing.

BIOL 695 - Graduate Seminar 1 (1)

This course provides students with essential science communication tools, which will allow them to compose and present seminars to a diverse audience. While the course is focused on seminar presentations, other formats of communications such as social media will also be introduced. Students will develop their ability to recognize effective life sciences communications by critically analyzing seminars presented by faculty, visiting scholars and their peers. Furthermore, students will also practice preparing and delivering presentations and receiving feedback on their performance, which will develop their skills in delivering high quality presentations describing their research topics and related areas.

Prerequisite: Undergraduate course in Biology (any stream) + Graduate standing.

BIOL 696 - Graduate Seminar 2 (1)

This course builds on skills learned in BIOL 695 and enhances students' skills in scientific communication. By another series of seminars given by faculty, visiting scholars and fellow graduate students, students will further broaden their knowledge and skill at recognising effective scientific communication. Through practicing preparing and delivering presentations of varying length and style, and receiving feedback on their performance, students will develop the ability to deliver their thesis seminar presentations describing their research topics to the fellow students and faculty members.

Prerequisite: BIOL695.

BIOL 699 - Thesis Research (9)

The student, under the supervision of a graduate faculty member, undertakes and completes a research topic that comprises an in-depth investigation of a specific problem in life sciences culminating in a thesis to be approved by the graduate advisory committee.

BIOL 700 - Molecular Life Sciences Laboratory Rotation (3)

During the first semester of enrollment in the PhD program, all doctoral students are required to undertake two rotations of six weeks each in two different laboratories in the Biology Department. These targeted laboratories will be defined by the department early before the start of the semester. Laboratory rotations will allow students to gain familiarity with the different laboratories and research activities in the department and provide an opportunity for students to learn multiple laboratory techniques. In addition, this course could help students select the research group they will join in order to complete their dissertation research. At the end of each rotation, students will submit a two-page report and present their rotation experience in an oral presentation to the rotation mentor/faculty and other members of the rotation laboratory.

Prerequisite: Enrollment in the PhD graduate program .

BIOL 701 - Advanced Techniques in Molecular Life Sciences (3)

This course is designed to teach students the advanced techniques in molecular life sciences, in addition to some fundamental knowledge that is required to perform experiments in Life Sciences. Necessary experimental skillset for the students to be able to perform, analyze, and interpret scientific experiments. The course will teach students the utility of set of advanced experimental methods in molecular life sciences in a problem-oriented manner.

Prerequisite: Undergraduate course in any related branches of biology or molecular life sciences and enrollment in a PhD graduate program.

BIOL 710 - Recent Advances in Protein Biochemistry (3)

This course aims to introduce students to advances in contemporary protein biochemistry. Starting with an overview of protein biochemistry, it will proceed to cover large scale proteomics and how it can be applied to elucidate physiological phenomena and to discover protein biomarkers. This will include protein profiling of complex mixtures of proteins, sample collection, protein and peptide separation techniques, mass spectrometry analysis, 3D structure prediction as well as data evaluation. Students will attend seminars from instructors describing topics selected from the current literature including their research fields. By the end of the course, students will have developed an ability to search available library databases and systematically review and critically evaluate methodologies and approaches within the field of protein biochemistry. To this end students are expected to select a research topic related to their thesis topic, write a review article, prepare and present (both written and orally) the review article and assess review articles presented by their peers.

Prerequisite: Graduate standing and enrollment in the PhD program.

BIOL 720 - Recent Advances in Cell Signaling and Cancer Biology (3)

The course aims to address the recent advances in the knowledge of cell signaling in the context of cancer as well as in the anti-cancer approaches and challenges. This includes the major aspects of cell and molecular biology of cancer, such as proliferation/metabolism, cell cycle/DNA repair/apoptosis, angiogenesis, tumor immunology, and anti-cancer approaches and challenges.

Prerequisite: Graduate standing and enrollment in the PhD program.

BIOL 730 - Recent Advances in Biotechnology (3)

This course is devised to touch upon the latest developments in the form of new discoveries, inventions, and innovations vis-à-vis biotechnological intervention in important fields related to health science, genetic engineering, biomedicine, microbial technology, food technology, environmental sciences, and agriculture, to name a few. As teaching material, the course will include latest papers published in the areas that constitute molecular life sciences with a strong focus on biotechnology and applied biotechnology. Course assessments will be based on instructor given quizzes and peer assessment of student presentations on critical review of the latest research in the field.

Prerequisite: Undergraduate course in any related branches of biology or biotechnology and enrollment in a PhD graduate program.

BIOL 740 - Recent Advances in Virology (3)

The course is aimed at students who want to further develop their existing advanced knowledge in virology and enhance their understanding of cutting edge research currently taking place in this discipline. The course will be organized to cover novel findings in different aspects of the viral life cycle: infection, host cell interactions, immune evasion, genome replication and new virus production. It will cover a range of viruses that are important to human health such as influenza, herpes viruses, adenoviruses, HIV, human papillomaviruses, hepatitis viruses, ebola, rabies, and coronaviruses. The first six weeks will be taught by the course instructor, followed by nine weeks where students will present and discuss assigned research papers in classes that are facilitated by the instructor. Course assessments will be based on instructor and peer assessment of student presentations and a short research proposal.

Prerequisite: Undergraduate course in microbiology or virology and enrollment in a PhD graduate program.

BIOL 750 - Recent Advances in Endocrinology (3)

This course covers advanced topics in Endocrinology relevant to basic and translational research. The course includes twelve weeks of lectures by the instructors, followed by three weeks of discussions. It is divided into four modules: neuro- and behavioral endocrinology, reproductive endocrinology, endocrinology and metabolism, and oncocrinology. The modules, which last three weeks each, cover endocrine system physiology, disease pathogenesis, as well as molecular targets for diagnosis and treatment. Students will lead a journal club style seminar as the final part of the course. Each student must present a research article on a topic related to the lecture material. Students will present data, critically assess the experimental approach, and propose future directions.

Prerequisite: Enrollment in a PhD graduate program + previous courses in Physiology and Cell Biology.

BIOL 760 - Recent Advances in Clinical Microbiology (3)

This course delivers a critical awareness of current problems and/or insights, much of which is at, or informed by the forefront of medical microbiology. This course introduces clinically important bacteria, viruses, parasites and fungi focusing on recent developments in the classification, pathogenicity and identification of these organisms. Microbial infections of humans will be explored in depth in terms of clinical presentation, laboratory diagnosis, molecular aspects of microbiology, immunity, antimicrobial therapy and infection control issues. Students will attend seminars from instructors describing topics selected from the current literature including their research fields. By the end of the course, students will have developed an ability to search available library databases and systematically review and critically evaluate methodologies and approaches within the field of clinical microbiology. To this end students are expected to select a research topic related to their thesis topic, write a review article, prepare and present (both written and orally) the review article and assess review articles presented by their peers.

Prerequisite: Graduate standing and enrollment in the PhD program.

BIOL 790 - Recent Advances in Drug Development and Delivery (3)

A multidimensional strategy is increasingly being used to find and develop new drugs as a result of scientific advancements and increased collaboration amongst scientific fields. This advanced course offers a deeper understanding of how pharmaceuticals are generated for different diseases and disease conditions based on their different modes of action. This course will deal about understanding the major drug-targeted pathways as well as the different experimental and methodological approaches used in drug discovery. Also, the course aims to understand the process of drug discovery and development that will ultimately help to enhance the treatment and prevention of a disease.

Prerequisite: Graduate standing and enrollment in a PhD graduate program.

BIOL 795 - Graduate Seminar I (1)

This course provides students with essential communication tools, showing how to identify the details needed for a presentation depending on the audience, using the appropriate language and visual aids to develop skills for public presentations. The course is focused on seminar presentations, although other formats of communications such as social media will also be introduced. By attending and critically analyzing seminars given by faculty, visiting scholars and fellow graduate students, students will develop the ability to recognise effective scientific communication. Through practicing preparing and delivering presentations and receiving feedback on their performance, students will develop the ability to deliver high quality presentations describing their research topics and related areas.

Prerequisite: Undergraduate course in Biology (any stream) + Graduate standing.

BIOL 796 - Graduate Seminar II (1)

This course builds on skills learned in BIOL 795 and enhances students' skills in scientific communication. By another series of seminars given by faculty, visiting scholars and fellow graduate students, students will further broaden their knowledge and skill at recognising effective scientific communication. Through practicing preparing and delivering presentations of varying length and style, and receiving feedback on their performance, students will develop the ability to deliver their thesis seminar presentations describing their research topics to the fellow students and faculty members.

Prerequisite: BIOL795.

BIOL 797 - Graduate Seminar III (1)

In this course, PhD candidates must present a public seminar on their thesis topic as part of the PhD program requirements before the semester in which they expect to graduate. The seminar is not an oral examination of the student's thesis. The seminar must be attended by at least the main advisor and one of the co-advisors. In addition to presenting a seminar, a PhD student must attend a minimum of 5 seminars on research topics given by faculty, visiting scholars and fellow PhD students. The student must submit a brief report about each seminar that he/she attends.

Prerequisite: SCIE796.

BIOL 799 - Thesis Research (36)

Students will conduct a novel research project investigating a problem of contemporary interest in one or more scientific disciplines.

BMED - Biomedical Engineering

BMED 600 - Physiological Systems (3)

This course introduces human physiology to a wide range of graduate students with diverse backgrounds and varying biological experience. This course is designed to provide students with the mechanism of body function, regulation and a brief overview of anatomic structure. Course content will include the basic physical and chemical laws, homeostatic control of nervous system, musculoskeletal, circulatory, and respiratory systems. In addition to the foundation material, a related case study or research topic will be discussed.

Offered: Fall Spring.

BMED 601 - Experimental Biochemistry (3)

This course explores the chemical and physical properties of the cell and its building blocks including structures of proteins and principles of catalysis. Topics include the chemistry of organic/inorganic cofactors required for chemical transformations within the cell, basic principles of metabolism and regulation in pathways, including glycolysis, photosynthesis, fatty acid synthesis/degradation, Krebs cycle and oxidative phosphorylation.

Offered: Fall.

BMED 602 - Innovation and Creativity in Technology Organizations (3)

This course will explore two terms used frequently in today's business world to describe companies or projects that go beyond conventional thinking: business "innovation" and "creativity." Many young jobseekers with an engineering background seek jobs with technology organizations that are innovative in the way that they define their business, structure their operations and workplace rules, build their products and compete in the marketplace. These innovative businesses – whether "intrapreneurial" projects within large technology organizations or small entrepreneurial startups – and their inspiring leaders are highly valued in today's market. The course will address questions like: where do the best ideas come from? How do organizations capture, develop, embrace, and harness these ideas? How do founders, leaders and other team members bring creative individualism to the project? How can creativity and innovation be increased without leading to chaos?

Offered: Fall Spring.

BMED 603 - Multivariate Statistics and Data Analysis (3)

Introductory graduate level course in Multivariate Data Analysis. This course focuses on the some of the most important techniques of data reduction and analysis of qualitative data, especially encountered in Biomedical Engineering.

Offered: Fall Spring.

BMED 611 - Clinical Pathology (3)

This course is intended to develop an understanding of the basic mechanisms of disease processes including the nature of cellular injury, inflammation, infection, repair, regeneration, neoplasia and abnormal vascular reactions.

BMED 612 - Molecular Genetics & Genome Technologies (3)

This course will cover concepts of genetics and genomics to advance the understanding of complex systems from the level of DNA and other molecules, through to cellular networks, tissues, to the whole organisms and interaction populations of organisms. The human genome is the primary focus of the course with other genomes used for comparative purposes. Applications of these disciplines of science will incorporate disease association studies, population genetics, diagnostic and precision medicine and gene editing.

BMED 620 - Cognitive and Computational Neuroscience (3)

This course will introduce graduate students to cognitive and computational neuroscience and its association with genetics, biochemistry, neurophysiology and signal processing in health and disease. Students will gain mathematical and experimental understanding of modelling from a functional and structural perspective, including; imaging technology and EEG, fNRS multisignal processing.

Offered: Fall.

BMED 621 - Applied Neuroscience and Engineering (3)

This course will introduce graduate students and health professionals aiming to increase their knowledge in neuroscience and engineering applications to clinical neuroscience and engineering solutions. Emphasis is placed on developing image analysis applications as a modality for neurodiagnostics and analysis of EEG and ERP for applications in neurofeedback and biofeedback.

BMED 630 - Deep Learning for Biomedical and Health Informatics (3)

This course introduces students to the specific applications of artificial intelligence to solve biomedical and healthcare problems. It includes topics such as disease diagnosis, gait recognition, 2D/3D medical images analysis, registration, report generation, text classification, and question-answering in the medical context. The students will gain hands-on experience in implementing different deep neural network architectures to manage and analyze different types of medical data.

Offered: Spring.

BMED 631 - Advanced Biosignal Processing (3)

Application of signal processing and modeling techniques in real world Bio signals (Electrocardiography (ECG), Electromyography (EMG) and Electroencephalography (EEG), Blood Pressure and heart Sound). MATLAB based physiological experiments, analysis and demonstration.

Offered: Spring.

BMED 632 - Physiological Control Systems (3)

This course will expose graduate students to the design "secrets" of a variety of physiological control systems from an engineering viewpoint. How states of "health" versus "disease" can be explained in terms of physiological control system function (or dysfunction) will be considered. Examples of physiological control systems to be explored include: control of muscle tone, posture and locomotion; determinants and control of heart rate and blood pressure, body temperature regulation, respiratory mechanics and control, renal function and its regulation.

BMED 633 - Advanced Rehabilitation Engineering (3)

This is a course that focuses via lectures, literature search and experimental work, on the rehabilitative and neural aspects of biomedical engineering, including human performance measurement and analysis, nerve stimulation, motor control and robotically assisted rehabilitation. Case studies from state of the art clinical platforms are also presented and discussed, including the Berkeley Lower Extremity Exoskeleton (BLEEX), the KineAssist and the Lokomat systems.

BMED 634 - Algorithms in Bioinformatics (3)

This course focusses on algorithms to explore the many types of data produced in the Life Sciences, while combining theory and practice. Given the interdisciplinary nature of Bioinformatics, the course highlights the major mechanisms in genetics to an extend that enables formal, algorithmic approaches to process the heterogeneous data from genomics- and proteomics-based technologies: DNA sequence assembly and alignment, functional gene annotation, biological relational databases, metabolic network analysis, comparative genomics, phylogenetics, gene expression analysis and structural bioinformatics. They are coupled with fundamental algorithmic techniques including graph algorithms, dynamic programming, Statistics/Machine Learning, hierarchical clustering, classification and Bayesian methods. We will combine programming (mainly BioPython) and state-of-the- art analysis tools and apply it to Bioenergy, Metagenomics and Biomedicine.

Offered: Fall.

BMED 635 - Healthcare Information Systems (3)

This course provides a detailed overview of healthcare information systems for professionals who will work at the interface of clinical care, information technology, and the healthcare system. Topics include evidence-based care, clinical workflow analysis, unintended consequences of systems, and life- cycle management of complex clinical computing systems.

BMED 640 - Biomaterials for Drug Delivery (3)

This course focuses on the principles of engineering controlled release systems for targeted drug delivery. The course integrates topics in polymer chemistry, biomaterials, pharmacokinetics, and pharmaceutics formulation.

Offered: Spring.

BMED 641 - Biosensors: Fundamentals and Applications (3)

This course focuses on principles of bioanalytical chemistry and fabrication technologies for biosensor design and development. The course integrates topics in polymer chemistry, biomaterials, analytical chemistry, signal transduction, bioinstrumentation and microfluidics.

BMED 694 - Selected Topics in Biomedical Engineering (3)

This course covers selectedcontemporary topics in biomedical engineering. The topics will vary from semester to semester depending on faculty availability and student interests. Proposed course descriptions are considered by the Department of Biomedical Engineering on an ad hoc basis and the course will be offered according to demand. The proposed course content will need to be approved by the College of Engineering Graduate Studies Committee. The course may be repeated once with change of contents to earn a maximum of 6 credit hours.

Offered: Fall Spring.

BMED 699 - Master's Thesis (9)

In the Master's Thesis, the student is required to independently conduct original research-oriented work related to important biomedical engineering problems under the direct supervision of a main advisor, who must be a full-time faculty in the Biomedical Engineering Department, and at least one other full-time faculty who acts as co-advisor. The outcome of the research should demonstrate the synthesis of information into knowledge in a form that may be used by others and lead to publications in suitable journals/conferences. The student's research findings must be documented in a formal thesis and defended through a viva voce examination.

Corequisite: ENGR695. Offered: Fall Spring Summer.

BMED 711 - Biomolecular and Cellular Engineering (3)

This course covers in-depth and critical understanding of genetic engineering in molecular and cellular level and application to tissue regeneration and drug delivery.

Offered: Fall.

BMED 712 - Rehabilitation and Augmentation of Human Movement (3)

In the course human movement will be addressed from both biomechanical and neural perspectives, focusing on pathophysiology associated with movement and on technological aids in rehabilitation and augmentation of human movement.

Offered: Spring.

BMED 713 - Advanced Physiological Systems (3)

To provide advanced knowledge of physiological systems and emerging tools and approaches for modeling complex systems and analyzing high dimension datasets found in biology and medicine.

Offered: Fall Spring.

BMED 716 - Medical Device Innovation (3)

Medical Device Innovation is a "real world" course in creating successful medical devices. The course is composed of frontal lectures, practical training, and a guided project.

Offered: Fall.

BMED 720 - Biophysical Engineering of Cellular Systems (3)

Cells are complex micron-sized machines that may best be understood through biophysical system analysis, i.e., leading to an understanding of the details of cellular functions and inherent physical processes and how they were optimized. To understand the functions, basic principles stemmed from physical chemistry, mechanochemical transduction, and diffusion theory will be tapped on.

Offered: Spring.

BMED 725 - Computational Systems Biology of Cancer (3)

This course will introduce PhD students to computational and mathematical modelling of oncology. In particular, we will cover topics related to cancer phenomena at different spatiotemporal scales, such as cancer genetics and signaling pathways, cancer cell interactions and clinical tumor growth.

Offered: Fall.

BMED 781 - Adv Multivariate Data Analysis (3)

This course focuses on the some of the most important techniques of data reduction and analysis of qualitative data, especially encountered in Biomedical Engineering.

BMED 782 - Advanced Physiological Systems (3)

This course introduces human anatomy and physiology to a wide range of graduate students with diverse backgrounds and varying biological experience. This course is designed to provide students with the mechanism of body function, regulation and a brief overview of anatomic structure. Course content will include the basic physical and chemical laws, homeostatic control of nervous system, musculoskeletal, circulatory, and respiratory systems. In addition to the foundation material, a related case study or research topic will be discussed.

BMED 794 - Selected Topics in Biomedical Engineering (4)

This course covers selected contemporary topics in electrical and computer engineering. The topics will vary from semester to semester depending on faculty availability and student interests. Proposed course descriptions are considered by the Department of Biomedical Engineering on an ad hoc basis and the course will be offered according to demand. The proposed course content will need to be approved by the Graduate Studies Committee. The Course may be repeated once with change of contents to earn a maximum of 6 credit hours.

Offered: Fall Spring Summer.

CHEG - Chemical Engineering

CHEG 604 - Desalination (3)

This course introduces the fundamental science and technology of water desalination to overcome water scarcity and ensure sustainable water supplies. It will cover in-depth the commonly adapted thermal and membrane based desalination technologies. This includes reverse osmosis, electrodialysis, flash-related desalination processes, and evaporation- related desalination processes. Renewable energy technologies coupled with desalination processes will be also presented. Additionally, fouling/scaling, corrosion, materials used and environmental impacts related issues will be covered. Finally, environmental, sustainability and economic factors of desalination systems for fresh water production and reuse will be presented.

Offered: Spring.

CHEG 606 - Wastewater Treatment Engineering (3)

This course is an overview of engineering approaches to protecting water quality with an emphasis on the application of fundamental principles. Theory and conceptual design of systems for treating municipal and industrial wastewater are discussed. These include reactor theory, models, (bio)reaction stoichiometry and kinetics. Physical, chemical and biological processes are also studied.

Offered: Spring.

CHEG 610 - Advanced Chemical Reaction Engineering (3)

This course examines theory and practice on chemical reaction systems with an emphasis on the advanced application of mass and heat transfer and fluid mechanics in real reactors. The subject starts with the review of ideal reactors with different reactions and under different operation conditions, then focus on the steady/unsteady/multiple reactions with external energy exchange (start-up and run-away); modelling of heterogeneous catalytic reaction processes with various control steps; residence time distribution and mixing kinetic models for the design of real reactor; real reactors with multiphase reaction systems.

Offered: Spring.

CHEG 611 - Polymer Reaction Engineering (3)

This course provides an introduction to the chemistry of polymerization and the polymer manufacturing process. It begins with basic concepts about polymers and polymerization and covers each major type of polymerization with relevant kinetics. The qualitative effect of reactor design on polymer manufacture is discussed as well as actual polymer manufacturing processes including those taking place in the UAE.

CHEG 620 - Mathematical Methods in Chemical Engineering (3)

This course introduces a range of analytical methods for the solution of mathematical models encountered in chemical engineering. Topics are motivated by and presented in the context of physical phenomena encountered in chemical engineering industrial and research problems. Students will be introduced to formulate and solve microscopic and macroscopic models in transport phenomena

Offered: Fall.

CHEG 621 - Numerical Methods in Chemical Engineering (3)

Engineering applications of numerical methods. Numerical integration, solution of algebraic equations, matrix algebra, ordinary differential equations, and special emphasis on partial differential equations. Emphasis on the application of numerical methods to chemical engineering problems which cannot be solved by analytical methods. This course focuses both on the models and the algorithms that are used to solve these problems together with the readily available tools such as COMSOL, MATLAB etc.

Offered: Fall Spring.

CHEG 622 - Process Simulation and Optimization (3)

Techniques of optimization, including the formulation of optimization problems, one-dimensional search techniques, analytical methods, n-dimensional search techniques, linear programming, and mixed integer programming. Advanced applications of the principles and theory to the synthesis of chemical processes and systems. Use of software packages for process optimization, synthesis, and analysis.

Offered: Fall Spring.

CHEG 623 - Systems Engineering (3)

The course introduces students to process systems engineering and its application in chemical engineering practice. Emphasis is placed on developing skills in problem formulation, system design, use of analytical tools, and group dynamics. The topics include systems analysis, process simulation software (Aspen Plus), experimental design, applied optimization, and data analytics. Applications of these tools will be illustrated with a series of case studies involving steady-state process simulation, and product and process design.

Offered: Fall Spring.

CHEG 630 - Advanced Chemical Engineering Thermodynamics (3)

In this course, the principles, concepts, and laws of classical and statistical thermodynamics will be used for applications that require quantitative knowledge of thermodynamic properties from a molecular to a macroscopic level. Different models for phase equilibria calculations are presented in the form of equations of state and activity coefficient models for gases and liquids. An introduction to statistical mechanics is given, providing the link to molecular physics, intermolecular forces and macroscopic properties. Classical and molecular methods will be applied to high-pressure phase equilibria, interfacial properties, polymers and electrolyte solutions. In addition, advanced chemical and combined chemical/phase equilibria will be discussed.

Offered: Fall.

CHEG 631 - Statistical Thermodynamics (3)

Statistical ensembles and relations to thermodynamic properties. Ideal mono- and diatomic gas. Mono-atomic crystals. Chemical equilibrium in ideal gas mixtures. Classical statistical mechanics. Equation of state for imperfect gases: Virial coefficients. Perturbation theory of liquids. Dilute electrolyte solutions. Polymer solutions. Transport properties of gases.

CHEG 640 - Transport Phenomena (3)

The course focuses on unified treatment of heat transfer, mass transfer and fluid mechanics with application to chemical processes. Emphasis are on formulating models and obtaining solutions through analytical methods. It includes, conduction and diffusion, laminar flow regimes, convective heat and mass transfer and simultaneous heat and mass transfer with chemical reaction.

Offered: Spring.

CHEG 641 - Multiphase Flow (3)

Continuum equations for conservation of momentum, heat and mass, averaging and combined phase equations. Motion of single particles, bubbles and ensembles. Bubble growth and cavitation. Gas-liquid, gas-solid and gas-liquid-solid flows, multiphase flow in chemical reactors. Flow through porous media.

CHEG 642 - Separation Processes (3)

The emphasis of the course will be on the understanding of the different separation processes concepts, theories and design. In addition, the separation method selection, operational behavior and design will be covered. This course will contain intensive separation process theories and mathematical work and calculations. The course will cover different levels of separation processes including gas/liquid, liquid/liquid, liquid/solid and gas/solid operations.

Offered: Fall.

CHEG 643 - Colloids and Interfacial Science (3)

Structure of solid surface sites. Instrumentation for surface characterization. Interaction of molecules in the gas phase with surfaces. Adsorption isotherms and adsorption coupled with surface reactions. Mechanisms of heterogeneous catalysis. Thermodynamics of interfaces. Solid–liquid interfaces and interfacial tension. Surfaces in contact with aqueous media, the electrical double layer, and adsorption from solution. Self-assembly of surfactant aggregates. Surface modification with surfactants.

Offered: Fall.

CHEG 644 - Consequence analysis of chemical releases (3)

This course provides technical information on how to conduct a consequence analysis to satisfy the safety requirement and analysis for chemical engineering processes according to HSE regulations and policies. It covers quantifying the size of a release, dispersion of vapor clouds to an endpoint concentration, outcomes for various types of explosions and fires, and the effect of the release on people and structures.

CHEG 651 - Combustion and Air Pollution Control (3)

This course present air pollution impact on the environment, the hydrocarbon fuel energy, the different combustion devices and systems, pollutant emission predictions from chemical equilibrium and ideal flow reactors, design of flues and chimneys, atmospheric dispersion models, air pollution sampling and measurement, and air pollution control methods and equipment.

Offered: Fall.

CHEG 652 - Advanced Process Control (3)

This course covers regulatory and supervisory control, multivariable control loops, time-delay systems, complex variable interactions, and the principles of industrial model predictive control. The course also covers multivariate data-driven process monitoring techniques for fault detection and diagnosis. Application studies involving relevant examples in the chemical industry.

CHEG 653 - Sustainable Energy Conversion Processes (3)

This course covers the fundamentals and quantification of energy in its different forms and its conversion processes. Assessment of current and potential energy systems, covering extraction, conversion, and end-use, with emphasis on meeting regional and global energy needs in a sustainable manner. Sustainability aspects of energy technologies, including economic, environmental and social aspects. Examination of energy technologies and energy types: renewable (solar, biomass, wind, hydro, geothermal), fossil (oil, gas, synthetic), nuclear, along with storage, transmission, and conservation. Focus on evaluation and analysis of energy technology systems in the context of political, social, economic, and environmental goals.

Offered: Fall.

CHEG 654 - Chemical Process Safety (3)

To understand inter relationship among occupational health, plant safety and environmental protection. To become familiar with various source models to estimate the possible damage distances in case of accidental release of liquids and gases from process plants. To study methods and techniques used to assess process plant safety, during design and in operations. To understand chemical reaction hazards and safety aspects for the design of process plant equipment. To evaluate and learn from detailed accident case studies.

Offered: Spring.

CHEG 655 - Air Quality Management (3)

The objective of this course is to understand the gravity of the problem of air pollution, its sources, and the industrial practices to reduce pollutant emission to ambient air. The course involves the design of air pollution mitigation systems adopted for different types of pollutants. The sampling and measurement techniques for ambient air and for industrial stacks will be discussed. Engineering control and best management practices for different types of equipment will be examined. Environmental impact and the technical and economic feasibility of emission control technologies will also be addressed.

CHEG 656 - Experimental Design (3)

The course presents a methodology for product and process improvement by i) defining customer goals and customer deliverables, ii) measuring current process or product performance to define improvement opportunities, iii) defining root causes of problems, iv) improving processes using statistical and experimental methods, and iv) applying controls to ensure long-term stability of improvements.

Offered: Fall Spring.

CHEG 657 - Materials Engineering and Corrosion (3)

This course presents fundamental material on corrosion and oxidation thermodynamics and electrochemical thermodynamics and kinetics. The course then describes commonly encountered corrosion environments and discusses typical forms of corrosion encountered in each environment. Methods of corrosion control are then described, and the course concludes with a description of important corrosion and oxidation monitoring techniques.

Offered: Fall.

CHEG 658 - Polymer Properties and Processing (3)

Study of various polymer properties (mechanical, morphological, barrier, thermal, viscoelastic etc.) related to their structure and contributing to their applications. Introduction to various polymer processing methods (mixing, extrusion, injection molding, blow molding, spinning, compression molding etc.). Extension of polymer processing to the conventional composites and nanocomposites technology.

Offered: Fall Spring.

CHEG 659 - Engineering Design for Process Safety (3)

The objective of this course is to learn the variety of potential solutions for identified concerns using the conventional hazard identification check list for large variety of chemical process equipment's. The course would serve to identify opportunities for inherent and passive safety feature to be considered in the design, fully understand all the hazards and resulting risk associate with design alternatives and use risk based approach to process safety system specification.

Offered: Fall.

CHEG 660 - Food Engineering and Science (3)

The course highlights chemical, biological, and physical aspects of food, with emphasis on food decomposition by lipid oxidation. The course provides an understanding of a range of food process technologies to enable students to design process methods and understand current problems and their potential solutions. The course will focus on the integration of biological and food science with engineering.

Offered: Spring.

CHEG 661 - Food Preservation and Packaging (3)

Methods of food preservation: post-harvest, thermal processing, chilling and freezing, water activity control, chemical preservation, non-thermal methods, and food packaging control. The course emphasizes practical, cost-effective, and safe strategies for using preservation methods and analyzes the precise operation or mechanism of each method, focusing on its impact on food properties.

Prerequisite: CHEG660.

CHEG 662 - Food Safety and Legislation (3)

This course covers the standards of food safety, techniques of food analysis for quality assurance, and laws related to food safety. It provides information on the standard monitoring systems and HACCP program for food quality and safety and on the implementation of the programs designed for Total Quality Management in the food manufacturing plants. The latter part of the course would involve information on the instrumentation used for quality inspection that are generally spectrophotometry techniques. The local and international laws that are followed by public food safety departments will also be covered.

Prerequisite: CHEG660.

CHEG 663 - Food Systems Engineering (3)

This course explores the development of our modern food production and distribution system and its effects on our environment and planet. We critically review published studies and other assessments that evaluate the environmental and social impact of food-related products and processes. We cover such topics as agricultural and food policy, industrialization and factory farming, the interrelationship between climate change and food production, water quality and scarcity, the role of technology in food production, and other relevant topics. The course emphasizes the methodologies and skills needed to critically assess the sustainability of various food products and practices.

Prerequisite: CHEG660.

CHEG 664 - Enzymes in Food Engineering (3)

This course covers current applications and recent developments of enzymes in food systems. It deals with the kinetic principles of enzymes behavior and sources of food enzymes and activity determination. Characteristics of enzymes in food, including lipases and proteases as well as oxidoreductases will be covered. Through the discussion, the students will learn the common requirements in enzyme immobilization for the food industry. Topics will help students learn applications of enzymes in the cereals, beverage, baking, starch and syrup, dairy and meat industries, and fruit and vegetable processing. It will also discuss the role of enzymes in flavor production. The course will cover the legal and health aspects of enzyme utilization in food products, their use in food analysis and other related aspects of enzymes and bioengineering.

Prerequisite: CHEG660. Offered: Fall.

CHEG 665 - Farming Technologies for Arid Climate (3)

This course covers the current advances of farming technologies in the Middle East arid climate. It takes a look at the fundamentals of plant growth and how different factors impact it. It also dives deeper into open field agriculture, the challenges and innovations toward increased yield and efficiency. On the other hand, it focuses on the closed and controlled environment cultivations including detailed studies of greenhouses design and considerations. Finally, it looks into the rising technologies of vertical farming and how automation, artificial intelligence and future trends can play a significant role in enabling regional food security.

Prerequisite: CHEG660.

CHEG 670 - Advanced Extractive Metallurgy (3)

This course covers chemical metallurgical processes taking place both in an aqueous environment and high temperature. It considers the principles and applications of pre-treatment, leaching, solution purification and concentration, roasting, smelting and metal recovery using electrowinning/refining for the production of metals using metallurgical processing of ores and concentrates. The unit processes are examined through consideration of thermodynamics and kinetics, and transport phenomena. It also considers practical industrial processes and discusses overall processes for the extraction of iron, aluminum, gold, copper, nickel, uranium, etc.

CHEG 671 - Advanced Physical Metallurgy (3)

This course introduces graduate students to advanced concepts of Physical Metallurgy and especially on the way processing, including heat treatment and thermo-mechanical treatment, shapes the microstructure and properties of metallic alloys. The course focuses on diffusional and non-diffusional phase transformations as well as computational simulation of the microstructural evolution in metals and alloys.

CHEG 672 - Materials Characterization (3)

This course introduces graduate students to advanced concepts of analytical materials characterization methods emphasizing the most common applications and limitations of each method. It covers the use of materials characterization techniques for both bulk- and thin-film characterization. Students will learn the principles, instrumentation and operation of X-ray diffraction (XRD), scanning/transmission electron microscopy (SEM/TEM), x-ray photoelectron spectroscopy (XPS), FTIR and Raman Spectroscopy, and thermal analysis using DTA and DSC. The student will gain an understanding of the importance of these tools in designing and solving materials-related problems.

Offered: Spring.

CHEG 673 - Phase Transformations in Metals (3)

This course introduces graduate students to advanced concepts of phase transformations in metals and how these transformations shape the microstructure of metallic alloys.

CHEG 694 - Selected Topics in Chemical Engineering (3)

This course covers selected contemporary topics in chemical engineering. The topics will vary from semester to semester depending on faculty availability and student interests. Proposed course descriptions are considered by the Department of Chemical Engineering on an ad hoc basis and the course will be offered according to demand. The proposed course content will need to be approved by the College of Engineering Graduate Studies Committee. The course may be repeated once with change of contents to earn a maximum of 6 credit hours.

Offered: Fall Spring.

CHEG 699 - Master's Thesis (9)

In the Master's Thesis, the student is required to independently conduct original research-oriented work related to important chemical engineering problems under the direct supervision of a main advisor, who must be a full-time faculty in the Chemical Engineering Department, and at least one other full-time faculty who acts as co-advisor. The outcome of the research should demonstrate the synthesis of information into knowledge in a form that may be used by others and lead to publications in suitable journals/conferences. The student's research findings must be documented in a formal thesis and defended through a viva voce examination.

Corequisite: ENGR695. Offered: Fall Spring Summer.

CHEG 700 - Sustainable Desalination Processes (3)

The course introduces key issues related to promoting sustainable desalination operations in today's desalination industry. The course analyzes developments in the desalination industry using the three elements of sustainability: cost, society, and the environment.

Offered: Fall Spring.

CHEG 703 - Applied nanotechnology (3)

Discussion on the principles driving the advantages of nanotechnology over the conventional systems. The course will also focus on the application of nanotechnology in various engineering sectors. Topics include: nano-architecture, nano-composites, nano-biotechnology, nano-devices and nano-fabrication.

Offered: Fall Spring.

CHEG 705 - Membrane Technology (3)

The course will describe in details membrane separation technology in the context of wide range of applications, especially in desalination, filtration and wastewater treatment. The course covers: global water shortages and need for membrane technology, Microfiltration, ultrafiltration, nanofiltration (NF), membrane distillation

(MD), membrane bioreactors (MBR) and reverse osmosis (RO) membrane processes. It also discusses operational issues of membrane-based systems, their limitations and system configuration and design

Offered: Fall Spring.

CHEG 708 - Phase Equilibria (3)

The purpose of this course is to educate all consequences of the Gibbs phase rule in understanding phase behavior and its practical applications in constructing and calculation of phase diagrams. As an additional feature, knowledge of phase transformation theory leads to the understanding how phases may transform into each other. Also it will be discussed how certain types of phase behavior are interrelated to each other.

Offered: Spring.

CHEG 710 - Kinetics and Mechanisms (3)

The course provides an advanced overview of chemical kinetics, statistical theories of reaction rates, and the microscopic aspects of chemical reaction dynamics with an emphasis on determination of rate parameters using computational chemistry and ab-initio methods. Topics include kinetics of gas, liquid, and surface reactions; quantum chemistry; transition state theory; surface adsorption, diffusion, and desorption processes; complex reaction networks; mechanism formulation, sensitivity analysis and Chemistry of catalytic reactions.

Offered: Fall Spring.

CHEG 712 - Physical and Chemical Treatment of Waters (3)

Theory and design of specific processes used for the physical and/or chemical purification of waters and wastewaters, including mixing, flocculation, sedimentation, flotation, filtration, disinfection, adsorption, ion exchange, aeration, and membrane filtration.

CHEG 715 - Biological Wastewater Treatment (3)

This course is about population kinetics of microorganisms and their role in the various waste treatment processes. Unit processes for wastewater treatment, such as suspended-growth, attached-growth processes, sludge treatment, and nutrient removal are presented.

Offered: Fall.

CHEG 720 - Modelling and Engineering of Microbial Environmental Bioprocesses (3)

The course covers in detail the modelling of the physical, chemical and biological principles involved in microbial bioprocesses. Fundamentals of microbial metabolism, stoichiometry, energetics, ecology and kinetics as well as bioreactor modelling and optimisation. The mathematical modelling and design of microbial bioreactors for environmental and industrial applications is emphasized.

Offered: Fall.

CHEG 730 - Experimental Techniques and Instrumentation (3)

This course is to train students with theories and skills in the advanced methods for Chemical Engineering analysis and materials characterization in order that they can select the most suitable one for analyzing and characterizing the properties of a specific system, for example, the in depth characterization of a material at a nanoscale. The students have access to the available advanced testing equipment in PI, to perform several practical and laboratorial works which will be presented as scientific reports.

Offered: Fall.

CHEG 735 - Electrochemical Engineering (3)

Fundamentals on electrodes and interfaces; Principles of thermodynamics and kinetics relevant to electrochemical engineering; Governing equations and reactions; Electrochemical energy conversion: Description of fuel cells, lead acid/Li-ion batteries; electrochemical techniques: stationary (polarization curves, chronometric techniques) and non-stationary (electrochemical impedance, voltammetry); Circuit Analysis.

Offered: Fall Spring.

CHEG 745 - Multicomponent Mass Transfer (3)

This course is about the diffusion and mass transfer processes that are really important, including: those with three or more species (the 'multicomponent') mixtures, those with more than one driving force, including electrical or pressure gradients, and those with a solid matrix such as a polymer or a porous medium.

Offered: Spring.

CHEG 750 - Molecular Thermodynamics (3)

This course aims to transfer detailed knowledge and understanding on the thermodynamics of a wide variety of systems of industrial importance. After a short refreshing of basic thermodynamic tools like chemical potential and fugacity, this course offers a treatment of modern thermodynamic models commonly in use for complex fluids as to be met in the oil and gas industry. Furthermore, attention will be given to the thermodynamics of polymer solutions, electrolyte and polydisperse systems. Also understanding of criticality will be presented. As computer simulations are an important tool to retrieve useful thermodynamic information, the course will offer an introduction to Monte Carlo and Molecular Dynamics simulations. Finally, a short introduction to non-equilibrium thermodynamics will be offered.

Offered: Spring.

CHEG 760 - Non-Equilibrium Thermodynamics (3)

A thermodynamic description is applied in terms of excess densities, developed by Gibbs for equilibrium, to non-equilibrium systems. The treatment is restricted to transport into and through the surface. Using local equilibrium together with the balance equations for the surface, expressions for the excess entropy production of the surface are derived.

CHEG 765 - Computational Fluid Dynamics for Chemical Engineers (3)

This course gives an introduction to CFD simulations of turbulence, mixing, reaction, combustion and multiphase flows. The emphasis on understanding the physics of these flow systems helps the students to select appropriate models with which to obtain reliable simulations. Besides presenting the equations involved, the basics and limitations of the models are explained and discussed. The students will be given hands-on experience of drawing, meshing and simulation. The tutorials cover different flow systems that serve the interest of many engineering disciplines (Chemical, Mechanical, Nuclear, Aerospace, and Environmental Engineering).

CHEG 770 - Heterogeneous Catalysis (3)

Study on pore structure and surface area follow, with details on experimental determination of porosity and surface area, along with hysteresis cases. Infrared and thermogravimetric characterization of catalyst represent the final part of the course, which ends with a session of lab trainings on characterization of different catalyst samples. Applications are emphasized through extensive problem work relating to practical cases.

Offered: Spring.

CHEG 781 - Adv Math Methods in Chem Eng (3)

This course introduces a range of analytical methods for the solution of mathematical models encountered in chemical engineering. Topics are motivated by and presented in the context of physical phenomena encountered in chemical engineering industrial and research problems. Students will be introduced to formulate and solve microscopic and macroscopic models in transport phenomena.

