King Fahd University of Petroleum & Minerals

Graduate Bulletin

2009 - 2011

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King Fahd University of Petroleum & Minerals

GRADUATE BULLETIN

2009 -2011

Dhahran 31261, Saudi Arabia

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About this Bulletin

The Graduate Bulletin of King Fahd University of Petroleum & Minerals (KFUPM) is an official publication of the University issued by the Office of the Dean of Graduate Studies. The current document was prepared during the 2007/2008 academic year and printed in the spring of 2009. The contents were compiled from inputs received from the various academic departments and administrative offices throughout the University. All changes from the previous Bulletin were verified against the Graduate Council's decisions.

The Bulletin gives, at the time of printing, up-to-date information about all graduate programs, some of which have been recently modified or introduced. It provides detailed information about each graduate academic program offered at KFUPM, a helpful summary of the University policies and procedures pertinent to graduate studies, selected activities and services, and a listing of the administrative officers and faculty. It is hoped that the Bulletin will serve as a useful guide to faculty members, graduate students, and staff whenever questions arise regarding the relevant University's rules and regulations, the graduate courses and their prerequisites, the degree requirements, and other academic matters.

The Bulletin is distributed by the Office of the Dean of Graduate Studies, KFUPM, Dhahran 31261, Saudi Arabia.

Dr. Abdul Muttaleb Jaber
Professor
Chemistry Department
Editor, Graduate Bulletin
2009-2011

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FOREWORD

The principle objective of the Deanship of Graduate Studies at KFUPM is to offer education beyond the baccalaureate level to those who aspire to become intellectual leaders in the professions and in various fields of teaching and scientific research. It undertakes to assist graduate students in developing and pursuing individual educational programs requiring superior accomplishment through carefully directed intellectual activity. Also, the primary purpose of the graduate programs is to train the creative type of scientist or engineer so urgently needed in educational, governmental and industrial development.

The purpose of this Bulletin is to provide information about the graduate programs of KFUPM to current and prospective students, as well as to the faculty and staff of the University. Information concerning requirements for admission to the graduate programs of KFUPM, the University research supporting units, services available to students, graduate course offerings and listings of the current graduate faculty and administrators of the University are all included in the Bulletin.

In the Graduate programs, KFUPM offers courses leading to the degree of Master of Science, Master of Engineering, Master of Business Administration, Master of City and Regional Planning, Master of Environmental Science, and Doctor of Philosophy in various disciplines.

Since it has been established in 1972, the Deanship of Graduate Studies (previously known as College of Graduate Studies) at KFUPM, has witnessed a phenomenal expansion. Currently 33 programs are being offered at the Master and 9 at the Ph.D. levels. These programs span the fields of Engineering, Science, Management, and Environmental Design.

At the start of the third millennium, the Graduate Studies at KFUPM is facing several challenges. First, the graduate programs have to be current and dynamic to keep up with and be able to accommodate the fast developments in knowledge and technology. Second, it has to accommodate more students, many of whom will be part-timers who do not fit the traditional model of a full time residential student. Third, the quality of the graduate education provided by KFUPM has to equal or surpass standards set by the international academic community. Fourth, to implement graduate studies of high quality within the unified regulations issued by the Ministry of Higher Education. Fifth, the Deanship of Graduate Studies has to develop effective ways and means to disseminate knowledge into the University and its surrounding community and to contribute and enhance the undergraduate education. In order to meet these challenges, the Deanship is continuously enhancing the flexibility and variety of its course offerings, forged stronger links with the international academic community through such innovative programs as scholarship and research assistantship programs and established a permanent system of independent periodic evaluation of graduate programs. It has also moved steadily to strengthen ties with industry through programs to establish endowment scholarships and industry-related projects.

The University has also been trying to upgrade its standards by having its programs evaluated by international bodies such as Accreditation Board of Engineering Technology (ABET), and the Association to Advance Collegiate School of Business (AACSB).

Currently, about 1000 students are pursuing studies in graduate programs spanning various disciplines. The University has a full-time faculty of more than 800. The faculty members are also very active in research-related work in their areas of specialization, thus contributing to the general atmosphere of intellectual curiosity and creative activity generated on the KFUPM Campus.

Dr. Salam Adel Zummo
Dean of Graduate Studies

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GENERAL INFORMATION

HISTORY AND PHILOSOPHY OF THE UNIVERSITY

King Fahd University of Petroleum and Minerals (KFUPM) was officially established by Royal Decree on 5 Jumada 1, 1383 (23 September, 1963). The first students were admitted a year later, on 23 September, 1964, when 67 young men enrolled in what was then named the College of Petroleum and Minerals (CPM). Since that time, the University enrollment has grown to a level that is expected to exceed 8,000 by the 2009-2009 academic year.

Several significant events have marked the University's growth. In 1971, at the first graduation ceremony, four men received their baccalaureate degrees in engineering. In 1975, the College of Petroleum and Minerals became the University of Petroleum and Minerals, a change both in name and academic status. In 1986, the University was renamed: The King Fahd University of Petroleum and Minerals. As a result of the vast growth of KFUPM, 18,563 degrees were awarded including 1,821 Master's and 86 Ph.D. degree by the end of the 2004/2005 academic year

The rapid growth of KFUPM is related to the rapid economic and technical development of the Kingdom. It also reflects the rising expectations of the people of Saudi Arabia, the expanding opportunities for the country's young men, and the increasing importance of the Kingdom as a major source of the world's energy.

The vast petroleum and mineral resources of the Kingdom pose a complex and exciting challenge for scientific, technical, and management education. To meet this challenge, the University has adopted advanced training in the fields of science, engineering, and management as one of its goals in order to promote leadership and service in the Kingdom's petroleum and mineral industries. The University also furthers knowledge through research in these fields. In addition, because it derives a distinctive character from its being a technological university in the land of Islam, the University is unreservedly committed to deepening and broadening the faith of its Muslim students and to instilling in them an appreciation of the major contributions of their people to the world of mathematics and science. All areas of KFUPM - facilities, faculty, students, and programs - are directed to the attainment of these goals.

KFUPM MISSION, VISION AND VALUE STATEMENTS

Mission, vision, and value statements of KFUPM are in accord with similar international institutions.

Vision

"To be a vibrant multicultural University of international repute focused on quality education and innovative research that prepares professionals and entrepreneurs to lead social, economic and technical development in the region.

Mission

KFUPM is an institution of higher learning committed to:

a. Preparing professionals empowered with the knowledge, skills, values and confidence to take a leadership role in the development of the Kingdom in the fields of science, engineering, environmental design and business.

b. Producing research that contributes to the knowledge and sustainable development of the Kingdom and region by providing innovative solutions to identify economic and technical problems and opportunities.

c. Providing a stimulating campus environment for the welfare of its students, faculty and staff, and offering outstanding professional services and out-reach programs to the society at large.

Values

The following ten core values, guided by the Islamic principles, form the foundation upon which KFUPM builds its reputation and success.

Creativity

Encourage and entertain creative ideas and solutions in teaching, learning, and research, placing it at the forefront of our focus and initiatives.

Excellence

Strive to excel in what we do by maximizing our skills and continuously improving our business processes to improve quality of our products and services.