CHEG 782 - Adv Chem Eng Thermodynamics (3)

In this course, the principles, concepts, and laws of classical and statistical thermodynamics will be used for applications that require quantitative knowledge of thermodynamic properties from a molecular to a macroscopic level. Different models for phase equilibria calculations are presented in the form of equations of state and activity coefficient models for gases and liquids. An introduction to statistical mechanics is given, providing the link to molecular physics, intermolecular forces and macroscopic properties. Classical and molecular methods will be applied to high-pressure phase equilibria, interfacial properties, polymers and electrolyte solutions. In addition, advanced chemical and combined chemical/phase equilibria will be discussed.

CHEG 783 - Adv Chemical Reaction Engineer (3)

This course examines theory and practice on chemical reaction systems with an emphasis on the advanced application of mass & heat transfer and fluid mechanics in real reactors. The subject starts with the review of ideal reactors with different reactions and under different operation conditions, then focus on the steady/unsteady/multiple reactions with external energy exchange (start-up and run-away); modelling of heterogeneous catalytic reaction processes with various control steps; residence time distribution and mixing kinetic models for the design of real reactor; real reactors with multiphase reaction systems.

CHEG 790 - Dynamic Behavior of Process Systems (3)

The overall objective of this course is to teach students how to develop, in a systematic manner, correct, complete and mathematically well-behaved models of the transient behavior of process equipment. The course focuses on first-principles mathematical models derived from an understanding of the fundamental process physics, and on the interactions between physics, mathematical formulations and mathematical/numerical solution methods. Ultimately, students should be able to apply these concepts to build and execute detailed models of process equipment using state-of-the-art modelling tools.

CHEG 794 - Selected Topics in Chemical Engineering (3)

This course covers selected contemporary topics in electrical and computer engineering. The topics will vary from semester to semester depending on faculty availability and student interests. Proposed course descriptions are considered by the Department of Chemical Engineering on an ad hoc basis and the course will be offered according to demand. The proposed course content will need to be approved by the Graduate Studies Committee. The Course may be repeated once with change of contents to earn a maximum of 6 credit hours.

Offered: Fall.

CHEM - Chemistry

CHEM 620 - Computational Chemistry (3)

The course presents fundamental principles in molecular modeling, simulation and theoretical chemistry, links microscopic phenomena and interactions with macroscopic properties and also models complex chemical systems. Students will use state-of-the art molecular simulation tools and will perform simulations of real oil and gas industry systems as well as performing energy minimization and mechanism-testing calculations.

CHEM 623 - Applied Inorganic Chemistry (3)

The course covers the chemistry of main group elements, transition metals and f-block elements that are important in the petroleum industry, and presents various significant areas such as group theory, MO theory, ligand field theory and coordination chemistry related to applications and instrumental characterization in advanced inorganic chemistry.

CHEM 625 - Applied Organic Chemistry & Instrumental Analysis (3)

This course applies advanced instrumental methods to analyze and characterize oil and gas components. It also focuses on a scientific study of the properties and behavior of hydrocarbons and their derivatives associated with the petroleum industry.

Offered: Fall Spring.

CHEM 630 - Advanced Industrial Catalysis (3)

The course covers fundamental aspects of homogeneous and heterogeneous catalysis including catalyst manufacturing and characterization and their most representative industrial applications for both chemical commodities and fine chemicals, respectively.

Offered: Fall Spring.

CHEM 640 - Advanced Organometallics & Applications (3)

The course covers the chemistry of organometallic compounds that are important in the petroleum industry, and presents various significant areas such as ligand substitution, reductive elimination, migratory insertion and olefin polymerization related to applications in advanced organometallic chemistry.

CHEM 650 - Spectrochemical Studies (3)

This course covers the application of spectroscopic methods to determine the structure of organic molecules. Structure determination is approached through problem solving using a variety of spectroscopic methods. Hands-on experience is achieved through the laboratory component.

CHEM 655 - Petroleum Production & Process Chemistry (3)

This course covers those areas of the oil and gas industry where chemicals play a key role in solving production, process and refining issues. The course provides advanced knowledge on the understanding and use of chemicals to prevent production problems, improve production/efficiency and extend the life of the oil well, reservoir and equipment.

Offered: Fall Spring.

CHEM 660 - Environmental Science & Water Technology (3)

This course links significant environmental phenomena to chemical pollution and describes methods to combat it. Analysis of minor and trace levels of pollution will be presented. Topics offered will include: handling oil spills, treatment of soil/water/air contamination, trace analysis of toxic gases as well as low-level organic, inorganic and radioactive pollution.

Offered: Fall Spring.

CHEM 665 - Fuels & Alternative Energy Sources (3)

This course provides an overview of the role of energy within the sustainable development paradigm. Following an introduction to the energy sector and sustainability indicators, the course divides into two main areas. The first area considers conventional (fossil) fuels along with methodologies, such as carbon capture and sequestration, to reduce environmental impacts associated with their use. In the second area the potential for various alternative energy technologies is presented within a sustainability context.

CHEM 666 - Construction Chemicals & Green Chemicals (3)

This course gives a basic introduction to drilling technology, and provides a background in the oilfield chemicals market. Principles of oil well cementing, cement slurry design and accompanying testing are covered as well as major chemical admixtures in construction chemistry. A lab component, related to the construction field, will be offered. The course is expected to guide the students towards technology development in the field of environmentally friendly oilfield and construction chemicals.

CHEM 668 - Corrosion Science & Advanced Physical Chemistry (3)

This course imparts the essential knowledge to apply thermodynamics/statistical thermodynamics and kinetics to problems in the oil and related industries. The course provides detailed knowledge of corrosion control in the oil and gas industry, primarily corrosion under insulation (CUI), microbial corrosion (MIC) and the use of corrosion inhibitors.

Offered: Fall Spring.

CHEM 670 - Polymers & Nanomaterials Chemistry (3)

This course presents information essential to an understanding of polymers and nanomaterials chemistry e.g. chain and step growth polymerization, properties of polymers, polymer manufacturing processes, chemical and physical analysis of polymers, solid state chemistry, semiconducting materials, nanomaterials and materials characterization.

Offered: Fall Spring.

CHEM 695 - Graduate Seminar I (1)

In this course students attend seminars given by faculty, visiting scholars and fellow graduate students, and present at least one seminar on an appropriate research topic.

Offered: Fall Spring.

CHEM 696 - Graduate Seminar II (1)

In this course students attend seminars given by faculty, visiting scholars and fellow graduate students, and present at least one seminar on an appropriate research topic.

Prerequisite: CHEM 695. Offered: Fall Spring.

CHEM 699 - Master of Science Thesis (9)

The student, under the supervision of a graduate faculty member, undertakes and completes a research topic that comprises an in-depth investigation of a specific problem in Applied Chemistry culminating in a thesis to be approved by the Research Supervisory Committee.

Offered: Fall Spring Summer.

CHEM 701 - Methods and Techniques in Chemical research (3)

This course will allow students to revise and update their knowledge of some advanced instrumental methods used in chemical research including FTIR, NMR (1D, multinuclear), chromatography-mass spectrometry systems, X-ray diffraction and ICP-MS. The emphasis will be on sample preparation and acquisition of data, adopting a problem solving approach simulating their use in research. NOTE: This course is a pre-requisite to producing a dissertation in Chemistry.

Offered: Fall Spring.

CHEM 704 - Electrochemistry & Corrosion S (3)

Theories of chemical reaction rates in gas and solution phases and at surfaces. Data analysis, kinetics and mechanisms of chemical reactions Fundamental of electrochemical reactions, thermodynamics and kinetics of electrochemical reactions, mass transfer/diffusion in electrolytes, electrochemical method of analysis, applications (fuel cells, electrolysis cells and other electrochemical reactions), Fundamentals of corrosion, types of corrosion, design against corrosion, corrosion protection principles, corrosion in common environments, corrosion resistant alloys. Each student will deliver a seminar on their chosen topic to the whole group who will peer-assess the seminar and provide feedback.

CHEM 705 - Synthesis & Reaction Mechanism (3)

This course covers fundamental aspects of writing mechanisms for organic and inorganic reactions. Basic principles and reaction are reviewed with a focus on mechanistic understanding and synthetic applications. In organic part; addition, elimination, substitution, and rearrangement reactions are covered based on polar and radical mechanisms. In inorganic part; ligand substitution reaction mechanisms will be covered for both coordination and organometallic complexes. Inner sphere and outer sphere redox reaction mechanisms and photochemical reaction mechanisms will be covered. In organometallic part; homogeneous catalytic mechanisms and their applications in cross-coupling reactions and C-H activation will be covered. All reactions and mechanisms will be applied in design and retrosynthesis of natural products.

CHEM 711 - Recent Developments in Inorganic Chemistry (3)

This course aims to introduce some recent advances in areas of modern inorganic. The course focuses on three main areas: preparation and uses of metal-organic frameworks (MOFs), organometallic metal-ligand complexes as catalysts and developments in modelling/simulation of metal containing compounds using Density Functional Theory (DFT). By the end of this course, the students will have broad knowledge of these areas as well as the ability to search available library databases and systematically review and critically evaluate methodologies and approaches within the field. Each student will select a research topic from those presented, preferably related to their dissertation topic and write and present a review article.

Offered: Fall.

CHEM 712 - Recent Developments in Organic Chemistry (3)

This course aims to introduce advancements in contemporary organic chemistry. The course focuses on the recent developments in the areas of organic chemistry such as natural product or enantioselective synthesis, organocatalysis, and spectroscopic and computational methods. Upon the completion of 10 weeks of lectures presented by instructor(s), each student is expected to choose a topic related his/her future dissertation topic and prepare a review article and present it during the last 5 weeks of semester. Students will attend all the presentations and assess each other.

Offered: Fall.

CHEM 713 - Recent Advances in Physical Chemistry (3)

This course covers the most recent developments in surface chemistry and related quantum mechanical calculations. The main aim of the course is to make the students aware of how molecules interacts with surfaces at the atomic and molecular levels and how their interactions influence different applications of science and technology. The students will be able to predict the behavior of surface active components in various areas such as catalysis, energy, and nanotechology. After selecting a topic of interest, students will independently conduct an in-depth critical review of the literature and write a review article in the style of a professional body review journal (e.g. Acc. Chem. Res., Chem. Rev., Chem. Soc. Rev.). The articles will be made available to all students who will offer peer feedback. Each student will deliver a seminar on their chosen topic to the whole group who will peer-assess the seminar and provide feedback.

Offered: Spring.

CHEM 714 - Recent Developments in Analytical Chemistry (3)

This course aims to introduce advances in contemporary analytical chemistry. The course focuses on the recent developments in burgeoning areas of analytical chemistry such as challenges in analytical separation; green chemistry; spectroscopy; process analytical chemistry; electrochemistry; sensors; lab-on-a-chip and chemometrics. Students will attend seminars from instructors describing topics selected from the current literature, including their research fields. By the end of this course, the students will have developed an ability to search available library databases and systematically review and critically evaluate methodologies and approaches within a field. To this end each student is expected to select a research topic related to their dissertation topic; write a review article; prepare and present (both written and orally) the review article and critical assess review articles presented by their peers.

Offered: Fall.

CHEM 715 - Recent Developments in Nanochemistry (3)

This course will allow students to update their knowledge of the chemistry of contemporary nanomaterials. The course focuses on the synthesis and advanced nano-characterization and application of zero- one- and two-dimensional functional nanomaterials, their heterostructures, advanced nanocomposites/ hybrid materials and 3D printing. Upon the completion of the lecture topic presented by instructor(s), each student will choose a topic related to his/her future dissertation topic, prepare a review article and present it during the last 3 weeks of semester. Students will attend all the presentations and peer-assess each other.

Offered: Spring.

CHEM 716 - Recent Developments in Environmental Chemistry (3)

This course allows students to update their knowledge of contemporary environmental chemistry. It introduces the students to the latest technology developments and some current aspects of research that aim to address existing and emerging air, soil, and water pollution concerns. The course surveys selected areas of waste management strategies, environmental remediation, and resource reclamation, focusing on sustainable approaches, and presents some advanced aspects of environmental monitoring and clean energy production. Students will attend lectures and seminars from instructors describing topics selected from the current literature, including their research fields. By the end of this course, the students will have developed an ability to retrieve and critically interpret the technical information within the expert field of knowledge, and communicate it in written and oral forms.

Offered: Spring.

CHEM 717 - Advanced topics in Biochemistry (3)

This course introduces advanced topics in biochemistry that are relevant to chemical research involving enzymes and cellular pathways focusing on drug interaction and drug discovery. The course is structured to deliver eleven weeks of traditional lectures by instructor(s) followed by four weeks of seminar. The first part of the course will cover protein structure, enzyme function, cell signaling molecules and their receptors. The second part of the course will focus on drug targets, their mode of action and structure-activity relationships. The final part of the course will be student led in a journal-club style format. Each student is expected to present a research article in a topic relevant to material covered in lecture. The student will present data, critically evaluate the experimental approach and provide a strategy for future directions.

CHEM 719 - Adv in Energy Storage Material (3)

This course covers the most recent progress in advanced materials for energy storage systems. The main objective of the course is to make the students aware of how advanced functional materials play critical role in energy storage systems such as secondary batteries, supercapacitors, thermal storage. Materials for hydrogen storage and mechanical energy technology. The students will be able understand energy storage properties of advanced materials. After selecting a topic of interest, students will independently conduct an in-depth critical review of the literature and write a review article in the style of a professional body review journal (e.g. Acc. Chem. Res., Chem. Rev., Chem. Soc. Rev.). The articles will be made available to all students who will offer peer feedback. Each student will deliver a seminar on their chosen topic to the whole group who will peer-assess the seminar and provide feedback.

CHEM 720 - Adv Topics in Theoretical Chem (3)

This course covers advanced topics in theoretical chemistry and is broadly divided into two areas: 1) Data Science: The course looks at recent advances in the application of data analytics, machine learning and artificial intelligence to chemistry. Students will learn the python programming language within the HPC linux environment. The scikit-learn python library will be used to do various machine learning problem-solving tasks related to chemistry research. 2) Atmospheric Chemistry: Advanced Topics in Atmospheric Chemistry will be considered including collision theory, atmospheric reaction mechanisms and modelling the chemistry of atmospheric reactions.

CHEM 721 - Green Analytical & Bioanalytic (3)

This course discusses advances and challenges in greening analytical and bioanalytical chemistry approaches. It introduces greenness metrics and emphasizes modern practices and methodologies contributing toward sustainability goals and aiming at reducing the analytical procedure's chemical wastes, energy consumption, and overall cost. Students will attend and engage in seminars on topics selected from the current literature. By the end of this course, the students will have developed an ability to retrieve and critically interpret technical information within the presented field of knowledge and communicate it in oral and written forms.

CHEM 722 - Adv Topics in Organic Chem (3)

The course introduces the concepts of biomass conversion and asymmetric catalysis, providing examples and a mechanistic understanding of the reactions shown.

CHEM 723 - Advanced Polymer Chemistry (3)

This course covers the most recent progress in advanced Polymer Chemistry. The main objective of the course is to make the students aware of how advanced polymer synthesis and characterization and methodologies. This includes sequence-controlled polymerization, Controlled radical polymerisation techniques, Polymerisation by radiation or in ordered states, Polymerisation of alkyne monomers, Click chemistry in polymer synthesis and modification, Green/renewable/recyclable polymers and Macromolecular engineering. After selecting a topic of interest, students will independently conduct an in-depth critical review of the literature and write a review article in the style of a professional body review journal (e.g. Acc. Chem. Res., Chem. Rev., Chem. Soc. Rev.). The articles will be made available to all students who will offer peer feedback. Each student will deliver a seminar on their chosen topic to the whole group who will peer-assess the seminar and provide feedback.

CHEM 799 - Entrepreneurship in Chemistry-Science (3)

This course will introduce students to the concepts and ideas involved in exploiting scientific research work and in setting up a small company to allow commercialization of research ideas. The aim is to provide graduate students in science with the tools, frameworks and thinking processes to enable translation of scientific discoveries into commercial products, services and processes. Specific topics include idea generation, opportunity recognition, intellectual property, accounting and financial analysis, customer needs, market assessment, competition, and business planning. Through selected readings from texts and case studies, we focus on the development of individual skills and management tools. It requires student participation in class discussions and assignments. Students can work individually or as part of a small (2-3 person) team in the preparation of a business plan based on student and faculty research as well as a funding 'pitch' of the business plan.

CIVE - Civil Engineering

CIVE 630 - Tensors Algebra & Applications (3)

The course focuses on a detailed exposition of tensor calculus and algebra as tools in the study of non-linear continuum mechanics principles and techniques necessary for the derivation, analysis, algorithmic development and critical evaluation of constitutive models and system solution procedures suitable for the analysis and the simulation of the response of civil and infrastructural engineering materials and systems.

Offered: Fall Spring.

CIVE 631 - Dynamic Response of Civil Engineering Constructions (3)

This course is to introduce the basic concepts and techniques for structural dynamics and their practical applications to structural engineering. Students will learn the response of single degree of freedom (SDOF) and multi degree of freedom (MDOF) systems due to free vibration and forced (harmonic, periodic, arbitrary, pulse) vibration, and the earthquake response of elastic and inelastic buildings. Modal analysis, response spectrum analysis, and time-stepping methods for structural systems will be briefly covered.

Offered: Spring.

CIVE 632 - Highrise Building Design (3)

This course aims to introduce the design concepts for high-rise buildings made in reinforced concrete and steel. Students will learn the structural systems used in high-rise buildings, the loadings applied to them, and the analysis methods for vertical and horizontal loads (including response spectrum analysis). They will also be introduced to the inelastic response of reinforced concrete and steel members and the concepts of capacity and performance-based design of reinforced concrete and steel structures. Students will have the opportunity to apply these concepts to the preliminary design of high-rise building using 'hand' methods and to the detailed design, using advanced commercial software packages.

Offered: Fall.

CIVE 634 - Design of Civil Engineering Structures for Fire Protection (3)

The course introduces the concepts of fire science and provides an outline of the key stages in ignition, fire growth and combustion products as they relate to fires in civil engineering constructions. Detailed methodologies for material selection, containment, fire resistant design, fire severity and post fire damage evaluation are presented and related to the requirements of various modern building codes. The course addresses issues faced by architects, fire safety engineers, civil engineers and building code regulators in controlling the effects of fire on civil engineering constructions and the available techniques, materials and design methodologies.

CIVE 635 - Railway Geotechnics (3)

This course provides in-depth understanding of railroad track geotechnical engineering concepts, which include track component and system design, construction, evaluation, maintenance, load distribution, and wheel/rail interaction. The course will include field trip(s) to observe railway tracks and their components.

CIVE 636 - Wind Effects on Structures (3)

This course utilizes principles and techniques from meteorology, aerodynamics, structural dynamics and aeroelasticity to describe and quantify the mechanisms of wind action on structures and the procedures used in the design of highrise buildings, towers, suspension bridges and industrial plants and the utilization of wind tunnels as design evaluation tools.

CIVE 637 - Pavement Monitoring & Rehabilitation (3)

The course focuses on the engineering concepts needed to maintain and rehabilitate pavement and their implications on flexible and rigid pavement performance over the infrastructure service life. On the basis of project evaluation, testing and analysis, the design of rigid and flexible overlays is examined, as well as rehabilitation alternatives. The effects of maintenance and rehabilitation activities are evaluated in terms of pavement performance and life cycle costs.

Offered: Spring.

CIVE 638 - Transportation Systems (3)

This course focuses on the efficient integration of different modes of transportation via multi-modal points in an urban area. An individual's trip consists of a combination of various modes of transportation including, auto (driver), auto (passenger), public transit (bus, rail, air), active modes (bike, walk), and other emerging modes. In order to implement such integration, it is essential to understand the mode-specific characteristics, associated utility, and logic models. It is also necessary to determine which intermodal points are suitable for the mode-pair transfers and when and how the transfers are to be executed.

CIVE 640 - Soil Structure Interaction (3)

The course focuses on the effects of soil-structure interactions (SSI) to understand the realistic response of structures on flexible foundation soils. Characterization of elastic and plastic soil behavior under static and dynamic loads, ground response analysis with linear and nonlinear soil properties, structural influence on ground response, ground deformation by seismic loads are studied. Kinematic and inertial SSI are covered regarding the structural embedment into soils, dynamic structural responses and soil deformations. Numerical modeling of soil-structure systems is studied including visco-elastic halfspace media, Winkler model, and finite element analysis.

Offered: Fall.

CIVE 641 - Coastal Engineering (3)

This course provides in-depth understanding of wave mechanics, mechanisms of wave generation, coastal waves' variations, coastal sedimentary processes and the design and verification of coastal protection structures.

Offered: Spring.

CIVE 650 - Construction Cost Estimating (3)

This course will provide students with knowledge of the principles and practices of construction cost estimating. The course covers techniques used in estimating including: the principles of the estimating process, creating unit costs for labor and equipment resources, range estimating, estimating earthwork and excavation, highways and pavements, concrete and steel structures, and masonry. Students will learn how to convert estimated costs to the bid estimate incorporating subcontractors' bids, overhead and profit, and contingency estimation based on risk analysis. Each topic is introduced with a detailed explanation of the techniques and methods involved with hands on estimating exercises.

Offered: Fall.

CIVE 651 - Sustainable Building Construction (3)

This course will provide students with knowledge of the principles and practices of sustainability in construction while exploring the cutting edge of sustainable construction. The course covers topics including: UAE green building rating systems (Estidama and Al Safat), proper site selection, energy and water efficiency, material reuse, indoor air quality and cutting edge technologies and practices of sustainable construction. Each topic is introduced with a detailed explanation of the techniques and methods involved with hands on exercises

CIVE 652 - Construction Safety (3)

This course addresses the vital issue of construction site safety from a management perspective while introducing students to local safety regulations. Students gain insight into the challenges of accident prevention and techniques for managing safe and secure construction projects. Covered topics include: a history of construction safety, accident causation theory, recognition, avoidance, abatement, and prevention of safety and health hazards, hazard control procedures, insurance and risk management, behavior-based safety initiatives, occupational safety and health management systems in construction firms.

CIVE 694 - Selected Topics in Civil & Infrastructural Engineering (3)

This course covers selected contemporary topics in civil and infrastructural engineering. The topics will vary from semester to semester depending on faculty availability and student interests. Proposed course descriptions are considered by the Department of Civil Infrastructure and Environmental Engineering on an ad hoc basis and the course will be offered according to demand. The proposed course content will need to be approved by the College of Engineering Graduate Studies Committee. The course may be repeated once with change of contents to earn a maximum of 6 credit hours.

Offered: Fall Spring.

CIVE 699 - Master's Thesis (9)

In the Master's Thesis, the student is required to independently conduct original research-oriented work related to important civil and infrastructural engineering problems under the direct supervision of a main advisor, who must be a full-time faculty in the Civil Infrastructure and Environmental Engineering Department, and at least one other full-time faculty who acts as co-advisor. The outcome of the research should demonstrate the synthesis of information into knowledge in a form that may be used by others and lead to publications in suitable journals/conferences. The student's research findings must be documented in a formal thesis and defended through a viva voce examination.

Prerequisite: ENGR695. Offered: Fall Spring Summer.

CIVE 703 - Groundwater Hydrology (3)

Fundamentals of subsurface flow and transport, emphasizing the role of groundwater in the hydrologic cycle, the relation of groundwater flow to geologic structure, and the management of contaminated groundwater. Topics include: D'Arcy equation, flow nets, mass conservation, the aquifer flow equation, heterogeneity and anisotropy, storage properties, regional circulation, unsaturated flow, recharge, stream-aquifer interaction, well hydraulics, numerical models, groundwater quality, geochemistry, contaminant transport processes, dispersion, decay, and adsorption.

Offered: Fall.

CIVE 707 - Environmental Remote Sensing and Satellite Image Processing (3)

This course provides a theoretical and practical understanding of technology and applications of satellite remote sensing and Geographic Information System (GIS) in forecasting, mapping, and monitoring the natural environment. It covers a range of remote sensing and GIS tools and techniques used to address environmental issues at local, regional and global scales, with hands-on experience in satellite data analysis, digital image processing, generation of maps and manipulation of layers of spatial information, and analysis of field data and ground-based measurement. Technical topics include radiometric correction, geometric correction, atmospheric and ground effects, multi-spectral and multi-temporal analysis, supervised and unsupervised classification, and change detection. All topics are accompanied by lab assignments using various image processing software systems. In addition, students will have the opportunity to work on applied GIS projects where spatial data are used to address real world problem.

Offered: Spring.

CIVE 712 - Remediation Engineering (3)

An advanced course on the remediation or cleanup of contaminants present in the subsurface (i.e. vadose zone soils and aquifers). Topics will include: (i) Subsurface characterization (i.e., determining porous media properties and contaminant delineation); (ii) Setting remediation endpoints based on environmental risk; (iii) Predicting natural attenuation of groundwater contaminants using bioenergetics models for the no-remedial-action scenario; (iv) Designing extraction?well arrays for contaminated soil vapor and groundwater recovery for pump-and-treat systems; (v) In situ treatment technologies (e.g., permeable reactive barriers (PRBs), in situ reactive zones; and (vi) Long-term monitoring, performance evaluation, and costs of site remediation.

CIVE 714 - Sustainable Desalination Processes (3)

The course introduces key issues related to promoting sustainable desalination operations in today's desalination industry. The course analyzes developments in the desalination industry using the three elements of sustainability: cost, society, and the environment.

Offered: Fall.

CIVE 717 - Membrane Technology (3)

The course will describe in details membrane separation technology in the context of wide range of applications, especially in desalination, filtration and wastewater treatment. The course covers: global water shortages and need for membrane technology, Microfiltration, ultrafiltration, nanofiltration (NF), membrane distillation (MD), membrane bioreactors (MBR) and reverse osmosis (RO) membrane processes. It also discusses operational issues of membrane-based systems, their limitations and system configuration and design.

CIVE 718 - Advanced Topics in Applied Environmental Chemistry (3)

Provides a theoretical and practical understanding for characterizing anthropogenic organic contaminant molecules in environmental media. Topics include: (1)

Theoretical basis for commonly used off-line and in-line analytical separations, such as chromatography, liquid-liquid extraction, and ion exchange; (2) instrumental methods of analysis and their detection techniques utilized for compound quantitation; and, (3) spectroscopy and spectrometry techniques employed for compound identity confirmation. Emphasis is placed on trace-level environmental contaminants that require sample pre-concentration or passive sampling techniques prior to analysis. Novel applications are discussed using recent examples from scientific literature.

CIVE 719 - Climate Dynamics (3)

Climate dynamics is an extremely young discipline in atmospheric sciences. Its basic assumption is that climate is not a quasi-static system – as mostly believed till the second half of the twentieth century – but a complex dynamical system evolving under both anthropogenic and internal forcing. The course will provide students with a quantitative understanding of atmospheric dynamics and thermodynamics, and will cover main topics in internal and anthropogenic climate variability, relying on both a dynamical (deterministic) and statistical/stochastic approach. Special emphasis will be given to the diverse uncertainty sources of future climate scenarios and to the assessment of climate variability impacts (both in terms of "average global" variability and "extreme events frequency" variability) on water resources, renewable energy harvesting and sustainable development.

Offered: Spring.

CIVE 720 - Nanotechnology in Water Purification (3)

This is a multidisciplinary course. The behavior of nano-materials by employing the adsorption approach. Analytical method of using specialized instruments to characterize the nanomaterials properties, and interpret the results. Membranes and their properties. Nanomaterials and their application in adsorption, electrosorption, membrane filtration and advanced oxidation water purification processes. Nano-photocatalytic oxidation process in water treatment. Potential risks associated with using nanomaterials in water purification.

Offered: Fall.

CIVE 721 - Aquatic Chemistry (3)

Environmental engineering has been defined as primarily the study of the fate, transport, and effects of chemicals in the natural environment, and the formulation of options for cleaning up and reducing the effects of anthropogenic and natural wastes in the environment. This course provides essentials of the chemistry for environmental processes. The topics include general chemistry, water/wastewater chemistry, atmospheric chemistry and soil chemistry

Offered: Fall Spring.

CIVE 722 - Solid and Hazardous Waste Management (3)

Solid waste analysis including: sources, types and composition of solid waste; handling, storage, collection and transfers; processing and resource recovery including incineration, pyrolysis and composting; hazardous waste and sanitary landfill design and management issues.

Offered: Spring.

CIVE 730 - Public Transit Operations and Planning (3)

This course focuses on various topics in urban public transit operations and planning. The course will help students: Learn the history of public transit, understand its role in sustainable urban development and society, State-of-art review of best-practice strategies, Analyze the transit performance and demands, Identify and solve problems both at operational level and strategic level, Transit economics of various transit modes, Design and schedule for transit networks, Review of emerging technologies and strategies.

Offered: Spring.

CIVE 750 - Non-Linear Mechanics of Construction Materials (3)

The course focuses on a detailed exposition of non-linear computational mechanics principles and techniques which are necessary for the derivation, analysis, algorithmic development and critical evaluation of a wide range of constitutive models suitable for the simulation of the inelastic response of civil and infrastructural engineering materials.

Offered: Fall.

CIVE 751 - Non-Linear FE Analysis of Civil Engineering Structures (3)

Standard finite element techniques and software do not capture the particularities of the highly non-linear response of civil engineering materials. The course focuses on the detailed derivation, analysis, algorithmic development and implementation and the critical evaluation of non-linear finite element techniques and algorithms suitable for the simulation of the response of civil and infrastructural engineering structures subjected to static or dynamic loading.

Prerequisite: CIVE750. Offered: Fall.

CIVE 755 - Geotechnical Natural Hazards Mitigation (3)

Natural hazards and role of geotechnical engineering. Field survey technics for reconnaissance. Evaluation of laboratory experimental data and prototype modeling. Theoretical soil behaviors under various loads. Case histories – landslides, soil liquefactions. Reliability concepts. Risk-based design. Soil-structure system performance. Ground improvement for hazard mitigation. Infrastructure investment, sustainable design. The course will use numerical analysis tools to model soil responses under natural disasters.

Offered: Spring.

CIVE 756 - Chemo-mechanical Modelling & Design of Flexible Pavements (3)

The course focuses on a detailed identification and the quantification of the role the chemical composition and the physical characteristics of the constituents of an asphaltic material play on determining the mechanical response of the material and its implications on flexible pavement performance. On the basis of a hierarchical approach, the physico-chemical characteristics of asphalt mix constituents at various scales are examined and the interactions between them are identified and utilised and/or manipulated for the design of asphalt mixes with material response characteristics optimized for the particular pavement design application

Prerequisite: CIVE750.

CIVE 757 - Dynamic Loading and Design of Bridges

CIVE 760 - Construction Procurement Management (3)

This course introduces the project procurement concept and relevant management and implementation mechanisms to help students apply these when developing a construction project. This course is primarily focused upon how project leaders can make and influence procurement decisions to realize a project that truly delivers value to project stakeholders for project and organizational success. Particular attention is paid to the nature of 'value for money' in this process along with the role of procurement strategies in order to achieve value for money for the client and customers.

Offered: Fall.

CIVE 761 - Productivity Improvement in Construction (3)

The objective of this course is to examine factors that impact construction productivity, the use of management tools to develop construction productivity improvement programs, methods for performing construction loss calculations, and strategies for developing productivity improvement programs for the construction environment. Higher productivity drives greater profitability by improving cost and schedule performance. Throughout the course, emphasis will be placed on techniques and methods that can manage and increase the efficiency of cost and schedule parameters. This course is designed to provide guidance to students, future owner, contractor, subcontractor, or construction manager on methods and processes by which construction productivity can be effectively managed and increased.

Offered: Spring.

CIVE 762 - Advanced Building Information Modeling (3)

This course addresses emerging technologies in the context of Project Management and Integrated Delivery, and includes modeling, visualization, 3D clash detection, digital site layout, 4D modeling, as-built model generation, and digital information management. This course will first introduce basic Virtual Design and Construction (VDC) and BIM concepts and review industry examples of how these concepts play out on design and construction projects. Students will learn advanced concepts of BIM through formal lectures, but they will also have the opportunity, through hands-on group projects, to apply the theoretical knowledge to development of a building project from conceptual design, through engineering and cost analyses, to detailed design and fabrication of models using rapid prototyping technology.

CIVE 782 - Adv Soil-Structure Interaction (3)

The course focuses on the effects of soil-structure interactions (SSI) to understand the realistic response of structures on flexible foundation soils. Characterization of elastic and plastic soil behavior under static and dynamic loads, ground response analysis with linear and nonlinear soil properties, structural influence on ground response, ground deformation by seismic loads are studied. Kinematic and inertial SSI are covered regarding the structural embedment into soils, dynamic structural responses and soil deformations. Numerical modeling of soil-structure systems is studied including viscoelastic half-space media, Winkler model, and finite element analysis. Recent research advances in soil-structure interaction will be discussed.

CIVE 783 - Advanced Building Construction (3)

This course will provide students with knowledge of the principles and practices of sustainability in construction while exploring the cutting edge of sustainable construction. The course covers topics including: UAE green building rating systems (Estidama and Al Safat), proper site selection, energy and water efficiency, material reuse, indoor air quality and cutting edge technologies and practices of sustainable construction. Each topic is introduced with a detailed explanation of the techniques and methods involved with hands on exercises. Recent research advances in building construction will be discussed.

CIVE 784 - Adv Transportation Systems (3)

This course focuses on the efficient integration of different modes of transportation via multi-modal points in an urban area. An individual's trip consists of a combination of various modes of transportation including, auto (driver), auto (passenger), public transit (bus, rail, air), active modes (bike, walk), and other emerging modes. In order to implement such integration, it is essential to understand the mode- specific characteristics, associated utility, and logic models. It is also necessary to determine which intermodal points are suitable for the mode-pair transfers and when and how the transfers are to be executed. Recent research advances in transportation systems will be discussed.

CIVE 794 - Selected Topics in Civil Infrastructural and Environmental Engineering (3)

This course covers selected contemporary topics in electrical and computer engineering. The topics will vary from semester to semester depending on faculty availability and student interests. Proposed course descriptions are considered by the Department of Civil Infrastructural and Environmental Engineering on an ad hoc basis and the course will be offered according to demand. The proposed course content will need to be approved by the Graduate Studies Committee. The Course may be repeated once with change of contents to earn a maximum of 6 credit hours.

Offered: Fall Spring.

CMHS - CMHS

CMHS 600 - CMHS Faculty Orientation (0)

Offered: Fall.

CODS - Computational Data Science

CODS 608 - Distributed Sys and Cloud Comp (3)

This course teaches in-demand technologies for distributed and parallel computation as well as storing and processing large amounts of data using cloud-computing technologies. While underlying network and architecture issues are discussed to the extent that enables a basic understanding, particular focus is on the data science aspects of Cloud computing and cloud applications complementary to other courses related to the realm of Data Science and Artificial Intelligence. It introduces general concepts and deploys the state-of-the-art systems from public cloud systems, but also instructs how to use locally available clouds.

CODS 610 - Model Estimation (3)

This course provides a rigorous introduction to statistical modeling. The topics covered include classical regression, nonparametric regression, penalized estimation, covariance parameters estimation, multivariate linear model, discrimination and allocations and principal component analysis.

Offered: Spring.

CODS 612 - Computational Methods and Optimization in Finance (3)

This course introduces the main classes of optimization problems (linear, quadratic, convex, integer, stochastic, and robust) and the algorithms to efficiently compute the optimum in each case. The methods will be applied to financial problems such as asset/liability management, option pricing and hedging, risk management, and portfolio optimization. The students will learn to use software related to each technique.

CODS 620 - Advanced Statistical Inference (3)

This course provides a rigorous introduction to classical statistical inference. Probabilistic concepts and tools are used to present inferential statistics methods, including sampling distributions, parametric point estimators and their properties, interval estimation, hypothesis testing and regression models. Students will study some elements of Bayesian statistics.

Offered: Fall.

CODS 622 - Data Science with Machine Learning (3)

This graduate-level course on data science builds upon the undergraduate courses on "Data Analytics" and on

"Introduction to Machine Learning". The course starts by introducing data analytics tasks like regression, classification and forecasting from the data science perspective and then shows how advanced ML techniques can be used to perform them. Topics include advanced clustering, time-series prediction, statistical learning theory, ensemble learning, probabilistic learning, dimension reduction, semi-supervised learning, transfer learning, etc.

Offered: Spring.

CODS 623 - Health Data Science (3)

This course provides an introduction to Health Data Science, with special emphasis on developing knowledge and competencies necessary understand the measurement and use of variables in health, their scales of measurement, and its use in biostatistics and Spatial Epidemiology.

CODS 624 - Space-Time Data Science (3)

Space-time data are becoming available in overwhelming volumes and diverse forms as a result of growing remote-sensing capabilities, ground-based sensor networks, crowdsourcing, citizen science data, climate models, and novel medical sensing technologies. Dealing with massive data sets having complex structures implies a collection of conceptual, methodological, and technical challenges, which are exacerbated by the data diversity. Space-time statistical methods were not designed to deal with global, high-volume, hyper-dimensional, heterogeneous and uncertain space-time data. In fact, the computational requirements of most available methods scale poorly with data size. Space-Time Data Science (STDS throughout) is based on the integration of Statistics, Computer Science and Machine Learning as fundamental vertices in a graph structure to be then synchronized with applied sciences, such as geography, physics, soil science, neuroscience, and epidemiology. Hence, the key of success of STDS is to be able to tailor interdisciplinary approaches to the analysis of diverse and big space-time data. This course will introduce the statistical and computational aspects of STDS.

CODS 636 - Introduction to High Performance Computing (3)

The goal of this graduate-level course is to provide students with the fundamentals of high-performance computing (HPC), their programming paradigms, and their applications to the data sciences and big data analytics. The course starts with motivational examples on the need for HPC in data sciences. Next, the students are introduced to HPC programming methods for distributed and shared memory systems, including message passing (MPI), multithreading (pThreads) and openMP. The course will also cover HPC methods based on data parallelism using single-instruction-multiple-data (SIMD) computing and Graphical-Processing Unit (GPU) accelerators. The HPC opportunities of cloud computing services will also be addressed, especially in their relation to business data analytics. Application examples from machine learning, business intelligence, econometrics and finance will illustrate the wide applicability of HPC to problems of practical importance. The students will use the HPC resources provided by KU Research Computing for their assignments and projects.

CODS 641 - Natural Language Proc. & Info. Retrieval (3)

The course will introduce the core concepts of Natural Language Processing such as word tokenization, Part of Speech Tagging, Vector Space representations and text related classification tasks using Machine Learning. High practical accessibility of the course is ensured through programming/project activities; in particular, the Python libraries NLTK, Gensim and CAMeL will provide a tight connection between conceptualization and practical applications.

Prerequisite: CODS622. Offered: Fall.

645 645 - Financial Machine Learning (3)

Prerequisite: CODS622.

CODS 650 - Data Processing & Visulalization (3)

Prerequisite: CODS622.

CODS 697 - CODS Graduate Project (3)

The project will provide students with an opportunity to apply knowledge gained from CODS program courses by working on a real-world computational data science project. The projects typically involves analysis of various types of data such as financial data, social media data, health data, and network data. Working on the project will enable students to gain valuable hands-on experience. They will also get first-hand experience in planning, implementing, documenting, and presenting their CODS work. Each groups typically consist of three students.

Corequisite: ENGR695. Offered: Spring Summer.

CODS 699 - Master's Thesis (9)

In the Master’s Thesis, the student is required to independently conduct original research-oriented work related to important Computational Data Science problems under the direct supervision of a main advisor, who must be a full-time faculty in either the Electrical Engineering and Computer Science Department or Mathematics Department, and at least one other full-time faculty who acts as co-advisor. The outcome of the research should demonstrate the synthesis of information into knowledge in a form that may be used by others and lead to publications in suitable reputable journals/conferences. The student's research findings must be documented in a formal thesis and defended through a viva voce examination.

Prerequisite: ENGR695. Offered: Fall Spring Summer.

COMM - Communication

COMM 601 - Technical and Scientific Writing (1)

This course imparts the essential knowledge and skills of academic, technical and scientific writing. It includes an examination of academic articles in Engineering and Applied Science and drafting practice in a variety of required genres such as proposal drafting.

Offered: Fall Spring.

COSC - Computer Science

COSC 601 - Data Mining: Finding the Data and Models that Create Value (3)

Offered: Fall.

COSC 602 - Software Engineering (3)

This course is an advanced course on software engineering, which deals with the advanced topics in quality requirements for mission-critical systems, large-scale software architecture, and data mining of software engineering repositories and artifacts. Topics include mission critical non-functional requirements safety, security, privacy, and trust; large-scale software architecture patterns and re-structuring; data mining error logs, and other selected topics.

Offered: Fall Spring.

COSC 603 - Multi-agent Systems (3)

This course is an advanced course on multi-agent systems, which deals with the analysis and design of distributed entities that interact with each other in both cooperative and non-cooperative domains. Topics include: cooperative and non-cooperative game theory, social choice, mechanism design, auctions, repeated games, distributed optimization, multi-agent learning and teaching, and other selected topics.

Offered: Fall.

COSC 604 - Artificial Intelligence (3)

This course is a graduate-level introduction to the field of artificial intelligence (AI). It aims to give students a solid understanding of the main abstractions and reasoning techniques used in AI. Topics include: representation and inference in first-order logic; modern deterministic and decision-theoretic planning techniques; Bayesian network inference and (Deep) Reinforcement Learning.