Integrity

Adhere to ethical and professional code of conduct that encapsulates honesty, sincerity and trustworthiness.

Fairness

Deal fairly and humanely with all people, respecting justice and individual rights and freedom.

Diversity

Attract and develop employees and students of different nationalities seeking to promote cultural diversity through inclusion of a broad range of people and perspectives.

Responsiveness

Be responsive to our stakeholders' requisites and demands with a strong customer focus.

Teamwork

Aim to create value through teamwork in our business within and outside, treating one another with respect and to help students to share the spirit of teamwork in their academic progression.

Leadership

Advocate leadership roles that uphold professionalism, responsibility and motivation.

Discipline

Focus on a disciplined behavior, interaction and approach to our professional work.

Transparency

Deal in a transparent manner in matters of education, performance and progress of faculty, staff and students.

KFUPM Commitment to Values

Teach and emphasize our values to the students through course work, extracurricular activities, advising and counseling, academic processes, outreach programs and preach-as-we-practice behavior of mentors

Make all employees aware of the institutional values through employment contracts or conditions, specified code of conduct, administrative processes and policies, and annual performance evaluation

Pay attention to our commitment to preserve and nurture these values by requiring the measurement of their enhancement in all proposed new initiatives, new programs and improvement of programs.

ORGANIZATION

King Fahd University of Petroleum & Minerals (KFUPM) is one of the 21 Saudi Universities that, beside the Council of Higher Education, the Ministry of Higher Education, as well as several specialized colleges and institutions, consist the main component of the higher education system in Saudi Arabia. KFUPM and the other Saudi Universities are supervised by the Ministry of Higher Education, and regulated by The Council of Higher Education.

KFUPM, same as other Saudi Universities, has a board chaired by the Minister of Higher Education while the rector serves as the deputy chairman. Membership of the Board includes the Secretary General of the Council of Higher Education, the vice rectors, the deans, and three external members appointed by the Minister of Higher Education. This Board is responsible for all university operations, it grants degrees to students, approves programs and curricula of existing departments, and makes recommendations to the Council of Higher Education in other matters.

The Rector of the University is the chief academic and executive officer of the University. He is responsible for administering its affairs in accordance with the Law, the Charter of the Council of Higher Education and the Universities, government edicts, and decisions of the Council of Higher Education and the University Board. He also represents the University in contacts with outside organizations.

The Rector is assisted by four Vice Rectors (Vice Rector for academic affairs, Vice Rector for Graduate Studies and Scientific Research, Vice Rector for Applied Research, and Vice Rector for Technology Development and Industrial Relations), four general supervisors (Supervisor for Financial and Administrative Affairs, Supervisor for Technical Affairs, Supervisor for Information and Communication Technology, and Supervisor for Dhahran Techno-Valley) and several advisory standing committees.

The Vice Rectors (appointed for renewable three-year terms) are assisted by Deans, Directors of the Centers in the Research Institute, Academic Department Chairs, the Director of the Information Technology Center (ITC), Director Generals and Directors of the administrative units. The Deans and Academic Department Chairs are appointed for renewable two-year terms. Director Generals and Directors of the administrative units are appointed for indefinite terms.

The University is financed principally by Saudi Arabian government grants, but also receives donations from oil companies, grants and awards from foundations, and other support. Eventually, the University will obtain a portion of its income from student tuition, but at the present time no charges are levied for full-time instruction, or accommodation.

The University's regular and adjunct faculty is multi-national. Instruction is in English and the resources of the technical library are predominantly, though not exclusively, printed in English. Teaching methods, curricula, administration, and organization of the University are largely designed in accordance with reputable international standards, which have been adapted to Saudi Arabian needs.

The academic organization of the University includes the Preparatory Year Program, seven undergraduate academic colleges, and the Deanship of Graduate Studies. The Preparatory Year Program is designed as a bridge between the level a student attains upon graduating from the secondary schools of the Kingdom and the academic and language requirements of each of the six undergraduate academic colleges. Although the great majority of students admitted to the University begin their studies in the Preparatory Year Program, a small number of high achievers may, upon passing a qualifying examination, enter the college of their choice directly. The seven undergraduate colleges are the College of Applied Engineering, offering degrees in Applied Chemical, Applied Civil, Applied Electrical, and Applied Mechanical Engineering; the College of Engineering Sciences, offering degrees in Chemical, Civil, Electrical, Mechanical, and Petroleum Engineering; the College of Sciences, offering degrees in Chemistry, Industrial Chemistry, Geology, Geophysics, Mathematics, Physics, and Statistics; the College of Environmental Design, offering degrees in Architecture, Architectural Engineering, and City Planning; the College of Industrial Management, offering degrees in Accounting, Finance, Information Systems, Marketing, and Operations Management; the College of Computer Sciences & Engineering, offering degrees in Computer Science, Computer Engineering, and Systems Engineering; and the College of Applied and Supportive studies that offers services courses in Islamic and Arabic Studies, English and General Studies. The Deanship of Graduate studies awards Master of Science (M.S.) degrees in 24 major fields, namely: Architectural, Chemical, Civil, Computer Science, Computer Networks, Electrical, Mechanical, Petroleum, Telecommunication, and Systems Engineering, as well as in Chemistry, Computer Science, City & Regional Planning, Construction Engineering & Management, Geology, Geophysics, Mathematics, Physics, and Medical Physics. The Deanship of Graduate Studies also awards Master of Engineering (M.Engg) in Civil Engineering, Master of Engineering (M.Engg) in Construction Engineering & Management, Master of Accountancy (M.Acc.), Master of Business Administration (M.B.A.), Executive Master of Business Administration (Executive M.B.A.), Master of Geology, and Master of Geophysics.

Doctoral programs are offered in nine specializations, namely: Chemical, Civil, Electrical, Mechanical, Petroleum, and Systems Engineering, and Computer Science & Engineering, as well as in Chemistry, and Mathematical Sciences.

LOCATION

The University is located in Dhahran, near the headquarters of the Saudi Arabian Oil Company (SAUDI ARAMCO) in the Eastern Province of Saudi Arabia. The campus is situated near the Arabian Gulf at a distance of about six kilometers from the town of Al-Khobar, and 15 kilometers from the city of Dammam. The academic buildings are located on a 100-foot "Jebel" (Arabic for hill). The University overlooks the Arabian Gulf, and is about 60 kilometers away from Bahrain and linked to it by the King Fahd Causeway.

The University is easily accessible by road or airline from any point in the Kingdom, or by international air, sea and road routes from Europe, Asia, Africa, or other Middle Eastern countries. The highway distance to Riyadh is about 400 kilometers and that to Jeddah is about 1,450 kilometers. A network of paved roads leads to various distant points, such as Najran, Abha, and Jaizan in the far south, to Burayadah and Hail northwest of Riyadh, to the lovely mountain resort of Taif near Makkah and Jeddah, and to Qaiysumah, Turaif, and Tabuk along the Northern frontier. King Fahd International Airport is about 50 kilometers from the University Campus, and regular airline service exists to all domestic and many international terminals.

FACILITIES

The campus of the University features a physical plan of exceptional beauty and size. The buildings are both architecturally imaginative and educationally sound and viable. Their exterior design combines the stark color and raggedness of the landscape with the graceful lines of the Islamic arch, dome, and minaret. Interiors feature laboratories, lecture halls, classrooms, seminar rooms, offices and a variety of special facilities including computer terminals, closed circuit television outlets, wireless connectivity (WiFi) service in all academic and administrative buildings, and other amenities.

The Academic Complex consists of several buildings, all of them completed and in use. The facilities available include: faculty/staff offices; shops and laboratory buildings, which include the Heavy Equipment Laboratory building and the Energy Research Laboratory building; the Information Technology Center; classrooms; the Administration Building; the Library; the Faculty/Student Center, which includes the Faculty Dining Hall, the Post Office, and the Stationery Shop; the Auditorium, which seats 850 people and is equipped for simultaneous translation in three languages; the Gymnasium; a Mosque; the Research Institute; the Stadium, which seats 10,000 people; the Medical Center; the Conference Center; and multi-story parking garages. The facilities also include a natural exterior amphitheater, playing fields and indoor courts for intercollegiate and intramural sports, and the distinctive KFUPM water tower with circulatory water systems.

To the north of the *Jebel* there are: Student Housing, including the Student Reception Center, the Student Cafeteria, Mosques, Student Clubs and Services; the Projects & Maintenance Complex; the University Storehouse; the Security & Safety Department; the Transportation Center; the Garage for maintenance of University vehicles; and the Preparatory Year Campus, consisting of the Preparatory Year Faculty Office Building, two classroom buildings, and various laboratories and service buildings. A new Academic Complex is under construction, consisting of a classroom building, faculty office building, an auditorium for 1,200 people and a mosque. The buildings will be equipped with high–tech facilities.

To the south of the *Jebel,* there is faculty & Staff Housing, including the Family Recreation Center and the Coop Store. The Telephone Exchange, the University Press Building, the Bookstore, the University Nursery and Kindergarten Schools are located on the southeast of the University campus.

The University also has a private beach, about half an hour's drive from the main campus, at Half-Moon Bay. At this facility, which is for the use of the whole university community, one can swim, surf, sail or merely relax and enjoy a change of pace by the sea, with undulating sand dunes and palm trees in the background.

The Conference Center, which is adjacent to the main University concourse and car park, has extensive modern facilities for hosting conferences of international level. In addition to the main auditorium, it has briefing and committee rooms and its own kitchen. Conference meetings are supported by the latest audio-visual equipment, Community Antenna Television (CATV), connecting with all parts of KFUPM campus, and its own typing facility.

The Medical Center. The KFUPM Medical Center provides the community (students, faculty, staff, laborers and their dependents) with the primary health care services. The Medical Center comprises multidisciplinary clinics with 17 doctors assisted by 33 technicians including males and females. Few beds are available for observation of patients in emergency cases before transferring them to the nearest governmental hospitals. The X-ray department, the dental clinic and the laboratory are equipped with the modern diagnostic and testing equipment including ultrasound, mammography, panoramic x-rays and others. A pharmacy with the majority of routinely prescribed medicines is also available. In general, the Medical Center provides the KFUPM community with the following services:

- Primary health care.
- Laboratory & X-ray Facility in parallel to the available medical facilities.

- Referrals to the local governmental hospitals for hospitalization, further investigations and consultations.
- Multi-specialty clinics in Internal Medicine, Pediatrics, Gynecology & Obstetrics, Ophthalmology, Psychiatry, Skin & Venereal Diseases, and Dentistry.
- Vaccinations, which include primary (essential) vaccinations for children, as well as participation in the national preventive campaigns.
- 24 hours first-aid service for management of emergency cases.
- 24 hours ambulance service to attend emergency cases.
- 24 hours nursing service which include giving injections, dressing and all possible nursing assistance, such as checking blood pressure and vision tests, etc.
- Few hours' observation inside the medical center, which ends up with either discharging the patients or referring them to hospitals.
- Issuing medical reports for residence permits (iqama), sick leaves, etc.
- Providing the majority of medicines according to the university policy.
- General dental clinics for dental care and oral hygiene.
- Check-up service for new students, students taking up coop programs, pre-employment of students after graduation, new employees including staff & faculty, laborers of KFUPM food services on regular basis every three months, housemaids and drivers working for staff & faculty, and KFUPM school before registration and before frequent short activities.

Student Housing. The University provides student housing for the total student enrollment in keeping with its policy of being an entirely residential institution. The undergraduate student dormitories, which constitute the majority of student housing at this time, are containing furnished rooms, having two beds per room, showers and hygienic facilities. These units are located in the Student Compound *(AI-Falah District),* in the North Sector of the campus with newer facilities of modern design, consistent with the architecture of the University, some multi-story buildings have already been completed and being used. Housing for graduate assistants is also included in this program.

Testing Services. Various international academic and professional examinations are administered through the Testing Center. These examinations include the Test of English as a Foreign Language (TOEFL), (GMAT), the Graduate Record Examination (GRE), the Certificate of the Association of Chartered Accountants (CACA), and SAT/ACH. It is expected that the number and range of examinations offered by the Testing Center will increase in the years to come.

The University Cafeteria. A large spacious building – *Student Cafeteria* – is situated adjacent to the Student Dormitories. It can accommodate more than 1500 students at a time. Students are provided with subsidized meals, comprising of breakfast, lunch and dinner.

Preparation of food is handled by a well-qualified and professional team in the Central Kitchen, equipped with modern machinery and equipment. The Food Services Department makes sure that the food offered to students consists of a balanced diet, conforming to the Saudi Standards (SASO).

Apart from the Student Cafeteria, there are a number of Coffee Shops, located in different academic buildings and student dormitories, offering varied refreshments.

The University Bookstore. The Bookstore is located in Building #55, near KFUPM Press. Textbooks are issued to students and faculty free of charge.

As a large number of specialized textbooks are needed for different University programs, a comprehensive textbook acquisition system is followed to ensure that the latest editions of books are used, as far as possible.

Sports and Recreation Facilities. The University's major sports facility is the Stadium, located near the main entrance to the University. It is designed to seat 10,000 spectators. The Stadium is open and has facilities for VIP seating, press box, and TV booths. It is consistent with the style and construction of all other permanent buildings within the Academic Complex.

Other facilities available are: swimming pools, changing rooms, soccer fields, tennis courts, athletics track, basketball and volleyball courts, handball courts, squash courts, and athletic support facilities.

THE UNIVERSITY LIBRARY

The University Main Library is centrally located in Building 8 within a walking distance of most classrooms and laboratories. It is an "open stack" library, allowing users free access to its resources. Reading areas are provided on the first, third, and fourth floors. Six (6) reading rooms are available on the third floor for serious reading, students-teacher meetings and discussions. To encourage and maximize utilization of its resources and services, the University Library operates with minimum regulations and restrictions.

The Library's current collection totals 393,756 volumes, of which 75% is in Science and Engineering, and the remaining 25% in Humanities and Social Sciences. The library is subscribing to about 670 periodical titles (of them many titles are available in both print and e-journal formats).

The library additionally has a fine collection of electronic resources, including 43 full-text and bibliographic online databases (providing access to more than 40,000 journals, including 15,000 full-text journals). The Library also provides access to more than 35,000 e-books through e-books databases and individual subscriptions.