Offered: Fall.

COSC 605 - Strategic Requirements Engineering (3)

This is an interdisciplinary graduate-level course on requirements engineering and the application of requirements engineering principles and techniques to the development of complex socio-technological systems. The course puts particular emphasis on the integration of economic, strategic, social, and technological requirements, and the analysis of their impact on the future evolution of the system.

COSC 606 - Machine Learning (3)

This course will cover graduate-level materials on machine learning in both theory and practice by building upon the undergraduate-level course on "Introduction to Machine Learning". The topics include statistical learning theory, ensemble learning, probabilistic learning, dimension reduction, recommender systems, advanced clustering, semi-supervised learning, transfer learning, etc.

Offered: Fall Spring.

COSC 607 - Algorithm Design Techniques (3)

Algorithms constitute the core of Computer Science and algorithm design is crucial for the performance of real-world software systems. This is an advanced algorithms course, focusing on techniques for the design and analysis of efficient algorithms, emphasizing methods useful in practice. Topics include average case analysis of search trees and hashing; amortized analysis; competitive analysis; parallel algorithms; approximation algorithms for hard optimization problems, algorithms for problems arising in computational geometry and number theoretic algorithms.

Offered: Spring.

COSC 608 - Distributed Systems and Cloud Computing (3)

This course teaches in-demand technologies for distributed and parallel computation as well as storing and processing large amounts of data using cloud computing technologies. While underlying network and architecture issues are discussed to the extent that enables a basic understanding, particular focus is on the data science aspects of Cloud computing and cloud applications complementary to other Computer Science courses related to the realm of Data Science and Artificial Intelligence. It introduces general concepts and deploys the state-of-the-art systems from public cloud systems, but also instructs how to use locally available clouds.

Offered: Fall Spring.

COSC 620 - Algorithms in Bioinformatics (3)

This course focusses on algorithms to explore the many types of data produced in the life sciences, while combining theory and practice. The course teaches the students how to deal with DNA and protein sequence data algorithmically. We will develop software to find disease causing mutations in cancer etc., to understand what genes do and to elucidate human ancestry. Towards those goals, we deal with functional gene annotation, biological databases, comparative genomics, phylogenetics, forensics and structural bioinformatics.

Offered: Spring.

COSC 621 - Data Science (3)

This graduate-level course on data science builds upon the undergraduate course on "Data Analytics". It covers the topics of big data methods, decision theory, data streams and online learning, time-series forecasting, and data science in different domains like string/sequence, text, image/video, and graph/network.

Offered: Spring.

COSC 625 - Sustainable Energy (3)

Offered: Fall.

COSC 631 - Blockchain Fundamentals and Applications (3)

Introduction to cryptocurrencies, wallets, and Blockchain; Blockchain key features, benefits, and popular use cases; Blockchain fundamentals, protocols, algorithms, and underlying infrastructure Building Ethereum and Hyberledger blockchains; Decentralized applications (DApps); Smart contracts; Trusted Oracles; Decentralized storage; Designing and architecting blockchain-enabled systems and solutions for applications in IoT, AI, Supply Chain Management and Logistics, Healthcare, Smart Grids, 5G networks, Telecommunication, etc. Cost and Security Analysis; Limitations and open research challenges in Blockchain.

COSC 632 - Advanced Operating Systems (3)

The course presents the main concepts of advanced operating systems (parallel processing systems, distributed systems, real time systems, network operating systems, and open source operating systems), including the hardware and software features that support these systems.

Offered: Fall Spring.

COSC 635 - Deep Learning System Design (3)

High level introduction to deep learning concepts and essential contexts, deep learning computational framework, system implementation practicalities, machine learning workflow, practical classification problems for different data modalities, state of the art deep learning models.

COSC 636 - Human Computer Interaction (3)

This course covers the principles of human-computer interaction, the design and evaluation of user interfaces. Topics include an overview of users' needs and how cognitive aspects affect the design of user interfaces; the principles and guidelines for designing usable user interfaces, with emphasis on the different and novel interactions and trends in HCI; the interaction evaluation methodologies and techniques that can be used to measure the usability of software. Other topics may include World Wide Web design principles and tools, crowdsening/sourcing, speech and natural language interfaces, and virtual reality interfaces.

COSC 637 - Parallel Programming (3)

This course is a hands-on introduction to parallel computing for MSc students with emphasis on the most common and accessible parallel architecture, namely, the Graphics Processing Unit (GPU). The course will introduce students to modern GPU architectures and the fundamental concepts of parallel computing, including data parallelism, scalable execution, memory and data locality, multithreading, and synchronization. The course will also cover some of the most common parallel patterns such as convolution, prefix sum, graph search, and sparse matrix multiplications, along with their GPU implementations. The case study of deep convolutional neural networks will be covered in detail. NVIDIA's CUDA programming environment will be used throughout the course for homework assignments and the course project.

COSC 638 - Artificial Intelligence Techniques for Cyber-Security (3)

This course provides student with a basic understanding of cybersecurity techniques incorporating Artificial Intelligence (AI) and Machine Learning (ML) technologies. Also, it outlines security and privacy issues of those systems.

Crosslisted as: CSEC638. Offered: Fall.

COSC 694 - Selected Topics in Computer Science (3)

This course covers selected contemporary topics in Computer Science. The topics will vary from semester to semester depending on faculty availability and student interests. Proposed course descriptions are considered by the Department of Electrical and Computer Science on an ad hoc basis and the course will be offered according to demand. The proposed course content will need to be approved by the Graduate Studies Committee. The Course may be repeated once with change of contents to earn a maximum of 6 credit hours.

COSC 699 - Master's Thesis (9)

In the Master’s Thesis, the student is required to independently conduct original research-oriented work related to important computer science problems under the direct supervision of a main advisor, who must be a full-time faculty in the Electrical Engineering and Computer Science Department, and at least one other full-time faculty who acts as co-advisor. The outcome of the research should demonstrate the synthesis of information into knowledge in a form that may be used by others and lead to publications in suitable reputable journals/conferences. The student’s research findings must be documented in a formal thesis and defended through a viva voce examination.

Corequisite: ENGR695. Offered: Fall Spring Summer.

COSC 704 - Techniques in Artificial Intelligence (4)

Offered: Fall.

COSC 705 - Strategic Requirements Engineering (3)

Prerequisite: COSC602. Offered: Spring.

COSC 781 - Algorithm Design Techniques (3)

Algorithms constitute the core of Computer Science and algorithm design is crucial for the performance of real-world software systems. This is an advanced algorithms course, focusing on techniques for the design and analysis of efficient algorithms, emphasizing methods useful in practice. Topics include average case analysis of hashing; amortized analysis; randomized algorithms, competitive analysis of online algorithms; approximation algorithms for hard optimization problems, algorithms for data streams, number theoretic algorithms, and machine learning algorithms.

CSEC - Cyber security

CSEC 601 - Cyber Physical Systems Security (3)

This course provides working knowledge of the security issues relating to various cyber-physical systems including industrial control systems and critical infrastructure systems. The course starts with the foundations of Cyber Physical System (CPS) Security, starting with Industrial network architectures, industrial control systems and operations. It deals with techniques for securing and protecting privacy in Cyber Physical Systems.

Offered: Spring.

CSEC 602 - Modern Cryptography (3)

This course investigates advanced topics in cryptography. It will cover number theory and basic theory of Galois fields used in cryptography; history of primality algorithms and the polynomial-time test of primality; discrete logarithm based cryptosystems including those based on elliptic curves; interactive protocols including the role of zero-knowledge proofs in authentication; construction of untraceable electronic cash on the net; and post-quantum cryptography. Other topics include digital watermarking, hashing, fingerprinting, and steganography.

Offered: Fall.

CSEC 603 - Secure Software Systems Engineering (3)

The course covers the security problem in software system engineering. It deals with the rise of software system security, software security measures, and open-source applications and secure software system development lifecycle. Also, the course focuses on code review tools, software systems architectural risk analysis, building knowledge of software systems security and taxonomy of coding errors.

Offered: Spring.

CSEC 604 - Cyber-security Threats and Mitigation (3)

The course covers Cyber Security attacks, defense and mitigation technologies such as advanced malware protection, spam filtering, network analysis, and patching, providing students with a deep understanding of the cyber security processes. The course includes extensive hands-on practice using cyber-range facilities.

Prerequisite: CSEC601. Offered: Fall.

CSEC 615 - Cloud and Mobile Digital Forensics (3)

The course deals with advanced techniques for forensics in virtualized and mobile environments. It focuses on physical and touchless analysis of mobile devices, including different types of UAVs, and on identifying traces and remnants in cloud-based applications.

Prerequisite: CSEC602. Corequisite: CSEC632.

CSEC 618 - Wireless Network and Mobile Security (3)

The course deals with the threat landscape and the attacks affecting wireless and mobile communication, focusing on WLAN and 5G protocol stacks. It studies security controls used to mitigate such threats and achieve confidentiality, integrity and authenticity in mobile communications.

Prerequisite: CSEC601, CSEC602. Offered: Fall.

CSEC 620 - Social Engineering and Human Hacking (3)

This course deals with social engineering techniques underlying phishing and insider security attacks. Social engineering is a security attack vector that uses human factors and interactions in order to manipulate humans to help breaking normal system security procedures and best practices. Social engineering is used in many cyber security attacks as it is often easier to exploit users' weaknesses than it is to find a software, hardware, or network vulnerability. The content of this course exposes students to a comprehensive coverage of the various social security engineering attacks and countermeasures.

Prerequisite: CSEC601.

CSEC 621 - Hardware and System Architecture Security (3)

This course provides the student with a good understanding of hardware and system architecture Security: hardware system architecture security. Topics include: Bus security and integrated networks, Memory Security, Side Channel Analysis, Fault Analysis, Physical unclonable functions, Physical Isolation and the Red/Black Architecture.

Prerequisite: CSEC602.

CSEC 622 - Penetration Testing (3)

This course provides the student with a good understanding of Penetration Testing (also referred to as Ethical Hacking). The course covers all aspects of the subject from ethics to social engineering and then the methodologies and tools and techniques that can be used. The course also addresses the capture of malicious software and the reporting of the results.

Prerequisite: CSEC601. Offered: Spring.

- CSEC 630
CSEC 638 - Artificial Intelligence Techniques for Cyber Security (3)

This course provides student with a basic understanding of cybersecurity techniques incorporating Artificial Intelligence (AI) and Machine Learning (ML) technologies. Also, it outlines security and privacy issues of those systems.

Offered: Fall.

CSEC 640 - Financial Cyber Security (3)

The course examines techniques to achieve security of financial systems within companies, with special reference to bank and finance organizations. Students analyze financial systems breaches, and learn common threats and frauds specifically related to financial systems. Several methods of cyber security risk assessment are explored, as well as the design of risk alleviation strategies, including choosing and designing technical and process security controls for fintech. Students analyze financial services industry regulation and discuss bank and finance compliance requirements.

Prerequisite: CSEC601.

CSEC 694 - Selected Topics in Cyber Security (3)

This course covers selected contemporary topics in Cyber Security. The topics will vary from semester to semester depending on faculty availability and student interests. Proposed course descriptions are considered by the Department of Electrical and Computer Science on an ad hoc basis and the course will be offered according to demand. The proposed course content will need to be approved by the Graduate Studies Committee. The Course may be repeated once with change of contents to earn a maximum of 6 credit hours.

CSEC 699 - Master's Thesis (9)

In the Master’s Thesis, the student is required to independently conduct original research-oriented work related to important Cyber Security problems under the direct supervision of a main advisor, who must be a full-time faculty in the Electrical Engineering and Computer Science Department, and at least one other full-time faculty who acts as co-advisor. The outcome of the research should demonstrate the synthesis of information into knowledge in a form that may be used by others and lead to publications in suitable reputable journals/conferences. The student's research findings must be documented in a formal thesis and defended through a viva voce examination.

Corequisite: ENGR695. Offered: Fall Spring Summer.

ECCE-Electrical-Computer-Engr

ECCE 610 - Digital Signal Processing (3)

This course is meant to be a second course in discrete-time signal processing. It provides a comprehensive treatment of signal processing methods to model discrete-time signals, design optimum digital filters, and to estimate the power spectrum of random processes. It includes topics such as signal models, parametric and nonparametric power spectrum estimation, optimal filters, the Levinson recursion, lattice filters, and Kalman filter.

Offered: Fall Spring.

ECCE 611 - Advanced Digital Signal Processing (3)

Statistical Signal Processing; Adaptive Filtering; Time-Frequency and Multiscale Signal Processing; ADSP Applications

Prerequisite: ECCE610. Offered: Fall.

ECCE 612 - Embedded Digital Signal and Image Processing (3)

This course introduces the students to the design, prototyping, and verification of real-time, embedded digital signal and image processing systems. Such systems have wide applications in communications, multimedia, surveillance, control, robotics, machine vision, remote sensing, biomedical signal processing and medical imaging. The course will focus on the development of working knowledge and advanced skills in the use of DSP hardware platforms for the implementation of a variety of real-time, embedded signal and image processing systems selected from the applications areas mentioned above. An advanced commercial DSP development kit will be used for hands-on experience and course lab and projects.

Offered: Fall Spring.

ECCE 620 - Real-Time Embedded Systems (3)

The design of embedded systems is often challenged by soft or hard timing requirements of the application and by the limited computational power of available platforms. This course addresses design aspects of real-time embedded systems and their applications.

Offered: Fall Spring.

ECCE 621 - Digital ASIC Design (3)

ASIC design flow: role of HDL in ASIC design. HDL coding style for synthesis. ASIC testing and testbench creation. Clocking in ASIC design. ASIC libraries. Constraints for synthesis. Static timing analysis (STA), statistical timing analysis and chip variation. Floor-planning. Place and Route of ASICs. Parasitics, noise, and cross talk. Chip filling and metal filing. Timing closure and tapeout. Fault models, test pattern generation and design for testability techniques. The course will use state of the art EDA (Electronic Design Automation) tools such as Cadence and Synopsys.

Offered: Fall Spring.

ECCE 622 - RF and Mixed-Signal Circuits Design (3)

The course covers most relevant topics in the design of the RF receiver architectures in CMOS technology. It also discusses issues related to the design of mixed-signal circuits. This is addressed in the context of the common wireless standards and modulation schemes.

Offered: Fall Spring.

ECCE 623 - Digital Systems Design with FPGA (3)

This course introduces the students to the design, prototyping, and verification of sophisticated digital systems using hardware description languages. The focus of the course will be on the development of modular digital designs and their architectural explorations to meet timing, area, and power design specifications and to use IP cores to design advanced digital systems. Examples of digital systems covered in the course include codecs, memory controllers, bus interfaces, and various accelerators such as crypto and linear algebra modules. The FPGA prototyping of such advanced digital systems will also be covered as part of the course lab assignments.

Offered: Fall.

ECCE 625 - Digital Integrated Circuits Design (3)

Analysis and design of digital integrated circuits. Fabrication processes, device characteristics, parasitic effects static and dynamic digital circuits for logic and memory functions. Process technology scaling and challenges, emerging technology and its impact on digital integrated circuits. Impact of process variation on circuit behavior. Design building block of digital system including memory, combinational, sequential, and IO. System integration options (TSV, SOC, SOP). Noise and noise sources in digital systems. Interconnect and its impact on digital design performance, power, and area. Synchronous and A synchronous design, clock generation and distribution. The course will use state of the art EDA (Electronic Design Automation) tools such as Cadence and Synopsys.

Offered: Fall.

ECCE 628 - Computer Architecture (3)

This course provides students with solid working knowledge of modern computer architecture and design. It covers the organization and architecture of computer systems hardware; the hardware/software interface; instruction set architectures; addressing modes; register transfer logic; processor design; pipelining; memory hierarchy; caches; virtual memory; input/output; and bus architectures.

Prerequisite: ECCE621.

ECCE 629 - Hardware Accelerators for Artificial Intelligence (3)

This course provides a hands-on introduction to the computational structures that are common to cognitive systems and to their hardware implementations on energy-and-area-constrained nodes. The course will explore the impact of including cognitive functions in existing devices such as low-cost microcontrollers and microprocessors as well as the design of novel constrained nodes with built-in cognitive functions.

Offered: Fall Spring.

ECCE 630 - Advanced Computer Networks (3)

Modern and popular computer network technologies, protocols and services. Next Generation Networks, Triple-play services, Network management, Firewall and Intrusion detection, Wireless ad-hoc networks. Performance analysis, modeling and simulation of computer networks.

Offered: Fall Spring Summer.

ECCE 631 - Blockchain Fundamentals & Applications (3)

Introduction to cryptocurrencies, wallets, and Blockchain; Blockchain key features, benefits, and popular use cases; Blockchain fundamentals, protocols, algorithms, and underlying infrastructure Building Ethereum and Hyberledger blockchains; Decentralized applications (DApps); Smart contracts; Trusted Oracles; Decentralized storage; Designing and architecting blockchain-enabled systems and solutions for applications in IoT, AI, Supply Chain Management and Logistics, Healthcare, Smart Grids, 5G networks, Telecommunication, etc. Cost and Security Analysis; Limitations and open research challenges in Blockchain.

Offered: Spring.

ECCE 632 - Advanced Operating Systems (3)

The course presents the main concepts of advanced operating systems (parallel processing systems, distributed systems, real time systems, network operating systems, and open source operating systems), including the hardware and software features that support these systems.

Offered: Fall Spring.

ECCE 633 - Machine Vision and Image Understanding (3)

The course covers the fundamental principles of machine vision and image processing techniques. This includes multiple view geometry and probabilistic techniques as related to applications in the scope of robotic and machine vision and image processing by introducing concepts such as segmentation and grouping, matching, classification and recognition, and motion estimation.

Offered: Fall Spring.

ECCE 635 - Deep Learning System Design (3)

High level introduction to deep learning concepts and essential contexts, deep learning computational framework, system implementation practicalities, machine learning workflow, practical classification problems for different data modalities, state of the art deep learning models.

Offered: Fall Spring.

ECCE 636 - Human Computer Interaction (3)

This course covers the principles of human-computer interaction, the design and evaluation of user interfaces. Topics include an overview of users' needs and how cognitive aspects affect the design of user interfaces; the principles and guidelines for designing usable user interfaces, with emphasis on the different and novel interactions and trends in HCI; the interaction evaluation methodologies and techniques that can be used to measure the usability of software. Other topics may include World Wide Web design principles and tools, crowdsensing/sourcing, speech and natural language interfaces, and virtual reality interfaces.

Offered: Fall.

ECCE 637 - Parallel Programming (3)

This course is a hands-on introduction to parallel computing for MSc students with emphasis on the most common and accessible parallel architecture, namely, the Graphics Processing Unit (GPU). The course will introduce students to modern GPU architectures and the fundamental concepts of parallel computing, including data parallelism, scalable execution, memory and data locality, multithreading, and synchronization. The course will also cover some of the most common parallel patterns such as convolution, prefix sum, graph search, and sparse matrix multiplications, along with their GPU implementations. The case study of deep convolutional neural networks will be covered in detail. NVIDIA's CUDA programming environment will be used throughout the course for homework assignments and the course project.

Offered: Spring.

ECCE 638 - Artificial Intelligence Techniques for Cyber-Security (3)

This course provides student with a basic understanding of cybersecurity techniques incorporating Artificial Intelligence (AI) and Machine Learning (ML) technologies. Also, it outlines security and privacy issues of those systems.

Crosslisted as: COSC 638, CSEC 638.

ECCE 640 - Communication Systems Design (3)

This course covers the main concepts in digital data transmission. The topics covered will provide the student with thorough understanding of the algorithms and techniques used to design digital transmitters and receivers to a high degree of fidelity.

Offered: Fall Spring.

ECCE 641 - Wireless Communications Systems (3)

This course covers advanced topics in wireless communication systems and communication theory. The goal of this course is the design and analysis of fundamental and emerging topics in wireless communication systems, e.g., multiple-input-multiple-output (MIMO) and multi-carrier systems. Further topics include, but not limited to, capacity analysis of fading channels, adaptive modulation and coding, MIMO-orthogonal frequency division multiplexing (OFDM), and cooperative communications.

Offered: Fall Spring.

ECCE 642 - Broadband Communication Networks (3)

The course is to present the key facets of broadband communication networks. The main topics include: introduction to networks, probabilistic description of networks, queuing analysis, and layering; mobile broadband-enabling technologies; LTE-Advanced; 5G and beyond; and hybrid terrestrial/satellite networks.

Offered: Spring.

ECCE 643 - Radar Systems (3)

The course introduces the fundamentals of modern radar systems design and operation. The covered topics include the Radar equation, propagation environment, radar cross-section, clutter characteristics, detection, tracking and parameter estimation, radar antenna, transmitter and receiver. The course covers Pulsed, Doppler, and FMCW radars as the well as Synthetic Aperture Radars (SAR).

Offered: Fall.

ECCE 644 - Radio Frequency Measurements (3)

The course covers experimental characterization of RF and high-speed digital electronics using modern frequency- and time-domain measurement techniques. Advanced RF network, spectrum, field, and noise analysis will be covered. It offers in-depth treatment of RF measurement concepts, experimental methods, and test equipment. The course is augmented with laboratory sessions and it follows hands-on learning approach.

Offered: Spring.

ECCE 645 - Stochastic Processes, Detection, and Estimation (3)

This is a graduate-level course to introduce some fundamentals of stochastic processes, detection, and estimation involving signal models in which there is some inherent randomness. The concepts that we'll develop are extraordinarily rich, interesting, powerful, and form the basis for an enormous range of algorithms used in diverse applications. The material in this course constitutes a common foundation for work in the statistical signal processing, communication, and control areas.

Offered: Fall Spring.

ECCE 650 - Linear Systems (3)

State space methods, Theory of multivariable systems, Jordan canonical forms, Transformation matrices, Realization theory, Controllability, Observability, Stability, Robust stability, State feedback controllers, Full and reduced order observers, Output feedback controllers, Compensation, Decoupling and model matching, Introduction to optimal control.

Offered: Fall Spring Summer.

ECCE 651 - Modern Control Engineering (3)
ECCE 652 - Modeling and System Identification (3)

Fundamentals of dynamic systems, models, and identification processes, models of linear and nonlinear time[1]invariant and time-variant systems, parametric estimation methods, convergence and consistency of solutions, asymptotic distribution, recursive identification methods, projection based methods, model selection and validation, applications and case studies.

ECCE 653 - Advanced Digital Control Systems (3)

Classical and modern digital control system analysis and design techniques. Various discrete time controllers are designed including series compensation methods, PID-controllers, pole placement, linear quadratic optimal control, optimal state estimation and Kalman filters, Use of computer-aided analysis and design tools.

Prerequisite: ECCE650. Offered: Fall Spring.

ECCE 654 - Adaptive Control (3)

Introduction to various approaches to adaptive control, direct and indirect adaptive control schemes such as model reference adaptive control, auto-tuning, gain scheduling, and self-tuning regulators, benchmark comparison of adaptive control designs, convergence, stability and robustness, typical industrial applications.

Prerequisite: ECCE650. Offered: Fall Spring Summer.

ECCE 655 - Artificial Intelligence for Control Engineering (3)

Intelligent control strategies: Fuzzy logic control, Neural networks, Optimization control techniques including Genetic algorithms, Swarm intelligence, and applications to engineering optimization problems.

Offered: Fall Spring.

ECCE 656 - Nonlinear Systems (3)

Introduction to nonlinear control systems by means of analysis, simulation, and synthesis. The course will include phase plane analysis and classification of equilibrium points, linearization, Lyapunov method, perturbed systems, input-to-state stability, feedback linearization, tracking, regulation, and describing functions.

Prerequisite: ECCE650. Offered: Spring.

ECCE 657 - Sensors Systems (3)

This course presents different types of sensors used in robotics, autonomous navigation, process industry, power systems, and biomedical engineering. This includes but not limited to temperature, force, torque, position, velocity, vibration, electric power, medical, and gas/liquid leak sensors. It also presents various signal conditioning techniques used for front-end sensor interfacing. Hardware and algorithmic solutions used to minimize the power consumption for seamless integration in wireless sensor networks and in IoT device will also be covered. Digital interfacing with microcontrollers and microprocessors to fill the gap for understanding various embedded sensor systems will also be addressed

Offered: Fall Spring.

ECCE 658 - Autonomous Robotic Systems (3)

The course addresses some of the main aspects of autonomous robotic systems. This includes artificial intelligence, algorithms, and robotics for the design and practice of intelligent robotic systems. Planning algorithms in the presence of kinematic and dynamic constraints, and integration of sensory data will also be discussed.

Offered: Fall Spring.

ECCE 659 - Modeling and Control of Robotic Systems (3)

The course covers the theory and practice of the modeling and control of robotic devices. This includes kinematics, statics and dynamics of robots. Impedance control and robot programming will also be covered. Different case-studies will be presented to support hands-on experiments.

ECCE 660 - Power System Analysis (3)

Power system modelling; Advanced load flow techniques; Symmetric faults on generators; Single machine and Multi-Machine transient stability; Transmission line transient analysis and Power systems transients.

Offered: Fall Spring.

ECCE 661 - Power Electronics (3)

The objectives of this course are to teach the principles of power electronics devices; introduce students to different electronics devices and converters and design of converters. The course includes: the application of electronics to energy conversion and control. Modeling, analysis and control techniques. Design of power circuits including inverters, rectifiers, and dc-dc converters.

Offered: Fall Spring.

ECCE 662 - Electric Drives (3)

Selection of drives based on motor and load characteristics, modeling, simulation and control of electric drives, regenerative braking, and power quality issues related to electric drives. High power drives and current topics in electric drives.

Prerequisite: ECCE650, ECCE661. Offered: Fall.

ECCE 663 - Distribution Systems Design and Operation (3)

Distribution feeders configurations; voltage levels; Voltage drop and power loss calculations in distribution networks; Distribution feeder modeling and analysis; Distribution Networks planning and reliability; impact of integrating distributed energy resources.

Prerequisite: ECCE660. Offered: Spring.

ECCE 664 - Distributed Generation (3)

The course provides up-to-date knowledge about the technical issues related to distributed generation. The course will provide an introduction to DG and their impacts on power system studies including load flow, short circuit and transient stability. The students will also learn how to perform studies, relevant to DG technology, which include protective device coordination and electricity market operation. By the end of the course, the students should have developed an understanding of some of the current challenges associated with the integration of DG in distribution systems and should be capable, through the tools presented in the course, of exploring new strategies to mitigate the impacts of DG in order to facilitate widespread integration of DG in distribution systems.

Prerequisite: ECCE660. Offered: Fall Spring.

ECCE 665 - Electric Power Quality (3)

Introduction to power quality, PQ standards, causes and effects of different power quality phenomena, characteristics and definitions, electrical transients, voltage sags and swells, unbalance, flicker, and harmonics; mitigation techniques, active and passive filters; passive filter design, DSTATCOM, DVR.

Prerequisite: ECCE660, ECCE661. Offered: Fall Spring.

ECCE 666 - Power System Protection (3)

Introduction and general philosophies of power system protection, Symmetrical components, Symmetrical and unsymmetrical fault calculation, CB sizing, Transformer protection, Generator protection, Busbar protection, Line protection, Advanced distance protection, Pilot protection system, System stability and Generator out-of-step protection.

Prerequisite: ECCE660. Offered: Spring.

ECCE 667 - High Voltage Engineering (3)

Materials used in high voltage insulation, including gas insulation and polymeric materials. Mechanisms of breakdown in gases, solids and liquids. Partial Discharge (PD), processes leading to insulation degradation. PD measurement and diagnosis in high voltage equipment. Overvoltages and insulation coordination in high voltage networks. High Voltage circuit breaker technologies. Monitoring of high voltage systems and numerical techniques for electric field computation. Aspects of grounding.

Offered: Fall Spring.

ECCE 668 - Advanced Electric Machines (3)

Electromechanical energy conversion, rotating and linear electric machines. Development of analytical techniques for predicting machine characteristics: energy conversion density, efficiency; and of system interaction characteristics: regulation, stability, controllability, and response. Use of electric machines in drive systems. Example problems taken from current research.

Offered: Spring.

ECCE 669 - Power System Operation (3)

This course deals with modern power system operation and control issues and solution techniques. Topics covered include: Economic dispatch of thermal power generation units, Load frequency control, Unit commitment, Interchange of Power and Energy, Power System Security, Optimal Power Flow, and State Estimation in Power Systems.

Prerequisite: ECCE660.

ECCE 670 - Micro/Nano Processing Technologies (3)

This course covers the theory and practice of semiconductor fabrication processing commonly found in the fields of MEMS, electronics and photonics: optical lithography, chemical and physical vapor deposition, spin-coating, oxidation and diffusion, layout design, plasma and wet etching, dicing and bonding.

Offered: Fall Spring.

ECCE 671 - Fabrication of Nano Devices (3)

The state of the art in the microsystems device fabrication will be covered, from standard CMOS processes to niche advanced prototyping techniques of usage in new areas as photonics, MEMS, OMEMS, thin-film FETs and biosensors. Non-standard techniques such as mixed-lithography, focused ion beam milling, nanostructure self-assembly and interference lithography will also be covered.

Prerequisite: ECCE670. Offered: Spring.

ECCE 672 - Integrated Microelectronic Devices (3)

The physics of microelectronic semiconductor devices for silicon integrated circuit applications. Topics: semiconductor fundamentals, p-n junction, metal-oxide semiconductor structure, metal-semiconductor junction, MOS field-effect transistor, bipolar junction transistor and basics of optoelectronic devices. Emphasis on physical understanding of device operation through energy band diagrams. Issues in modern device scaling outlined.

Offered: Fall Spring.

ECCE 673 - Secure Embedded System Design (3)

This course covers information security as it relates to both the digital design of hardware for cryptographic primitives and the design of temper-resistant hardware systems. The course will appeal to graduate students who are interested in acquiring a multi-disciplinary perspective on the design of secure information systems, including fundamental algorithms, their software models, and their hardware implementation.

Offered: Spring.

ECCE 680 - Fundamentals of Photonics (3)

The field of Photonics describes the use of light to perform functions that are traditionally under the domain of Electronics, such as computing, data storage, information processing and telecommunications. In particular, Silicon Photonics allows the integration of optical and electronic devices on the same integrated microchip. This course covers both fundamental and advanced concepts that are needed for understanding, designing and simulating simple passive building blocks for such photonic integrated circuits (PICs). The course merges optical physics and mathematical tools, including differential equations, differential operators (Laplacian, curl, divergence, gradient), Fourier transforms, coupled-mode theory, and finite-difference time-domain (FDTD) simulations. A quick review of ray and wave optics is presented, along with electromagnetic wave propagation in isotropic media. Planar and two-dimensional dielectric waveguides are then explored, as well as an introduction to photonic crystals. The theory of ring resonators and optical add/drop multiplexers (OADM) is also covered, and simple optical architectures for interconnects, routers and switches are presented. Advanced numerical simulations in MATLAB and MEEP/Lumerical (FDTD software) are also covered. This course is essential for students focusing their research in Photonics.

Offered: Fall Spring.

ECCE 681 - Semiconductor Optoelectronic Devices (3)

This course covers optical properties of semiconductors; physics of absorption, spontaneous and stimulated emission. Theory and design of semiconductor optoelectronic devices, applications and current state-of-the-art are covered in depth. Devices covered include photo-detectors (p-i-n, avalanche, MSM), modulators (carrier injection, electro-absorption), light-emitting diodes (LEDs), semiconductor optical amplifiers and semiconductor lasers.

Prerequisite: ECCE672. Offered: Fall.

ECCE 694 - Selected Topics in Electrical and Computer Engineering (3)

This course covers selected contemporary topics in electrical and computer engineering. The topics will vary from semester to semester depending on faculty availability and student interests. Proposed course descriptions are considered by the Department of Electrical and Computer Science on an ad hoc basis and the course will be offered according to demand. The proposed course content will need to be approved by the Graduate Studies Committee. The Course may be repeated once with change of contents to earn a maximum of 6 credit hours.

Offered: Fall Spring.

ECCE 699 - Master's Thesis (9)

In the Master’s Thesis, the student is required to independently conduct original research-oriented work related to important electrical and computer engineering problems under the direct supervision of a main advisor, who must be a full-time faculty in the Electrical Engineering and Computer Science Department, and at least one other full-time faculty who acts as co-advisor. The outcome of the research should demonstrate the synthesis of information into knowledge in a form that may be used by others and lead to publications in suitable reputable journals/conferences. The student's research findings must be documented in a formal thesis and defended through a viva voce examination.

Corequisite: ENGR695. Offered: Fall Spring Summer.

ECCE 701 - Power System Modelling and Control (3)

This course gives depth learning for developing the transient model of power system equipment and FACTS devices. The course covers modeling issues for AC transient, fault, generation units, transformers, Transmission system (OHTL and Cables), FACTS devices, renewable energy systems, distributed generation, power system control as well as power system conceptual studies with practical example serving to illustrate the subject. Several cases will be applied in details to highlight the practical situation encountered in power system.

Offered: Fall Spring.

ECCE 703 - Embedded Generation Operation and Control (3)

The course provides an advanced outlook at the technical and economic issues related to distributed generation. A detailed description of the theory of operation of the most dominant renewable energy systems (PV and Wind) will be presented. The impact of DG on the distribution system planning and operation will be presented with emphasis on stochastic planning, Volt/Var control, islanding detection and power quality. A detailed DG connection impact assessment from the regulatory perspective will be presented. The course will focus on advanced techniques and methods used for microgrid operation and control. A detailed economical evaluation for DG integration will be presented.

Offered: Fall Spring.

ECCE 706 - Power Quality and FACTS Devices (3)

Power Quality is an issue that is becoming increasingly important to power system engineers and electricity consumers at transmission and distribution levels. The worldwide trend of generation of electricity from renewable energy sources, especially connected to low voltage distribution networks, additionally introduces challenges in ensuring adequate quality of power. The course is designed to provide an in-depth understanding of the major power quality problems, their analysis and different modern mitigation techniques to overcome the power quality issues.

Offered: Fall Spring Summer.

ECCE 710 - Analysis of Power Systems Over-voltages and Transients (3)

This course presents key aspects in analysis of power system transients. It provides students with the theory of numerical simulation tools such as the EMTP and numerical electromagnetic analysis. Procedures and techniques for the determination of transient parameters for the main power components: synchronous machine, overhead line, underground cable, transformer, surge arrester, and circuit breaker. It also presents important aspects in creating an adequate and reliable transient model of each component, including transient and dynamic characteristics of renewable energy systems.

Offered: Spring.

ECCE 711 - Advanced Power System Grounding and Safety (3)

The course provides highly specialized material with analytical and computational techniques for the design and testing of grounding systems in high voltage power installations. DC, AC, high frequency and impulse performance of ground electrodes and systems are treated and the course will contain practical elements including laboratory and field-based testing using research-based test equipment.

Offered: Fall Spring.

ECCE 714 - Application of Heuristic Optimization Techniques to Power Systems (3)

This course gives an overview of modern heuristic techniques and covers specific applications of heuristic approaches to power system problems, such as optimal power flow, power system scheduling and operational planning, power generation expansion planning, reactive power planning, transmission and distribution planning, and power system control.

Offered: Fall Spring.

ECCE 721 - Analog Mixed Signal Design Techniques (3)

This course covers general architecture and circuit level design issues for A/D and D/A converters used in sensors and communication circuits. It introduces different architectures and system level design concepts for A/D and D/A converters followed by circuit level design techniques. System level issues and trade-offs needed for block/circuit level specifications are extensively discussed. The course starts from fundamental concepts like quantization noise, sampling, linearity and will evolve to complete architectures used in A/D and D/A conversion Students will gain a significant amount of experience in simulating A/D and D/A circuits at the transistor level using state of the art EDA (Electronic Design Automation) tools such as Cadence and Synopsys

ECCE 722 - Numerical Simulation of Circuits and Systems (3)

This course covers the theory, algorithms, and best programming practices for the numerical simulation of circuits and systems. Methods for the automatic generation of large-scale circuit netlists are presented, including the nodal, modified nodal, and tableau formulations. Linear DC circuits are solved first using the direct and iterative techniques of numerical linear algebra with emphasis on the sparse nature of the circuit graph. Numerical issues such as stability, pivoting, conditioning, and accuracy are discussed in depth. Next Newton's algorithm for the DC analysis of non-linear circuits is presented along with the automatic generation of the companion models of nonlinear circuit elements. For transient analysis, the course covers the numerical algorithms for the solution of non-linear ordinary differential equations using first-order and higher-order methods with emphasis on linear multistep methods along with their stability and error theories. Advanced topics related to specialized circuits such as interconnect-dominated or RF circuits will be introduced, and exemplary algorithms from state-of-the-art commercial circuit simulators will be given. This course will appeal to graduate students in both electronics and power engineering.

Offered: Fall.

ECCE 723 - High Speed Communication Circuits (3)

This course covers general architecture and circuit level design issues for wired/wireless/fiber optics communication circuits. It introduces different architectures and system level design concepts for wired/wireless/fiber optics communication followed by circuit level design techniques. High Speed Communication Circuits like High Speed Logic are introduced in the first part, followed by Transimpedance amplifiers, Limiters, Laser drivers and Data and Clock Recovery Circuits. In the second part of the course many building blocks needed in a modern Wireless Transceiver are discussed (LNA, PA, Mixers, VCO, PLL's) and their design equations derived. The specifications for the building blocks is a result of System Level Considerations and trade-offs. Students will gain a significant amount of experience in simulating RF/Broadband circuits at the transistor level using state of the art EDA (Electronic Design Automation) tools such as Cadence and Synopsys.

Offered: Fall Spring.

ECCE 730 - Advanced Deep Learning (3)

This course will provide the students with the knowledge and skills required for applying advanced AI models in real-life applications, such as identifying functional modules in biological networks, autonomous driving, and learning from the small number of training samples. Topics include deep social networks, deep reinforcement learning, deep meta-learning, and lifelong learning. It will also cover active research topics in these topics.

Offered: Spring.

ECCE 731 - Distributed Computing (3)

Motivation, models, architectures and enabling technologies of distributed computing systems and their applications. Models for communication, processes, remote invocation, distributed naming, synchronization, replication, consistency, fault tolerance, distributed file systems, and distributed clocks. Cloud and grid computing, storage systems, and peer-to-peer systems. Design and implementation of distributed applications.

Offered: Fall.

ECCE 732 - Machine Learning and Applicatications (3)

Machine learning, a subset of Artificial Intelligence, aims to create systems that automatically improve with experience. It has many applications, including on-line data analysis, data mining and anomaly detection for cyber-security. Prediction and the study of generalization from data are central topics of Data Analysis and Statistics. These two domains aim at the same goal, that is, gaining insight from data and enabling prediction. This course provides a selection of the most important topics from both of these subjects. The course will start with machine learning algorithms, followed by some statistical learning theory, which provides the mathematical foundation for them. We will then bring this theory into context, providing the transition into Bayesian analysis.

Offered: Fall Spring.

ECCE 733 - High Speed Computer Arithmetic (3)

Study the theory and design of high-performance implementations of arithmetic in computers. Various types of numbering systems, computer arithmetic operations: adders, high-speed adders, multi-operand adders, multipliers, and dividers, fixed-point numbers, floating-point numbering system and floating point primitives. Implementation techniques for high-speed VLSI architectures, DSP and cryptographic protocols.

Offered: Spring.

ECCE 734 - Advanced Computer Architecture (3)

This course covers advanced topics in computer architecture with focus on emerging advancement in the field. A project will be used to enhance students' practical capabilities on research, communication, and technical writing.

Offered: Fall Spring.

ECCE 735 - Advanced Computer Vision Paradigms (3)

Computer systems that automate the analysis and the interpretation of image are getting increasing demand in areas of basic research and industrial applications. Current applications include remote sensing medical diagnosis from radiographic images, control of manufacturing through parts inspection, image recovery from web servers, database management and image archives, automatic digital photo generation, criminal and forensic investigation, to mention just few. This course covers the essential and recent advanced in computer vision paradigms related deep learning and other advance image analysis techniques for solving real work applications.

Offered: Fall.

ECCE 736 - Advanced Topics LoT and Blockchain (3)

IoT applications and protocols including MQTT and CoAP; IoT hardware and sensors; IoT deployment within the cloud and fog networks; Cloud platforms for IoT; Democratization of IoT devices using blockchain; Programmability of blockchain using smart contracts; Blockchain-based solutions for IoT; Open research problems in IoT including IoT Security.

Offered: Spring.

ECCE 737 - Network and Information Security (3)

Secure Network Communication: Cryptographic algorithms, Digital Certificates, PKI. Network Entity Authentication and Access Control, Network Reconnaissance, Firewalls, Intrusion Detection and Prevention Systems, Honeynets. Security Protocols: IPsec, SSL, VPN, HTTPS. Application Security: Popular application attacks and countermeasures. Advanced Topics in cyberecurity: IoT Security, Blockchain, Cloud Security, Cyber Physical Systems (CPS) security.