The library serves the whole University community and also welcomes guest users. In addition, it provides borrowing privileges and other services to local government agencies and private institutions.

Library services include:

a. Circulation of library materials

b. Reference and information services

c. Research assistance, including literature searches and online searching of bibliographic and full-text databases,

d. Multimedia services

e. Interlibrary loan and photocopy services

f. Library instruction (orientation of new faculty and preparatory year students in effective use of the library, and

g. Acquisition of new books, research reports, theses, and multimedia instructional programs to support the academic and research programs of the University.

There are two separate Internet search labs for faculty and students with over 50 workstations providing access to electronic resources through the Intranet and the Internet.

Multimedia materials and services are provided through a well equipped multimedia department. The department's present collection consists principally of CDs, DVDs, videotapes, and microforms. The Library auditorium is used by faculty and students for projection of multimedia materials, and also for seminars, lectures, short courses, theses defense, and other presentations.

The Library currently uses the Horizon library system, which has all the features of a modern library system, including client/server architecture, GUI, Internet interface, etc. With these features, users are able to perform multiple tasks from a single workstation, including access to the Internet, KFUPM Intranet and the Horizon Information Portal (HIP), a web-based catalog

INFORMATION TECHNOLOGY CENTER

The Information Technology Center (ITC) is the primary computing facility at KFUPM. It provides computing support for education, research, and administration at the University. ITC also provides services to some government and industrial agencies.

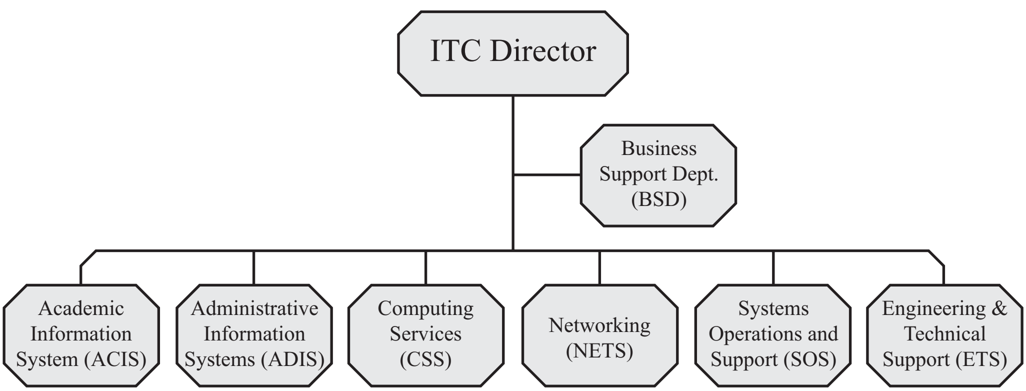
Organization of ITC

ITC consists of the following departments as shown in the figure on next page: Academic Information Systems (ACIS); Administrative Information Systems (ADIS); Computing Services Department (CSS); Networking (NETS); Systems Operations and Support (SOS) and Engineering & Technical Support (ETS). In addition Business Support Department (BSD) handles all ITC administrative & financial support services.

The CSS department at ITC serves the faculty, students, staff and the Research Institute with extensive IT consulting services and help desk support in addition to comprehensive exam generation and grading services. CSS also supports PC Labs for general-purpose, departmental and teaching use. The ETS department supports faculty, students and staff in hardware installation & maintenance, cabling services as well as training and awareness. The ADIS department maintains the University's administrative applications including ERP system (Oracle E-Business Suite modules), such as HR, Financial Management, Material Management, Medical Care, Projects, Housing, Maintenance, Book Store, Smart Cards, etc. In addition ADIS department has a software development section for developing new applications or reengineering existing administrative systems.

The NETS department is responsible for all the networking activities including infrastructure, management and IT security. The department provides Internet and Intranet services to the KFUPM community. Other services include LAN services for all academic buildings and student housing, wireless networking, ADSL network for home users inside campus, secure remote access services (RAS & VPN). NETS is also responsible for monitoring and managing all network devices which includes routers, switches, access-points, firewalls, load balancers, servers and critical services running on those servers. In addition, NETS works to secure the KFUPM IT infrastructure from inside and outside threats. Network connectivity from KFUPM and networking services within remote university sites such as. Dammam Community College and SCITECH are provided and maintained by NETS department.

The ACIS department is responsible for ERP system applications related to student information systems (SunGard Banner modules). In addition, the ACIS department provides technical support to the University Libraries and their automation systems. Other services supported by ACIS include Web, portal (SunGard SCT Luminis portal), process workflow, development of Web-based satellite application systems and document management support services. The SOS department provides systems and operational support to different operating system platforms (UNIX/AIX, Win2K & Linux on Intel in addition to HPC platform). Comprehensive technical support, design and implementation of ERP systems running on Oracle databases, for E-Business Suite, Real Application Cluster (RAC) based Banner database, data warehouse, Medicare System, etc, is provided by the SOS department. The SOS department is also responsible for administration of course management systems such as WebCT,



database management for all back-end servers, email services and Internet access authorization. SOS provides online storage through SAN & NAS disk storage management, data backup & recovery procedures and operations & management of the Business Continuity Center (BCC).

ITC Mission

ITC is committed to providing high-quality information services that foster a productive academic and research environment for students, faculty, staff, and management at KFUPM.

Towards a Technology Campus

ITC has introduced advanced technology into classrooms. Smart classrooms create new opportunities in teaching and learning by integrating networks, computers, and audio visual technologies. Currently all the university classrooms on the KFUPM campus are smart classrooms and available for faculty use. ITC has taken many steps to redefine the way information is delivered utilizing the latest computing and communication technologies. Major projects completed to support classroom teaching include Wireless Campus, University Laptop Program, ERP implementation for both administrative and academic modules, Portal implementation (single point of access to all applications) and enhanced university Website. High Performance Computing (HPC) facilities include a state-of-the-art 128-processor Linux cluster which is currently operational. In addition, smaller HPC clusters are also available to support research.

University Network

Networking facilities at KFUPM have seen exponential growth over the last five years. Computing facilities, which started with Novell-based PC labs in the early 90s, now support fiber optic Gigabit Ethernet backbone serving more than 15,000 fast-Ethernet switched network points. All faculty offices, classrooms and PC labs are connected to the network. Faculty houses and multi-story student dorms buildings are also connected to network. Wireless LAN connectivity is available to all the academic and administration buildings across the campus. The university enterprise network is logically divided into different VLANs for faculty, staff, students and wireless users in order to provide secure access. Network Services are offered through ACLs (Access Control Lists) which ensures sensitive data can be accessed only by authorized users. All faculty houses are equipped with remote access facilities (DSL and RAS connectivity). Remote Access VPN services have been introduced to KFUPM community to allow users to securely connect to KFUPM network from any where in the world using a standard Internet connection. Services provided through VPN include remote desktop connection, KFUPM email (POP & SMTP) and internal KFUPM website browsing.

General-Purpose PC Laboratories

ITC operates several general-purpose PC labs throughout the campus. These labs provide PC's for accessing the network as well as printing facilities. The locations and operation hours for each of these labs are maintained at the ITC website.

Internet and e-mail

All faculty and students at KFUPM are provided with Internet, e-mail, portal and e-business services. A faculty member or student needs a login ID and password for these services, which can be obtained from the ITC. The use of these services is expected to be in compliance with the applicable rules and regulations, provided at the time of application. Faculty members can also post their course managements requests or personal web pages. Such services can be obtained by contacting the ITC.

Departmental Support

The CSS department at ITC provides technical support to all academic department PC labs, which are mostly operated by the departments themselves. It also provides support services to faculty in using technology to support teaching and learning. Technology training is also provided to all types of users. e-Learning facilities with over 3000 standard IT courses online is also available.

University Laptop Program

ITC implemented a major component of the strategic university plan to enhance mobile computing infrastructure which also compliments the deployment of wireless network across all academic buildings. High-end laptop computers are distributed to all faculty members. Laptops and the wireless network help improve academic programs. Faculty has enhanced support for e-Learning technologies inside classrooms and elsewhere to deploy effective teaching methods and learning experiences. Programs for students to acquire laptops are also supported by ITC through Student Affairs.

User Support

The CSS staff at ITC offers a wide range of support services to faculty members. They also provide assistance to faculty members regarding hardware and software installation and support. A Help Desk to answer user queries is operated during daytime office hours. In addition, ITC offers frequent short courses, tutorials, awareness seminars and workshops on PC applications as well as general user-orientation of university computing facilities.

Online storage administration and maintenance is also provided by ITC. Each faculty/staff can get a free space of 500 MB while students can acquire 200 MB on the network-based filer storage for storing personal documents. These documents are accessible from all over the world through the Internet. ITC also provides high speed 24/7 network connectivity to faculty housing using DSL technology.

For additional information, please visit the following URL:

www.kfupm.edu.sa/itc

DEANSHIP OF ACADEMIC DEVELOPMENT

The faculty, curricula, and facilities are the key components of the academic system of any University. The effectiveness of each of these components directly influences the effectiveness of student learning. King Fahd University of Petroleum & Minerals (KFUPM) realized from the very beginning the vital importance of continuous improvement and development of its faculty, academic programs and instructional technology which forms the corner stone in the quality of its graduates. Although the University has a rigorous academic system based on the regulations of the Ministry of Higher Education, on international standards and through various academic committees at all University levels, it has always been dynamic in exploring ways and means that lead to excellence in all academic activities. The Deanship of Academic Development (DAD) has therefore been established to help the university community, particularly the faculty members, to increase their effectiveness in teaching and learning, to insure the highest quality in academic programs, and to utilize the latest technologies in teaching.

DAD was originally established as the Academic Development Center (ADC) in the year 2000, which was later promoted to a Deanship in the year 2003. The DAD creates a focal point for the emphasis on academic matters such as teaching excellence, program development, quality assurance, and e-Learning at KFUPM. It deals directly with issues related to the development of academic excellence for all faculty members through a variety of means such as workshops, discussion forums, seminars, publications, and faculty peer consultation.

Objectives

The DAD mission will be accomplished by assisting the academic departments in their pursuit of the following objectives:

1. Excellence in teaching: Enhance the teaching effectiveness of faculty and teaching assistants that provide instruction consistent with the best systems on quality teaching and learning.
2. Excellence in research: Continuous improvement of faculty development to enable faculty members to reach their highest potential in research and to progress in academic rank in a timely fashion.
3. Effective processes and methods: Enhance the effectiveness of processes and methods that are critical to teaching and research.
4. Quality assurance: Assist the departments toward the quality assurance of their academic programs and academic advising.

Activities and Services

In order to achieve its objectives, the DAD identified specific fields of interest, which are reviewed periodically according to the University's evolving plans and polices. The main areas currently under the DAD focus include:

- Faculty development to enhance teaching, learning and research productivity;
- Quality assurance of academic programs;
- Assessment of student learning;
- Self-Assessment of academic programs;
- Development of administrative skills;
- Instructional technologies;
- Development and delivery of quality online courses;

The DAD offers most of its services to the University community through its four Centers. It provides a range of academic development workshops, discussion forums and seminars in which international, national and local experts participate. The Deanship, through its Centers, sponsors activities related to teaching, research, faculty evaluation, student learning and curriculum often with a specific audience in mind, such as new faculty members, department's chairmen, and college deans. The Deanship also conducts training programs on web-based education and develops its own expertise in this direction. In addition, personal consultation is available to any faculty member to enhance his teaching.

DAD also provides financial support/ incentives through various grants to enable faculty to meet their objectives. The faculty members involved are expected to conduct studies in the various academic development areas such as faculty development; enhancement of the learning environment; technology-enhanced learning, etc.. The Deanship is keen to collaborate with members of the University community on issues that lead to academic development at KFUPM. DAD also manages a resource center, offering a range of books, newsletters, journals and multimedia references such as videotapes, CD's, slides and other materials relating to its main areas of interest, especially teaching and learning and quality-assurance related issues. In addition, the Deanship publishes the proceedings of its workshops and discussion forums, as well as pamphlets on research and practices relating to teaching, learning, assessment and evaluation. These resources can be accessed by contacting the Deanship's office.

Organization of the Deanship of Academic Development

The Deanship of Academic Development (DAD) has four centers under its patronage namely:

1. Teaching & Learning Center
2. Program Assessment Center
3. e-Learning Center
4. Testing & Evaluation Center

Each center carries out various activities in its specific domain and is headed by a Director who reports to the Dean. The Dean reports directly to the Rector of the University. A standing Committee on Academic Development comprises members from various academic departments of the university, also supports in carrying out the activities of the Deanship.

Teaching & Learning Center

KFUPM believes that every individual on campus has a right to experience personal growth and development through enriched academic opportunities. The purpose for establishing the Teaching & Learning Center (TLC) as one of the centers of the Deanship of Academic Development, is to provide such experience by promoting excellence in teaching at all ranks and excellence in student learning inside and outside the classroom. The TLC activities include workshops, mini-courses, seminars, consulting services and resources to the faculty and graduate teaching assistants to enhance teaching and learning. The TLC also administers several special programs including academic development grants.

Program Assessment Center

Continuous assessment is the key for quality assurance at the University. The aim of assessment is to understand how educational programs are working and to determine whether they are contributing to student growth and development. Program assessment focuses on programs rather than on individual students. It provides information on whether the curriculum as a whole provides students with the knowledge, skills and values that graduates should possess in accordance with its mission and set educational objectives and learning outcomes.

The new trends in accreditation criteria have brought outcome assessment to focus. Accrediting agencies such the Accreditation Board for Engineering and Technology (ABET), the Association to Advance Collegiate Schools of Business (AACSB), and the National Architectural Accrediting Board (NAAB) require programs or colleges seeking accreditation to have self-assessment. Industry push and competitive job markets have also contributed to the need for continuous program quality improvement that focus on student learning and preparation for professional practice after graduation.