ECCE 738 - High Performance Computing (3)

This course is a hands-on introduction to high-performance computing (HPC) for PhD students whose research includes highly complex computational problems. The course will cover the HPC hardware infrastructure and programming models with emphasis on the HPC cluster currently available in KU. The first half of the course will focus on familiarizing the students with the available HPC tools such as the multicore processing nodes, graphics processing nodes, operating system, programming languages, job submission, communication protocols, and programming models. The second half of the course will apply these tools to the solutions of computational problems from various engineering disciplines, including video processing, computer animation, large-scale power grid analysis, deep learning, computational electromagnetics, and computational fluid dynamics. One distinguishing feature of this course is a semester-long project that will result in the implementation of a full, working HPC program and its application to a computational problem in the student's area of PhD research.

Offered: Fall.

ECCE 741 - Advanced Digital Communications (3)

This course discusses the fundamental techniques used in the physical layer of digital communication systems. In particular, it covers topics related to the design and performance of digital communication systems over AWGN and multipath fading channels.

Offered: Spring.

ECCE 742 - Advanced Concepts in Stochastic Processes, Detection, and Estimation Theory (3)

The aim of this course is to cover some advanced and important topics in stochastic processes, signal detection, and estimation. The course includes topics such as Detection of Random Signals with Unknown Parameters, Unknown Noise Parameters, Model Change Detection, Complex/Vector Extension, Bayesian Estimation, General Bayesian Estimators, Linear Bayesian Estimators, Estimation for Complex Data and Parameters.

Offered: Fall Spring.

ECCE 743 - Broadband Communication Systems (3)

The course covers topics in single-carrier and multi-carrier OFDM transceivers. It also discusses issues related to multiple-Antenna techniques, relaying and cooperative Communications, spectrum management, the next generation wireless networks, and satellite communication standards.

Offered: Fall Spring.

ECCE 744 - Optical Wireless Communication System (3)

The course covers topics related to optical wireless communications, including, but not limited to, optical light sources and their characteristics, link performance analysis, optical diversity techniques and visible light communications.

Offered: Fall.

ECCE 751 - Discontinuous Control Systems (3)

Relay feedback and variable-structure systems as two main types of discontinuous control systems. Describing function analysis of self-excited oscillations in discontinuous control systems. Definition of sliding mode, sliding mode in relay and variable structure systems. Multidimensional sliding modes. Design of sliding surface. The use of second Lyapunov's method for sliding mode control design. Principal and parasitic dynamics. Chattering phenomenon and chattering reduction. LPRS analysis of chattering and closed-loop performance of sliding mode systems. Sliding mode observers. Integral sliding mode. Second-order and higher-order sliding mode control. Applications of discontinuous control.

Offered: Fall.

ECCE 752 - Nonlinear Control (3)

Analysis and design of nonlinear control systems. The course will cover advanced topics in nonlinear control including passivity and input-output stability, stability of feedback systems, tracking, regulation, disturbance rejection, sliding mode control, observers, and backstepping.

Offered: Spring.

ECCE 753 - Computational Prototyping of Dynamical Systems (3)

This course covers the theory, algorithms, and best programming practices for the numerical simulation of dynamical systems. The course will draw examples from a variety of engineering disciplines, including electrical, mechanical, chemical, and aerospace engineering. Methods for the automatic generation of large-scale, state-space descriptions are presented. Direct and iterative techniques from numerical linear algebra are used to compute steady state solutions of linear systems. Numerical issues such as stability, pivoting, conditioning, and accuracy are discussed in depth. Special attention is given to sparse matrix techniques. Newton’s algorithm for finding the equilibrium points of non-linear systems is presented next along with the automatic generation of the companion models of nonlinear elements. For transient analysis, the course covers the numerical algorithms for the solution of non-linear ordinary differential equations using first-order and higher-order methods with emphasis on linear multistep methods. The stability and error theories of such methods are also covered. State-of-the-art topics related to the macromodeling of dynamical systems using model-order reduction methods will wrap up the course. One distinguishing feature of this course is a semester-long project that will result in the implementation of a full, working dynamical system simulator and its application to solve a computational problem in the student’s area of PhD research.

ECCE 754 - Computational Prototyping of Partial Differential Equations (3)

This course covers the theory, algorithms, and best programming practices for the numerical solution of partial differential equations. The course will draw examples from a variety of disciplines, including fluid dynamics, heat and mass transfer, electromagnetics, solid mechanics, and mathematical finance. Algorithms covered include: finite-difference schemes, finite-element methods, boundary-element methods, and random-walk methods. One distinguishing feature of this course is a semester-long project that will result in the implementation of a full, working PDE solver and its application to a computational problem in the student’s area of PhD research.

ECCE 755 - Cognitive Robotics (4)

To provide students with an advanced treatment of autonomous systems, how cognitive systems acquire information about the external world through learning and association of interrelationships between the observed world and their contextual frames. To learn how robotics cognitive systems can be designed to produce appropriate responses that make them more intelligent and autonomous.

Offered: Fall Spring.

ECCE 756 - Robotic Perception (4)

To provide students with knowledge in the principles and practices of quantitative perception for robotic devices. To study both sensing devices and algorithms that emulates perception and intelligent systems. Learn to critically examine the sensing requirements of typical real world robotic applications. To acquire competences for development of computational models for autonomous robotic systems.

Offered: Fall Spring.

ECCE 757 - Control of Robotic Systems (3)

This course is designed to teach students concepts and tools for analysis, design and control of robotic mechanisms. Kinematics, statics and dynamics of robotic systems.

Offered: Fall.

ECCE 762 - Voltage Source Converters (3)

Voltage source converters are widely used in modern power electronic systems such as grid-connected renewable energy sources, electric drives, gird integration of energy storage devices, V2G and G2V systems, standalone renewable energy sources, regenerative power converters, HVDC, High frequency AC link, FACTS devices etc. The course is designed to provide an in-depth understanding of the VSC. Various VSC topologies and their pulse-width modulation algorithms are discussed. The modelling, design, simulation and hardware implementation of pulse-width modulation and application of VSC are discussed.

Prerequisite: ECCE661. Offered: Fall.

ECCE 771 - Advanced Integrated Circuits Technology (3)

What are the practical and fundamental limits to the evolution of the technology of modern MOS devices and interconnects? How are modern devices and circuits fabricated and what future changes are likely? Advanced techniques and models of devices and back-end (interconnect and contact) processing. What are sub-10nm future structures and materials to maintain progress in integrated electronics? MOS front-end and back-end process integration.

ECCE 772 - Advanced Microsystem Design (3)

This course covers the design, modeling and characterization of micro-electro-mechanical systems (MEMS) with emphasis on the full microsystem design flow using state-of-the-art computer-aided design (CAD) tools. It addresses the various MEMS sensing and actuation modalities and provides in-depth treatment of the multi-faceted interplay between process, device, and electronic interface with its impact on overall system performance. Throughout the course, repeated use will be made of fundamental multi-domain formulations, CAD tools, and parameterized macromodels. Specific MEMS case studies will be selected from the areas of inertial motion sensing, piezoelectric energy harvesting, ultrasound transduction, RF-MEMS, and optical MEMS.

ECCE 773 - Photonic Materials and Metamaterials Design for Engineers (3)

The design of photonic devices and systems requires a strong background on the materials behavior with light. For an engineer there are significant opportunities in designing new metamaterials that provide functionality not found in natural materials, for application in fields such as energy harvesting, sensing, advanced displays, to name a few. The student will learn the modeling concepts and design flow for designing and fabricating novel engineered optical materials.

Offered: Fall Spring.

ECCE 774 - Advanced Photonic Integrated Circuits (3)

This course covers optical signal processing for photonic integrated circuits (PICs) and discusses state-of-the-art PIC components. The primary focus is being placed on multi-stage filter design and synthesis. Minimum, maximum, and linear-phase filters, optical lattice filters, Fourier filters, and generalized pole-zero architecture. Techniques such as least squares methods for IIR filter designs will be presented. State-of-the-art PIC examples including bandpass/bandstop filters, optical gain equalizer, dispersion compensators, and arrayed waveguide grating (AWG) routers will be discussed in depth. Also included Bragg grating synthesis algorithm using coupled-mode approach. System-level application examples to microwave photonics, sensor networks, and coherent optical detection will be given. In addition to learning filter synthesis methods, students will gain a significant amount of experience in optimizing optical circuits at the subsystem level using MATLAB/Simulink and Lumerical software suite. The above techniques will take into consideration process variations, wavelength, and polarization dependence.

Offered: Fall Spring.

ECCE 778 - Physics and Manufacturability of Advanced Micro and Nano Devices (3)

Explores the impact of physics on nanoscale devices and associated manufacturing challenges. Presents advanced physical models and practical aspects of advanced architecture devices' front-end microfabrication processes, such as oxidation, diffusion, ion implantation, chemical vapor deposition, atomic layer deposition, etching, and epitaxy. Covers topics relevant to CMOS, bipolar, and optoelectronic device fabrication, including high k gate dielectrics, gate etching, implant-damage enhanced diffusion, advanced metrology, SiGe and fabrication of process-induced strained Si. BEOL Integration and reliability. Studies CMOS process integration concepts for advanced planar and 3D devices with Si, Si-Ge, III-V, 2D material systems. Assess the interaction of device characteristics, processing scheme and the design space. Leading to yield modeling and manufacturability vs. process complexity and the required balancing. Students use modern process simulation tools.

Offered: Spring.

ECCE 781 - The Physics of Solar Cells (3)

The physics of solar cells: solar history, semiconductor fundamentals, p-n junction physics, mono-crystalline solar cells, thin film solar cells, managing light, new novel solar concepts, TCAD solar cells design and simulation, cleanroom fabrication of solar cells.

ECCE 782 - Linear Systems (3)

State space methods, Theory of multivariable systems, Jordan canonical forms, Transformation matrices, Realization theory, Controllability, Observability, Stability, Robust stability, State feedback controllers, Full and reduced order observers, Output feedback controllers, Compensation, Decoupling and model matching, Introduction to optimal control.

ECCE 783 - Power System Analysis (3)

Power system modelling; Advanced load flow techniques; Symmetric faults on generators; Single machine and Multi-Machine transient stability; Transmission line transient analysis and Power systems transients.

ECCE 784 - Digital Signal Processing (3)

This course is meant to be a second course in discrete-time signal processing. It provides a comprehensive treatment of signal processing methods to model discrete-time signals, design optimum digital filters, and to estimate the power spectrum of random processes. It includes topics such as signal models, parametric and nonparametric power spectrum estimation, optimal filters, the Levinson recursion, lattice filters, and Kalman filter.

ECCE 785 - Digital ASIC Design (3)

ASIC design flow: role of HDL in ASIC design. HDL coding style for synthesis. ASIC testing and testbench creation. Clocking in ASIC design. ASIC libraries. Constraints for synthesis. Static timing analysis (STA), statistical timing analysis and chip variation. Floor-planning. Place and Route of ASICs. Parasitics, noise, and cross talk. Chip filling and metal filing. Timing closure and tapeout. Fault models, test pattern generation and design for testability techniques. The course will use state of the art EDA (Electronic Design Automation) tools such as Cadence and Synopsys.

ECCE 786 - Integrated Microelectronic Dev (3)

The physics of microelectronic semiconductor devices for silicon integrated circuit applications. Topics: semiconductor fundamentals, p-n junction, metal-oxide semiconductor structure, metal-semiconductor junction, MOS field-effect transistor, bipolar junction transistor and basics of optoelectronic devices. Emphasis on physical understanding of device operation through energy band diagrams. Issues in modern device scaling outlined. Advanced short channel effects, new device design, new materails and intro to nanotechnolgy covered. Advanced TCAD simulation of devices.

ECCE 787 - Deep Learning Systems Design (3)

High level introduction to deep learning concepts and essential contexts, deep learning computational framework, system implementation practicalities, machine learning workflow, practical classification problems for different data modalities, state of the art deep learning models.

ECCE 788 - Advanced Computer Networks (3)

Modern and popular computer network technologies, protocols and services. Next Generation Networks, Triple-play services, Network management, Firewall and Intrusion detection, Wireless ad-hoc networks. Performance analysis, modeling and simulation of computer networks.

ECCE 794 - Selected Topics in Electrical and Computer Engineering (4)

This course covers selected contemporary topics in electrical and computer engineering. The topics will vary from semester to semester depending on faculty availability and student interests. Proposed course descriptions are considered by the Department of Electrical and Computer Engineering on an ad hoc basis and the course will be offered according to demand. The proposed course content will need to be approved by the Graduate Studies Committee. The Course may be repeated once with change of contents to earn a maximum of 6 credit hours.

Offered: Fall Spring Summer.

ENGR - Engineering

ENGR 602 - Engineering Numerical Methods (3)

This is an introductory graduate level course that deals with the numerical treatment of engineering problems encountered in various disciplines. Rudiments of how to develop, analyze, and use numerical methods are covered. Emphasis is put on the algorithms and application of numerical techniques and not on the theory except in passing.

Offered: Fall Spring.

ENGR 603 - Multivariate Data Analysis (3)

Introductory graduate level course in Multivariate Data Analysis. This course focuses on the some of the most important techniques of data reduction and analysis of qualitative data, especially encountered in Biomedical Engineering.

ENGR 605 - Systems Optimization (3)

This course provides an introduction to systems optimization focusing on understanding system tradeoffs. It introduces modeling methodology (linear, integer, and nonlinear programming), with applications in production planning, scheduling and workforce planning, time-phased planning, inventory planning, and supply contracts, logistics network design, facility sizing, and capacity expansion, capital budgeting models, assignment and matching, and transportation models. In this class, students will learn powerful modeling and solution techniques for decision-making problems that are used today by thousands of successful companies to help them make millions of dollars.

Offered: Fall Spring.

ENGR 606 - Advanced Engineering Mathematics (3)

This course focuses on concepts and techniques, analytical as well as numerical, for solving applied problems arising in various engineering disciplines. Analytics cover separation of variables, integral transforms, Green’s functions, similarity, and perturbation methods. Numerics include finite differences, finite elements, and discrete and fast Fourier transforms. Emphasis would be on formulating and solving problems as well as on interpreting and analyzing the solutions to gain physical insight. Engineering applications would be stressed in addition to mathematical formalities. MATLAB is required in some of the homework problems.

Offered: Fall.

ENGR 610 - Risk, Reliability and Uncertainty in Engineering Systems (3)

Engineering risk, reliability, uncertainty. Risk degrees, reliability analysis, data modeling and analysis, Monte-Carlo simulation, design problems.

Offered: Fall.

ENGR 695 - Seminar in Research Methods (0)

This course introduces graduate students to research methodologies and the process of formal inquiry in engineering and applied sciences. It develops the skills necessary to read and critically evaluate the research of others with emphasis on contemporary issues. The course covers the process of developing, documenting and presenting research proposals. It also addresses codes of ethics in the engineering profession. Finally, the course will provide suggestions and best practices for success in graduate studies.

Offered: Fall Spring.

ENGR 699 - Master's Thesis (36)

A student must complete a master’s thesis that involves significant creative, research-oriented work within the particular engineering field of interest, under the direct supervision of at least one full-time faculty advisor from the particular research discipline. The student must submit a formal report at the end of each semester that details the progress made in the research and the plans for the following semester. The thesis advisors assess the reports and approve the submission of the final thesis. During the final semester, the research findings must be documented in a formal thesis and defended successfully in a viva voce examination. The student must register for a minimum total of 24 credit hours of Master’s Thesis.

Corequisite: ENGR695. Offered: Fall Spring Summer.

ENGR 701 - Research Methods in Engineering (3)

This course provides sound knowledge and understanding of research methodology and project management skills and their application to engineering research and project development. Topics covered include Aspects of PhD research, Critical literature review, Citations and references, Technical writing, Presentation skills, Software and Experimental Methods, Modeling and Simulation Methods, Reliability and Validity of Results, Analysis and Interpretation of Results, Project management, and Professional issues in research.

Offered: Fall Spring.

ENGR 703 - PhD Research Seminar I (0)

In this course a PhD student is required to attend a minimum of 5 seminars on research topics given by faculty, visiting scholars and fellow PhD in Engineering students. The student must submit a brief report about each seminar that he/she attends.

Prerequisite: ENGR701. Offered: Fall Spring.

ENGR 704 - PhD Research Seminar II (0)

In this course, PhD candidates must present a public seminar on their thesis topic as part of the PhD program requirements before the semester in which they expect to graduate. The seminar is not an oral examination of the student's thesis. The seminar must be attended by at least the main advisor and one of the co-advisors. In addition to presenting a seminar, a PhD student must attend a minimum of 5 seminars on research topics given by faculty, visiting scholars and fellow PhD in Engineering students. The student must submit a brief report about each seminar that he/she attends.

Prerequisite: ENGR796. Offered: Fall Spring.

ENGR 795 - PhD Written Qualifing Examination (0)

The primary objective of the PhD Written Qualifying Exam (WQE) is to ensure that students pursuing a doctoral degree in a particular concentration/specialization have a graduate level understanding of the undergraduate fundamentals of that concentration/specialization. The PhD WQE evaluates a student's understanding of the fundamental principles and her/his ability to apply them to solve problems in three topical exam areas. The syllabi for the topical exam areas are taken from undergraduate courses in the College of Engineering at Khalifa University. Full-time PhD students typically take the PhD WQE at the end of their 2nd semester of active registration. Part-time students typically take the PhD WQE at the end of their 4th semester of active registration. A student who registers to take the WQE can count that, if he/she so wish, to be the equivalent of one course in the particular semester he/she will do the exam. This is in order to give the student time to prepare for the WQE during that semester. This does not affect the minimum credit requirements of the PhD in Engineering program.

Offered: Fall Spring.

ENGR 796 - PhD Research Proposal Examination (0)

The PhD Research Proposal Examination (RPE) is an oral exam that evaluates the student's ability to synthesize and integrate material as applied to her/his research focus area. It is expected that the student demonstrates a certain breadth of knowledge and is able to apply this knowledge to the research problem he/she is focusing on. The student must pass the RPE before being allowed to progress further in the PhD program. Full-time PhD students typically take the PhD RPE at the end of their 4th semester of active registration. Part-time students typically take the PhD RPE at the end of their 6th semester of active registration. The PhD RPE is assessed on Pass/Fail basis. A student who registers to take the RPE can count that, if he/she so wish, to be the equivalent of one course in the particular semester he/she will do the exam. This is in order to give the student time to prepare and defend the research proposal during that semester. This does not affect the minimum credit requirements of the PhD in Engineering program.

Prerequisite: ENGR795. Offered: Fall Spring.

ENGR 799 - PhD Research Dissertation (48)

A student must complete a minimum of 36 credit hours of PhD Research Dissertation that involves novel, creative, research-oriented work under the direct supervision of at least one full-time faculty advisor from the College of Engineering. The main research advisor of a student who opts for a PhD with a concentration/specialization must be a full-time faculty member in the department offering the particular concentration/specialization. The outcome of research should demonstrate the synthesis of information into knowledge in a form that may be used by others. The research findings must be documented in a formal dissertation and defended successfully in a viva voce Dissertation Defense examination

Corequisite: ENGR701. Offered: Fall Spring Summer.

ERTH - Earth Sciences

ERTH 701 - Petroleum Systems (3)

The course provides a comprehensive overview of the entire petroleum system from hydrocarbon play concepts, preservation of organic matter, source rocks, maturation of source rocks, migration of petroleum, accumulation, and alteration to reservoirs, traps and seals and their temporal occurrences in sedimentary basins. Techniques for seismic facies analysis, sequence stratigraphy, correlation techniques, basin modeling, source rock evaluation and assessing organic maturation are reviewed. Special attention will be given to source rock evaluation related to unconventional play assessment. Students will work in teams to complete a technical assessment of the prospectivity within a basin by defining the petroleum system and identifying the plays, prospects and leads.

Offered: Spring.

ERTH 702 - Laboratory Techniques in Sedimentology and Geochemistry (3)

This course provides students with an overview of the appropriate analytical methodologies for best practices in accurate data collection, analysis and interpretation whilst employing appropriate health, safety and environment practices related to working in analytical laboratories. This is a required course for all Ph.D. students working in areas related to, but not limited to, geochemistry, sedimentology, petrography and structural geology.

Offered: Spring.

ERTH 703 - Laboratory and Field Techniques in Geophysics (3)

This course will familiarize students with the logistics and equipment used in geophysical surveys. It will also provide an overview of the instrumentation and software available at Department of Earth Science for research in geophysics and rock physics. The course will introduce and discuss methodologies for best practices in geophysical data collection and analysis. This is a required course for all PhD students working in areas related to, but not limited to, geophysics.

ERTH 711 - Carbonate Petrology and Stratigraphy (3)

The course will investigate carbonate sediments at all scales from microscopic studies at the pore-scale to reservoir-scale sequence stratigraphic frameworks. The course will utilise a wide range of examples from throughout the stratigraphic record with a particular emphasis on carbonate systems of the Middle East. This is an elective course recommended for all Ph.D. students working in areas related to, but not limited to, sedimentology, petrography, geochemistry and structural geology. The course will include 3 days of fieldwork.

Offered: Fall.

ERTH 712 - Field Geology of Petroleum Systems (4)

Field Geology of Petroleum Systems focuses on the application and integration of sedimentary, stratigraphic and structural principals to undertake field-based descriptions and interpretations of lithologies and structures, and integrate the results with regional studies. Students record stratigraphic and lateral variations in sedimentary facies geometries in order to facilitate temporally-constrained palaeogeographic reconstructions of depositional facies architecture. Large- and small-scale structural features are considered, in order to understand petroleum systems in three dimensions. The course includes four weeks of field-based data-collection followed by a period of literature reviewing, data integration and report writing based at the Petroleum Institute.

ERTH 713 - Rock Physics (4)

This course covers the major rock physics methods used in geological and geophysical data interpretation. Students gain advanced knowledge on rock properties, and learn about physical processes in rocks related to geophysical exploration and hydrocarbon production. This includes the study of relations between rock properties, fluid type and distribution, and interaction with seismic and electromagnetic waves. Emphasis is on applications of rock physics in carbonate rocks

Offered: Fall Summer.

ERTH 714 - Seismic Interpretation in Petroleum Exploration and Production (3)

The course provides hands-on experience of interpreting two-dimensional and three-dimensional seismic datasets from a variety of basin types using industry-standard computer workstation systems. The course aims to expose students to a wide range of structural and stratigraphic styles, as well as reservoir geophysics. Special emphasis is given to applications in hydrocarbon exploration and production.

Offered: Spring.

ERTH 715 - Seismic Modelling and Imaging (4)

Seismic modelling is a fundamental tool being used for both seismic interpretation and processing. Numerical simulations for the seismic wave propagation in the Earth are required to validate the possible Earth models that fit available geophysical and geological data. A quantitative analysis of observable phenomena in synthetic Earth models can contribute also to the acquisition planning, especially when complex 3D geometries and rheologies are involved, as anisotropic, viscoelastic and poro-elastic effects. Seismic modeling is an important component of advanced algorithms for seismic imaging, such as reverse-time migration, multiple attenuation, non-linear diffraction tomography and full-waveform inversion. Full-waveform modeling is based commonly on three methods: finite-difference, finite-element and spectral methods. Other methods are based on the ray theory, which still allows estimating travel times and amplitudes in complex geological models.

Offered: Spring.

ERTH 717 - Applied Micropaleontology (3)

The course will provide an advanced-level overview of microfossils and their applications for solving geological problems. Emphasis will be given on those groups of microfossils commonly used for dating, correlation, and sedimentary environment interpretation. The course will be mainly lab-based and will include: sampling methods, separation and preparation techniques for carbonate microfossil analysis, microfossil counting and concentration calculations, microfossil imaging using scanning electron microscopy, analysis of microfossil diversity, abundance and distribution through time and space. Practical applications of microfossils including quantitative biostratigraphy, correlations, interpretation of sedimentary environments, paleogeographic and paleoclimate reconstructions will be discussed.

ERTH 718 - Biogeochemical Cycles (3)

Biogeochemical cycles of carbon, sulfur, nitrogen, phosphorus, calcium, and strontium will be discussed, and changes of reservoirs and reactions over geologic time as well as interactions between cycles will be examined. The elements discussed are important for the evaluation of global change and its effects on the biosphere and lithosphere. Recent anthropogenic perturbations of individual biogeochemical cycles will be evaluated and compared with perturbations known from the geologic past. The evolution of biogeochemical cycles will be evaluated in the context of petroleum systems, focusing on the temporal and spatial distribution of source rocks and reservoirs.

Offered: Spring.

ERTH 719 - Deformation and Structures of Sedimentary Rocks (3)

The course deals with the range of structures produced in sedimentary rock by deformation and especially the role of fractures/faults; the role of structures in trapping hydrocarbons and their effect on production. Course topics include rheology of rocks; stress and strain, effects of temperature, pressure, and strain rate on deformation; kinematic and dynamic analysis of deformed rock; brittle failure and joints; origin and mechanisms of fractures and faults/shear zones; mechanics of sedimentary basins; basins associated with extension, compression and strike-slip deformation; geomechanics and fractures as well as methods to characterize fractured reservoirs.

Offered: Fall.

ERTH 720 - Organic Geochemistry (3)

This course provides students with an overview of organic matter cycling in the biosphere and geosphere. The course will provide an understanding of analytical techniques and applications of organic geochemistry in modern and ancient environments. It covers theoretical concepts and analytical methods related to organic matter production, preservation, migration and degradation.

ERTH 721 - Sedimentary Basins Analysis (4)

The course covers the essential processes of the formation and evolution of sedimentary basins, and their implications for the development of petroleum systems. Students will learn the dynamics of basin evolution in tectonically active settings, including convergent, divergent, and strike-slip plate margins and interiors. In addition, students will develop a solid understanding of the major structural, tectonic, and geophysical processes that produce sedimentary basins, and develop skills in basin analysis that allow them to interpret those processes from the stratigraphic record. Key basins to be investigated include the United Arab Emirates (UAE) rifted margin and overlying foreland basins.

Offered: Fall.

ERTH 722 - Shared Earth Models (3)

In this course the quantitative integration of different measurements from geophysics, geology and petrophysics will be introduced, and practical applications will be evaluated and tested with real field data. The results of the reservoir simulation obtained by the integrated Shared Earth Models will be discussed and compared with models obtained from less integrated workflows.

ERTH 723 - Isotope Geochemistry of Sedimentary Systems (3)

Isotope geochemistry are applied to studies of Earth processes such as paleoclimatic, paleo-oceanographic, and diagenetic reconstructions of sedimentary systems. In this course, students will explore the fundamental techniques and applications of isotope geochemistry in understanding the modern and ancient Earth system.

Offered: Fall.

ERTH 724 - Clastic Sedimentology and Depositional Systems

ERTH 750 - Earth's Paleoclimate (3)

This course explores our understanding and the record of paleoclimatic change in Earth's History. Students will examine the basic principles that govern climate and climatic change on Earth. They will analyze and discuss the tools used to reconstruct past climate (i.e., geochemical, sedimentological and numerical), and the role of past climate reconstruction as it relates to on-going anthropogenically driven climate change.

ERTH 751 - Geology of the Solar System (3)

This module provides a basic introduction to our solar system and he current theories of how it formed and evolved. It also explores the basic geological processes that shape up solar system bodies using data from past and active space missions that explored the major planets, numerous moons, dwarf planets, and various small bodies.

ERTH 752 - Plate Tectonics & Geodynamics (3)

This course examines the geodynamic processes that shape the solid portions of Earth with emphasis on the structure of the planet's interior and the theory of plate tectonics. Quantitative approaches are used to explain the physical processes governing the formation of major tectonic and magmatic features. The course contributes to a comprehensive understanding of geodynamic processes in continental extensional provinces, oceanic domains, subduction systems, volcanic arcs and orogenic belts.

ERTH 753 - Field Geology of the UAE (3)

Field Geology of the UAE focuses on the application and integration of sedimentary, stratigraphic and structural principles to undertake field-based descriptions and interpretations of lithologies and structures. Field observations and interpretations will be integrated with regional studies of the Arabian Plate. Students record stratigraphic variations in sedimentary facies in order to facilitate temporally-constrained palaeogeographic and plate-tectonic reconstructions. Large- and small-scale structural features are recorded and interpreted to understand the geological evolution of the UAE since the Neoproterozoic. The course includes 11 days of field excursion and data collection, on-campus data analysis and interpretation and classroom presentations.

ERTH 754 - Environm& Eng Geophysics (3)

This course covers geophysical techniques to image and investigate the near-surface for environmental and engineering applications. The course introduces the concepts microgravity, geomagnetic, electrical, ground penetrating and seismic methods, their acquisition techniques and applications in environmental and engineering studies

ERTH 755 - Remote Sensing Earth& Plan Sci (3)

This module provides an understanding of the processes governing the evolution of planetary surfaces and the remote sensing methods used in their exploration. By integrating the technical methodology with the most recent discoveries and paradigms, a student will learn not only the current state of knowledge in planetary surface processes, but also how to critically assess the advantages and limitations of different remote sensing techniques.

ERTH 756 - Climate & Atmospheric Dynamics (3)

This course covers the processes that drive weather patterns, the general circulation of the atmosphere and the climate on Earth. Topics include: the structure and composition of the atmosphere; sources of energy that drive atmospheric processes; weather forecasting and forces that create severe weather; the influence of humans on the atmosphere; and, factors that influence climate, climate variability and climate change.

ERTH 757 - Global Change, Nat Haz & Disas (3)

This course explores the complex relationship between climate change as a driver of increased natural hazards and disasters. It examines the mechanisms, impact, and magnitude of the disaster in terrestrial and marine systems, the mitigation strategies for risk reduction as well as adaptation, economics and policy.

ERTH 758 - Phys & Chem of Solar System (3)

This module provides an understanding of the physical principles related to various topics in planetary science in addition to the fundamental chemistry in various solar system bodies.

ERTH 759 - Astrobiology (3)

Astrobiology studies the origins, evolution and potential distribution of life on Earth and in the Universe as whole. In this course, after a broad presentation of the general layouts on the formation of our Solar System and other planetary systems, students will learn about the conditions that give rise to life and its proliferation in a planet. Since the history of our planet Earth serves as important analogue in Astrobiology, students will be further introduced to the 1) coevolution of life and environments on Earth, 2) adaptability and proliferation of life in extreme environments, and 3) main tools used to find evidences for extraterrestrial life and habitability of other planets in the Solar System and beyond.

ERTH 793 - Special Topics in Earth Science (4)

To introduce special areas of importance and of interest to petroleum geosciences as selected by the faculty and which are not covered in regular courses listed in the curriculum.

Offered: Fall Spring.

ESMA-Engr-Sys-Management

ESMA 601 - System Architecture (3)

Systems architecting is one of the first stages in the product design and development process in which the system's or the product's concept is generated. These early stage decisions are fundamental to the success of the product or system because they impact all of the detailed design decisions made later on. They are also challenging because the system architect must manage ambiguity, complexity, and project management all prior to giving a formal quantitative basis to the new concept. This course will give students the tools to analyze and conceive system architectures systematically in small group environments. The course will address system form, function, and concept and conclude with special topics in systems architecting.

Offered: Fall Spring.

ESMA 602 - Product Design and Development (3)

The course covers modern tools and methods for product design and development. The cornerstone is a project in which teams of management, engineering, and industrial design students conceive, design, and prototype a physical product. Class sessions employ cases and hands-on exercises to reinforce the key ideas. Topics include: product planning, identifying customer needs, concept generation, product architecture, industrial design, concept design, and design-for-manufacturing.

Offered: Fall.

ESMA 603 - Systems Optimization (3)

This course provides an introduction to systems optimization focusing on understanding system tradeoffs. It introduces modeling methodology (linear, integer, and nonlinear programming), with applications in production planning, scheduling and workforce planning, time-phased planning, inventory planning, and supply contracts, logistics network design, facility sizing, and capacity expansion, capital budgeting models, assignment and matching, and transportation models. In this class, students will learn powerful modeling and solution techniques for decision-making problems that are used today by thousands of successful companies to help them make millions of dollars.

Offered: Fall Spring.

ESMA 604 - System Dynamics for Business Policy (3)

Advanced concepts in system dynamics modeling for applications in business operations, strategy and policy. Students gain recognition of dynamic modes of behavior in complex systems and develop skills to represent this behavior in formal modeling structures and test policies using simulation experiments. Emphasizes a formalized modeling process covering problem articulation and formulation, dynamic hypotheses, simulation model formulation, model testing, and policy design and evaluation. Extensive use of system dynamics modeling software with applications to case studies.

Offered: Spring.

ESMA 605 - System Project Management (3)

This course guides students through fundamental project management concepts and behavioral skills needed to successfully plan and manage complex systems projects. Assuming that a system/project has already been selected, the course then focuses on the preparation, planning, monitoring and adaptation of projects. The course is organized into five loosely interwoven modules.

Offered: Fall Spring.

ESMA 607 - Management and Entrepreneurship for Engineers (3)

This course provides an overview of management issues for graduate engineers and deeper review of the dynamics of start-up firms and entrepreneurship in a variety of organizations. The topics approached aim to provide the engineering practitioner with tools, frameworks and thinking processes to support the translation of engineering technology into commercial products, services and processes. Specific topics include idea generation, opportunity recognition, innovation, intellectual property, financial analysis, customer needs, market assessment, competition, exit strategy, innovation ecosystems, and business planning. Through selected readings from texts and case studies we focus on the development of individual skills and management tools. The course requires student participation in class discussion, final examinations, and a term project that involves preparation and presentation of a start-up business plan.

Offered: Fall.

ESMA 608 - Environmental Policy and Economics (3)

This course tackles issues related to the impact of the economy on the environment, climate change challenges, and the appropriate way of regulating economic activity so that balance is achieved among environmental, economic, and other social goals. We discuss and measure the impact on the environment of producers' behavior and consumers' needs. We address the role of markets in determining the "right" amount of pollution and market failures in achieving the socially desirable amount of pollution. We analyze the development of GHG emissions policies and other environment related policies. In addition, we explore issues faced by different countries in the developed and developing world with regard to environmental policy.

Offered: Spring.

ESMA 610 - Business Analytics, Statistics for Engineering Systems (3)

This course deals primarily with the descriptive and predictive functions of business analytics, which uses data and statistical methods to analyze past performance and build predictive models to support business-planning decisions. The course focuses on the basic topics of data collection, analysis and statistics, data visualization and summarization, Hypothesis testing, descriptive statistical measures, probability distributions, data modeling, sampling and estimation, statistical inference, linear regression analysis, forecasting and data mining techniques.

Offered: Fall Spring.

ESMA 617 - Innovation and Creativity in Technology Organizations (3)

This course explores three important concepts in business: creativity, innovation, and entrepreneurship. The course introduces several techniques to develop creativity and innovation in an organization. It explains how to develop a plan for building an innovation strategy and shows the importance of leveraging the potential of the digital transformation for innovation and research. Finally, the course describes the Lean Start-up method, and shows how entrepreneurs validate concepts and ideas, and refine their business strategy to create value and grow their business.

Offered: Fall Spring.

ESMA 618 - Strategic Management of Technology and Innovation (3)

This course focuses on developing general management tools and analytical frameworks that are particularly applicable to managing technology and innovation in private industry and government agencies. The course identifies strategic and operating challenges commonly encountered in meeting performance, cost and schedule requirements in new product development and roll-out, and discusses policy, organizational, financial and program management structures that can help to meet such challenges. The appropriate use of various budget and financial management tools such as earned value and total quality management will be explored in the context of the high project risk often associated with innovative technologies. Course requirements include extensive student participation in class discussions and exercises, written class assignments, a group project, a mid-term exam and a final exam.

Offered: Spring.

ESMA 619 - Advanced Quality Management System (3)

This course addresses topics in advanced Quality Management Systems and its implementation into process control, product development, certification, and problem solving strategies. Examples of the specific techniques and concepts will include Failure Modes and Effect Analysis, Quality Loss Function and Orthogonal Arrays. The course is structured in three modules; Introduction to Quality and Data collection, Quality Control, and Quality Management.

Offered: Spring.

ESMA 621 - Production, Operations and Inventory Management (3)

This course covers concepts and problems underlying the design and operation of contemporary production systems. The course content includes: models for inventory control; dynamics of production processes; production, operations and inventory planning activities from queuing theoretic perspective. While the emphasis is placed on manufacturing facilities, many of the presented results apply also to the design, planning and control of operations taking place in the service sector

ESMA 623 - Advanced Lean Manufacturing (3)

This course provides a deep understanding into the fundamental principles of lean manufacturing. Specific topics covered include: lean philosophy, push vs pull;

value stream mapping, current and future state mapping, implementing the future state; establishing continuous flow, designing level pull and material distribution strategies; mixed model value streams; strategies to respond to dynamic demand; seeing the whole.

ESMA 633 - System Simulation: Modelling and Analysis (3)

This course provides an advanced and in-depth treatment of discrete-event simulation modeling and analysis techniques. Topics include: modeling large-scale and complex systems; queuing theory; pseudo-random number and random variate generation, input modeling (data collection, analysis, and fitting distribution), output analysis (initial bias and termination bias, variance reduction techniques), sensitivity analysis, design of experiments, comparison of alternative systems.

ESMA 641 - Supply Chain, Logistics and Transportation Networks (3)

This course focuses on mathematical modeling and optimal solution techniques for designing and evaluating large scale supply chain, logistics and transportation networks. The covered topics include network design fundamentals and solution methodologies. Factors considered include: shipping routes, warehouse locations, modes of transportation (air, road, rail, and sea), pricing, transportation and distribution costs (volatile fuel costs), infrastructure constraints, security and regulatory requirements, risks, etc.

Offered: Spring.

ESMA 642 - Global Supply Chain Management (3)

The course focuses on development and management of complex global supply chains for companies sourcing components form as well as selling products in the global market. The topics covered in this course include strategic sourcing, structuring the global supply chain, international logistics, material management and replenishment strategies, coordination and collaboration, quality management, efficiency, responsiveness, resilience and risk management for global supply chain. The course is particularly structured to design and manage lean supply chains.

ESMA 643 - Warehousing and Distribution (3)

A systems approach to managing the movement of goods through the supply chain with an emphasis on warehouses for storage and demand-driven distribution centers. The course provides the fundamental concepts, issues, and algorithms to design and operate these facilities. Topics covered include warehouse configuration, storage and handling equipment, space management and storage policies; cross-docking, order picking; inbound/outbound logistics; and vendor managed inventory

ESMA 650 - Cost Engineering (3)

Cost engineering provides an analytical framework for cost determination in various contexts such as in merchandising, manufacturing, service and projects. Topics include cost estimation, cost control, business planning and management, profitability analysis, project cost management, and life cycle costing.

Offered: Fall.

ESMA 671 - Healthcare Operations Management (3)

Healthcare spending and the demand for health services continue to increase. Thus, improving the quality and efficiency of healthcare delivery are urgently needed. This course introduces the students to healthcare management as well as the methods used in the design and structure of healthcare systems. In addition, the course explores opportunities for improvement in the design and management of healthcare operations using data analytics.

Offered: Fall Spring.

ESMA 672 - Lean Service Systems (3)

This course provides an overview of the fundamental principles of lean service systems, especially in healthcare, that balances inefficiency with service availability. Specific topics covered include lean philosophy, value in healthcare; healing pathway analysis (value stream mapping), current and future state mapping, implementing the future state; implementing value-based initiatives; finding solutions for the whole.

ESMA 673 - Healthcare Information Systems (3)

This course provides a detailed overview of healthcare information systems for professionals who will work at the interface of clinical care, information technology, and the healthcare system. Topics include evidence-based care, clinical workflow analysis, unintended consequences of systems, and life-cycle management of complex clinical computing systems.

ESMA 694 - Selected Topics in Systems and Engineering Management (3)

This course covers selected contemporary topics in Engineering Systems and management. The topics will vary from semester to semester depending on faculty availability, and faculty and student interests. Proposed course descriptions are considered by the Department of Industrial and Systems Engineering on an ad hoc basis and the course will be offered according to demand. The proposed course content will need to be approved by the Graduate Studies Committee. The Course may be repeated once with change of contents to earn a maximum of 6 credit hours.

Offered: Fall Spring.

ESMA 699 - Master Thesis (9)

In the Master's Thesis, the student is required to independently conduct original research-oriented work related to important industrial systems engineering problems under the direct supervision of a main advisor, who must be a full-time faculty in the Industrial & Systems Engineering Department, and at least one other full-time faculty who acts as co-advisor. The outcome of the research should demonstrate the synthesis of information into knowledge in a form that may be used by others and lead to publications in suitable journals/conferences. The student's research findings must be documented in a formal thesis and defended through a viva voce examination.

Corequisite: ENGR695. Offered: Fall Spring Summer.

ESMA 701 - Advanced Systems Optimization (3)

The course covers state-of-the-art techniques to solve integer programming problems, with respect to both theory and the practice. The course we will cover modeling, polyhedral theory and valid inequalities, and solution techniques such as cutting plane methods, branch-and-bound, branch-and-cut, branch-and-price, column generation and Danzig-Wolfe decomposition, as well as available commercial software

Offered: Fall Spring.