The Program Assessment Center (PAC) at KFUPM strives to achieve its mission towards developing quality education that meets local industry needs following reputable international standards. It provides the necessary services and support for the various academic programs and research units at the University. It also facilitates and coordinates their efforts to meet their objectives and institutional goals.

e-Learning Center

With the new emerging information and instructional technologies and their influence on teaching and learning, it becomes a must to equip faculty members with the necessary skills to cope with these developments and utilize their benefits in teaching and learning. The e-Learning Center assists the University community in exploiting the potential of technology to enhance teaching and learning. One of the primary goals of the e-Learning Center is to promote quality self-paced, learner-centered education through the development and delivery of quality web-based courses that can be delivered completely online. Moreover, the e-Learning Center provides assistance to KFUPM faculty members to enhance teaching and learning effectiveness through the development of interactive web-based supplementary material to traditional courses as well as organizing training workshops related to the development and delivery of online material.

Testing & Evaluation Center

The Testing & Evaluation Center is a specialized resource for support and training in methods of test construction and validation, which is meant to provide further stimulus for active learning and objectives-based instruction. A significant component of the work of the Center is to study student selection procedures in order to provide reliable information to the administration for decision-making purposes on a continuous basis. The Center is determined to achieve high standards of excellence, while abiding by the rules of fairness and equity. Placement exams as well as outcome exams (exit exams) are other important components of the work of the Center. Yet another major concern for the Center is to study and evaluate faculty performance indicators.

OFFICE OF PLANNING AND QUALITY

As the University moves forward to the next chapter of its growth and evolution, it unerringly recognizes that it must improve its functional efficiencies with proactive policies and processes, and strategically align the University to seize the emerging opportunities and counteract the competitive threats. With this realism, **the Office of Planning & Quality (OPQ)** is committed to provide services to the University in three key areas: *Strategic Planning, Quality and Process Improvement, and Information and Data Management*.

Mission

The mission of the OPQ is to review, update, and, if necessary, redevelop University's strategic plan that aims to address the strategic directions of the University in Teaching and Learning, Research, and Community Service, to improve the quality of services and the processes, and to provide University decision-makers with data and information designed to improve the quality of planning and to make informed decisions.

Objectives

The objectives of the Office of Planning & Quality are:

a) to be proactively involved in all stages of strategic plan, including identification of strategic issues, review and updating of the strategic plan in place, and redevelopment of the plan as and when necessary;

b) to provide advice and support services for quality management plan through improvement in processes and controls;

c) to provide the decision-makers with data and information that are required for all aspects of planning, bench marking and quality assurance program.

ENGLISH LANGUAGE PROFICIENCY

The English Language Department (ELD) offers service courses designed to enhance students' spoken and written communication skills in English in order to prepare them for future academic and professional life. The ELD offers three undergraduate English courses Composition I: An Introduction to Academic Discourse, Composition II: Introduction to Report, and ENGL 214: Writing Academic & Professional Communication. There is also a graduate course offered by the ELD, ENGL 510, which is a thesis-writing course for graduate students intent on pursuing post-graduate studies at KFUPM.

RELIGIOUS AFFAIRS

Religion is an important part of student life, and both individual and group activities are available. Students are encouraged individually to seek the mosques on the campus for prayers and to utilize the large collection of books on Muslims thought available in the University Library. In addition, KFUPM provides special programs of group activities in the spirit of Islam. The University, for example, has a full-time Religious Advisor who is available in the student housing area for advising and counseling individuals or groups, and who supervises or directs a variety of religion-centered activities e.g.,

- Religious seminars held throughout the week.
- Meeting and study sessions after Al-Isha or Al-Fajr prayers and religious issues are discussed.
- Religious symposia and open discussions held periodically and often attended by faculty and staff members as well as students
- Lectures delivered by reputable religious scholars. These are organized by the Islamic Studies committee.

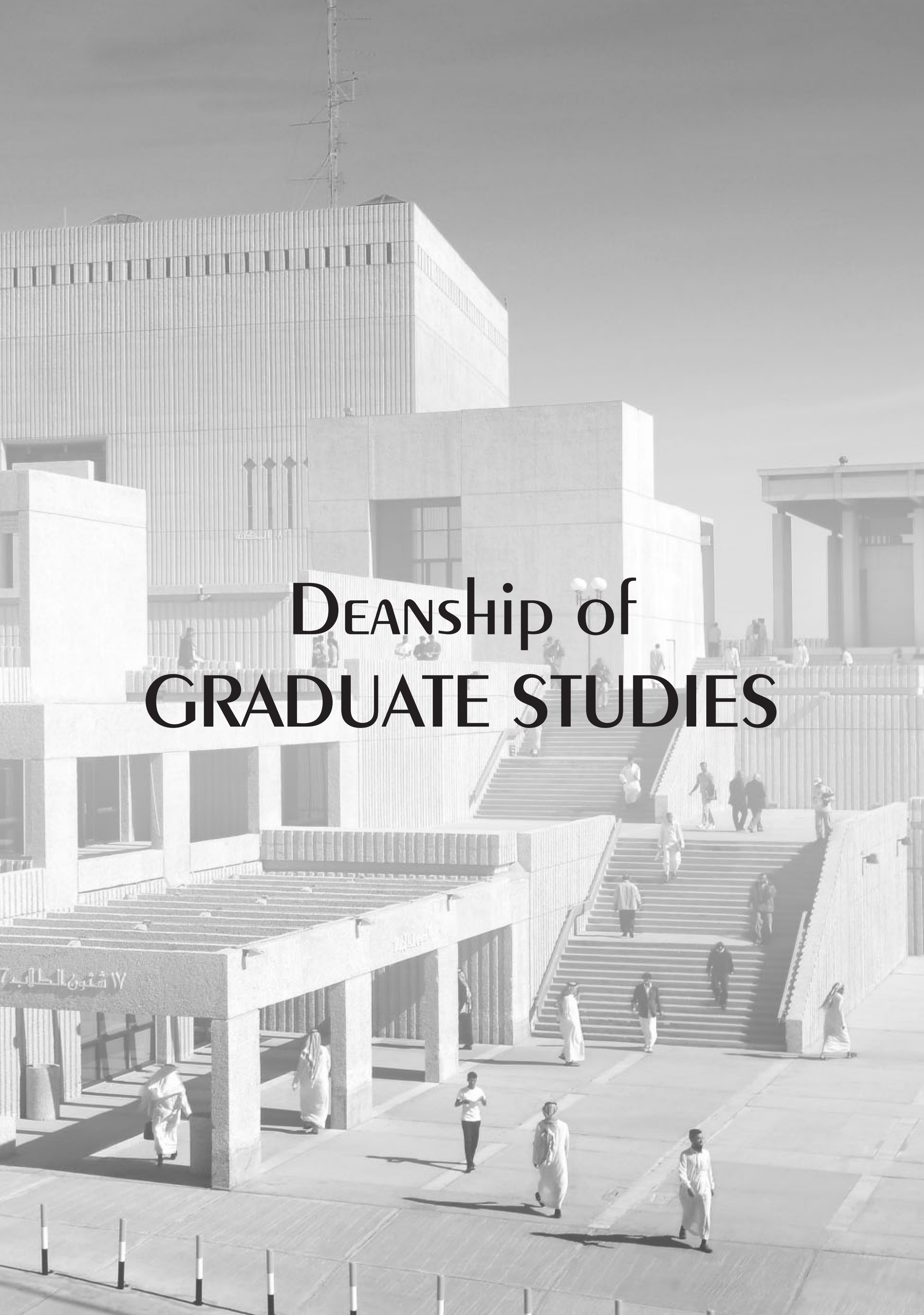
The University also schedules breaks to coincide with the periods of the Id' Al-Fitr and Id Al-Adha vacations.