ESMA 710 - Times Series Analysis Modeling and Prediction (3)

This course will cover modeling and prediction of time series. The emphasis will be on the time domain, although the frequency domain will also be explored. The structure of the model will depend on the physical knowledge of the process, as well as the form of the observed data. Models that relate the present value of a series to past values and past prediction errors are called ARIMA models (Autoregressive Integrated Moving Average). Central problems are the properties of different models and their prediction ability, estimation of the model parameters, and the model's ability to accurately describe the data. Particular attention will be given to linear modeling of time series: meaning of linearity, autoregressive and moving average models and their statistical properties, likelihood estimation and residual analysis, forecasting and simulation. An integral part of the course is the use of a statistical or numerical software such as MATLAB or R for simulation, calculation, and implementation of time series analysis techniques.

ESMA 711 - Advanced Business Analytics (3)

This course is intended for graduate students who have taken the introductory course in Business Analytics or equivalent courses. It equips the students with deeper understanding of the theory, analysis and application of regression as well as other advanced topics such as classification and time series methods.

Offered: Fall Spring.

ESMA 720 - Advanced Production and Operations Management (3)

This is a PhD level course on the analysis of production, inventory, and distribution systems. The emphasis of this course is on principles of inventory management, demand estimation, production planning, and scheduling. Topics covered include: deterministic inventory models, variability assessment, lot sizing, aggregate planning, production planning with time-varying demand, stochastic inventory models, and multi-echelon inventory problems with deterministic and stochastic demand, facility location problems.

ESMA 721 - Stochastic Processes and Applications (3)

Techniques and methods for solving engineering design problems for stochastic systems: Renewal Theory, Markov Chains, Queueing Theory, Markov Decision Processes. Methods to analyze and capture short- and long-term effects of randomness in the real-life systems. Applications including inventory, reliability, and service systems will be discussed.

Offered: Spring.

ESMA 722 - Technology strategy (3)

This course provides a series of strategic frameworks for managing high-technology businesses. The emphasis throughout the course is on the development and application of conceptual models which clarify the interactions between competition, patterns of technological and market change, and the structure and development of organizational capabilities. This is not a course in how to manage product or process development. The main focus is on the acquisition of a set of powerful analytical tools which are critical for the development of a technology strategy as an integral part of business strategy. These tools can provide the framework for deciding which technologies to invest in, how to structure those investments and how to anticipate and respond to the behavior of competitors, suppliers, and customers. The course should be of particular interest to those interested in managing a business for which technology is likely to play a major role, and to those interested in consulting or venture capital

Offered: Fall Spring.

ESMA 730 - Complex Network Analysis (3)

This course is intended to analyze complex systems or networks from a graph theory point of view. A large portion of the course is dedicated to mathematical modelling, algorithms design, and complexity analysis through the use of graph theory. This course covers fundamental network ?ow problems and also reviews the latest research publications in graph theory applications on complex system: energy, transportation, water, health, and social-communication.

Offered: Fall.

ESMA 740 - Sustainable Development: Theory & Policy (3)

This course examines alternative conceptions and theoretical underpinnings of the notion of "sustainable development." It focuses on the sustainability problems of industrial countries (i.e., aging of populations, sustainable consumption, institutional adjustments, etc.); and of developing states and economies in transition (i.e., managing growth, sustainability of production patterns, pressures of population change, etc.). It also explores the sociology of knowledge around sustainability, the economic and technological dimensions and institutional imperatives along with implications for political constitution of economic performance

Offered: Fall Spring.

ESMA 741 - Advanced Modeling for Energy Planning (3)

Advanced Modeling for Energy Planning is a PhD seminar course that deepens the understanding and applications of modeling and simulation tools as used in medium and long-range energy planning. The seminar consists of three modules: Fundamental dynamics of the global energy systems with a view of the energy transition, Energy modeling approaches, and Constraints and practical implications of using models for energy planning. The seminar provides a deep understanding of the dynamic behaviors of global and regional energy systems including trade, presents a comprehensive review of energy modeling methodologies used for planning purposes, provides the context for applying these through practical guidelines and pitfalls that should be avoided for effective policy analysis.

ESMA 742 - Energy Economics, Finance and Policy (3)

This course teaches advanced theories of energy economics, finance and policy and reviews the latest development of theoretical/empirical research in these fields

Offered: Fall.

ESMA 743 - Engineering for Energy and Poverty Solutions (3)

Engineering Energy and Poverty Solutions examines the challenges of reducing poverty within developing communities by promoting improved access to modern energy services. Normative assumptions underlying various definitions and approaches for development are examined, with an emphasis on the human development and capabilities approach as a useful theoretical foundation on which to base effective engineering solutions. Statistical data and indicators on energy poverty and energy access are critically examined to better understand current global energy needs. Students learn and apply advanced tools and methodologies for localized energy needs assessment, energy planning, and design of integrated energy systems. Throughout the semester, students work in small teams on a structured, in-depth design project that addresses an energy related need for a specific community, and participate in a week-long visit to work with the community on the project. The course is highly interactive and multidisciplinary, and relies heavily on readings, class participation and the successful management of team projects.

ESMA 780 - Advanced Urbanism: Urban Design Ideals and Action (3)

Urban design is an increasingly popular and powerful means of shaping settlement, influencing social forces, and accentuating economic activity via the purposeful manipulation of the built environment. Yet the form and realization of good urban design are often uncertain. Contrasting ideologies, shifting power structures, and competing imperatives make designers' jobs challenging. The result is that many human environments seem little impacted by the ideals of urban design. There is only a single city; how can there be multiple urban designs? The course material and research are structured to investigate:

How is one to evaluate which urban design ideals to subscribe to, and thus design better sustainable environments?

ESMA 781 - Modeling Urban Systems Energy Flow (3)

Using numerical modeling, this course analyzes the challenges that cities will face and strategies they can use to mitigate the negative environmental impacts of energy use in the built environment. A primary focus of the course is the study of energy flows in the urban environment. The scale of the investigation ranges from individual buildings to blocks/districts to cities. Students will learn to use model-based techniques (detailed and simplified) to predict and modify energy use and urban microclimate. Emphasis will be on understanding and modeling the strong interaction, in dense urban settings, between buildings, vegetation, paved roads and the urban microclimate. The mode and intensity of this interaction can significantly impact energy use and thermal comfort. These microclimatic effects include shading of neighboring buildings, long-wave radiation, wind flow patterns and urban heat island (UHI). Students are expected to be able to (or be willing to learn to) use various software tools such as Rhinoceros/Grasshopper and MATLAB. Limited tutorial sessions will be offered.

ESMA 783 - Advanced Cost Engineering (3)

Cost engineering provides an analytical framework for cost determination in various contexts such as in merchandising, manufacturing, service and projects. Topics include cost estimation, cost control, business planning and management, profitability analysis, project cost management, and life cycle costing.

ESMA 784 - Optimization for Eng Systems (3)

This course provides an introduction to systems optimization focusing on understanding system tradeoffs. It introduces modeling methodology (linear, integer, and nonlinear programming), with applications in production planning, scheduling and workforce planning, time-phased planning, inventory planning, and supply contracts, logistics network design, facility sizing, and capacity expansion, capital budgeting models, assignment and matching, and transportation models. In this class, students will learn powerful modeling and solution techniques for decision-making problems that are used today by thousands of successful companies to help them make millions of dollars.

ESMA 785 - Business Analytics for Eng Sys (3)

This course deals primarily with the descriptive and predictive functions of business analytics, which uses data and statistical methods to analyze past performance and build predictive models to support business-planning decisions. The course focuses on the basic topics of data collection, analysis and statistics, data visualization and summarization, Hypothesis testing, descriptive statistical measures, probability distributions, data modeling, sampling and estimation, statistical inference, linear regression analysis, forecasting and data mining techniques.

ESMA 794 - Selected Topics in Engineering Systems and Management (3)

This course covers selected contemporary topics in Engineering Systems and Management. The topics will vary from semester to semester depending on faculty availability and student interests. Proposed course descriptions are considered by the Department of Engineering Systems and Management on an ad hoc basis and the course will be offered according to demand. The proposed course content will need to be approved by the Graduate Studies Committee. The Course may be repeated once with change of contents to earn a maximum of 6 credit hours.

Offered: Spring.

HSEG-Health-Safety-Environment

HSEG 601 - Introduction to HSE Engineering (3)

Concepts of workplace health, safety and environment (HSE) will be discussed as they relate to the oil, gas, petrochemical and associated industries. Students will develop an understanding of how businesses manage HSE and the regulatory responsibilities, and be able to prepare for further study in the field. Included is a historical perspective of the legislative process of regulations, explanation of HSE terms, ethics and professionalism, recordkeeping and HSE statistics, accident investigation and analysis, emergency preparedness, security, workers' compensation, concepts of pollution control, waste management, and HSE management systems.

Offered: Fall Spring.

HSEG 602 - Industrial Hygiene Engineering (3)

This course studies the anticipation, recognition, evaluation, and control issues associated with industrial health and hygiene in the workplace. Topics include toxicology, epidemiology, noise, ionizing and non-ionizing radiation, chemicals, airborne contaminants, biological substances and sampling techniques. These subjects will be discussed in relation to all regulatory requirements using engineering and non-engineering controls for reducing or eliminating health hazards in the workplace.

Offered: Fall Spring.

HSEG 604 - Hazard Control in Production Systems (3)

This course addresses the application of scientific and engineering principles and methods to achieve optimum safety and health through the analysis and design of processes, equipment, products, facilities, operations, and environments. Topics will include mechanics of failure applications, plant layout and design, systems safety, powered industrial vehicles, machine guarding, robotics, industrial processes, welding and cutting, walking and working surfaces, materials handling and storage, electrical practices and release of hazardous energy. These subjects will be discussed in relation to regulatory requirements.

Offered: Fall Spring.

HSEG 605 - System Safety Engineering and Risk Management (3)

This course focuses on the evaluation of system design and process safety from the standpoint of risk, using system safety analysis techniques. Topics covered include concept of risk, system definition, hazard identification, risk assessment, risk management, sensitivity analysis and economics of system safety methodology, mathematics of systems analysis including statistical methods, Boolean algebra and reliability. Skills gained include the ability to calibrate a risk assessment matrix, perform preliminary hazard analysis (PHA), failure mode and effect analysis (FMECA), fault tree analysis (FTA), job safety analysis, event tree analysis, task analysis, process flow analysis, HAZOP (hazard and operability) analysis, and other system safety analysis techniques.

Offered: Fall.

HSEG 606 - Fire Protection Engineering (3)

This course covers fire and fire protection systems and fire program management. Topics covered include the physics, chemistry, characteristics and behavior of fire, fire hazards of materials, fire suppression systems, extinguishing agents, and detection and alarm systems. Relevant design and regulatory requirements will also be covered.

Offered: Fall Spring.

HSEG 607 - Industrial Security and Disaster Preparedness (3)

This course will introduce the student to the fundamentals of security and emergency planning, including the nature, scope, history, and essential elements of security in the workplace, with emphasis on facilities. Specific areas include the operational aspects of security strategies for identifying and controlling security exposures, applicable legal issues, personal protection, property protection, role of intelligence, and concepts of disaster planning and management.

Offered: Spring.

HSEG 608 - QHSE Program Management (3)

This course examines the concepts and principles used in the development and management of an effective Quality, Health, Safety and Environment (QHSE) Program with emphasis on minimizing undesired operational events (accidents, downtime, errors and product/process defects). In addition, analytical concepts and quantitative techniques that support these concepts will also be covered. The philosophy and historical development of major concepts are presented with particular emphasis on areas of special concern in operational incident prevention. Special attention is given to the influence of morale, education and training, the role of the supervisor, inspections, auditing, total quality management, policies and procedures, and other program elements of value to the QHSE manager. The course is designed to familiarize students with the basic information applicable to organizational operational incident prevention and development of operational incident prevention programs.

Offered: Fall.

HSEG 610 - Hazardous Waste Management (3)

This course covers standards and regulations on management of hazardous waste that include identification, storage, transportation, monitoring, avoidance, reuse, reduction, recycling, recovery, treatment and disposal practices. Current environmental cleanup practices and technologies as well as principles for restoration of contaminated land based on formation type and local regulations will be thoroughly emphasized.

Offered: Fall Spring.

HSEG 611 - Ergonomics and Human Factors Engineering (3)

This course studies human performance and its effect on the safety and reliability of systems. Information about human abilities, limitations and other characteristics will be used to design jobs, equipment, work methods and environmental conditions that will optimize human productivity in occupational settings. Engineering anthropometry, human information processing, biomechanics of motion and work posture, work physiology and human performance, thermal conditions (heat stress), the human visual system, vibration, illumination and indoor air quality, are covered in context of their application and workplace design.

Offered: Spring.

HSEG 612 - Construction Safety Management (3)

Offered: Fall.

HSEG 613 - Analysis and Design of Air Pollution Control Systems (3)

This course covers analysis and engineering design of air pollution mitigation systems. Pollutant sampling techniques across occupational, community, and personal exposures will be addressed. Students will be exposed to data analysis methods and use these skills to interpret the health effect of air pollutants. Engineering controls and best management practices required of the practicing HSE engineer will be discussed. Also included will be industrial emission control technologies for compliance in the workplace. Environmental impact assessment will also be addressed

Offered: Fall Spring.

HSEG 614 - Analysis and Design of Water Pollution Control Systems (3)
HSEG 615 - Research Methods in HSE (1)

Offered: Fall.

HSEG 694 - Selected Topics in HSEG (3)

This course covers selected contemporary topics in health, safety and environmental engineering. The topics will vary from semester to semester depending on faculty availability and student interests. Proposed course descriptions are considered by the Department of Industrial and Systems Engineering on an ad hoc basis and the course will be offered according to demand. The proposed course content will need to be approved by the Graduate Studies Committee. The Course may be repeated once with change of contents to earn a maximum of 6 credit hours.

HSEG 697 - HSEG Graduate Project (3)

In this course the student undertakes a major project under the supervision of a faculty member that brings to bear the competencies acquired through the program. This course allows students to build on and use earlier course information and to draw upon their engineering background, experience, and other pertinent resources to support the capstone report. Students also learn to apply suitable research techniques and methodologies as well as data collecting and analysis methods. An interim and a final presentation will be required

Prerequisite: ENGR695. Offered: Fall.

IICS-Insti-Inter-Civil-Security

IICS 601 - Introduction to International Relations and Security Issues (3)

This course provides a broad overview of how international security is studied and pursued. In doing so, students will learn about contending views on the nature of security and how it is best attained. They will be introduced to such concepts as the national interest, geopolitics, dimensions and measures of power, grand strategy, the changing nature of war, the security dilemma, deterrence, offense and defense, alliances, security regimes, the role of small states, the role of civil security, economics and security, belief systems and security, and security and human welfare. Finally, the course will survey major threats to international and regional security, including emerging threats and possible responses

Offered: Fall Spring.

IICS 602 - Introduction to Civil Security (3)

Civil security involves the combined and coordinated effort by governments, non-government organizations and individuals to prevent, prepare, respond and recover from natural and man-made hazards/threats which have their impact primarily within the State's borders. The role of civil security is to protect the state, its people, assets and interests which conceptually, involves the integration of multiple security paradigms (e.g. state, human and transnational security). Civil security is more than homeland security. Homeland security is predominantly a US concept focusing on countering terrorism, homeland defence and disaster management. This course introduces security to many civil security dimensions including physical security and risk management as well as natural disasters, technological disasters, and disaster and emergency response. The focus of the course is practical rather than theoretical, which reflects both the limited theoretical base of civil security and that the management of hazards and threats are derived from practitioner methodologies rather than theory. The course is focused at the governmental level rather than an organization level which reflects the fact that governments are the main driver of formal civil security responses.

Offered: Fall Spring.

IICS 603 - Social Science Research Methods (3)

The purpose of this class is to provide students with the foundations to successfully conduct research and analysis in the social sciences, including international studies and civil security. The course will also provide students with practical skills in research and writing that they can apply to professional activities after graduation. Both qualitative and quantitative methods of social science inquiry are introduced.

Offered: Fall Spring.

IICS 604 - Regional Security and the Terrorist Threat (3)

This course introduces student to concepts and events associated with state and non-state violence. It looks first at possible definitions of terrorism its various typologies. Additionally, an exploration of the theories and possible explanations for political violence and whether this is a new phenomenon lays the groundwork for discussions about terrorist groups, actions, motivations and, in some cases, their demise. This includes a historical and worldwide survey of violent extremist movements from the late 19th century. After examining movements and groups from both the left and right of the political spectrum, the course moves to an exploration of so-called Islamist terrorism. The course looks at the emergence of radical Islamism in the Middle East and the wider region. The first focus is on al-Qaeda, with an examination of its origins, its justifications for its actions, and the international effort to bring an end to its activities. We then explore other violent "franchise" groups such as Islamic State, Boko Haram and al-Shabaab, taking an in-depth look at their actions and rhetoric but also questioning what local and regional variables inhibited or encouraged their rise. The final portion of the course looks at counterterrorism efforts that may involve a spectrum of responses: intelligence, military action, law enforcement, economic operations, interrogation, and information warfare. Finally, the course explores the future of terrorist groups and actions, focusing on potential weapons, funding sources, and targets, with a look at strategy that seeks to end terror primarily by eliminating its root causes. Students, having evaluated the spectrum of possible causes and response to Islamist extremism, will develop counterterrorism strategies relevant to the UAE and/or other states based on an analysis of previous counterterrorism efforts (military, legal, extra-legal etc.).

Offered: Fall Spring.

IICS 621 - Technology and International Security (3)

Technology influences security and globalization in comprehensive political and economic terms. The problem, however, is that the nature of the relationship between technology and security is unclear, especially during times of rapid and pervasive technological change. The purpose of this seminar is to explore the ways in which technology influences international security by examining its political, economic, and strategic implications. This seminar begins by examining technologies that shaped security in the 20th century, and then shifts the discussion to how contemporary technologies are influencing political, economic, and military security in the 21st century.

Prerequisite: IICS601. Offered: Fall Spring.

IICS 622 - Technology and Civil Security (3)

This course will examine common security technology using the methodology of design and evaluation of physical protection systems. This methodology is an industry standard, and security objectives to be the basis of design. This provides a structured approach to examining technologies to detect, delay and respond. These include exterior and interior intrusion sensors, entry control technology, radiological detection, access delay technology, and critical infrastructure and border security technologies.

Prerequisite: IICS602. Offered: Fall Spring.

IICS 623 - Regional Security Challenges and Policy Options (3)

This course will introduce the student to the international relations (IR) of the Middle East/Arabian Gulf. Understanding the current situation requires historical context, and the course will begin with an overview of the region's history since the end of World War I and the collapse of the Ottoman Empire. The course will then turn to look at four specific aspects of regional security and IR: The Iraq/Iran war and the politics of identity; Energy Security, Oil and Political Economy in the IR of the Middle East; the Gulf Wars and the IR of the Gulf; and the Middle East and its evolving relationship with the US, China, India, Russia and other state actors. IR in the Middle East is shaped by a variety of material factors, including military power and technology; great power intervention; globalization and economic development; geography and natural resources; and demography and migration. The course will look at proposed solutions to conflict and regional conundrums, both in terms of diplomatic approaches to specific conflicts, and broader efforts to address the roots of regional (and global) conflict. For all of these issues, the role and perspective of the UAE will be considered first and foremost.

Prerequisite: IICS601. Offered: Fall Spring.

IICS 624 - Creating Integrated Civil Security (3)

The primary purpose of civil security is to protect society from major threats and facilitate the restoration of society when disasters occur. This is an inherently interdisciplinary problem requiring a working partnership of all levels of government, the private and service sectors, numerous operational disciplines and the general public. This course will examine the stakeholders in this endeavor, the models for integration, the goals and challenges of their collaboration, and current approaches for building and strengthening comprehensive integrated civil security.

Prerequisite: IICS602. Offered: Fall Spring.

IICS 625 - Globalization and Middle East Security (3)

Developments in the UAE, the Arabian Gulf, and the broader Middle East occur in the context of deepening global integration, a phenomenon, generally referred to as "globalization." This course builds on its prerequisite, IICS 601, and looks in depth at how globalization is reshaping the security environment for the UAE and the region, including: deepening economic interdependence, the revolutionary integration of global media and information systems, the global diffusion of weapons technologies, the global reach of terrorist groups, and the creation of a global labor force. These factors and trends are examined in terms of their impact on the regional balance of interstate power, the reshaping of power within states, political extremism, social stability, terrorism and counterterrorism, and, overall, the challenges confronting domestic and regional security. At the beginning of the course, the class will read the Abu Dhabi 2030 Plan and other future visions of prosperity in a context of peace. The term paper will represent an exploration—in light of the factors listed above—on how best to secure the future security and prosperity of the UAE and the region.

Prerequisite: IICS601. Offered: Fall Spring Summer.

IICS 626 - Comparative Civil Security Systems (3)

The goals of civil security are similar across countries. It seeks to protect the state, its people and its interests from threats and hazards that primarily have their impact within the State's borders. However, each country approaches building civil security is a particular way which reflects the country's unique history and circumstances. This course compares and contrasts how different countries approach civil security. Insights from this examination allow students to gain a greater understanding of why the UAE approaches civil security in the way it does, and alternative approaches to achieving UAE civil security goals.

Prerequisite: IICS602. Offered: Fall Spring.

IICS 645 - Policy Analysis (3)

The purpose of this class is to provide students with the foundations to successfully conduct research and analysis in policy-related topics, including international studies and civil security. Methods of analysis are explored in the context of the policy-making process. The set of "policy options" arises from the complicated interactions among actors in the policy process. The course will ask how policy problems and solutions can be framed differently, looking at a variety of case studies.

Prerequisite: IICS601, IICS602 . Offered: Fall Spring.

IICS 646 - Intelligence and National Security (3)

Intelligence is a critical element of national and civil security. The primary purpose of national intelligence is to support situational awareness and decision making by leaders across all levels of government. This course introduces students to the role of intelligence in support to the decision making process, the intelligence process, and practical issues of national intelligence in the emerging national, regional, and global security environment

Prerequisite: IICS601, IICS602. Offered: Fall Spring.

IICS 647 - Exercise Design and Technology (3)

This course provides students with the knowledge, skills and technology to develop and deliver security related exercises. Exercises are a primary methodology for research, analysis and process improvement in many aspects of security. Students who complete this course will have a strong understanding of the uses of exercises, how they are developed, and related technologies that can be used to enhance them. This course will provide hands on experience in the use of these powerful practices and tools and their uses in analysis, evaluation and improvement of security practices.

Prerequisite: IICS 601, IICS 602. Offered: Fall.

IICS 648 - The Changing Nature of War and Conflict (3)

This course provides a multidisciplinary understanding of the characteristics, practice and consequences of the use of force by states and non-state actors throughout the international system. It situates strategic studies in broader international relations and security studies debates whilst exploring core concepts such as the causes of war; the legality and morality of the use of force; revolutions in military affairs; the role, concepts and practices of land power, sea power and airpower; the so-called "new wars", and counterinsurgency.

Prerequisite: IICS601, IICS 602. Corequisite: IICS601. Offered: Fall Spring.

IICS 649 - Cybersecurity and its Implications for Statecraft (3)

This policy oriented course designed to meet the UAE's unique security needs provides a multidisciplinary understanding of the components of cybersecurity as it pertains to national security and statecraft. It builds on traditional warfighting domains such as land, air and sea and explores the ramifications of cyber in a holistic fashion. The course delves into the role of cyber in the military defense, civil security protection, stability of civilian life, environmental security and economic prosperity.

Prerequisite: IICS601, IICS602. Offered: Fall Spring Summer.

IICS 651 - Comparative National Security (3)

Prerequisite: IICS601, IICS602. Offered: Fall Spring.

IICS 690 - Critical Infrastructure Protection Design (3)

Asses the key elements of civil infrastructure protection design, including: threat and hazard assessment; conventional and nuclear environments; conventional and nuclear loads on structures; behavior of structural elements; dynamic response and analysis; connections, openings, interfaces, and internal shock; and structural systems-behavior and design philosophy.

Prerequisite: IICS602. Offered: Spring.

IICS 691 - Nuclear Security (3)

Assesses the key elements of nuclear security, including: safeguards and nonproliferation, safeguards principles and logistics, nuclear materials accountancy methods, accountancy and verification measurements, and international nuclear law and the Middle East context.

Prerequisite: IICS601, IICS602. Offered: Fall Spring.

IICS 692 - Computer and Network Security (3)

Assesses the foundations of computer and network security, including: identification and authentication, access control, vulnerability assessment and management, malicious codes, foundations of network security, network based threats and attacks, security services and security mechanism, and network security devices and firewalls.

Prerequisite: IICS601, IICS602.

IICS 693 - Wireless Network and Mobile Security (3)

This course presents information on wireless network sand mobile security, including: Wireless security threats, wireless LAN technology, wireless PAN security, mobile security fundamentals, third generation security, E- and M-commerce security

Prerequisite: IICS692.

IICS 694 - Information Security Management (3)

This course presents the fundamental principles and practices used in the management of information security, including: the need for information security management, management techniques, management tools and applications, security strategy, policy and standards, building IT security architecture.

Prerequisite: IICS601, IICS602.

IICS 698 - Thesis Workshop (3)

This workshop is designed to help MA students develop a well-crafted Master's Thesis, sustain their research and writing agenda throughout the dissertation process, and learn about the academic profession as a whole. This class requires a high level of student interaction and engagement.

Prerequisite: IICS601, IICS602, IICS603, IICS604. Offered: Fall Spring.

IICS 699 - Master's Thesis (9)

Prerequisite: IICS698. Offered: Fall Spring Summer.

MATH - Mathematics

MATH 601 - Engineering Mathematical Analysis (3)

Introductory graduate level course in engineering mathematical analysis. Review of vector calculus and linear algebra; solution of ordinary differential equations; special functions; partial differential equations of engineering physics: linear elliptic, parabolic, and hyperbolic PDE's governing heat transfer, electromagnetic, and vibratory phenomena; Eigen function expansions.

Offered: Fall Spring.

MATH 602 - Numerical Methods in Engineering (3)

Introductory graduate level course in numerical methods in engineering. Numerical integration for initial value problems; finite difference methods; linear algebra; optimization; and the finite element method.

Offered: Fall Spring.

MATH 603 - Multivariate Data Analysis (3)

Introductory graduate-level course in Multivariate Data Analysis. Multivariate Data Analysis is the study of multiple variables in a set of data where the relations among these variables and their structures are important. This course focuses on some of the most important techniques of data reduction and analysis of qualitative data.

Prerequisite: Undergraduate courses in linear algebra, differential equations, and engineering statistics (or equivalent).

MATH 604 - Multivariate Data Analysis (3)

Graduate level course providing an introduction to Multivariate Data Analysis. This course focuses on the some of the most important techniques of data reduction and analysis of qualitative data. These techniques have a wide range of engineering applications such as Materials Science, classification of engineering-geological environments and of correspondence analysis in clinical trials.

Offered: Fall.

MATH 605 - Analytical Foundations of Risk and Optimization (3)

The course provides a solid and rigorous introduction to analytical and optimization methods of primary importance in modern economic and financial applications. The recent evolution of the concept and taxonomy of risk provides a comprehensive mathematical framework to evaluate and assess the exposure to sources of risk whose impact may severely jeopardize effective decision-making. The course additionally includes recently developed methods for optimal decision-making under uncertainty.

Prerequisite: Graduate standing, introductory probability, linear algebra, or by consent of instructor.

MATH 606 - Differential Equations (3)

This course will address the behavior of solutions: existence and uniqueness theorems for nonlinear systems, continuous dependence on data; and dynamical systems properties: long time existence, stability theory, Floquet theory, invariant manifolds and bifurcation theory. Many applications shall be discussed.

Prerequisite: Undergraduate courses in calculus II, calculus III, engineering mathematics, and introduction to differential equations.

MATH 610 - Model Estimation (3)

This course provides a rigorous introduction to statistical modeling. The topics covered include classical regression, nonparametric regression, penalized estimation, covariance parameters estimation, multivariate linear model, discrimination and allocations and principal component analysis.

Offered: Spring.

MATH 611 - Quantitative Tools for Data Science (3)

This course introduces the basic concepts of data analysis and statistical computing that are frequently used in the social sciences and humanities. The course emphasizes practical applications of quantitative reasoning, visualization, and data analysis.

Prerequisite: Undergraduate courses in introductory probability and statistics and a working basic knowledge of linear Algebra is recommended.

MATH 612 - Computational Methods and Optimization in Finance (3)

This course introduces the main classes of optimization problems (linear, quadratic, convex, integer, stochastic, and robust) and the algorithms to efficiently compute the optimum in each case. The methods will be applied to financial problems such as asset/liability management, option pricing and hedging, risk management, and portfolio optimization. The students will learn to use software related to each technique.

Prerequisite: Undergraduate courses in linear algebra, programming, and introductory probability and statistics.

MATH 613 - Financial Risk and Portfolio Management (3)

This course explores how imperfect correlation between assets leads to diversified and optimal portfolios as well as its implications in asset pricing. Students will learn how to design an investor's profile by building a perfect portfolio through the combination of strategic and tactical asset allocations. Additionally, students will thoroughly explore risk by examining its different facets as well as exploring tools and methods for measuring, managing, and hedging risk. Utilizing real data, students will implement these techniques using appropriate software.

Prerequisite: Undergraduate courses in linear algebra and introductory probability and statistics.

MATH 614 - Factor Models with Machine Learning (3)

Introduction to factor models and key machine learning concepts for financial applications. Includes regression and principal-component factor models, factor analysis, neural networks, the kernel trick, and classification. All methods will be implemented in R or Python.

Prerequisite: Familiarity with multivariate calculus and some basic linear algebra will be assumed as well as some prior knowledge of undergraduate probability and statistics. The knowledge of various standard results concerning probability and statistics is assumed. If you are not familiar with these standard results, please contact the instructor as soon as possible.

MATH 615 - Abstract Algebra (3)

Group Theory

Basic arithmetic properties of Z. Equivalence relations; definitions: group, subgroups, order; homomorphisms, isomorphism; Cosets; Lagrange's Theorem and applications; cyclic groups; group actions; orbits; stabilizers; orbit partition; normalizers; centralizers; conjugacy; symmetric groups; Cayley's Theorem; Orbit-Stabiliser Theorem; Sylow's Theorems; quotient groups; the canonical homomorphism; direct products; finite abelian groups; finite abelian p-groups; the Hall polynomial; Structure Theorem of finitely generated abelian groups.

Ring Theory

Basic examples and definitions; subrings; homomorphisms kernels and Ideals. Quotient Rings. Factorization; Reducibility; roots; special classes of rings; prime and maximal ideals; field extensions; minimal polynomials of finite algebraic extensions; field automorphisms and the Galois Group; the Galois correspondence; fundamental theorem of Galois Theory; a Burly example; application: solution by radicals; insolubility of the quintic.

Prerequisite: Undergraduate courses in fundamentals of mathematical reasoning.

MATH 616 - Linear Algebra and Optimization (3)

The course revises important notions from linear algebra, which leads to an introduction to the main classes of optimization models: linear, quadratic, second-order cone, robust and semidefinite optimization. The students will learn to use software related to each technique.

Prerequisite: Undergraduate courses in linear algebra and programming.

MATH 617 - Numerical Solutions of Differential Equations (3)

This course focuses on numerical methods for partial differential equations (PDEs), with an emphasis on a rigorous mathematical basis. The fundamentals of numerical approximations and efficient numerical approaches are presented. Particular attention is given to a qualitative understanding of PDE models, the basic concepts of finite differences and finite elements, as well as important concepts such as stability, convergence, and error analysis.

Prerequisite: Undergraduate courses in differential equations, engineering mathematics, basic knowledge of functional analysis and partial differential equations, and some programming skills.

MATH 618 - Mathematical Biology (3)

This course provides an introduction to the use of continuous and discrete differential equations in the biological sciences. Biological topics include single species and interacting population dynamics, modeling infectious diseases, regulation of cell function, molecular interactions, as well as neural and biological oscillators. The course also exposes students to mathematical tools necessary to analyze and interpret biological models. Such tools include phase portraits, bifurcation diagrams, perturbation theory, and parameter estimation techniques.

Prerequisite: Undergraduate courses in calculus II, calculus III, engineering mathematics, and introduction to differential equations.

MATH 619 - Mathematical Methods for High-Dimensional and Discrete Data with Machine Learning Applications (3)

Technological and scientific advances in our ability to collect, observe, and store data throughout science, engineering, and commerce call for a change in the basic understanding of how we are to learn and handle data. This course rigorously surveys the modern literature concerning the mathematical foundations of several statistical learning and inference problems. A particular emphasis is on non-asymptotic results. Topics covered include sparse recovery, high dimensional PCA, and nonparametric least squares. The aim is to develop algorithms that are effective both in theory and in applications.

Prerequisite: Graduate standing, familiarity with multivariate calculus, linear algebra, and a solid course in undergraduate probability and statistics. The knowledge of various standard results concerning probability and statistics is assumed. If you are not familiar with these standard results, please contact the instructor as soon as possible.

MATH 620 - Advanced Statistical Inference (3)

Offered: Fall.

MATH 621 - Measure Theory (3)

Measure theory provides a foundation for many branches of mathematics, such as harmonic analysis, ergodic theory, theory of partial differential equations and probability theory. It is a central, extremely useful part of modern analysis, and many further interesting generalizations of measure theory have been developed. This course is an introduction to abstract measure theory and the Lebesgue integral. The Lebesgue integral is introduced, and the main convergence theorems are proved. Emphasis is given to the construction of the Lebesgue measure in Rn. Other topics treated in the course are Lp–spaces, the Radon-Nikodym theorem, the Lebesgue differentiation theorem, and the Fubini theorem.

Prerequisite: Undergraduate courses in Linear algebra, real analysis, and topology.

MATH 622 - Real Analysis (3)

This course is at a higher level compared to MATH 324 and covers more advanced topics as well as the standard topics more deeply. In this course, students will be introduced to the difference between pointwise and uniform convergence. The integration and differentiation of a sequence of functions will be treated in depth. The course provides a foundation for employing the Riemann-Stieltjes integral and using the Weierstrass M-test for a series of functions. Determining whether a series of functions converges uniformly will be discussed as well as the facility with power series of functions and their use in solving differential equations. This course also allows the students to demonstrate familiarity with common pathological counterexamples regarding sequences and series of functions. It introduces the students to Riemann integration and its use in analysis, various convergence theorems and their applications, equicontinuity and the Arzela-Ascoli theorem, the Arzela-Ascoli theorem to ODEs, and how to use the Stone-Weierstrass theorem in practical situations.

Prerequisite: Undergraduate courses in fundamental of mathematical reasoning, calculus II, and real analysis.

MATH 623 - Health Data Science (3)

This course provides an introduction to Health Data Science, with special emphasis on developing the knowledge and competencies necessary to understand the measurement and use of variables in health, their scales of measurement, and their use in biostatistics and Spatial Epidemiology.

Prerequisite: Familiarity with multivariate calculus and some basic linear algebra will be assumed as well as some prior knowledge of undergraduate probability and statistics. The knowledge of various standard results concerning probability and statistics is assumed. If you are not familiar with these standard results, please contact the instructor as soon as possible.

MATH 624 - Space-Time Data Science (3)

Space-time data are becoming available in overwhelming volumes and diverse forms as a result of growing remote-sensing capabilities, ground-based sensor networks, crowdsourcing, citizen science data, climate models, and novel medical sensing technologies. Dealing with massive data sets having complex structures implies a collection of conceptual, methodological, and technical challenges, which are exacerbated by data diversity. Space-time statistical methods were not designed to deal with global, high-volume, hyper-dimensional, heterogeneous, and uncertain space-time data. In fact, the computational requirements of most available methods scale poorly with data size. Space-Time Data Science (STDS throughout) is based on the integration of Statistics, Computer Science, and Machine Learning as fundamental vertices in a graph structure to be then synchronized with applied sciences, such as geography, physics, soil science, neuroscience, and epidemiology. Hence, the key of the success of STDS is to be able to tailor interdisciplinary approaches to the analysis of diverse and big space-time data. This course will introduce the statistical and computational aspects of STDS.

Prerequisite: Undergraduate course in Statistical Inference (or equivalent).

MATH 626 - Financial Derivatives and Risk Management (3)

The concept of Financial Derivatives, which includes options, futures, and forwards, is crucial for risk management, speculation, and for arbitrage activities. This course covers the foundational theory in derivatives valuation and risk management from the mathematical modeling point of view. It demonstrates the strengths and weaknesses of different models. It also illustrates and exemplifies how valuation models and risk measures are applied in the financial industry.

Prerequisite: Linear algebra, programming, and introductory probability and statistics.

MATH 630 - Research Methods in Science (3)

This course provides sound knowledge and understanding of research methodology and project management skills and their application to science research and project development. Topics covered include aspects of MSc research, critical literature review, citations and references, technical writing, presentation skills, software and experimental methods, modeling and simulation methods, reliability and validity of results, analysis and interpretation of results, project management, and professional issues in research.

Prerequisite: Graduate standing.

MATH 699 - Master's Thesis (9)

In the Master's Thesis, the student is required to independently conduct original research-oriented work related to important Applied Mathematics problems under the direct supervision of a main adviser, who must be a full-time faculty in the Department of Mathematics, and at least one other full-time faculty who acts as co-advisor. The outcome of the research should demonstrate the synthesis of information into knowledge in a form that may be used by others and lead to publications in suitable reputable journals/conferences. The student's research findings must be documented in a formal thesis and defended through a viva voce examination. The student must register for a minimum of 9 credit hours of Master's Thesis.

Prerequisite: Approval of the Department Chair and the Associate Dean for Graduate Studies.

MATH 701 - Combinatorial Analysis (3)

This is a graduate course to develop understanding of discrete mathematics through study of combinatorial principles. Topics include: Graphs; Trees; Coloring of graphs and Ramsey theorem; Dilworth's theorem and extremal set theory; Inclusion-exclusion principle; Recursions and generating functions; Partitions; (0, 1)-Matrices; Hadamard matrices; Reed-Muller codes; Codes and designs; Strongly regular graphs and partial geometries; Projective and combinatorial geometries; Polya theory of counting.

MATH 702 - Functional analysis (3)

Functional analysis is a branch of mathematical analysis dealing with the study of normed, Banach, and Hilbert spaces endowed with some kind of limit-related structure such as for instance an inner product, norm, topology, etc. and the linear operators acting upon these spaces and respecting these structures in a suitable sense. The historical roots of functional analysis lie in the study of spaces of functions and the formulation of properties of transformations of functions such as the Fourier transform as transformations defining, e.g., continuous, unitary, etc. operators between function spaces. This point of view turns out to be particularly useful for the study of differential and integral equations.

Offered: Fall Spring.

MATH 703 - Finance and Stochastic Calculus (3)

The course gives an up-to-date and modern overview of the main concepts in Mathematical Finance in continuous time. This includes mastering the basic tools of the subject such as Wiener processes, martingales, ItÃ´ calculus and Feynman-Kac formula. The tools will then lead to the study of important problems such as portfolio optimization, hedging and replication in continuous time, as well as the calculus of option prices.

Offered: Fall Spring.

MATH 704 - Matrix Comutations (3)

Reliable and efficient algorithms for solution of linear systems, least squares problems, the eigenvalue problems and related problems. Perturbation analysis of problems as well as stability and sensitivity of algorithms and certain conditions of problems. Algorithms for structured matrices. Designing and programming reliable numerical algorithms using MATLAB leading to high performance matrix computations codes.

Offered: Fall Spring.

MATH 705 - Mechanics of interacting particles (3)

The course gives an up-to-date and modern overview of the main concepts in the mechanics of interacting particles. Using the Lagrangian/Hamiltonian formalisms, the course continues with an axiomatic approach to quantum mechanics. Path integrals and path integral quantization of Bosonic and Fermionic particles are also treated. An introduction to gauge theories, the Higgs field and the

Bosonic string theory are also given

MATH 706 - Modern Statistical Predictionand Data Mining (3)

This course will train students in a variety of modern statistical and computational methods that enable researchers to learn from data and make sense of the vast amounts of data being generated in many fields. Although emphasizing applications in computer code, this course will also require mathematical proofs and derivations. Techniques taught in this course include regularization, kernel smoothing, model selection, model inference (bootstrap and EM algorithm), additive models, boosting and additive trees, neural networks, support vector machines, and ensemble learning. Particular emphasis is placed on understanding the strengths and weaknesses between different methodologies used for extracting patterns and trends from large and complex data.

Offered: Spring.

MATH 707 - Nonlinear Optimization (3)

course in real analysis in finite dimensional spaces. Optimization has applications in many fields, both in research and industry, and forms an integral part of parameter estimation and control, as well as machine learning. This course aims to give doctoral students an overview of the current state of the art in nonlinear optimization. We will discuss the theoretical underpinnings and convergence of various optimization approaches and offer practical guidelines for their use and implementation. Topics include unconstrained and constrained optimization, linear and quadratic programming, Lagrange and conic duality theory, interior-point algorithms and theory, Lagrangian relaxation, generalized programming, and semi-definite programming. Algorithmic methods used in the class include steepest descent, Newton's method, conditional gradient and sub-gradient optimization, interior-point methods and penalty and barrier methods.

Offered: Spring.

MATH 708 - Partial Differential Equations (3)

Many laws of physics are formulated as partial differential equations (PDEs). This course discusses the simplest examples, such as waves, diffusion, gravity, and static electricity. Non-linear conservation laws and the theory of shock waves are discussed. Further applications to physics, chemistry, biology, and population dynamics.

Offered: Fall.

MATH 709 - Probability and Stochastic Processes (3)

This course aims at presenting the mathematically rigorous concepts underlying classical continuous-time stochastic processes. In the first part of the course, some fundamental notions of modern probability measure theory are revised together with the notion of measure-theoretic derivative. Then, fundamental topics of stochastic processes, such as martingales, Kolmogorov's extension and Brownian motions, will be presented.

Offered: Fall.

MATH 710 - Selected topics in group theory (3)

The course gives an up-to-date and modern overview of the main concepts in group theory. Group theoretical properties and several examples of groups arising in many branches of mathematics, physics, and chemistry are studied to show how group theory emerges in different mathematical fields and in applied sciences. Group theory and the closely related representation theory have many applications in physics and chemistry since various physical systems, such as crystals and the hydrogen atom, can be modeled by symmetry groups.

MATH 711 - Selected Topics in High Dimensional Statistics (3)

Technological and scientific advances in our ability to collect, observe, and store data throughout science, engineering, and commerce call for a change in the basic understanding of how we are to learn and handle data. This course rigorously surveys the modern literature concerning the mathematical foundations of several statistical learning and inference problems. A particular emphasis is on non-asymptotic results. Topics covered include sparse recovery, high dimensional PCA, and nonparametric least squares. The aim is towards developing algorithms that are effective both in theory and in applications.

Prerequisite: MATH706, MATH709. Offered: Fall.

MATH 712 - Quantitative Princ in Biology (3)

This is an advanced course in the general field of Mathematical and Physical Biology and related topics. The course attempts to identify candidate quantitative principles for Biology. The mathematical tools used in this course span from stochastic processes, probability, network and information theory. The material presented here is beyond the classical courses of Mathematical Biology and meets the current research trends.

MATH 713 - Measure Theory (3)

Measure theory provides a foundation for many branches of mathematics such as harmonic analysis, ergodic theory, theory of partial differential equations and probability theory. It is a central, extremely useful part of modern analysis. This course is an introduction to abstract measure theory and the Lebesgue integral. The Lebesgue integral is introduced, and the main convergence theorems proved. Emphasis is given to the construction of the Lebesgue measure in Rn. Other topics treated in the course are Lp-spaces, the Radon-Nikodym theorem, the Lebesgue differentiation theorem, and the Fubini theorem.

Offered: Fall.

MATH 714 - Real Analysis (3)

This course is at a higher level compared to MATH 324 and covers more advanced topics as well the standard topics more deeply. In this course, students will be introduced to the difference between pointwise and uniform convergence. The integration and differentiation of a sequence of functions will be treated in depth. The course provides a foundation on how to employ the Riemann-Stieltjes integral, and how to use the Weierstrass M-test for series of functions. Determining whether a series of functions converges uniformly will be discussed as well as the facility with power series of functions and their use in solving differential equations. This course also provides the students with the ability to demonstrate familiarity with common pathological counterexamples regarding sequences and series of functions. It introduces the students to Riemann integration and its use in analysis, various convergence theorems and their applications, equicontinuity and the Arzela-Ascoli theorem, the Arzela-Ascoli theorem to ODEs, and how to use the Stone-Weierstrass theorem in practical situations.

Offered: Fall.

MATH 715 - Analytical Foundations of Risk and Optimization (3)

The course provides a solid and rigorous introduction to analytical and optimization methods of primary importance in modern economic and financial applications. Recent evolution of the concept and taxonomy of risk provides a comprehensive mathematical framework to evaluate and assess the exposure to sources of risk whose impact may severely jeopardize effective decision making. The course additionally includes recently developed methods for optimal decision making under uncertainty.

Offered: Fall.

MATH 717 - Methods of Mathematical Physics (3)

This course will combine theoretical physics with high-level math courses in differential equations, vector calculus, and applied mathematics. The course will also get plenty of chances to apply that learning with hands-on labs in computer programming, optics, and provides an introduction to mathematical aspects of Quantum Mechanics and Quantum Field Theory, and to make some fundamental topics in this research area accessible to graduate students with interests in Analysis, Mathematical Physics, PDEs, and Applied Mathematics.

Offered: Fall.

MATH 725 - Computational Systems Biology (3)

This course will introduce PhD students to computational and mathematical modelling of oncology. In particular, we will cover topics related to cancer phenomena at different spatiotemporal scales, such as cancer genetics and signaling pathways, cancer cell interactions and clinical tumor growth.

Offered: Fall.

MATH 777 - Mathematical Models for Biology and Epidemiology (3)

This is an advanced course in Mathematical Modelling for the Biosciences with emphasis on Epidemiology and related topics. The instructor should select timely topics and adapt the course to the needs of the students from a vast portfolio of research areas including population dynamics, epidemiology, modelling of infectious diseases and model calibration and validation.

Offered: Fall Spring.

MATH 787 - Mathematical Imaging (3)

This course will cover the mathematical conceptual foundations of medical imaging science. These fundamentals cover topics such as signal processing, noise analysis, and image reconstruction with a large focus on Fourier Transforms. The course includes theoretical foundations and concept applications through exercises based on computational environment such as Matlab. The course includes also a project compiling all the fundamental concepts introduced for real data applications such as medical and engineering research challenges.

Offered: Spring.

MDBS - MDBS

MDBS 601 - Molecules, Genes and Cells (6)

Foundational concepts of cell biology, biochemistry, histology, medical genetics, and disease prevention form the basis of this introduction to medicine. Energy production and utilization in cells, biological molecules associated with cells, cell compartmentalization, and cell communication are discussed in depth. The role of enzymes in cellular processes, metabolic pathways, their interrelatedness, regulation, and the consequences of biomolecular defects on these processes at the molecular and cellular levels are explored. Students extend their knowledge of human patterns of genetic inheritance beyond Mendelian concepts with the objective of seeing patients through a genetic lens

Offered: Fall.

MDBS 602 - Structural Organization of the Human Body (4)

First year medical students are introduced to the basics of human anatomy, including general principles of embryology, of organ histology and of gross anatomy of the musculoskeletal, cardiovascular, respiratory, nervous, endocrine, renal and gastrointestinal systems. Course content provides the foundation for a thorough comprehension of subsequent courses in physiology, pharmacology, pathology, and the practice of medicine. Learning outcomes are achieved by means of tutorials, lectures, and demonstrations using prosected cadavers, anatomical models, plastinated specimens, and online learning resources.

Offered: Fall.

MDBS 603 - Introduction to Physiology and Immunology (5)

During this introduction to physiology and immunology, medical students explore normal functions of the human body at the molecular, cellular, tissue, organ, and organ system levels and the body's immune response to bacteria, viruses, and other foreign substances. Case scenarios enable students to develop skills in identifying normal and pathological conditions, identifying, and interpreting appropriate diagnostic tests, and developing management plans.

Offered: Fall.

MDBS 604 - Pathology (3)

Medical students explore the causes, mechanisms, structural changes, and clinical manifestations of human illness and disease. Course content focuses on the cell as a unit of health and disease; cell injury, cell death, and adaptations; inflammation and repair; hemodynamic disorders, thrombembolism and shock; neoplasia; genetic and pediatric diseases; environmental and nutritional diseases; and foundations of laboratory medicine. The foundational concepts covered in this course serve as building blocks for organ-specific pathology presented throughout Period 2.

Offered: Fall.

MDBS 605 - Microbiology and Infectious Diseases (3)

An exploration of the roles of microorganisms (bacteria, viruses, fungi and parasites) on human health and disease. Medical students study the epidemiology, routes of transmission, techniques in detection, and pathogenesis of infectious diseases. Based on clinical findings, students develop differential diagnoses and treatment plans, including use of broad spectrum and targeted antimicrobial therapies.

Offered: Fall.

MDBS 606 - Pharmacology and Therapeutics (4)

During this introduction to the principles of pharmacology and therapeutics, medical students explore the major drug classes, including their routes of administration, absorption, distribution, onset and duration of action, dose response, metabolism, and excretion. Course content focuses on target and common drug mechanisms, drug interactions, and factors influencing drug efficacy and toxicity, including comorbidities, demographic, environmental and genetic factors.

Offered: Fall.

MDBS 701 - Cardiovascular&Respiratory Sys (6)

An introduction to the cardiovascular and respiratory systems and their interrelationships with other organ systems. Medical students review the molecular and cellular biology, genetics, embryology, anatomy, histology, microbiology, physiology, and pathology of the cardiopulmonary system. The course delves into the pathophysiologic mechanisms that lead to common disorders of the heart and lungs and diagnostic and therapeutic strategies to manage and/or prevent these disorders. Clinical correlations, application exercises, and other teaching and learning strategies are used to illustrate the relevance of the biomedical sciences in the practice of cardiopulmonary medicine.

Offered: Fall.

MDBS 702 - Hematopoietic&Lymphoreticular (3)

An exploration of genetic and acquired disorders of the hematopoietic and lymphoreticular systems. Emphasis is given to recognition of structural, morphological, and functional changes produced by these disorders while highlighting clinical–pathologic correlations, acquisition of the appropriate vocabulary, fundamental concepts of clinical hematology, oncology, and blood banking. Molecular diagnostic and targeted ancillary studies are reviewed.

Offered: Fall.

MDBS 703 - Integumentary System (2)

The skin is the largest organ in the human body and, with its appendages, comprises the integumentary system. This course introduces medical students to the structures and functions, normal development, and pathological conditions of the integumentary system, including common congenital diseases. Students have the opportunity to develop skills in reviewing and interpreting diagnostic tests and applying pathophysiologic reasoning to determine differential diagnoses and appropriate treatment options.

Offered: Fall.

MDBS 704 - Musculoskeletal System (3)

Expanding on the foundations from the Period 1 anatomy course, medical students explore the normal development, structure, and function of the musculoskeletal system, review common congenital and acquired pathologic conditions, and interpret diagnostic tests to form differential diagnoses and identify basic treatment options. Course content emphasizes the effects of environment, nutrition, exercise, and aging on bone and joint homeostasis; radiological assessment and correlation with pathoanatomy; and the basis of autoimmunity, rheumatologic diseases and inflammatory disorders.

Offered: Fall.

MDBS 705 - Gastrointestinal System (4)

Building upon the foundational sciences, medical students explore the gastrointestinal (GI) system and its interrelationships with other organ-systems and its molecular and cellular biology, genetics, embryology, anatomy, histology, microbiology, pathology, and physiology. The course also delves into the pathophysiologic mechanisms that lead to common GI disorders, and diagnostic and therapeutic strategies to manage and/or prevent these disorders. Special attention is given to the role the GI System plays in nutrition and nutritional disorders. Clinical correlations, application exercises, and other teaching and learning strategies are used to illustrate the relevance of the biomedical sciences of the GI system to the practice of medicine.

Offered: Fall.

MDBS 706 - Endocrine System (3)

The endocrine system comprises glands and organs that produce and release hormones that regulate biological processes in the body. Medical students study the component organs, normal physiologic processes, and common endocrine disorders and explore the mechanisms of disease. Course content focuses on biologic, environmental, and behavioral factors that influence endocrine disease and diagnostic strategies, therapeutic interventions, and counseling techniques for the management of endocrine diseases.

Offered: Fall.

MDBS 707 - Reproductive System (3)

An overview of the normal development and common abnormalities, disorders, and diseases of the male and female reproductive systems throughout the lifespan. Medical students study human embryological and fetal development and role of the hypothalamic–pituitary–gonadal axis on the production of hormones and the development of puberty and reproductive function.

Offered: Fall.

MDBS 708 - Renal System (3)

Building on the subjects studied during Period 1, medical students study the Renal System and its interrelationships with other organ-systems. Students explore the role of the renal system in the excretion of waste products, maintenance of electrolytes and water balances, acid base homeostasis and the regulation of blood pressure. Normal renal function and acute and chronic conditions affecting the renal system and their pathogenesis, diagnosis, and management are discussed

Offered: Fall.

MDBS 709 - Nervous System &Special Senses (6)

Neuroanatomy, neurophysiology, neuropathology, clinical neurology, and neuropharmacology principles form the basis for understanding essential concepts of normal and pathological neurological functions. Integrated and multidisciplinary course material provides an overview of functional and structural relationships between the central and peripheral nervous systems in diseased and healthy conditions. Medical students explore the normal anatomy and function of the special senses, including hearing (ears), vision (eyes), and taste (tongue), and pathological conditions involving these organs. Students have the opportunity to develop skills in assessing patient symptoms, locating problem areas within the nervous system and special senses, and diagnosing and treating abnormalities.

Offered: Fall.

MDBS 710 - Behavioral Science (3)

Psychological and psychiatric principles form the basis for understanding essential concepts of normal and pathological behavior. Integrated and multidisciplinary course material provides an overview of functional concepts in psychiatry. Medical students explore key concepts of childhood development, clinical psychiatry, psychopharmacology, and psychotherapy. Students have the opportunity to develop skills in assessing and diagnosing normal and abnormal behaviors, and become acquainted with classic and novel therapies for managing different types of psychiatric conditions.

Offered: Fall.

MDBS 800 - Med. Sci. in Clinical Practice (3)

This review of the core biomedical sciences is integrated with the clinical clerkships throughout Period 3, enabling medical students to apply theoretical knowledge to the practice of medicine. Using a case-based, learner-centered approach, the course presents student with clinical scenarios patterned after real-world cases. Clinical challenges promote student-driven inquiry, data analysis, problem solving, and communication skills, while expanding basic science and clinical knowledge. Course content helps students prepare for the International Foundations of Medicine (IFOM) examination, United States Medical Licensing Examination (USMLE) Step 1, and other examinations required for application to residency training programs.

Offered: Fall.

MDCM - MDCM

MDCM 600 - Practice of Medicine & Physicianship I (8)

A combination of classroom instruction and hands-on training enables medical students to develop and refine essential skills required in the practice of medicine. Using patient simulators and standardized patients, students have the opportunity to practice: communicating with patients, eliciting medical history, conducting physical and mental status examinations, and performing basic procedures. Preceptorship experiences in a local hospital enable students to observe and participate in real-world patient encounters.

Offered: Fall.

MDCM 700 - Practice of Medicine II (5)

A variety of instructional methods are employed to prepare medical students for their future roles as physicians. Content is aligned with the organ-system courses conducted throughout Period 2, enabling students to apply theoretical basic science concepts to patient care. Students practice developing problem lists and working differential diagnoses. Objective structured clinical examinations (OSCEs) assess student preparedness for interactions with patients during the clinical clerkship phase of the curriculum.

Offered: Fall.

MDCM 801 - Internal Medicine (8)

The clinical clerkship in Internal Medicine involves inpatient and outpatient experiences during which medical students participate in the care of patients with common medical problems and diseases of adult patients. Emphasis is given to health promotion, prevention, and diagnosis and treatment of disease and disability in older adults (geriatric medicine). Students are expected to perform admission histories and physical examinations, develop differential diagnoses and management plans, participate in daily rounds with the attending physicians, and assist in the management of patient care.

Offered: Fall.

MDCM 802 - Surgery (8)

The clinical clerkship in Surgery provides medical students with experience in general and trauma surgery in both inpatient and ambulatory care settings. Students have the opportunity to develop an understanding of the scientific basis of diseases and disorders requiring surgical intervention, and to develop skills in recognizing and managing surgical diseases. Students perform assessments, develop differential diagnoses, participate in preoperative care, operative procedures, outpatient surgery clinics, evaluation of normal and complicated postoperative recovery. Throughout this experience, students are expected to develop competency in in ethical decision-making, applying evidence-based medicine, communicating with patients and families and working effectively as members of interprofessional health care teams.

Offered: Fall.

MDCM 803 - Medical Imaging (4)

The clinical clerkship in Medical Imaging enables medical students to develop a basic understanding of common medical imaging techniques. Students are expected to develop competency in interpreting imaging studies to diagnose common clinical conditions. The clerkship involves a flipped-classroom component during which medical students complete assignments prior to participating in classroom activities. During the final two weeks of the clerkship is a hospital-immersion component during which students gain real-world experience with various imaging modalities in a patient-care setting

Offered: Fall.

MDCM 804 - Neurology (4)

The clinical clerkship in Neurology offers medical students an opportunity to develop practical skills in obtaining complete and focused histories and physical examinations in patients with neurological conditions. Through a combination of inpatient and ambulatory care and clinical simulation experiences, student become familiar with common neurological disorders, identify normal from abnormal findings on a neurological examination, formulate differential diagnoses, and develop a sense for when neurologic consultation is appropriate.

Offered: Fall.

MDCM 805 - Obstetrics and Gynecology (6)

The clinical clerkship in Obstetrics and Gynecology enables medical students to participate in the provision of medical care and counseling services to adult and adolescent female patients in a variety of settings, including hospital wards, ambulatory clinics, operating rooms, emergency departments, and labor and delivery suite. Students are expected to develop competency in diagnosing and managing common obstetrical and gynecological conditions across the lifespan, including prepubertal and early menarche, primary care for healthy women, normal pregnancy and delivery, infertility, pregnancy loss, cancer, and other obstetric and gynecologic diseases and disorders.

Offered: Fall.

MDCM 806 - Pediatrics (6)

The clinical clerkship in Pediatrics enables medical students to gain experience in the delivery of routine preventive and health maintenance care for pediatric patients and participate in evaluating, diagnosing, and managing acute and chronic pediatric illnesses. Through a variety of inpatient, ambulatory, and simulation experiences, students are expected to develop competency in performing and documenting complete and focused histories and physical examinations, ordering and interpreting common laboratory tests, and developing care plans for pediatric and adolescent patients.

Offered: Fall.

MDCM 807 - Psychiatry (6)

The clinical clerkship in Psychiatry introduces medical students to general and specialty psychiatry and allows students to develop competency in assessing, diagnosing, and treating patients with psychiatric disorders and associated behavioral health issues. Clinical and didactic experiences focus on DSM-5 diagnoses, behavioral and pharmacotherapeutic management, and becoming an active member of a mental health clinical team.

Offered: Fall.

MDCM 808 - Family Medicine (6)

The clinical clerkship in Family Clerkship provides medical students with experiences in the evaluation, diagnosis, and management of common clinical conditions typically seen by a family practitioner. Students participate in the care of patients presenting with acute illnesses, chronic illnesses, and health maintenance needs. Students also participate in simulation laboratory scenarios, interactive learning exercises, and didactic lectures to reinforce diagnostic and procedural skills commonly encountered in the practice of family medicine.

Offered: Fall.

MDCM 900 - Emergency Medicine (4)
MDCM 901 - Advanced Medicine (4)
MDCM 903 - Sub Internship (4)
MDCM 904 - Elective 1 (4)
MDCM 905 - Elective 2 (4)
MDCM 906 - Elective 3 (4)
MDCM 907 - Elective 4 (4)
MDCM 908 - Elective 5 (4)
MDCM 909 - Elective 6 (4)
MDCM 999 - Transitions V & Capstones (0)

MDMS - MDMS

MDMS 600 - Medicine and Society I (3)

Future leaders of healthcare are socially accountable physicians who have a good understanding of the social determinants of health and global health. They analyze the root causes of ill health beyond the well-known biologic determinants and devise comprehensive interventions to address them. During this course, medical students have opportunities to develop the skills needed to become physicians capable of addressing the health care needs of patients, communities and populations. Through workshop-based sessions, learners explore the concepts of health systems, systems-based practice, social determinants of health, and medical ethics, critically analyzing the evidence and evaluating how those concepts affect their lives and future careers. Concepts are linked to real-life scenarios bridging knowledge to practice and policy.

Offered: Fall.

MDMS 700 - Medicine and Society II (3)

Social determinants affect the health of individuals, communities, and populations. This course provides the space to explore social determinants in relation to patient care, equipping learners with the skills needed to become physicians capable of providing high quality holistic care. These concepts are applied through BALSAM, a service learning, community-based, household-focused, longitudinal program that offers learners the chance to transfer their knowledge into practice. Medical students have the opportunity to develop or reinforce competencies in multiple domains.

Offered: Fall.

MDMS 800 - Medicine And Society III (3)

Social determinants of health, systems-based practice and health systems are further explored through the BALSAM Program. BALSAM is an experiential learning, community-based, household-focused, longitudinal program that offers learners the chance to transfer their knowledge into practice. During this longitudinal experience, which emphasizes older adult care, medical students use reflective writing to explore their values, attitudes, and professional identity while enhancing communication skills and empathy.

Offered: Fall.

MDMS 900 - Medicine & Society IV (3)

MDPS - MDPS

MDPS 600 - Transitions I (0)

Transitions I is designed to help entering medical students understand the many personal, educational and professional challenges they will experience over the next four years of undergraduate medical training. Students are exposed to the various educational pedagogies used in the MD program, including team-based learning (problem-based learning, case-based learning), a flipped classroom, and simulation training. Students are also introduced to concepts of assessment and evaluation, including formative and summative evaluation, self- and peer- assessment, and objective structured clinical evaluation (OSCE). Students are introduced to clinical skills learning involving standardized patients and will undergo training to acquire Basic Life Support (BLS) certification. Students will work individually with a learning specialist to identify their preferred learning styles, any potential weaknesses, and strategies to address such weakness. Time management, resource management, test-taking strategies, and personal health and wellness are also explored to maximize student success in the MD program.

Offered: Fall.

MDPS 601 - Physicianship I (3)

Physicianship is a longitudinal strand in the Doctor of Medicine (MD) curriculum that is designed to guide students in the development of knowledge, skills, attitudes and behaviors that will sustain lifelong personal and professional growth. This introductory course aims to prepare medical students for the diverse experiences of the educational path and their future life as professionals. Course content enables students to become aware of their personal characteristics, opportunities and mechanisms for growth, the dynamics and challenges of operating in the healthcare workplace, and how these can impact professional development and health outcomes.

Offered: Fall.

MDPS 700 - Physicianship II (3)

Continuing the development of physician competencies in the longitudinal Physicianship Strand of the curriculum, medical students are exposed to diverse psychological experiences associated with the clinical setting and professional life. Through a series of active-learning workshops, students have opportunities to develop understanding and awareness of their behavioral and personal issues, the emotional stress arising from the practice of medicine, and how these can impact patient care and health outcomes. Course content is organized around four themes: mindfulness, counseling patients and families, culturally competent care, and the regulatory policies associated with reproductive health

Offered: Fall.

MDPS 701 - Transitions II (0)

Offered: Fall.

MDPS 800 - Physicianship III (3)

As future health professionals, medical students need to be introduced to basic principles of process enhancement and outcome improvement while operating within a safe environment. This course delves deeper into the core and sub-competencies of Systems-Based Practice and Practice-Based Learning and Improvement. Drawing on actual experiences in the busy realm of health service, medical students gain real-life exposure to the safety and quality processes that govern care delivery that is both safe and data-driven.

Offered: Fall.

MDPS 801 - Transitions III (0)

Offered: Fall.

MDPS 900 - Physicianship IV (3)
MDPS 901 - Transitions IV (0)

MDRT - MDRT

MDRT 600 - Research, Technology and Innovation I (3)

Research, application of technology, and innovation are integral parts of medical education. This introductory course, which comprises of two parts, intends to develop skills in research, technology application, and effectively utilizing the skills to foster innovation. Part I focuses on the foundations of research, including the scientific method, quantitative and qualitative research, evidence-based medicine, and human subjects research. Part II couples initial clinical experiences with research literature to formulate research questions focused on healthcare quality improvement. Students appraise evidence as a basis for addressing a healthcare/clinical query and develop strategies for implementing evidence-based changes

Offered: Fall.

MDRT 700 - Research, Technology, and Innovation II (3)

Topics fundamental to the conduct of research are introduced during this Period 2 course, including population health, study designs, evidenced-based medicine (EBM), research regulatory affairs, biostatistics, epidemiology, and data analysis and reporting.

Offered: Fall.

MDRT 800 - Res. Tech. & Innovation III (3)

Applying theoretical concepts learned during Period 2, medical students work under the supervision of a research mentor to develop or refine their research or technology and innovation project proposals, conduct literature reviews, and hone skills in data collection, data analysis, writing research reports, developing prototypes and implementation plans for innovation projects.

Offered: Fall.

MDRT 900 - Research, Technology & Innovation IV (3)

MEEN - Mechanical Engineering

MEEN 601 - Advanced Dynamics (3)

Dynamics of particles and rigid bodies using Newtonian and variational methods of mechanics. Gyroscopic mechanics, Lagrangian and Hamiltonian mechanics, applications.

Offered: Fall Spring.

MEEN 602 - Advanced Vibrations (3)

This course builds upon the undergraduate vibrations course. It introduces energy based methods for derivation of governing equations (Lagrange’s equation, Hamilton’s principle), vibration of distributed parameter systems (strings, rods, beams, and membranes). The second half of the course is focused on practical aspects including signal processing (sampling process, FFT, FRF calculation), basics of modal analysis, dynamics and condition monitoring of rotating machinery.

Offered: Fall Spring.

MEEN 603 - Advanced Thermodynamics (3)

This course provides a strong basis in the fundamentals of classical and statistical thermodynamics. The covered topics include: Maxwell relations and thermodynamic properties, Gibbs and Helmholz free energy, thermodynamics of mixing, chemical equilibrium, introduction to statistical thermodynamics, Boltzman statistics, partition function, interfacial phenomena and surface tension.

Offered: Fall Spring.

MEEN 604 - Advanced Fluid Mechanics (3)

To introduce advanced concepts of fluids and fluid mechanics, and enable the students to solve more practical engineering problems in fluid motion. This course will cover the formulation of the fluid flow problem, friction, viscous flow, boundary layer theory, transition, and incompressible and compressible flow.

Offered: Fall Spring.

MEEN 605 - Advanced Continuum Mechanics (3)

The course presents an introduction to the fundamentals of the mechanics of continuous media, applied to solids and fluids. It provides a holistic treatment of the conservation field equations and their solutions for the cases of elastic, and fluid media.

Offered: Fall Spring.

MEEN 606 - Advanced Mechanics of Solids and Materials (3)

This course presents the physical laws, mathematical methods, and computer algorithms that are used to predict the response of materials and structures to mechanical and/or thermal loading. Topics include: Fundamentals of solid mechanics, Review of Cartesian Tensors, Two and Three Dimensional Theories of Stress and Strain (Method of Continuum Mechanics, Theory of Elasticity), Isotropic linear elasticity and isotropic linear thermo-elasticity. Boundary value problems for linear elastic solids. Variational and energy methods. Linear viscoelasticity. Small-strain elastic-plastic deformation; nonlinear elasto-plastic material behavior. Failure modes, failure theories and fracture in solid materials.

Offered: Fall Spring.

MEEN 607 - Sustainable Energy (3)

Assessment of current and potential energy systems, covering extraction, conversion, and end-use, with emphasis on meeting regional and global energy needs in a sustainable manner. Examination of energy technologies and energy types: renewable (solar, biomass, wind, hydro, geothermal), fossil (oil, gas, synthetic), nuclear (fission and fusion), along with storage, transmission, and conservation issues. Focus on evaluation and analysis of energy technology systems in the context of social, economic, and environmental goals.

Offered: Fall Spring.

MEEN 610 - Applied Finite Element Analysis (3)

This course provides a review of solid mechanics with a brief introduction to the theory of elasticity. An in-depth derivation of the finite element procedure is presented. Applications of static and dynamic finite elementanalysis of real world mechanical systems are performed. A commercial Finite Element Method code is used to perform analysis.

Offered: Fall Spring.

MEEN 611 - Combustion Theory and Applications (3)

Combustion thermo-chemistry of different fuels, adiabatic flame temperature and combustion products composition, chemical kinetics and important combustion chemical mechanisms, ideal flow reactors, laminar premixed flames, diffusion flames including liquid droplet and solid particle combustion, turbulent premixed and non-premixed flames, pollutant emissions and control. All of the above are treated with emphasis on a wide variety of practical applications that motivate or relate to the various theoretical concepts and current research interests.

Offered: Fall.

MEEN 612 - Advanced Viscous Flow Analysis (3)

This course focuses on viscous flow concepts and theory. It introduces the fundamentals necessary for the analysis of incompressible Newtonian viscous flows, incompressible boundary-layers and free shear flows in the laminar and turbulent regime. It aims to develop skills required by engineers working in Thermofluids and prepares for advanced courses in Turbulence and its modeling, Computational Fluid Dynamics, and Convective Heat Transfer.

Offered: Spring.

MEEN 613 - Advanced Heat Transfer (3)

Rigorous review of conductive, convective and radiative heat transfer with a short extension to mass transport. Thermal conductivity and mechanisms of energy transport.

Differential and integral form of the energy conservation equation. Impulsive and unsteady non-isothermal flows. Energy transport in turbulent flows. Radiation transport with emphasis on participating media. Brief reference to the similarities between heat and mass transfer.

Offered: Fall Spring.

MEEN 614 - Advanced Energy Conversion (3)

This is a graduate level course designed to give students an overview of conventional and non-conventional energy conversion techniques. Basic background, terminology, and fundamentals of energy conversion are introduced. Current and emerging technologies for production of thermal, mechanical, and electrical energy are discussed; topics include fossil and nuclear fuels, solar energy, wind energy, fuel cells, and energy storage.

Offered: Fall Spring.

MEEN 615 - Multiphase Flow Engineering (3)

This course is designed to introduce the fundamental concepts and principles that underlie multiphase flow processes. It introduces the fundamentals necessary for the analysis of two phase flows such as liquid-gas and liquid-solid flows. Measurements techniques, CFD Analysis and applications of multiphase flow processes are covered together with examples of applications involving the oil and gas industries.

Offered: Spring.

MEEN 616 - Solar Thermal Analysis, Design and Testing (3)

Course develops advanced heat transfer topics applied to collection, storage, conversion, and utilization solar thermal energy. Solar position, shading, atmospheric attenuation and sky models are covered. Optical properties of materials and reflector and receiver geometries are developed. Dynamic models and simulation are introduced. Low-temperature applications of desalination, water heating, and space-heating and cooling (SHAC) and high temperature applications of concentrating solar power (CSP) and advanced solar cooling are described. The course will include the following topic areas: fundamental engineering principles of solar energy collection, thermal energy storage, and thermodynamic cycles for power, cooling, and dehumidification. Students will be introduced to system modeling in TRNSYS, EES and/or MATLAB and will perform laboratory measurements and standard tests on typical flat-plate, line- and heliostat-concentrating collectors

Offered: Fall.

MEEN 617 - Fuel Cell Systems (3)

This course covers fundamentals of fuel cell systems for both mobile and distributed power applications. It includes detailed analyses of the principles and component designs of various types of fuel cells including proton exchange membrane fuel cell (PEMFC), phosphoric acid fuel cell (PAFC), solid oxide fuel cell (SOFC), and molten carbonate fuel cell (MCFC); discussions on water and thermal management, and balance of power plant; review of hydrogen storage and safety consideration; and challenges and future opportunities.

Offered: Spring.

MEEN 618 - Computational Fluid Dynamics and Fire Modeling (3)

This course introduces the methods of CFD with an emphasis on the numerical methods that are used for elliptic and parabolic equations. Topics will include flows near solid boundaries as well as reactive flow modeling with emphasis on modeling of fires. Applications will be illustrated utilizing ANSYS-FLUENT and the Fire Dynamic Simulator.

MEEN 619 - Fire Dynamics Laboratory (3)

The course exposes the students to the experimental techniques that are used for the study of fire dynamics. The students are asked to combine visualization with quantitative measurements, analyze critically the results, and explore the effect of physical parameters on fire characteristics, such as temperature, heat release, and combustion products.

MEEN 620 - Measurements and Instrumentation (3)

This is an advanced course on the theory and design of engineering measurements. Integrated throughout the course are the necessary elements for the design of measurements systems and measurement test plans, with an emphasis on the role of statistics and uncertainty analysis in design. Topics also include sensors, signal conditioning circuits and noise reduction techniques. Typical sensor topics include temperature, force, torque, pressure, flow and acceleration. Practice will be given to students, through course projects, on the measurement of mechanical engineering quantities. Software use such as LabVIEW and MATLAB will be integrated into course projects.

Offered: Fall Spring.

MEEN 621 - Feedback Control (3)

This course provides basic material about feedback control of systems. Topics include a review of Laplace transform techniques and time response analysis; stability and feedback interconnections; basic transfer function analysis and design methods; robustness; state-space analysis and state feedback design.

Offered: Fall Spring.

MEEN 622 - Control System Theory and Design (3)

This is a fundamental graduate course on the modern theory of dynamical systems and control. It builds on an introductory undergraduate course in control and emphasizes state-space techniques for the analysis of dynamical systems and the synthesis of control laws meeting given design specifications.

Offered: Fall Spring.

MEEN 623 - Introduction To Hydrodynamic Stability (3)

This course introduces the concept of linear instability behind the transition of thermo-fluid systems from a "regular state" (steady, symmetric, laminar) to a "less regular state" (unsteady, asymmetric, turbulent). This course deals with the various kinds of instabilities encountered in thermo-fluid systems including Rayleigh, Kelvin-Helmholtz, and Rayleigh-Bernard instabilities. This course focuses on the physical origin of the instabilities and their mathematical formalism as well as the specific numerical methods used to solve the instability problems.

MEEN 630 - Advanced Engineering Mathematics (3)

This course focuses on concepts and techniques, analytical as well as numerical, for solving applied problems arising in various engineering disciplines. Analytics cover separation of variables, integral transforms, Green's functions, similarity, and perturbation methods. Numerics include finite differences, finite elements, and discrete and fast Fourier transforms. Emphasis would be on formulating and solving problems as well as on interpreting and analyzing the solutions to gain physical insight. Engineering applications would be stressed in addition to mathematical formalities. MATLAB is required in some of the homework problems

Offered: Fall Spring.

MEEN 631 - Fatigue and Fracture of Engineering Materials (3)

This is an advanced course in fatigue and fracture of engineering material with in-depth presentations on fatigue, linear elastic fracture mechanics, damage modeling, life prediction methods. It also covers fatigue fracture of composites, as well as emerging new engineering materials such as nanocomposites.

Offered: Spring.

MEEN 632 - Micro/Nanotechnology and Applications (3)

This course will give an advanced survey to different aspects of active research in micro and nanotechnology, covering the broad area of science in micro- and nano-scale materials. Introduction to micromachining, fundamental properties of micro and nanotechnology such as, mechanical, electronic, magnetic, optical, and biochemical properties will be covered.

Offered: Spring.

MEEN 633 - Advanced Manufacturing Processes (3)

This is an advanced course in manufacturing processes where a survey of important manufacturing processes is presented. The course will also cover fundamentals of machining, advanced machining processes and microelectronics fabrication, rapid prototyping, tribology, and some competitive aspects in manufacturing.

MEEN 651 - Advanced Manufacturing Process (3)
MEEN 656 - Nonlinear Systems (3)

Introduction to nonlinear control systems by means of analysis, simulation, and synthesis. The course will include phase plane analysis and classification of equilibrium points, linearization, Lyapunov method, perturbed systems, input-to-state stability, feedback linearization, tracking, regulation, and describing functions.

MEEN 659 - Modeling and Control of Robotic Systems (3)

The course covers the theory and practice of the modeling and control of robotic devices. This includes kinematics, statics and dynamics of robots. Impedance control and robot programming will also be covered. Different case-studies will be presented to support hands-on experiments.

MEEN 694 - Selected Topics in Mechanical Engineering (3)

This course covers selected contemporary topics in mechanical engineering. The topics will vary from semester to semester depending on faculty availability and student interests. Proposed course descriptions are considered by the Department of Mechanical Engineering on an ad hoc basis and the course will be offered according to demand. The proposed course content will need to be approved by the Graduate Studies Committee. The Course may be repeated once with change of contents to earn a maximum of 6 credit hours.

Offered: Fall Spring.

MEEN 699 - Master's Thesis (9)

In the Master's Thesis, the student is required to independently conduct original research-oriented work related to important mechanical engineering problems under the direct supervision of a main advisor, who must be a full-time faculty in the Mechanical Engineering Department, and at least one other full-time faculty who acts as co-advisor. The outcome of the research should demonstrate the synthesis of information into knowledge in a form that may be used by others and lead to publications in suitable reputable journals/conferences. The student's research findings must be documented in a formal thesis and defended through a viva voce examination.

Corequisite: ENGR695. Offered: Fall Spring Summer.

MEEN 701 - Fracture Mechanics and Fatigue (3)

Concept of linear elastic fracture mechanics, stress intensity factor, Griffith energy balance, determination of the elastic field at a sharp crack tip, J integrals analysis, experimental determination of fracture toughness, elastic plastic fracture mechanics, fatigue crack growth, elastic-plastic crack tip fields, critical crack sizes and fatigue crack propagation rate prediction. Fracture mechanisms and fracture modes associated with failure of engineering materials.

Crosslisted as: AERO 711. Offered: Fall Spring.

MEEN 702 - Damage Mechanics of Solids and Structures (3)

This course aims to teach students the basic mechanisms of damage (degradation) and fracture (cracking) and how to develop theoretical models and computational algorithms that can be used in simulating and understanding damage evolution, fracture, and ultimate failure of various engineering materials, composites, and structural systems and devices. Damage and fracture in various brittle and ductile materials and their engineering implications will be studied. Formulation of time-independent and time-dependent damage and fracture models taking into consideration linear and nonlinear material behavior will be discussed in this course. Modeling of damage and fracture due to various loading conditions (e.g., mechanical, thermal, chemical, electrical, fluid) will be presented. Also, the capabilities and limitations of well-known damage and fracture models for various applications will be assessed.

Offered: Fall Spring.

MEEN 703 - Linear and Nonlinear Finite Element Methods (3)

This course is designed to provide a unified framework to model, formulate and numerically solve advanced linear and nonlinear problems in solids, structures and fluids using finite element methods. Two- and three-dimensional linear and nonlinear initial/boundary value problems are covered with particular emphasis on interdisciplinary applications. Various nonlinearities are studied in detail to gain insights into mathematical and numerical aspects. This course particularly emphasizes on formulation of geometrically nonlinear and materially nonlinear finite elements. Incremental and iterative methods for solution of nonlinear systems of equations and their computer implementation issues are rigorously addressed.

Offered: Fall Spring.

MEEN 704 - Computational Inelasticity (3)

This course introduces students to advanced topics in solid mechanics using tensor algebra. In addition to the theoretical approach for elastostatics, the course focuses on computational inelasticity and nanomechanics

Offered: Fall.

MEEN 705 - Micromechanics of Materials (3)

Introduction Overview; materials classification; typical microstructural constituents--grains, phases, particles, etc.; stress, strain and simple tension experiments Review of necessary elements of solid mechanics Tensor algebra, Stress, Strain and deformation, Conservation principles Elastic and thermal properties of heterogeneous materials: Maxwell and Voigt simple bounds; self-consistent field models; bounding approaches, Unit cells of crystalline materials; Hooke's law, physical basis of linear elasticity; anisotropic linear elasticity; elastic properties of heterogeneous media Micromechanics of failure/damage: Constitutive behavior of materials with voids and cracks; localization of plastic flow; local failure mechanisms. Dislocation theory Ideal shear strength of perfect crystals; topology and properties of dislocations; generation of dislocations and resultant permanent deformation; dislocation interaction with other dislocations and with other defects. Toughening mechanisms Critical resolved shear stress in single crystals; plastic deformation in polycrystals; strengthening mechanisms; plastic yielding under complex stress states; limit analysis. Phase transformations. Current research topics in mechanics of materials

Crosslisted as: MSEN 705. Offered: Fall Spring.

MEEN 706 - Theory of Plasticity (3)

This course introduces phenomenological and mathematical formulation of the constitutive laws of plasticity; yield criteria and their experimental verification; plastic stress-strain relations and their associated flow rules; correspondence between rate-independent and rate-dependent plasticity; solutions to basic boundary-value problems, including plane problems and those involving cylindrical and spherical symmetries; variational and minimum principles; limit analysis; plane-strain problems and crystal plasticity; finite-strain theory.

Offered: Spring.

MEEN 720 - Statistical Thermodynamics

Crosslisted as: MSEN 720.

MEEN 721 - Computational Fluid Mechanics (3)

This course provides engineering applications of computational fluid dynamics with background information on the most common numerical methods; two dimensional inviscid and viscous flows; boundary layer flows; and an introduction to three dimensional flows. Applications will be illustrated utilizing FLUENT code.

Offered: Fall Spring.

MEEN 722 - Non-Newtonian Fluid Dynamics (3)

Course material includes rheology of complex fluids, in particular polymeric liquids and their characteristics used to understand the modelling of their flow behaviour. It includes inelastic and visco-elastic fluids. Applications to polymer melt flows will be highlighted.