GRADUATION

Upon satisfactory completion of all requirements for a degree from the University, students are invited to participate in the graduation ceremony. This colorful, time-honored university tradition, was instituted at KFUPM in 1972, and was the first such ceremony to be held at a university in Saudi Arabia.

A unique feature of the graduation ceremony is the dress worn by graduates. Designed especially for KFUPM, the gown is the Arabian *meshlah*, featuring color of the specific college from which a particular student graduates. Instead of the usual “mortarboard” cap, the KFUPM graduate wears his traditional *ghutra* and *egal*. The ceremony and the dresses are an impressive blending of academic and Arabian traditions.

Deanship of GRADUATE STUDIES



DEANSHIP OF GRADUATE STUDIES

The Deanship of Graduate Studies (DGS) is the organizational unit of the University responsible for the administration of programs, and instruction leading to graduate credit and graduate degrees. It utilizes the specialized faculty and physical facilities of the five academic colleges and draws upon other University facilities such as the Library, Information Technology Center (ITC), the Research Institute (RI), Centers of Research Excellence, Dhahran Techno-Valley (DTV) for services essential to its instruction and research programs.

Vision

To enable KFUPM be a leader in the region in providing quality graduate programs in Science, Engineering and Management.

Mission

To provide quality graduate programs according to the best international practices that will enhance the research environment at KFUPM and contribute to the dissemination of knowledge.

Goals

The goals of the Deanship of Graduate Studies are to:

I. Enhance the research environment at KFUPM.
II. Increase knowledge dissemination in the society.
III. Improve quality and efficiency of the graduate programs.
IV. Increase quality and diversity in graduate student body.
V. Increase the efficiency of the processes of the Deanship of Graduate Studies.

To achieve these goals, the University offers graduate courses, conducts research, and grants graduate degrees. Currently the Deanship of Graduate Studies offers graduate programs leading to the Doctor of Philosophy (Ph.D.), Master of Science (M.S.), Master of Engineering (M.Engg.), Master of City and Regional Planning (M.C.R.P.), Master of Accountancy (M.Acc.), and Master of Business Administration (M.B.A.). Master of Medical Physics (M.Med.Phys.), Master of Environmental Sciences (M.Env.Sci.), Master of Geosciences (M.Geos.), and Executive MBA (EMBA).

STRUCTURE OF THE DEANSHIP

- **The Dean of Graduate Studies** has primary responsibility for the academic direction and administration of the Deanship. The Dean of the Graduate Studies is assisted by the Deputy Dean, and the Graduate Council.
- **The Deputy Dean of Graduate Studies** assists the Dean in his responsibilities.
- **The Director of Admission** manages the admission office and registration for graduate students.
- **The Director of Auditing and Follow up** is responsible for all academic matters and requests related to graduate students.

The Graduate Council is composed of the following**:** The Dean of Graduate Studies (Chairman), the Dean of Scientific Research, the Deputy Dean of Graduate Studies (Deputy Chairman), and one faculty from each college offering a graduate program. This Council is charged with advising the Vice Rector for Graduate Studies & Research of the University, and through him the Rector of the University on all policies relating to the graduate studies and programs, exercising supervision over the academic requirements for all advanced degrees, and performing various other administrative duties related to the graduate programs.

ACCREDITATION

The quality of University programs is periodically appraised and monitored by independent qualified agencies from outside the Kingdom.

Assessment of Programs: King Fahd University of Petroleum & Minerals, from its inception, has taken careful steps to meet the standards required for accreditation, even where formal accreditation and evaluation were not possible. Its programs and courses of instruction have been certified as the equivalent of those which can be formally accredited. Thus 97 American universities have indicated that they will accept KFUPM students for transfer and grant transfer credits for courses similar to those which they have taken. KFUPM has been evaluated and listed by the American Association of Collegiate Registrars and Admissions Officers since 1967.

Standards: The University uses the standards of the Accreditation Board for Engineering and Technology (ABET) for professional development as the basis for all engineering programs; the American Assembly of Collegiate Schools of Business for programs in accounting, business administration and industrial management; the American Chemical, Mathematical, and Physical Societies for courses and programs leading to degrees in mathematics, and the sciences, and the Association of Computing Machinery (ACM) for programs in Computer Science. Evaluation is conducted periodically to determine adherence to such standards.

ACADEMIC SYSTEM

The Credit Hour System: The University and the Deanship of Graduate Studies are organized on a modification of the American university model, adjusted to Saudi needs. The academic year is divided into two semesters of 16 weeks each, including examination periods. A summer session of eight weeks is scheduled, with attendance voluntary or for required make-up of deficiencies.

Classes are scheduled for five days a week, Saturday through Wednesday; though certain specialized work may be scheduled during the evening or on weekends.

The basic unit for measure for the quantity of instruction is the credit hour. This unit is defined as the equivalent of one class-hour per week of formal instruction, with necessary preparation and assignments outside of class, for a standard semester. The amount of out-of-class work for graduate instruction is greater than for undergraduate, so that all course work must also be identified as "undergraduate", or "graduate." In general, 2 to 3 hours preparation outside of class is expected in undergraduate courses, and 3-4 hours outside of class per class hour, is expected in graduate courses.

The maximum full-time load for a graduate student in the Sciences and Engineering is 12 graduate credit hours per semester, not counting credit for the master's thesis. To schedule a course load greater than this, a graduate student must secure approval from his advisor, his academic department head, and the Dean of Graduate Studies. When suitable courses are available, a graduate student may register for a maximum of 6 credit hours during a summer session. Part-time graduate students are required to take a reduced course load.

- **The Grading System:** The basic unit of measure of academic quality, or achievement, in instruction is the Grade-Point System. The term "quality point" is sometimes used interchangeably with "grade-point". The University grading system for both undergraduate and graduate courses is shown in the table below.

IC grade: upon the instructor's recommendation, the council of the department which teaches the course may allow the student to complete the requirements on any course during the next term. In such an event the grade IC will be recorded for the student in his academic record.

A grade of **IC** must be removed during the regular semester immediately following that in which the grade was given, or it will automatically become a grade of **F**. Under very exceptional circumstances, the Dean of Graduate Studies may permit extension of time,

Letter Grade	Points	Grades in English
A+	4.00	Exceptional
A	3.75	Excellent
B+	3.50	Superior
B	3.00	Very Good
C+	2.50	Above Average
C	2.00	Good
D+	1.50	High-Pass
D	1.00	Pass
F	0.00	Fail
IP	-	In Progress
IC	-	Incomplete
DN	0.00	Denial
NP	-	No Grade-Pass
NF	-	No Grade-Fail
W	-	Withdrawn
WP	-	Withdrawn With Pass
WF	0.00	Withdrawn With Fail
AU	-	Audit

not to exceed one semester, for the removal of a grade of **IC**. The temporary grade of **IP** is recorded for work on the thesis or dissertation only during those semesters when the graduate students is formally registered for thesis work. When the thesis is completed and given final approval by the Deanship, the grade is changed to NP.