MEEN 723 - Advanced Combustion (3)

Extend the combustion theory and applications course and draws the connection between reactive flow, combustion fundamentals, combustion engineering, flames, and aerodynamics interactions. The main topics will focus on the following areas: Reactive flow transport phenomena, chemical kinetics, preferential-diffusion and flame stretch interaction, reaction mechanism reduction, combustion engineering, Biofuel combustion characterization, hydrodynamic and aerodynamic flame stability, oxygen enhanced combustion, combustion driven acoustics and vibration, fire dynamic simulation, combustion mechanisms in spark ignition and compression ignition engines, flamelet models for CFD combustion. A wide variety of practical models and applications related to the various concepts as well as experimental methods and diagnostics will be covered in lab and through literature survey.

Crosslisted as: AERO 723.

MEEN 724 - Advanced Modeling of Cooling Systems (3)

Establishes comprehensive heat and mass transfer, psychrometric, and refrigerant state relations needed to rigorously model a wide variety of cooling and dehumidification processes. Effectiveness-NTU methods using concentration and enthalpy difference analogous to temperature difference formulation are covered. Two-phase moving boundary models are formulated for evaporator and condenser models. Physical and semi-empirical compressor models are comprehensively explained working with measured and published performance data. Numerical methods of successive approximation, grid search and Newton-Raphson are applied to solve systems of non-linear equations and systems of empirical and first-principles component models. Linear regression methods to identify models from measured cooling load time series and resulting model used to estimate seasonal performance of a given chiller or heat pump design.

Offered: Fall.

MEEN 725 - Multiphase Flow in Porous Media (3)

The course is focused on the achievement of a clear and rigorous understanding of the fundamental properties, concepts and theories which are of importance in treating storage and multiphase fluid flow in porous media, with or without heat transfer, mass transfer, and/or chemical reactions.

Offered: Spring.

MEEN 726 - Machine Learning for Fluid and Heat Flow Modelling

MEEN 741 - Advanced Conduction and Radiation Heat Transfer (3)

This course covers in depth the physical processes involved in the transfer of thermal energy by conduction and radiation heat transfer. Topics include steady and transient multi-dimensional conduction, blackbody radiation, radiation surface characteristics, radiation exchange in enclosures, radiation through continua, and combined mode heat transfer. Emphasis is placed on the use of analytical methods, numerical techniques and approximate solutions. Problems and examples highlighting theory and applications drawn from a spectrum of engineering design problems are presented.

Offered: Fall.

MEEN 742 - Advanced Convection Heat Transfer (3)

This course covers the conservation equations of momentum and energy. Topics covered include: convection boundary layers, laminar and turbulent flows, mixed convective heat transfer, convective heat transfer at high speed flow, forced convection phase change heat transfer, and impingement heat transfer.

Offered: Fall.

MEEN 743 - Micro-Nano Energy Transport (3)

This course covers energy transport at micro/nanoscale where it focuses on energy states, energy transport and thermal energy storage at the micro and nanoscale by means of statistical mechanics and solid state physics. Energy transport will be introduced by means of kinetic theory and Boltzmann Transport Equation. The course will focus on energy transport and energy storage in gases and solids by diffusion and radiation in addition to some applications to heat transfer in micro/nanofluidics.

Offered: Spring.

MEEN 744 - Interfacial Transport and Phase Change Heat Transfer (3)

This course aims to present an insightful understanding of phase-change and multiphase flow phenomena in nature, power, and energy industries. It covers different levels of principles, from fundamental gas kinetics, liquid-vapor interfacial behavior, to interfacial liquid-vapor transport dynamics, to evaporation and condensation characteristics, and to transient analysis of thermal-fluid processes. Theoretical analysis, numerical simulation and experiments are used together to probe complicated multiphase thermal-fluid physics. Advanced lab characterization tools are introduced to engage state-of-the-art thermal-fluid research with knowledge discovery and innovation in power and energy sectors.

Offered: Fall Spring.

MEEN 745 - Concentrated Solar Power and Thermal Energy Storage (3)

This course covers principles of concentrated solar power (CSP) technologies (solar field optics theory, heat transfers, and production of electricity in the power block) and associated thermal energy storage (TES) systems at commercial and research level.

Offered: Spring.

MEEN 761 - Advanced Process Dynamics and Control (3)

This course aims to provide multidisciplinary fundamentals and solid mathematical foundation of modern energy process systems engineering. It presents a systematic framework for physics-based and empirical dynamic process modeling, transient analysis, feedback control and optimization. This course is particularly dedicated to the most popular advanced control strategy in energy process industries - model predictive control (MPC). Other optimal control approaches are also introduced to deal with plant disturbances, uncertainties, nonlinearities, instabilities and constraints. This course emphasizes the use of advanced math tools to develop dynamic models and design advanced controllers for energy process systems.

Offered: Fall Spring.

MEEN 762 - Analysis and Simulation of Mechatronics Systems (3)

This course focuses on the modeling of dynamic engineering systems in various energy domains using Bond Graph Modeling Technique, analysis and design of dynamic systems, response of linear systems, and computer simulation using MATLAB.

Offered: Spring.

MEEN 763 - Theory and design of digital control systems (3)
MEEN 764 - Optimal Control (3)

This course is designed to teach students methods of optimal control and parameter estimation using Linear Quadratic Gaussian design approach, optimal control theory of non-deterministic systems, optimal control of nonlinear and time-varying systems with known inputs, as well as parameters and state estimation.

Offered: Fall Spring.

MEEN 765 - Acoustics and Noise Control (3)

This course covers principles of acoustics; propagation, transmission, reflection and absorption of acoustic waves; passive and active noise control methods

Offered: Spring.

MEEN 766 - MEMS Theory and Applications (3)

This course is designed to teach students Micro-Electro-Mechanical Systems (MEMS) design, analysis and applications. The course focuses on advanced MEMS theory, design considerations, squeeze film damping, types of sensors and actuators, micro-resonators, gyroscopes and their applications, and economics of microfabrication.

Offered: Spring.

MEEN 767 - Control of Robotic Systems (3)

This course is designed to teach students concepts and tools for analysis, design and control of robotic mechanisms. Kinematics, statics and dynamics of robotic systems.

MEEN 781 - Materials Selection in Mechanical Design (3)

This course introduces procedures for selection the optimum materials(s) under multiple constraints resulting from functional, reliability, safety, cost and environmental issues. A variety of problems that illustrate materials-limited design and relationship between design and materials selection will be covered.

MEEN 782 - Materials Characterization Techniques (3)

This course introduces the different materials characterization techniques to determine atomic structure, morphology and physical properties of the engineering materials. The selection process of the most suitable characterization method for a certain application of materials is also discussed. The common advanced techniques covered in this course are electron microscopy (SEM and TEM with principles of bright-field, dark-field and weak-beam imaging), Scanning Tunneling Microscopy (STM) and Atomic Force Microscopy (AFM), thermal analysis (DSC, TGA), X-ray diffractometer (XRD), spectroscopic methods (IR, Raman, and UV), and chromatographic methods.

Offered: Fall.

MEEN 783 - Adv Dynamics and Applications (3)

Dynamics of particles and rigid bodies using Newtonian and variational methods of mechanics. Gyroscopic mechanics, Lagrangian and Hamiltonian mechanics, applications.

MEEN 784 - Advanced Control System (3)

This course provides basic material about feedback control of systems. Topics include a review of Laplace transform techniques and time response analysis; stability and feedback interconnections; basic transfer function analysis and design methods; robustness; state-space analysis and state feedback design.

MEEN 785 - Adv Mechanics of Solid Materia (3)

This course presents the physical laws, mathematical methods, and computer algorithms that are used to predict the response of materials and structures to mechanical and/or thermal loading. Topics include: Fundamentals of solid mechanics. Review of Cartesian Tensors. Two and Three Dimensional Theories of Stress and Strain (Method of Continuum Mechanics, Theory of Elasticity). Isotropic and anisotropic linear elasticity and isotropic linear thermo-elasticity. Boundary value problems for linear elastic solids. Variational and energy methods. Linear Finite Element Analysis. Small-strain plasticity theory. Failure modes and failure theories for solids.

MEEN 786 - Adv Fluid Mech of Incompressib (3)

To introduce advanced concepts of fluids and fluid mechanics, and enable the students to solve more practical engineering problems in fluid mechanics. This course will cover the formulation of the fluid flow problem, friction, viscous flow, boundary layer theory, flow transition, and incompressible and compressible flows, as well as recent research advances in fluid mechanics.

MEEN 791 - Inference and Estimation from Models and Data (3)

This course presents a variety of inversion (or parameter estimation) and forecasting techniques. The advanced mathematical and statistical underpinnings of each technique are developed. The course combines theory with programming exercises that include use of existing MATLAB routines and coding advanced algorithms thus providing the numerical and statistical tools to test models and make inferences from observations of natural processes or experiments. The student will gain practice and judgment in selection of appropriate models.

MEEN 792 - Advanced Nanomaterials and Their Mechanical Applications (3)

This course is designed for PhD students, aiming to provide a broad background on nanotechnologies, and offer substantial depth on nanomaterials and their mechanical applications. The course will cover the background of nanotechnology, physics at nanoscale, nanomaterials and nanosystem, nano-characterization, and their applications in mechanical engineering. A project will be used to enhance students' practical capabilities on research, communication, and technical writing

Offered: Fall Spring.

MEEN 794 - Selected Topics in Mechanical Engineering (3)

This course covers selected contemporary topics in Mechanical Engineering. The topics will vary from semester to semester depending on faculty availability and student interests. Proposed course descriptions are considered by the Department of Mechanical Engineering on an ad hoc basis and the course will be offered according to demand. The proposed course content will need to be approved by the Graduate Studies Committee. The Course may be repeated once with change of contents to earn a maximum of 6 credit hours

Offered: Fall Spring.

MEPH - Medical Physics

MEPH 600 - Physiological Systems (3)

Crosslisted as: BMED600 - Physiological Systems.

MEPH 620 - Radiation Biology and Research Methods and Ethics (3)

The course will cover the basic principles of radiobiology and cancer biology. It will also cover a brief review of types of radiations, radiation induced chromosome damage and repair, cell survival curves, fractionation, accelerated RT, oxygen effect, normal tissue tolerance, heritable and fetal effects, Linear Energy Transfer (LET), Relative Biological Effect (RBE), Oxygen Enhancement Ratio (OER), cell cycle and kinetics and tumor radiobiology. The course also provides an introduction to research methods and incorporates research and professional ethics.

Offered: Fall.

MEPH 630 - Radiological Physics and Radiation Protection (3)

The course along with laboratory component presents the basic principles of radiation physics, radioactivity, the physics of ionizing and non-ionizing radiation, radiation dosimetry, and their applications in medicine. Concept and principles related to Cavity Theory, radiation detection and measurement (Geiger-Mueller (GM), proportional counters, scintillators, TLDs, ionization chambers, neutron detectors, etc.). The course also covers the principles of radiation protection and regulations of radiation safety.

Offered: Fall.

MEPH 640 - Physics of Radiotherapy (3)

The course along with the laboratory component will cover the physics of radiation oncology and related dosimetry. The course will discuss the physics of therapy machines, treatment techniques, treatment planning and dose computation, as well as radiation protection in radiation therapy. Both the physics of external beam therapy and brachytherapy are covered.

Prerequisite: MEPH620, MEPH630. Offered: Spring.

MEPH 650 - Physics of Diagnostic Imaging (4)

The course covers practical aspects of medical imaging physics and applications in medical techniques such as X-ray, fluoroscopy, mammography, angiography, and CT. The course also covers imaging theory and imaging parameters such as image resolution, contrast resolution, noise, MTF and artefacts in medical imaging.

Offered: Fall.

MEPH 660 - Non-Ionizing Radiation Imaging (2)

The course will cover the physics of MRI and ultrasound imaging, as well as the basis of multi-modality imaging.

Prerequisite: MEPH650. Offered: Spring.

MEPH 680 - Physics of Nuclear Medicine (3)

The physics of radioactivity and the applications of radioisotopes and radiopharmaceuticals in medical diagnosis. Topics covered include radiation spectrometry, the scintillation camera, image analysis and data processing in nuclear medicine, single photon emission tomography, and positron emission tomography.

Offered: Spring.

MEPH 699 - Medical Physics Master's Thesis (9)

Thesis research leading to an MSc thesis.

Prerequisite: MEPH635. Offered: Fall, Spring and Summer.

MSEN-Material-Sc-Engineering

MSEN 605 - Structure and Properties of Polymers (3)

Review of polymer molecular structure and bulk morphology; survey of molecular and morphological influence on bulk physical properties, biopolymers and carbohydrates, solid-state deformation, and toughness. Case studies for functionalized polymers and polymer applications.

Offered: Fall Spring.

MSEN 606 - Materials Processing and Manufacturing Technologies (3)

Discusses a wide variety of basic and recent technologies related to materials processing and manufacturing including materials removal, deformation, joining and solidification. Emphasis will be on the underlying science of a given process rather than a detailed description of the technique or equipment.

Offered: Spring.

MSEN 607 - Thermodynamics of Materials (3)

This course provides students with an advanced treatment of the laws of thermodynamics and their applications to equilibrium and the properties of materials. The course is useful to the students who are interested in doing research in materials field. They will learn the concepts of thermodynamics of materials and their applications to understand materials processing.

Offered: Fall Spring.

MSEN 608 - Kinetics of Materials (3)

This course presents a unified treatment of phenomenological and atomistic kinetic processes in materials. Topics include: irreversible thermodynamics; diffusion; nucleation; phase transformations; fluid and heat transport; morphological instabilities; gas-solid, liquid-solid, and solid-solid reactions.

Offered: Spring.

MSEN 611 - Photovoltaic Technologies: Materials, Devices and Systems (3)

Photovoltaic technologies that enable the direct conversion of solar energy into electricity are presented from the science and engineering viewpoints. The materials and fundamental processes involved are emphasized first. The device level is then treated through design, modeling, simulation as well as implementation and testing perspectives. Thin-film, third-generation, novel and emerging PV technologies are also addressed.

Offered: Spring.

MSEN 612 - Physics for Solid-State Application (3)

Crystal lattices, electronic energy band structures, phonon dispersion relations, effective mass theorem, semiclassical equations of motion, electron scattering and semiconductor optical properties will be developed. Band structure and transport properties of selected semiconductors will be calculated. Connection of quantum theory of solids with quasi-Fermi levels and Boltzmann transport used in device modeling will be made.

Offered: Fall Spring.

MSEN 619 - Crystallography and Diffraction (3)

Major topics of the course include: crystallography – symmetry, point group, space group, lattice and crystal systems; Principles of x-ray diffraction – x-ray sources, x-ray detectors, x-ray scattering by matters, Bragg's law, structure factor; Experimental techniques for x-ray diffraction, unit cell determination and refinement, structure determination and refinement.

Offered: Fall Spring.

MSEN 621 - Mechanical Properties of Materials (3)

This course deals with the mechanical properties of various materials and their relationship with: (1) the internal structure (atomic, molecular, crystalline, micro-and macro); (2) processing and; (3) service conditions.

Offered: Fall Spring.

MSEN 622 - Electrical, Optical and Magnetic Properties of Amorphous Materials (3)

Electrical, optical, opto-electronic and magnetic properties of non crystalline (amorphous) materials. Discussion of roles of disorder, defects and doping on the optoelctronic properties of the materials. Discussion of methods of growth and characterization of these materials. A number of applications using these materials will be discussed in detail.

Offered: Fall Spring.

MSEN 623 - Electrical, Optical and Magnetic Properties of Crystalline Materials (3)

Electrical, optical, opto-electronic and magnetic properties of mono and poly-crystalline materials (metals, semiconductors). Discussion of roles of bonding, structure (crystalline, defect, energy band and microstructure) and composition in influencing and controlling physical properties.

Offered: Fall Spring.

MSEN 624 - Thermal Properties of Materials (3)

This course explores the thermophysical and radiative properties of various materials such as metals, semiconductors, ceramics. It examines the correlations of these properties with: (ii) The materials internal structures (atomic, molecular, crystalline, micro-and macro); (iii) Fabrication and processing conditions.

Offered: Fall Spring.

MSEN 657 - Materials Engineering and Corrosion (3)
MSEN 670 - Advanced Extractive Metallurgy (3)
MSEN 671 - Advanced Physical Metallurgy (3)

Prerequisite: CHEG 350, MEEN 225.

MSEN 672 - Materials Characterization (3)
MSEN 673 - Phase Transformations in Metals (3)
MSEN 694 - Selected Topics in Material Science and Engineering (3)

This course covers selected contemporary topics in material science and engineering. The topics will vary from semester to semester depending on faculty availability and student interests. Proposed course descriptions are considered by the Department of Mechanical Engineering on an ad hoc basis and the course will be offered according to demand. The proposed course content will need to be approved by the College of Engineering Graduate Studies Committee. The course may be repeated once with change of contents to earn a maximum of 6 credit hours.

MSEN 699 - Master's Thesis (9)

In the Master's Thesis, the student is required to independently conduct original research-oriented work related to important material science and engineering problems under the direct supervision of a main advisor, who must be a full-time faculty in the Mechanical Engineering Department, and at least one other full-time faculty who acts as co-advisor. The outcome of the research should demonstrate the synthesis of information into knowledge in a form that may be used by others and lead to publications in suitable reputable journals/conferences. The student's research findings must be documented in a formal thesis and defended through a viva voce examination.

Corequisite: ENGR695. Offered: Fall Spring Summer.

MSEN 701 - Electrochemical Processes and Devices (3)

This course covers a variety of topics concerning electrochemical engineering, including thermodynamic and transport properties of aqueous and non-aqueous electrolytes, the electrode/electrolyte interface, and the kinetics of electrode processes. It also covers electrochemical characterization with regards to D.C. techniques (controlled potential, controlled current) and AC. techniques (voltammetry and impedance spectroscopy). Applications of the following will also be discussed: electrowinning, electrorefining, electroplating, and electrosynthesis, as well as electrochemical power sources (batteries and fuel cells).

Offered: Fall.

MSEN 705 - Micromechanics of Materials (3)

Introduction Overview; materials classification; typical microstructural constituents--grains, phases, particles, etc.; stress, strain and simple tension experiments Review of necessary elements of solid mechanics Tensor algebra, Stress, Strain and deformation, Conservation principles Elastic and thermal properties of heterogeneous materials: Maxwell and Voigt simple bounds; self-consistent field models; bounding approaches, Unit cells of crystalline materials; Hooke's law, physical basis of linear elasticity; anisotropic linear elasticity; elastic properties of heterogeneous media Micromechanics of failure/damage: Constitutive behavior of materials with voids and cracks; localization of plastic flow; local failure mechanisms. Dislocation theory Ideal shear strength of perfect crystals; topology and properties of dislocations; generation of dislocations and resultant permanent deformation; dislocation interaction with other dislocations and with other defects. Toughening mechanisms Critical resolved shear stress in single crystals; plastic deformation in polycrystals; strengthening mechanisms; plastic yielding under complex stress states; limit analysis. Phase transformations. Current research topics in mechanics of materials.

Offered: Spring.

MSEN 710 - Advanced Solid State Physics (3)

The purpose of this course is to provide a deep and operational understanding of classical and quantum mechanical models of electrons and lattice vibrations in solids aimed at the development of numerical models. The course will emphasize physical models for elastic properties, electronic transport, and heat capacity. Crystal lattices, electronic energy band structures, phonon dispersion relations, effective mass theorem, semiclassical equations of motion, electron scattering and semiconductor optical properties will be developed.

Offered: Spring.

MSEN 712 - Imaging of Materials: Scanning Electron Microscopy and X-ray Microanalysis (3)

This course will study and investigate principles and applications of imaging techniques for materials characterization including scanning electron microscopy and X-ray microanalysis. Topics include: electron optics, electron guns, electron lenses and their aberration, electron specimen interactions, image formation and interpretation, X Ray Spectral Measurement and Quantitative X Ray Analysis, SEM sample preparation including organic and inorganic samples. Lectures are complemented by real-case studies and computer simulations. The course will enable the students to start their SEM practical experience with the SEM training in Quanta 250

Offered: Fall Spring.

MSEN 715 - Advanced Imaging of Materials: Transmission Electron Microscopy (3)

This course focuses on the principles and applications of transmission electron microscope (TEM). Students choosing this course will learn advanced theory and applications of TEM operation and sample preparation during the semester. Topics include: Electron optics, lens aberrations, depth of field, depth of focus, resolution, contrast, bright and dark field microscopy, selected area diffraction, calibration, specimen preparation, electron scattering, electron diffraction, Bragg's law, Laue conditions, structure factor, Ewald construction, double diffraction, twinning, Kikuchi lines, contrast theory, kinematical theory of diffraction by perfect and imperfect crystals, extinction contours, dynamical theory, special techniques, introduction to HRTEM.

Offered: Fall.

MSEN 720 - Statistical Thermodynamics

MSEN 730 - Science and Engineering of Thin Films, Surfaces and Interfaces (3)

Technologies used in the synthesis and growth of thin films of various materials (metals, semiconductors, and ceramics). Processing and transformations of surfaces and interfaces. The course includes elements of vacuum science and technology, structural, physico-chemical and functional characterization methods for thin-films, surfaces and interfaces. Case studies are drawn from a variety of applications including active and passive thin films and coatings, semiconductor devices, nanostructures, advanced and functional materials.

Offered: Fall Spring.

MSEN 740 - Advances in Investigation of Intermolecular and Surface Forces (3)

Intermolecular forces embrace all forms of matter, and yet one finds very few university courses devoted to the fundamental aspects of this subject. This course aims at presenting a comprehensive view of intermolecular and surface forces and the common way to investigate these forces by means of different scanning probe microscopy techniques. The first part of the course will describe the role of such force in determining the properties of simple and complex system. This subject touches on a very broad area of phenomena in physics, chemical engineering and biology and due to the wide range topic covered and different disciplines to which the course is addressed, I have presumed only the basic knowledge of molecular science. The second part of the course present the fundamentals underlying Atomic Force Microscopy (AFM) for the investigation of intermolecular and surface forces. AFM is one of the foremost tools for imaging, measuring, and manipulating matter at the nanoscale by gathering information of the surface throughout a mechanical probe.

Offered: Fall Spring.

MSEN 745 - Concentrated Solar Power and Thermal Energy Storage (3)

This course covers principles of concentrated solar power (CSP) technologies (solar field optics theory, heat transfers, and production of electricity in the power block) and associated thermal energy storage (TES) systems at commercial and research level.

Offered: Spring.

MSEN 750 - HighEfficiency Silicon Solar Cells: Designs and Technologies (3)

The course addresses the surface physics and chemistry of crystalline silicon including the critical phenomenon of surface passivation. It covers in depth the recombination mechanisms of charge carriers in crystalline silicon. A study of the different passivation approaches to the surface and their impact on the performance of solar cell technologies such as PERC, PERL and HIT, newer architectures will be explored.

Offered: Fall.

MSEN 760 - Thin Film Solar Cells: From Design to Applications (3)

Photovoltaic technologies that enable the direct conversion of solar energy into electricity are presented from the science and engineering viewpoints. The materials and fundamental processes involved are described. The device level is then treated through design, modeling, simulation as well as implementation and testing perspectives. Thin-film, third-generation, novel and emerging PV technologies are addressed. Case studies are presented including manufacturing, applications and deployment of diverse PV technologies.

MSEN 781 - Adv Thermodyn & Thermostat Mat (3)

This advanced course is designed to provide students with an in-depth understanding of the laws of thermodynamics and their applications to equilibrium and the properties of materials. The course will cover advanced topics such as thermodynamic potentials, phase equilibria, and the thermodynamics of surfaces and interfaces. Students who are interested in pursuing research in the field of materials will find this course particularly useful. By studying the thermodynamics of materials, students will gain a fundamental understanding of the relationships between the structure, composition, and properties of materials. This knowledge can then be applied to understanding the behavior of materials under different conditions, such as during processing or in extreme environments. Throughout the course, students will also learn about the various experimental techniques that are used to measure thermodynamic properties, including calorimetry, thermal analysis, and spectroscopy. They will gain experience in analyzing and interpreting experimental data, which will be important for their future research. Overall, this advanced course will provide students with a comprehensive understanding of the laws of thermodynamics and their applications to materials science. This knowledge will be essential for students who wish to pursue research in this exciting and rapidly evolving field.

MSEN 782 - Materials Characterization Techniques (3)

This course introduces the different materials characterization techniques to determine atomic structure, morphology and physical properties of the engineering materials. The selection process of the most suitable characterization method for a certain application of materials is also discussed. The common advanced techniques covered in this course are electron microscopy (SEM and TEM with principles of bright-field, dark-field and weak-beam imaging), Scanning Tunneling Microscopy (STM) and Atomic Force Microscopy (AFM), thermal analysis (DSC, TGA), X-ray diffractometer (XRD), spectroscopic methods (IR, Raman, and UV), and chromatographic methods.

Offered: Fall.

MSEN 783 - Elec,Opt & Magnetic Prop Mater (3)

This course focuses on the study of the electrical, optical, opto-electronic, and magnetic properties of materials, both mono and poly-crystalline, including metals and semiconductors. The course delves into the roles of bonding, structure, and composition in influencing and controlling these physical properties. This course also discusses how energy bands affect a material's electrical and optical properties. This includes investigating how electrons behave within materials, particularly how they migrate and interact with light. The impact of grain boundaries, flaws, and other features on microstructure on material physical properties is also covered in the course. Understanding the connections between material composition and physical qualities is a major focus of the entire course.

MSEN 784 - Adv Phys of Solid-State Apps (3)

This advanced solid-state physics course builds on foundational concepts and explores the atomic and electrical principles that govern material behavior. It will give students the mathematical tools to model and analyze advanced materials and semiconductor devices. The first part of the course will cover crystal lattices, including their varieties and properties. Then, we'll study electronic energy band topologies and how they affect materials' electronic properties. Phonon dispersion relations will show pupils how vibrational modes affect thermal characteristics. The effective mass theorem and semiclassical equations of motion will explain electron motion in a crystal lattice and how external factors affect it. Electron scattering will also be covered. Electronic band structures and semiconductor light absorption and emission will be discussed. Calculating the band structure and transport characteristics of selected semiconductors will follow. Ultimately, the course will address the quantum theory of solids and quasi-Fermi levels to study semiconductor device electrical behavior. Boltzmann transport, which models semiconductor electron transport, will be taught.

MSEN 785 - Phenomenological & Atomistic K (3)

In this course students will learn about the interconnected processes that occur in materials at the macroscopic and microscopic levels in this course. Understanding irreversible thermodynamics—how systems evolve over time toward equilibrium—will be the focus. Diffusion—the movement of atoms or molecules from high-concentration to low-concentration regions—will be covered throughout the course. Nucleation—the production of small atom or molecule clusters that can expand into bigger structures—will also be examined. Phase transformations, when materials change phases, will be studied in details explaining the processes leading to ssolidification, melting, and crystallization. Fluid and heat transmission will also be discussed. The course will explain how viscosity and thermal conductivity affect these processes. Morphological instabilities—when a system becomes unstable and changes shape or structure—will also be examined. The causes of pattern creation and surface roughness evolution are examined. Gas-solid, liquid-solid, and solid-solid processes will conclude the course. Students will discover how temperature, pressure, and surface area affect these reactions. This course teaches students about material kinetic and thermodynamic processes.

MSEN 792 - Advanced Nanomaterials and Mechanical Applicaitons (3)

This course is designed for PhD students, aiming to provide a broad background on nanotechnologies, and offer substantial depth on nanomaterials and their mechanical applications. The course will cover the background of nanotechnology, physics at nanoscale, nanomaterials and nanosystem, nano-characterization, and their applications in mechanical engineering. A project will be used to enhance students' practical capabilities on research, communication, and technical writing

Offered: Fall Spring.

MSEN 794 - Selected Topics in Materials Science and Engineering (3)

This course covers selected contemporary topics in Material Science and Engineering. The topics will vary from semester to semester depending on faculty availability and student interests. Proposed course descriptions are considered by the Department of Mechanical Engineering on an ad hoc basis and the course will be offered according to demand. The proposed course content will need to be approved by the Graduate Studies Committee. The Course may be repeated once with change of contents to earn a maximum of 6 credit hours.

Offered: Spring.

NUCE - Nuclear Engineering

NUCE 601 - Thermal Hydraulics in Nuclear Systems (3)

This course provides the basic principles of nuclear system thermal hydraulics, and cover from advanced single-phase fluid mechanics and heat transfer relevant to nuclear system to basic two-phase flow principles and modeling. Topics include thermal hydraulic characteristics of power reactors, thermal design principles and reactor heat generation, thermodynamics of nuclear energy conversion, thermal analysis of fuel elements, review of single-phase flow, transport equations for two-phase flow, two-phase flow dynamics, two-phase heat transfer, and single channel analysis.

Prerequisite: Undergraduate level knowledge in Fluid Mechanics, Heat Transfer, and Thermodynamics of energy conversion. Offered: Fall Spring.

NUCE 602 - Nuclear materials, Structural Integrity and Chemistry (3)

This course provides an understanding of the materials behaviors in nuclear power plant environments including identification of the key aging mechanisms of alloys and components in relation to the operating environments; How to assess the integrity of key components using fracture mechanics; An understanding of the role of water chemistry in managing the materials aging on light water reactors. Topics include failure of materials and structures, micro-structural aspects of failure, corrosion, environmentally assisted cracking, low allow steels, stainless steels, nickel alloys, non-destructive evaluation, fracture mechanics, flaw analysis, PWR primary water chemistry and secondary system chemistry.

Prerequisite: Undergraduate level knowledge of materials science. Offered: Fall Spring.

NUCE 603 - Nuclear Reactor Theory (3)

To provide students with a principled understanding of the reactor physics theory and practice involved in the design of nuclear reactors and applications in related areas. Topics include neutron transport, numerical solutions of the diffusion equation, multi-group diffusion theory, the treatment of resonance, reactor kinetics including numerical exercises, elements of the Monte Carlo method in reactor analysis, and modeling exercise using various reactor codes.

Prerequisite: Undergraduate knowledge of nuclear reactor physics. Offered: Fall Spring.

NUCE 606 - Radiation Measurement and Applications (3)

This course provides a theoretical and hands-on understanding of radiation detection and measurements and its applications in measurements and analysis. Topics include a review of radiation interactions and the physical principles of detection and measurements, radiation detection electronics, uncertainty and error analysis in measurements, gas filled detectors, scintillation detectors, semiconductor detectors, spectroscopy analysis, background sources of radiation, neutron detectors, applications in radiation detection, security and safeguards.

Prerequisite: Undergraduate level knowledge of calculus. Offered: Fall Spring.

NUCE 607 - Principles of Radiological Protection (3)

This course aims to provide students with an overview of radiation quantities and units, an understanding of biological effects due to the exposure to ionizing radiation, an overview of the organization and components of the International Commission on Radiological Protection System for Radiological Protection, an introduction to dose assessments, both for external and internal exposures, and an introduction to the methodologies to control radiation exposure.

NUCE 608 - Radiological Protection in Planned Exposure Situations (3)

This course aims to provide students with an overview of international Radiation Protection Institutions and their roles, an overview of the current ICRP System for Radiological Protection and a detailed understanding of modern Radiation Protection issues in various fields.

NUCE 609 - Radiological Protection in Existing and Emergency Exposure Situations (3)

This course aims to provide students with an overview of the current ICRP System for Radiological Protection, a detailed understanding of modern Radiation Protection issues in existing exposure situations, a detailed understanding of modern Radiation Protection issues in emergency exposure situations, and an overview of the current approach towards radiological protection of the environment.

NUCE 611 - Nuclear Systems Design and Analysis (3)

This course provides the fundamentals of nuclear systems design, including design aspects of critical individual components as well as the balance of plant and to provide the basis for analysis on thermodynamic principles. Topics include a review of engineering design principles, the thermal hydraulic design and analysis of reactor cores, the steam generators, the pressurizer, the coolant pumps, the turbine and finally, the design and analysis of the balance of plant.

Prerequisite: NUCE601. Offered: Fall Spring.

NUCE 612 - Nuclear Safety and Probabilistic Safety (3)

This course deals with safety principles, various accident phenomena including design basis and severe accidents, preventive and mitigative safety system design, deterministic and probabilistic analyses of those accidents, and safety management for LWRs (Light Water Reactors).

Prerequisite: NUCE601, NUCE602. Offered: Fall Spring.

NUCE 613 - Nuclear Fuel Cycle and Safeguards (3)

The aim of this course is to provide students with fundamental knowledge of nuclear fuel cycles and nuclear material safeguards, to cover the entire range of processes from ore in the ground to recycled products and wastes. The full range of nuclear material accounting and monitoring measures for all stages of nuclear fuel cycle will be covered. Topics include an overview of the nuclear fuel cycle, nuclear fuel resources, stages of nuclear fuel cycle from mining to waste disposal, economics of the nuclear fuel cycle, the principles and logistics of safeguards, nuclear materials accountancy, accountancy and verification measurements, integrated safeguards (protocols, cyber security etc.), and statistical accountancy.

Prerequisite: NUCE603, NUCE606. Offered: Fall Spring.

NUCE 614 - Nuclear Nonproliferation and Security (3)

This course provides the key elements of nuclear nonproliferation and security, including describing the historical aspects, treaties and agreements, main principles of nuclear security and physical protection. Topics include an overview of the subject area, the historical perspectives, international treaties and agreements, means of detection of undeclared activities, and approaches and systems for physical protection of nuclear materials.

Prerequisite: NUCE603, NUCE606. Corequisite: NUCE613. Offered: Fall Spring.

NUCE 615 - Radiation Dosimetry (3)

This course aims to provide students with an overview of the problems in dosimetry of ionizing radiation, a detailed understanding of the physics and technology underlying external exposure determinations, a detailed understanding of the physics and technology underlying internal exposure determinations, and a detailed understanding of dose assessments.

Prerequisite: NUCE606.

NUCE 616 - Occupational Radiological Protections (3)

This course aims to provide students with an overview of the general issues in occupational Radiation Protection, a detailed understanding of operational external exposure determinations and controls, a detailed understanding of contamination assessments on surfaces, in the air, and in liquid and solid volumes, including food, and an overview of personal protective equipment against radiation exposure risks.

Prerequisite: NUCE607. Corequisite: NUCE606.

NUCE 621 - Nuclear Instrumentation and Control (3)

This course provides students with introduction to nuclear instrumentation and control (IC) system, basic and advanced knowledge on static and dynamic characteristic of IC, fundamentals of signal processing and sensors, control theories including lead lag compensators and PID controller, human-machine interface (HMI) design and evaluation, fundamentals and underlying concepts of nuclear IC system, and finally nuclear power plant (NPP) instrumentation, control, and protection systems.

Prerequisite: NUCE603, NUCE606. Offered: Fall Spring.

NUCE 622 - Thermal Hydraulics Computations & Modelling (3)

This course provides sufficient background on flow regimes and heat transfer for single and multi-phase flows, the modeling approaches used, empirical treatments for two-phase flows and sources of errors in numerical predictions. The computer laboratories allow for the student to apply the theory part and to gain hands on how to produce meaningful results with existing commercial codes by following the correct steps in Pre-processing, computation, post-processing and results analysis.

Prerequisite: NUCE601. Offered: Fall Spring .

NUCE 623 - Radiological Environmental Impact Assessment (3)

To provide students with an overview of the regulatory requirements applicable to radioactive discharges and associated Radiological Environmental Impact Assessment (REIA), an understanding of the physical and chemical processes which determine the behavior of radionuclides released into the environment and experience in the application of state-of-the art methodologies for REIA.

Prerequisite: NUCE606. Offered: Fall Spring.

NUCE 624 - Radiation Damage and Nuclear Fuels (3)

This course provides the knowledge on the characteristics of various type of fuels and their required properties, an understand the fundamentals of radiation damage and their effects on the changes of the materials properties through the interaction of various defects generated by irradiation, identification of the key damage mechanisms of oxide nuclear fuels and zircalloy cladding in water reactor environments and knowhow to assess the integrity of nuclear fuel affected by the various damage mechanisms. Topics include overview on types of nuclear fuel, basics of radiation damage, ion interactions with solids, displacement cascades, point defect characteristics, multi-dimensional defects in solids, interaction of defects, dimensional changes, property changes due to irradiation, radiation damage in fuels and fuel cladding integrity.

Prerequisite: NUCE602. Offered: Fall Spring.

NUCE 625 - Advanced Core Physics for Light Water Reactors (3)

This course is focused on learning advanced computational methods for analyzing light water reactors. The course presents detailed description of the computations performed on both the fuel assembly- and full core-level of a nuclear reactor. Nuclear cross section libraries, resonance treatment of cross sections, assembly homogenization techniques, cross section functionalization approaches, and pin-power reconstruction techniques are discussed. On the core level, this course presents advanced nodal methods for the numerical solution of the neutron diffusion equation. Modern nodal methods, based on transverse integration procedure including Nodal Expansion Method (NEM) and Analytical Nodal Methods (ANM), are discussed. This course combines theory and practice by studying the application of state-of-the-art, engineering-grade codes to the neutronic design, analysis, and modeling of nuclear fuel assembly and core. The computational paradigm is based on the traditional divide-and-conquer approach where fuel assembly characteristics are obtained using 2-D transport codes; then, a 2-group diffusion code is used to model the 3-D nuclear reactor core. The students will be instructed in the use of a 2-D lattice physics transport code for assembly design and analysis and a 3-D full-core diffusion code for power distribution.

Prerequisite: NUCE603. Offered: Fall.

NUCE 630 630 - Biological Effects of the Exposure to Ionizing Radiation (3)

This course aims to provide students with an overview of the interaction of radiation with biological matter, a detailed understanding of the mechanisms generating biological harm at high and low doses, a detailed understanding of the consequences of radiation exposure, and an overview of ongoing research in the field of low doses and non-targeted radiation effects.

Prerequisite: NUCE606, NUCE607.

NUCE 694 - Selected Topics in Nuclear Engineering (3)

This course covers selected contemporary topics in nuclear engineering. The topics will vary from semester to semester depending on faculty availability and student interests. Proposed course descriptions are considered by the Department of Nuclear Engineering on an ad hoc basis and the course will be offered according to demand. The proposed course content will need to be approved by the College of Engineering Graduate Studies Committee. The course may be repeated once with change of contents to earn a maximum of 6 credit hours.

NUCE 699 - Master's Thesis (9)

In the Master's Thesis, the student is required to independently conduct original research-oriented work related to important nuclear engineering problems under the direct supervision of a main advisor, who must be a full-time faculty in the Nuclear Engineering Department, and at least one other full-time faculty who acts as co-advisor. The outcome of the research should demonstrate the synthesis of information into knowledge in a form that may be used by others and lead to publications in suitable journals/conferences. The student's research findings must be documented in a formal thesis and defended through a viva voce examination.

Corequisite: ENGR695. Offered: Fall Spring Summer.

NUCE 701 - Advanced Computational Methods of Particle Transport (3)

This course provides the students with thorough understanding of the principal numerical methods used to solve the Boltzmann transport equation for neutral particles. It will also describe and use mathematical tools to evaluate the performance of different discretization schemes.

Prerequisite: Nuclear Reactor Theory, or equivalent. Offered: Fall Spring.

NUCE 702 - Nuclear Systems and Materials/Accident analysis (3)

This course consists of Part I (Reactor Coolant System and its Materials) and Part II (Engineered Safety Features and Accident Analysis). Part I provides an understanding of design bases and degradation of nuclear fuel and reactor coolant system (RCS) components. These components are exposed to the primary coolant and neutron irradiation environments, which cause various material degradation. Considering the material degradation and performance the integrity of the RCS system is discussed. Part II provides an understanding of design basis accident and beyond design basis accident in terms of safety features in nuclear power plant. The students will learn safety system implemented in nuclear power plant and how these systems mitigate the accident by various accident scenario in safety report.

Prerequisite: Graduate level courses on Thermal Hydraulics in Nuclear Systems and Nuclear Materials, Structural Integrity and Chemistry courses (or equivalent). Offered: Fall Spring.

NUCE 703 - Aging Management of Nuclear Materials (3)

This course provides an understanding of material aging and degradation in nuclear power plant environments: General and localized corrosion of metallic and concrete structures; Stress corrosion cracking (SCC) of the primary and secondary components; Irradiation assisted stress corrosion cracking (IASCC) of reactor vessel internals; Radiation embrittlement of reactor vessel. The proposed degradation mechanisms and mechanical, material, and environmental factors controlling the aging and degradation will be presented. Considering the previous operation experience in other nuclear power plants, the aging management of APR 1400 nuclear plants over the design life is discussed.

Prerequisite: Graduate level course on Nuclear Materials, Structural Integrity, and Chemistry. Offered: Fall Spring.

NUCE 704 - The Reactor Core Design Analysis for light water reactors (3)

This course is aimed to provide the students with an in-depth description of the fuel system design, nuclear design and the thermal-hydraulic design concepts for the pressurized water reactors. In particular, the design features of the APR1400 are discussed in this course. Furthermore, the computational tools used for such a design analysis with the associated capabilities and limitations are described.

Prerequisite: Graduate level courses on Thermal Hydraulics in Nuclear Systems and Nuclear Reactor Theory (or equivalent). Offered: Fall Spring.

NUCE 705 - Nuclear Criticality Safety Assessment (3)

To provide students with an in depth understanding of nuclear criticality safety outside of the confines of the nuclear reactor, to provide them with a full range of analytical techniques for assessment of safe critical limits and to give them a thorough understanding of the guides, principles and standards governing nuclear criticality safety.

Prerequisite: Graduate level course on Nuclear Reactor Theory and Radiation Measurement and Applications (or equivalent). Offered: Fall.

NUCE 781 - Adv Therm Hydraulics in NUCE (3)

This course provides the principles of nuclear system thermal hydraulics and cover from advanced single-phase fluid mechanics and heat transfer relevant to nuclear system to two-phase flow principles and modeling. Topics include thermal hydraulic characteristics of power reactors, thermal design principles and reactor heat generation, thermodynamics of nuclear energy conversion, thermal analysis of fuel elements, review of single-phase flow, transport equations for two-phase flow, two-phase flow dynamics, two-phase heat transfer, and single channel analysis.

Prerequisite: Undergraduate level knowledge in Fluid Mechanics, Heat Transfer, and Thermodynamics of energy conversion.

NUCE 782 - Adv Nuc Mats,Struc Integ& Chem (3)

This course provides an understanding of the materials behaviors in nuclear power plant environments including identification of the key aging mechanisms of alloys and components in relation to the operating environments; How to assess the integrity of key components using fracture mechanics; An understanding of the role of water chemistry in managing the materials aging on light water reactors. Topics include failure of materials and structures, micro-structural aspects of failure, corrosion, environmentally assisted cracking, low allow steels, stainless steels, nickel alloys, non-destructive evaluation, fracture mechanics, flaw analysis, PWR primary water chemistry and secondary system chemistry.

Prerequisite: Undergraduate level knowledge of materials science.

NUCE 783 - Nuclear Reactor Theory (3)

To provide students with a principled understanding of the reactor physics theory and practice involved in the design of nuclear reactors and applications in related areas. Topics include neutron transport, numerical solutions of the diffusion equation, multi-group diffusion theory, the treatment of resonance, reactor kinetics including numerical exercises, elements of the Monte Carlo method in reactor analysis, and modeling exercise using various reactor codes.

Prerequisite: Undergraduate knowledge of nuclear reactor physics.

NUCE 794 - Selected Topics in Nuclear Engineering (3)

This course covers selected contemporary topics in Nuclear Engineering. The topics will vary from semester to semester depending on faculty availability and student interests. Proposed course descriptions are considered by the Department of Nuclear Engineering on an ad hoc basis and the course will be offered according to demand. The proposed course content will need to be approved by the Graduate Studies Committee. The Course may be repeated once with change of contents to earn a maximum of 6 credit hours.

PEEG - Petroleum Engineering

PEEG 610 - Advanced Well Test Analysis (3)

This course will review the fundamentals of fluid flow through porous media, followed by flow and build up test analysis for slightly/fully compressible fluids. The course will cover well test design, methods and test data interpretation in hydraulically fractured wells, naturally fractured reservoirs, injection wells and horizontal wells. The effect of reservoir heterogeneities and wellbore conditions on pressure behaviour is studied and considered in well test interpretations.

Offered: Spring.

PEEG 620 - Advanced Drilling Engineering (3)

This course will cover the advanced principles of drilling oil and gas wells. Theories, operational procedures, associated drilling problems, and new developments in drilling will be covered. The course outline is listed below. It is tailored to help the students effectively take part in day-to-day drilling activities on the rig and to do better drilling engineering work in the office after graduation.

Offered: Spring.

PEEG 621 - Underbalanced Drilling (3)

This course will cover the fundamentals and latest principles of underbalanced drilling technology. The course outline is listed below. It is tailored to help the graduate students effectively perform detailed engineering work in the office as well as in the field operations after graduation.

Prerequisite: PEEG620.

PEEG 623 - Well Stimulation (3)

The course covers in-situ stresses, effects of stress gradient, theory of hydraulic fracturing, mathematical models of fracture geometry, design and execution of hydraulic fracture treatment with proppant in vertical and horizontal wells, post-fracture productivity analysis, causes of formation damage, theory of matrix acidizing, treatment design of matrix acidizing (sandstone and carbonates), and models of acid fracturing in carbonates and its treatment design.

Offered: Spring.

PEEG 630 - Advanced Reservoir Engineering (3)

The course touches the basics of reservoir engineering; however, the main objective remains discussing the latest advances in reservoir dynamics, suitable flow modeling techniques, complex issues of reservoir/aquifer interactions and description of different types of oil gas reservoirs. Students will be exposed to review current practices and understand their applications, shortcomings and limitations. Characterization and modelling of unconventional reservoirs will be deliberated in brief.

Offered: Fall.

PEEG 631 - Petroleum Reservoir Simulation (3)

This is a first formal course in reservoir simulation. Rudiments of the numerical treatment of fluid flow in porous media are covered. Specific topics covered include conservation of mass, Darcy's Law, permeability tensor, gridding and grid orientation effects, mathematical formulation of flow and transport equations, Finite Difference solution schemes, numerical dispersion, multiphase flow, relative permeability, and capillary pressure.

Offered: Fall Spring.

PEEG 632 - Enhanced Oil Recovery (3)

This course will cover theory and applications of various EOR processes and a few IOR techniques. A tentative list of topics to be covered follows. Field application aspects will be highlighted through classroom exercises and assignments. Therefore, the course will incorporate a significant student-centered learning component.

Prerequisite: PEEG630. Offered: Fall Spring.

PEEG 640 - Well Performance Evaluation (3)

The course provides detailed coverage of inflow performance relationships, multiphase flow in pipes and well performance evaluation. The emphasis is on the analysis, design and optimization of the production system using nodal analysis. Commercial software packages will be used to apply learned methods to flowing and artificially lifted wells, injection wells and field-scale production optimization.

Offered: Fall.

PEEG 641 - Well Completion and Workover (3)

The course provides a comprehensive coverage of the various types of well completions and their applications and selection criteria: Design and selection of tubing and subsurface production control equipment - Review of the types and applications of completion and workover fluids - Detailed study of perforating and sand control operations - Remedial cementing and stimulation operations - Design and planning of basic workover operations. Remaining challenges in both conventional and non-conventional environments are deliberated as well. Several case studies are reviewed and learned lessons are discussed in the class.

PEEG 650 - Advanced Petroleum Economics (3)

The first segment of the course is dedicated to review principles of petroleum related economics tools. Later, an overview on how the petroleum industry functions as an economic entity within the business community will be deliberated. Special emphasis will be placed on maintaining a positive cash flow while keeping risks under control. Decision analysis in an environment of uncertainty and risk will be comprehensively discussed. Practical case studies and learned lessons from the petroleum industry will be used as a guideline to understand critical concepts. Students will be exposed to current economic challenges facing modern petroleum industry, and expected to contribute in analysing problems and solution options – some of their own!

Offered: Fall Spring.

PEEG 694 - Selected Topics in Petroleum Engineering (3)

This course covers selected contemporary topics in petroleum engineering. The topics will vary from semester to semester depending on faculty availability and student interests. Proposed course descriptions are considered by the Department of Petroleum Engineering on an ad hoc basis and the course will be offered according to demand. The proposed course content will need to be approved by the College of Engineering Graduate Studies Committee. The course may be repeated once with change of contents to earn a maximum of 6 credit hours.

Offered: Fall.

PEEG 699 - Master's Thesis (9)

In the Master's Thesis, the student is required to independently conduct original research-oriented work related to important petroleum engineering problems under the direct supervision of a main advisor, who must be a full-time faculty in the Petroleum Engineering Department, and at least one other full-time faculty who acts as co-advisor. The outcome of the research should demonstrate the synthesis of information into knowledge in a form that may be used by others and lead to publications in suitable reputable journals/conferences. The student's research findings must be documented in a formal thesis and defended through a viva voce examination.

Corequisite: ENGR695. Offered: Fall Spring Summer.

PEEG 723 - Stimulation of Conventional and Unconventional Reservoirs (3)

The course covers in-situ stress analysis, theory of hydraulic fracturing and its treatment design, multi-stage horizontal fracturing and execution and evaluation of hydraulic fracture treatment. Hydraulic fracturing content includes unconventional and mature assets. The course also covers formation damage due to mechanical skin, inorganic scales, and its diagnosis and treatment design and removal by optimized acidizing technique. This also includes design of advanced stimulation techniques using hybrid EOR/IOR methods from Lab scale to Piloting.

Offered: Fall.

PEEG 730 - Fluid Flow and Transport Processes in Porous Media (3)

This is a graduate engineering course Ph.D. level in fluid flow and transport processes in porous media. The course covers both theory and practice of Fundamentals Fluid Flow and Transport Processes in Porous Media and students should be able to see the linkage and relevance of their understanding of reservoir engineering and evaluation in field applications. We study mass, momentum and energy transport in single- and multiphase flow in porous media. Emphasis is placed on use of classical methods for describing these processes on a fluid-fluid and fluid-rock basis. Surface and interfacial phenomena are also presented. Application of theory to various problems in petroleum engineering and groundwater hydrology are emphasized.

Offered: Fall.

PEEG 732 - Hybrid Enhanced Oil Recovery (3)

This is a graduate engineering course Ph.D. level in theory and applications of various emerging and hybrid Enhanced Oil Recovery (EOR) processes and a few IOR techniques that have been suggested in coupled or modified format. A tentative list of topics to be covered follows. Field application aspects will be highlighted through classroom exercises and assignments. This course will therefore, incorporate a significant student-centered learning component. Further details on topical review report and classroom exercises will be provided.

Prerequisite: . Offered: Spring.

PEEG 733 - Miscible Gas Flooding (3)

This is a graduate engineering course Ph.D. level in theory and applications of Miscible Gas Flooding processes. A tentative list of topics to be covered follows. Field application aspects will be highlighted through classroom exercises and assignments. This course will therefore, incorporate a significant student-centered learning component. Further details on topical review report and classroom exercises will be provided.

Offered: Spring.

PEEG 746 - Emerging Well Construction Technology (3)

This course is a very extensive course designed to provide knowledge in the application of drilling to effective, efficient and economical drilling practices as well as solutions to drilling problems encountered during drilling operations of deviated, horizontal and multilateral wells.

PEEG 747 - Horizontal and Multilateral Drilling and Completion (3)

This course is a very extensive course designed to equip the students with theoretical and practical knowledge about horizontal and multilateral wells completion and stimulation at its current level of understanding. Commonly asked questions about horizontal and multilaterals technology, other applications, and limitations are covered.

Offered: Fall.

PEEG 749 - Characterization and Modelling of Unconventional Reservoirs (3)

Characterization and Modeling of Unconventional Reservoirs: Geological background and factors contributing to the formation of UCRs (Unconventional Reservoirs). Petrophysical properties comparison between CRs (Conventional Reservoirs) and UCRs. Phase behavior envelop of UCR. In-place, reserves and RF evaluation of UCR. Fluid flow in UCR media. Static dynamic modeling of UCR. Production challenges hydraulic fracturing. FD (Field Development) of UCR. Economical evaluation, uncertainties and risk involved with play assessment and FD of UCR.

Offered: Fall.

PEEG 752 - Simulation of Naturally Fractured Reservoirs (3)

This is a graduate engineering course Ph.D. level in Petroleum Engineering. The course covers advanced simulation aspects of naturally fractured reservoirs from single continuum to dual- and multi-continuum approaches. Specific topics include: discerption of fractures and fissured medium, classification of fractures and scales, fracture connectivity and networks, mathematical modelling of NFRs, dual porosity models, dual porosity/dual permeability models, FD numerical schemes, Mixed Finite Elements, DFN, multiscale approaches, pressure transient analysis of NFRs, and multiphase flow in NFRs.

Offered: Fall Spring.

PEEG 781 - Well Pressure Transient Analys (3)

This course will review the fundamentals of fluid flow through porous media, followed by flow and build up test analysis for slightly/fully compressible fluids. The course will cover well test design, methods and test data interpretation in hydraulically fractured wells, naturally fractured reservoirs, injection wells and horizontal wells. The effect of reservoir heterogeneities and wellbore conditions on pressure behaviour is studied and considered in well test interpretations.

PEEG 782 - Adv Character & Reservoir Eng (3)

This course's prerequisite is PEEG 331 (Reservoir Engineering I) and PEEG 334 (Reservoir Engineering II) or their equivalents. The course touches the basics of reservoir engineering; however the main objective remains discussing the latest advances in reservoir dynamics, suitable flow modeling techniques, complex issues of reservoir/aquifer interactions and description of different types of oil gas reservoirs. Students will be exposed to review current practices and understand their applications, shortcomings and limitations. Characterization and modelling of unconventional reservoirs will be deliberated in brief.

PEEG 783 - Adv Well Performance Evaluatio (3)

The course provides detailed coverage of inflow performance relationships, multiphase flow in pipes and well performance evaluation. The emphasis is on the analysis, design and optimization of the production system using nodal analysis. Commercial software packages will be used to apply learned methods to flowing and artificially lifted wells, injection wells and field-scale production optimization.

PEEG 794 - Selected Topics in Petroleum Engineering (3)

This course covers selected contemporary topics in Petroleum Engineering. The topics will vary from semester to semester depending on faculty availability and student interests. Proposed course descriptions are considered by the Department of Petroleum Engineering on an ad hoc basis and the course will be offered according to demand. The proposed course content will need to be approved by the Graduate Studies Committee. The Course may be repeated once with change of contents to earn a maximum of 6 credit hours.

Offered: Fall Spring.

PGEG-Geo-Sciences

PGEG 611 - Carbonate Reservoir Petrology (4)

Carbonate Reservoir Petrology covers carbonate depositional textures, microfacies, diagenesis, permeability, and porosity. Students will learn how to unravel the complex geologic history of carbonate reservoirs from deposition through diagenesis to emplacement of hydrocarbons to develop 3D predictive reservoir models.

Offered: Fall.

PGEG 612 - Sequence Stratigraphy of Carbonate Systems (4)

This course instructs in the sedimentological, petrographic, and stratigraphic methods used to analyze and interpret carbonate sediment and sedimentary sequences. Students will learn to interpret physical processes and depositional environments from sedimentary structures, facies, and textures and to apply sequence stratigraphic methods to interpret and model facies and sedimentary basin evolution. The course incorporates modern and ancient examples from the Middle East, particularly from the UAE.

Offered: Fall.

PGEG 613 - Advanced Reservoir Characterization (4)

Students integrate well log, core, thin section, seismic reflection, and other datasets to characterize and develop geologically realistic, predictive computer model of a carbonate reservoir. Focus is given to depositional geometries, diagenetic processes, and reservoir compartmentalization.

Offered: Spring.

PGEG 623 - Remote Sensing for Earth Sciences Applications and GIS (3)

After completing the course, students should understand the physical principles of remote sensing, grasp the basic skills of image visualization, processing, interpretation and data manipulation for mapping and be familiar with the major earth observation remote sensing satellites and datasets. The students will learn the basic skills of image visualization, processing, interpretation and data manipulation for mapping. The course emphasizes the use of satellite images as an essential information source for fieldwork.

PGEG 689 - Special Topics in Petroleum Geosciences (4)

The content of this course will include special areas of importance and of interest to Petroleum Geosciences as selected by the faculty and which are not covered in regular courses listed in the curriculum.

Offered: Fall Spring Summer.

PGEG 695 - Graduate Seminar I (1)

In this course students attend seminars given by faculty, visiting scholars and fellow graduate students.

Offered: Fall Spring.

PGEG 696 - Graduate Seminar II (1)

In this course students attend seminars given by faculty, visiting scholars and fellow graduate students, and present at least one seminar on an appropriate research topic.

Offered: Fall Spring.

PGEG 699 - Master'sThesis (9)

Thesis research leading to an MSc thesis.

Offered: Fall Spring Summer.

PGEG 799 - PhD Dissertation Research (0)

Offered: Fall Spring Summer.

PHYS - Physics

PHYS 701 - Advanced Computational Physics (3)

The course discusses the computational techniques that are used to solve complex physics systems. The methods discussed will be utilized to solve quantum mechanical systems using several approximations techniques. In addition, other methods will be utilized to sample from equilibrium distribution defining statistical mechanics systems.

Offered: Fall.

PHYS 702 - Advanced Quantum Mechanics (3)

The course discusses advanced concepts in quantum mechanics. Scattering theory is developed and an introduction to the Dirac equation and consequences for the fine and hyperfine atomic structure is provided. Field quantization is introduced by application to the electromagnetic field and applications to atom-field interactions and system-environment interactions outlined. Quantum theory of systems with identical particles is discussed and a field quantization approach to many-body problems introduced. The student is thus prepared for the more rigorous and formal development of quantum field theory (PHYS706)

Offered: Spring.

PHYS 703 - Molecular Biophysics (3)

The course details physics principles of molecular mechanism inside the cell of a living organisms. Topics such as random walks, diffusion, entropic forces, and chemical forces will be discussed. In addition, different molecular machines and mechanisms will be analyzed.

Offered: Fall.

PHYS 704 - Advanced Electromagnetic Theory (3)

The course provides an overview of classical electrodynamic theory, with an emphasis on time-dependent electric and magnetic fields. The course also provides explanation of wave function and Green’s function, wave propagation in vacuum and in different medium. Waveguides structures, resonance cavity modes, energy flow in waveguides are covered. Radiation systems, multipole radiation and multipole expansions of electromagnetic field are explained. Dynamics of relativistic particles and radiation from moving charges are also discussed, including Lagrangian and Hamiltonian methods in electrodynamics and Lienard-Wiechert potentials.

Offered: Fall.

PHYS 705 - Nanophysics and Nanotechnology (3)

The course explores the impact of physics on nanoscale devices and associated technical challenges. The course gives thorough analysis to the physics of nano and two dimensional materials. The course presents theoretical concepts in addition to experimental methods for fabrication and characterization of nanomaterials and nanostructures.

Offered: Fall.

PHYS 706 - Quantum Field Theory (3)

The course discusses theoretical principles of quantum fields. Dirac Equation, Lagrangian field theory, Klein-Gordon equation, Lorentz group, QED, Feynman diagrams, renormalization, and symmetries.

Offered: Fall.

PHYS 707 - Advanced Solid State Physics (3)

The course will review the classical theory of solids. The course will discuss the classical and quantum theory of harmonic crystals. It will provide in-depth discussion of many body theory and Hartree-Fock Theory, energy band structure and Bloch's Theorem, the BCS theory and superconductive, Quantum Hall Effect and Physics of mesoscopic materials.

Offered: Fall.

PHYS 708 - Theoretical Astroparticle Physics (3)

Theoretical astroparticle physics is a branch of high-energy astrophysics where high-energy cosmic messengers such as cosmic rays, gamma rays and neutrinos are used to probe the Universe. The course will discuss the mechanisms that can produce high-energy particles in extreme environments such as supernova remnants inside our Galaxy or extra-galactic objects like active galactic nuclei and gamma-ray bursts. It will discuss how high-energy particles interact with matter and magnetic/radiation fields producing non-thermal radiation from radio frequency to high-energy gamma rays. It will describe how high-energy particles escape from the sources, and propagate through the Galactic and inter-galactic space. It will also discuss how combining information from the different cosmic messengers improves our understanding of the Universe. The course will also include a project work where students can apply their knowledge to current problems in theoretical astroparticle physics.

Offered: Spring.

PHYS 709 - Experimental Techniques in Astroparticle Physics (3)

Astroparticle Physics is an advancing field where high-energy cosmic rays, gamma rays and neutrinos are used to study the Universe. This course discusses the different experimental techniques in Astroparticle Physics, focusing mainly on ground-based experiments. The course is designed keeping in mind the recent advances in the field. It will present how extensive air showers are developed, and how they produce Cherenkov, radio and fluorescence emissions. Different types of detectors such as plastic/liquid scintillator, water Cherenkov detector and photomultiplier tubes will also be presented. The course will discuss cosmic-ray measurements using particle detector arrays and radio antennas as well as high-energy gamma-ray detection using Imaging Atmospheric Cherenkov telescopes and measurements of astrophysical neutrinos using Cherenkov technique in water/ice. Students will be introduced to advanced simulation and data analysis tools like CORSIKA, GEANT4 and ROOT. The course also includes a project work where students will work on data analysis and Monte-Carlo simulation of cosmic-ray and gamma-ray experiments.

PHYS 710 - Planetary Astrophysics (3)

Physics of planetary and interplanetary gases, fluids and plasmas applied to solar and extra-solar planetary systems, planetary atmospheres, solar wind, and solar system magnetic fields. Introduction to star and planet formation and celestial dynamics of solar system bodies will be covered.

PHYS 711 - Quantum Transport and Optics (3)

This course bridges the gap between fundamental quantum mechanics and techniques needed to understand and calculate the optical response of advanced semiconductor materials. It delivers techniques that can be applied to study quantum semiconductor optics in the frontier of knowledge and to design state of the art devices

Offered: Spring.

PHYS 712 - Atomic and Molecular Physics for Space Scientists (3)

This course will focus on the atomic and molecular processes in planetary and astrophysical environments. Topics that will be covered include: quantum mechanics, atomic and molecular structure, spectroscopy, gas phase equilibrium, and kinetics. Selected examples involving astrophysical molecules and environments will be discussed and covered as projects.

Offered: Fall Spring.

PHYS 713 - Electron Microscopy for Materials Characterization (3)

This is an advanced level course for graduate and post-graduate students in Physics, and Chemistry. The course covers the fundamental as well as advanced concepts in physical optics of charged particles, quantum mechanics of scattering theory, crystallography, solid state physics, image analysis techniques, and computational physics. The course includes studio activities and independent work that cover the concepts discussed in the lectures.

Offered: Spring.

PHYS 715 - Electromagnetism (3)

The course provides an overview of classical electrodynamic theory, with an emphasis on time-dependent electric and magnetic fields. The course also provides deep understanding of wave function and Green's functions, wave propagation in vacuum and in different media, and wave reflection and transmission. Optical Fibers and Waveguide structures, resonance cavity modes, energy flow in waveguides are covered. Radiation systems, multipole radiation and multipole expansion of electromagnetic field are explained. Dynamics of relativistic particles and radiation from moving charges are discussed. NOTE: This course is a pre-requisite to producing a dissertation in Physics

PHYS 716 - Advanced Statistical Mechanics (3)

The course provides an overview of Statistical Mechanics. That covers a probabilistic approach to equilibrium properties of large numbers of degrees of freedom. In this course, basic principles of statistical mechanics are examined. Topics include: Thermodynamics, probability theory, kinetic theory, classical statistical mechanics, quantum statistical mechanics of interacting systems, quantum statistical mechanics, and identical particles. The course also provides deep understanding of microstates and macrostates, entropic dynamics, Application of quantum field theory and Temperature dependent Greens function to statistical mechanics. NOTE: This course is a pre-requisite to producing a dissertation in Physics

PHYS 717 - Quantum Mechanics (3)

The course bridges the gap between basic quantum mechanics of a BSc course and PhD studies. It delivers the basis for understanding advanced courses at all levels of the PhD program. NOTE: This course is a pre-requisite to producing a dissertation in Physics

PMED-Pre-Med

SCIE - PhD in Science

SCIE 701 - Research Methods in Science (3)

This course provides sound knowledge and understanding of research methodology and project management skills and their application to science research and project development. Topics covered include Aspects of PhD research, Critical literature review, Citations and references, Technical writing, Presentation skills, Software and Experimental Methods, Modeling and Simulation Methods, Reliability and Validity of Results, Analysis and Interpretation of Results, Project management, and Professional issues in research.

Offered: Fall Spring.

SCIE 702 - Research Seminar I (0)

This course provides students with essential communication tools, showing how to identify the details needed for a presentation depending on the audience, using the appropriate language and visual aids to develop skills for public presentations. The course is focused on seminar presentations, although other formats of communications such as social media will also be introduced. By attending and critically analyzing seminars given by faculty, visiting scholars and fellow graduate students, students will develop the ability to recognise effective scientific communication. Through practicing preparing and delivering presentations and receiving feedback on their performance, students will develop the ability to deliver high quality presentations describing their research topics and related areas.

Offered: Fall Spring.

SCIE 703 - Research Seminar II (0)

This course builds on skills learned in SCIE 702 and enhances students' skills in scientific communication. By attending and critically analyzing another series of seminars given by faculty, visiting scholars and fellow graduate students, students will further broaden their knowledge and skill at recognising effective scientific communication. Through practicing preparing and delivering presentations of varying length and style, and receiving feedback on their performance, students will develop the ability to deliver high quality presentations describing their research topics and related areas.

Offered: Fall Spring.

SCIE 795 - PhD Written Qualifying Examina (0)

The purpose of the PhD Written Qualifying Examination (WQE) is (a) to ensure that the student has the required breadth and depth of content knowledge, and (b) to evaluate the student's ability to research a specific topic and critique its state of the art. The examination is intended to test the student's understanding of the chosen field of study as evidenced by his/her proficiency in three pertinent topical areas chosen from an approved list, in consultation with his/her Main Advisor and Co-Advisor(s). CoAS PhD students typically take the PhD WQE towards the end of their 3rd semester of active registration. A student may, if they wish, register for one fewer course in that semester in order to prepare for the WQE. This is in order to give the student time to prepare for the WQE during that semester. In the event of failure to pass the WQE, a resit must be taken in the student's fourth semester.

Offered: Fall Spring.

SCIE 796 - PhD Research Proposal Examinat (0)

The PhD Research Proposal Examination (RPE) is an oral exam following submission of a short research proposal that evaluates the student's ability to focus attention on a careful description of the proposed research problem and its background and context. It is expected that the student demonstrates a breadth of knowledge and is able to apply this knowledge to the research problem he/she will study. The student must pass the RPE before being allowed to progress further in the PhD program. Full-time PhD students typically take the PhD RPE at the end of their 4th semester of active registration. If the RPE is not passed in the first attempt, it must be retaken in the next semester

Prerequisite: SCIE795, or PGEG797. Offered: Fall Spring.

SCIE 799 - PhD Thesis Dissertation (36)

Students will conduct a novel research project investigating a problem of contemporary interest in one or more scientific disciplines.

Offered: Fall Spring Summer.

SCIN-Sustainable-Critical-Infr

SCIN 601 - Transportation Systems Analysis: Demand and Economics (3)

This course offers an overview of the fundamental principles of transportation systems analysis and modeling, emphasizing the theory and applications of the demand and economics of these systems. It will cover topics such as pricing, regulation, and the evaluation of transportation services. We will draw upon examples from the public transit, road, freight, maritime, and airline industries.

Offered: Fall.

SCIN 602 - Urban Design for Sustainability: Theory and Practice (3)

This is a graduate theory and practice course focused on the body of knowledge and history that informs historical and modern theories in urban design. The course materials will address the major urban design debates, positions, theories, paradigmatic shifts, and unanswered questions. One important agenda will be stressing a series of major debates and models of urban form, its significance and impacts, and proposals to establish healthy and sustainable new communities. The course is ultimately structured to assess and synthesize the classical and contemporary urban design theories related to the intersection of urban form and sustainability. We will accomplish the aforementioned agenda through an extensive set of lectures, readings, assignments, and workshops that synthesize the transformation and debates in urban design theory and practice. Case studies reflecting a wide range of "cities and life style" are introduced to provide a constructed ground for understanding the strategic initiatives and spatial orders being implemented in classical and contemporary urbanism. The course also explores the broader application of specific urban design strategies and interventions within the UAE's geographic setting and socio-political context. In short, this course explores ways to make better urban places both as a means to serve cities inhabitants, and also as a catalyst to urban regeneration. The seminar should be of benefit to all students interested in the design and morphological aspects of cities. The course also prepares students with no prior design background like engineers and scientists for learning core urban design theories, skills, and applications.

Offered: Fall.

SCIN 603 - Management of Infrastructure Systems (3)

Infrastructure systems, such as transportation systems, telecommunication systems and electric power systems, have become a crucial component of modern society. This course will apply techniques of risk assessment and decision making under uncertainty in all phases of the infrastructure life cycle to better manage these systems. Emphasis is placed on the planning and design phases since these are most relevant to the region with particular attention to the Abu Dhabi 2030 Economic Vision. The course will also introduce concepts of system reliability, optimization, resilience, and flexibility to uncertainty using real options analysis. Course material will be drawn from textbooks, research papers, and instructor notes.

Offered: Spring.

SCIN 604 - Infrastructure Finance (3)

The infrastructure finance course focuses on the application of financial theory and risk analysis to the financing of infrastructure projects. It discusses various sources of financing for infrastructure development and evaluates cost and risk, both from an investor and a project perspective. A number of issues such as public and private financing, limited and full recourse financing, valuation of projects, and refinancing are discussed. This course takes a global perspective, with analysis of international infrastructure projects and discussion of sovereign and exchange rate risk. It also discusses the concept of infrastructure as an asset class, and infrastructure asset based securitization.

Offered: Spring.

SCIN 605 - Planning Theory, Practice, and Ethics (3)

Planning is an ill-defined field. Feinstein and Campbell give four reasons for the difficulty in defining the field, and thus, planning theory: the apparent overlap between the concerns of planning and those of many other social science disciplines; the fuzzy boundaries between planning and other related professions; disagreement as to whether the field should be defined by its object or by its method; and, finally, the fact that planning borrows methodologies from other fields. Given these characteristics of the field, this course is structured to discuss planning theory and its evolution and influence on practice. This course provides you in-depth understanding of the intellectual history, paradigmatic structure, and contemporary debates in the field of planning theory. The course reading materials, discussion sessions, case studies, assignments, and workshops are organized into two major parts. The first batch of sessions will chronologically (1) explain why planning is unique and different from other social science disciplines; (2) discuss the purpose of defining a body of thought as planning theory by explaining the character and object of theory in the literature; (3) discuss the evolution of planning by describing how different theories influenced planning scholarship and practice and how the integration of some of these traditions form the current theoretical framework that shapes contemporary planning as it is practiced today; and (4) discuss how the concept of sustainability can be considered a compelling normative position to organize and better delineate the central tasks for planning theory in city design, implementation processes, and decision making. The second batch of lectures, on the other hand, will (1) discuss the content/subjects of planning (physical planning) emphasizing sustainable urban form design and planning principles; (2) recognize and assess the suitability of universally acknowledged planning principles and interventions to UAE's political and social norms (3) Introduce Abu Dhabi community facility codes, standards, and zoning strategies; and (4) discuss different approaches and policies in city planning through multiple case studies including: Portland, Chicago, Hamburg, Tokyo, Dubai, San Francisco etc.

Offered: Spring.

SCIN 606 - Geographic Information Systems (3)

This course introduces the basic elements of Geographic Information Systems (GIS) and its application in general management activities including resource management. The application of GIS as a tool to collect, store, manage, and analyze spatial data for strategic decision making has been explored in all fields of study. Recent improvement in GIS provides researchers to perform spatial statistical analysis. However, the potential of GIS in dealing with urban issues is still evolving. As a tool of analysis, GIS can be used to for informed decision making to deal with demands of and both current and emerging issues at local, regional and global scale. As a basis from which to pursue these objectives, GIS introduces the current and potential future roles of GIS in support of infrastructure management. The course provides a framework for understanding the real-world application of GIS for crisis management and for addressing the applied research needed to enable more effective GIS application in this context.

Offered: Fall Spring.

SCIN 607 - Infrastructure and Development (3)

What is the relationship between infrastructure and economic growth and development? How does energy security affect geopolitical relations among nations as well as socioeconomic relations within nations? This seminar will cover some of these timely and complex questions linking infrastructure, energy, and their technologies.

SCIN 608 - Urban Planning and Design Studio (3)

This class is a studio course that gives hands-on experience in the actual development of a site plan. This course incorporates community design and site planning in concert with geological constraints, aesthetic values, environmental concerns, and legal issues (e.g. zoning). Another important key of this class is to learn the design of "space". Students learn various aspects of community design and site planning through a semester-long site plan project that designs a residential community that incorporates the principles of design.

Offered: Fall.

SCIN 609 - Comparative Land Use and Transportation Planning (3)

This course focuses on the land use-transportation "interaction space" in metropolitan settings. The course aims to develop an understanding of relevant theories and analytical techniques, through the exploration of various cases drawn from different parts of the world. During the first part of the course, students will develop a basic understanding of: the major forces, patterns and trends of metropolitan growth today; conceptual and analytical models of urban development and the role of transportation; and the relevant planning institutions. The second part of the course will introduce the concept of accessibility and related issues of individual travel demand. Building on these foundations, in the third part of the course students will explore the influence of the metropolitan built environment on travel behavior, including historical interest and evidence, relevant theories and analytical approaches, techniques for measuring relevant aspects of the "built environment," and implications for planning tools and policies. The fourth part of the course turns to the other side of the land use-transportation "interaction space;" that is, the role of transportation on metropolitan land development. Students will learn about historical influences and then study in more detail the effects as they relate to provision of both public transportation infrastructure and roadways. We will also examine the implications for various financial instruments and institutional structures. Finally, the fifth part of the course will take a prospective perspective, looking at the implications of the land use-transportation interaction space for metropolitan futures, and our abilities to forecast them.

Offered: Spring.

SCIN 610 - Public Transportation Systems (3)

Evolution and role of urban public transportation modes, systems, and services, focusing on bus and rail. Description of technological characteristics and their impacts on capacity, service quality, and cost. Current practice and new methods for data collection and analysis, performance monitoring, route design, frequency determination, and vehicle and crew scheduling. Effect of pricing policy and service quality on ridership. Methods for estimating costs associated with proposed service changes. Organizational models for delivering public transportation service including finance and operations. Select transit management topics including labor relations, fare policy/technology, marketing and operations management.

Offered: Fall.

SCIN 611 - Thermal Energy in Buildings (3)

Worldwide, a significant portion of the demand for energy can be traced back to buildings. The building sector is therefore an ideal target for the implementation of energy efficiency enhancement initiatives. This course focuses on the technical and, to some extent, financial feasibility of energy efficiency in buildings. It examines the flow of energy in a building and the function of a building's envelope. The course also covers the building systems in charge of maintaining indoor comfort conditions as well as the modeling and lifecycle analysis of building's energy performance. Upon culmination of the course, students would be able to apply their knowledge to the optimal design of new construction and the marginal enhancement (‘retrofit’) of existing buildings. Advanced topics such as building performance diagnostics and interaction with the urban microclimate and systems will also be covered. The main emphasis of the course will be on challenges posed by hot and humid climate. At the outset, the course describes the fundamental heat, moisture and mass transfer phenomena occurring in buildings and presents methods and techniques used at different stages of a building's life-cycle—design, operation, retrofit—to strike an optimal balance between indoor thermal comfort and energy efficiency. The role of the building envelope (foundation, wall, roof, glazing) in separating indoor space from outdoor climate will be investigated in depth. Interactions between building envelope components and building systems (heating ventilation and air-conditioning, lighting, building management system) are of particular interest. In the final section of the course, students learn to accurately model said interactions and develop life-cycle analysis of buildings. These models are used to inform and support real life engineering decisions.

Offered: Fall.

SCIN 612 - Sustainable Building Science: Fundamentals, Tools, and Applications (3)

This course explores the multidisciplinary challenges and opportunities to make the built environment more sustainable, by covering building science fundamentals, tools, and applications. Various topics are covered including green building design principles, methods to assess building energy performance, life-cycle analysis, the relationship and interaction of buildings with their inhabitants, and finally, the study of buildings in respect to their urban environment and infrastructure. This course adopts a practical and holistic approach by introducing students to contemporary solutions and trends both in the industry and in academia. It also teaches them fundamental tools to assess and critique sustainability solutions from a life-cycle perspective, while accounting for how these solutions affect – and are affected by – building users. This is expected to prepare students to work on multi-disciplinary teams with professionals from various fields including engineers, urban planners, human factors and ergonomics experts, social scientists, and architects.

Offered: Fall Spring.

SCIN 694 - Selected Topics in Sustainable Critical Infrastructure (3)

This course covers selected contemporary topics in Sustainable Critical Infrastructure. The topics will vary from semester to semester depending on faculty availability, and faculty and student interests. Proposed course descriptions are considered by the Department of Industrial and Systems Engineering on an ad hoc basis and the course will be offered according to demand. The proposed course content will need to be approved by the Graduate Studies Committee. The Course may be repeated once with change of contents to earn a maximum of 6 credit hours.

SCIN 699 - Master's Thesis (9)

In the Master's Thesis, the student is required to independently conduct original research-oriented work related to important industrial systems engineering problems under the direct supervision of a main advisor, who must be a full-time faculty in the Industrial & Systems Engineering Department, and at least one other full-time faculty who acts as co-advisor. The outcome of the research should demonstrate the synthesis of information into knowledge in a form that may be used by others and lead to publications in suitable journals/conferences. The student's research findings must be documented in a formal thesis and defended through a viva voce examination.

Corequisite: ENGR695. Offered: Fall Spring Summer.

THS - Thesis

THS 699 - Thesis (36)

Offered: Fall Spring Summer.

WENV-Water-Env-Engr

WENV 601 - Chemicals in the Environment: Fate and Transport (3)

Behavior of chemicals in the environment. Emphasis on man-made chemicals, and their movement and fate in natural environmental media (water, air, soil) and engineered environments. Physical transport, as well as chemical and biological sources and sinks, are discussed. Linkages to health effects, sources and control, and policy aspects are explored.

Offered: Fall.

WENV 602 - Industrial Ecology (3)

Engineers can fundamentally change the environmental footprint of modernity. To effect change, engineers require tools to identify "better" design and operational options. This course examines the use of life-cycle thinking and assessment tools to identify product and system design options that balance environmental and economic performance. While this is very relevant, as a core course, to Water and Environmental Engineering students, it is also very helpful to students from other disciplines.

Offered: Fall Spring.

WENV 604 - Desalination (3)

The course will cover in-depth the commonly adapted thermal and membrane based desalination technologies. This includes reverse osmosis, electrodialysis, flash-related desalination processes, and evaporation-related desalination processes. Renewable energy technologies coupled with desalination processes will be also presented. Additionally, fouling/scaling, corrosion, materials used and environmental impacts related issues will be covered. Finally, environmental, sustainability and economic factors of desalination systems for fresh water production and reuse will be presented.

Offered: Fall Spring.

WENV 606 - Wastewater Treatment Engineering (3)

This course is an overview of engineering approaches to protecting water quality with an emphasis on the application of fundamental principles. Theory and conceptual design of systems for treating municipal and industrial wastewater are discussed. These include reactor theory, models, (bio)reaction stoichiometry and kinetics. Physical, chemical and biological processes are also studied.

Offered: Fall Spring.

WENV 611 - Hydrologic Analysis (3)

This graduate course is to give students an advanced and practical approach to the various facets of the subject of Hydrology. Therefore, students will have the opportunity to use advanced modeling techniques to understand the dynamics of hydrological processes. A special focus will be given to the application of hydrological theory and concepts for the solution of practical engineering problems in an arid region context. In addition, a number of open-source and commercial models will be presented to students.

Offered: Spring.

WENV 622 - Data Analysis for Environmental Modeling (3)

This course provides an overview of statistical methods commonly utilized in environment modeling to provide students with training in analytical approaches. Course topics will include approaches for data manipulation, quantitative analysis based on descriptive statistics, linear models, non-linear models, time series, and spatial data analysis. Examples and problem sets will utilize MATLAB to analyze data. There will be an emphasis on exploring and plotting data, and presenting model results.

Offered: Fall Spring.

WENV 623 - Global Climate Change: Impacts and Adaptation (3)

This graduate course provides students with an overview on global environmental, social and economic impacts of climate change, with a particular focus on the arid and semi-arid regions of the world and their criticalities. The first part of the course addresses the scientific basis of global climate change, the different sources of uncertainty in predicted climate scenarios, and the interpretation of results from the recently issued (IPCC) Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change. Special emphasis is given to the effects of climate variability on water resources, food security and human health, and to the role of renewable energy sources in mitigating climate change and supporting sustainable development. Students are also guided through the understanding and assessment of adaptation strategies that human communities already adopted and those they will most likely have to implement under future climate change scenarios. The final part of the course is devoted to measures / technologies / policies for climate change mitigation, again with a regional prospective and main emphasis on water-limited climates.

Offered: Fall.

WENV 694 - Selected Topics in Water and Environmental Engineering (3)

This course covers selected contemporary topics in Water and Environmental Engineering. The topics will vary from semester to semester depending on faculty availability and student interests. Proposed course descriptions are considered by the program on an ad hoc basis and the course will be offered according to demand. The proposed course content will need to be approved by the College of Engineering Graduate Studies Committee. The Course may be repeated once with change of contents to earn a maximum of 6 credit hours.

Offered: Fall.

WENV 699 - Master's Thesis (9)

In the Master's Thesis, the student is required to independently conduct original research-oriented work related to important water and environmental engineering problems under the direct supervision of the main advisor, who must be a full-time faculty in either the CIVIL Engineering Department or the Chemical Engineering Department, and at least one other full-time faculty who acts as co-advisor. The outcome of the research should demonstrate the synthesis of information into knowledge in a form that may be used by others and lead to publications in suitable reputable journals/conferences. The student's research findings must be documented in a formal thesis and defended through a viva voce examination.

Corequisite: ENGR695. Offered: Fall Spring Summer.

Index