The AU grade will be assigned to students who attend a course as auditors without being given any grades, regardless of their performance in the course. The effect of this assignment on the student's cumulative or semester grade is the same as the grade "no-grade pass" or NP.

The scholastic index, which represents the overall performance in any selected group of courses, is a weighted average known as the Grade-Point-Average **(GPA)**. This index is found by multiplying the number of semester-credit-hours in each course by the numerical point equivalent of the grade received in that course, then adding the results for all courses being considered in the index. This sum is known as the "Total Grade-Points". When this sum has been divided by the total number of semester-credit-hours included in the courses being considered, the quotient is the weighted average known as Grade-Point-Average or GPA. This index is normally calculated to three decimal places (Example: GPA 3.475), and all University scholastic regulations assume this degree of accuracy.

The GPA index may be applied to various groups of courses. Thus, it may be applied to all the courses taken at a certain level, or in a particular subject by a single student. It may also be applied to all the courses taken by a specific group of students, etc. The GPA index is frequently employed at the University as a quantitative measure in academic evaluations.

The following are in regular use:

1. The "Semester or Term GPA" is based on all work during a particular semester;
2. The "Cumulative GPA" which is based on all academic work taken at the University, whether submitted for degree requirements or not; and
3. The "Degree GPA" which is based on all courses taken in fulfillment of a degree requirements, whether passed or not. The GPA is calculated only on work taken at KFUPM. Thus credit for work transferred from another university may be accepted to meet the total credit hours requirement for a degree but will not affect the GPA.

⌘ **Methods of Instruction:** The Deanship of Graduate Studies is based on a concept of instruction, which involves three elements.

1. Acquiring skills and mastering existing knowledge in the subject area;

2. Demonstrating proficiency in the use of these skills and knowledge in practical applications; and,
3. Discovering new techniques and new knowledge through problem solving and research.

Graduate programs are, therefore, more than merely an array of graduate courses and an extension of undergraduate work. They require an element of creativity on the part of the successful student. It is not enough to memorize, repeat, and verify the knowledge assembled by others. The graduate student must be able to use and apply the existing knowledge and, also, to discover new knowledge.

In addition to classroom lectures and standardized experiments in laboratories, familiar from undergraduate days, the graduate student will participate in seminars and in laboratory investigations where the ultimate results are not known. The culmination of these methods of instruction is the preparation of a thesis or a dissertation based upon original research applied to a carefully defined problem.

The Graduate Seminar is a method of sharing knowledge among students and faculty. The students, in turn, present their projects, discuss the problems they have encountered, and defend their conclusions. In the interplay of trained minds concerned with different but similarly directed projects, each learns from the other and from the exposition and discussion of each other's research.

⌘ **The Master's Thesis or Ph.D. Dissertation:** The preparation of a graduate thesis or dissertation involves several formal steps in the process of discovering original knowledge:

1. Identification of the problem;
2. Finding a successful procedure for tackling the problem;
3. Design of the experiment, where relevant;
4. Data collection, storage, and manipulation, where relevant;
5. Postulating and obtaining a solution;
6. Verification;
7. Writing a detailed report followed by an oral defense;
8. Defense of the thesis or dissertation.

While working on his research, the student reports his progress regularly at seminars. Upon completion, he is examined by a faculty committee. Six credit hours are assigned to the M.S. thesis. Twelve credit hours are assigned to the Ph.D. dissertation, which is expected to involve original scholarly research conducted on a full-time basis on the KFUPM campus, and under KFUPM faculty supervision.

⌘ **Thesis/Dissertation Advisor:** After consultation with the department graduate coordinator, a thesis/dissertation advisor is chosen to be the student's principal source of guidance for his thesis or dissertation preparation. It is the advisor who guides the research activities until the thesis or dissertation normally is completed and presented for final evaluation, defense, and approval. The advisor is a member of the academic department in which the student is seeking a degree and preferably be holding a rank higher than or equal to that of an Associate Professor. The professional relationship between the thesis or dissertation advisor and a graduate student is one of the most important and rewarding of all academic relationships. It frequently continues throughout the student's subsequent professional career.

- **M.S. Thesis Committee:** Following the selection of a thesis topic, with the help of his thesis advisor (chairman of the thesis committee), the student selects a thesis committee whose membership reflects the specialized professional requirements of the thesis topic. The proposed thesis committee should be then approved by the Department Graduate Committee, Department Council, the College Council and the Dean of Graduate Studies. The membership of the committee is always an odd number (at least 3), with at least one member holding a rank higher than or equal to that of an Associate Professor. An Assistant Professor can participate as a member in an M.S. thesis committee if he has at least two (2) years experience at the University, and at least two (2) journal publications. One member of the committee may be from outside the department but the advisor must be from the student's department while the co-advisor may be from another department. The decision of the committee is based on a majority vote, and the advisor and co-advisor should not comprise this majority vote. This is an ad-hoc committee which is dissolved following official approval of the student's thesis and degree. It is significant to note that the number of thesis committee members must be greater than that of the supervisors (chairman and co-chairman) and the total number of the committee members (including chairman and co-chairman) should be either three (3) or five (5) or in some special cases, seven (7).

- **Department Graduate Committee** is appointed by the chairman of each department to advise the graduate students on matters relating to graduate studies in their departments. It is composed of the department graduate coordinator and selected members of the senior faculty.

- **Department Graduate Coordinator** is appointed by the department's chairman, with the approval of the Dean of Graduate Studies, as the principal source of guidance for graduate students preparing the degree plans of studies and choosing a thesis advisor. He becomes the academic advisor of all newly admitted graduate students. He also makes sure at the beginning of the semester that the registered courses conforms to the degree plan already devised for the student. In case any courses to be taken in a semester are different from those in the degree plan, the coordinator may recommend that the student may, with the approval of the department chairman, petition to change the degree plan.

- **Degree Plan** is a list of courses that the student selects to be counted towards his degree in agreement with the approved degree plan of the corresponding program of study. All graduate students are expected to submit their approved degree plans by the end of their second semester from their enrollment in the program. The degree plan has to be approved by the student advisor, Department Chairman and the Dean of Graduate Studies.

Graduate students have to submit their degree plans in their second semester of enrolment at max.

- **Ph.D. Dissertation Committee:** Following the selection of a thesis topic, with the help of his dissertation advisor (chairman of the dissertation committee), the student (with the advice of his advisor) selects a dissertation committee whose membership reflects the specialized professional requirements of the dissertation topic. The proposed dissertation committee should be then approved by the Department Graduate Committee, the Department Council, the College Council and the Dean of Graduate Studies. The membership of the committee is always an odd number (at least 5), with members holding the rank higher than or equal to that of an associate professor. Members must be active researchers with an established research record in the candidate's field, while one may be from a related research area. At least one member of the committee must be a Professor. One member of the committee should be from outside the department or another institution but the advisor must be from the students department while the co-advisor may be from another department. The decision of the committee is based on a majority vote, although the advisor and co-advisor should not comprise this majority vote. This is an ad-hoc committee which is dissolved following official approval of the student's dissertation and degree. It is significant to note that the number of committee members must be greater than that of the supervisors (chairman and co-chairman) and the total number of the committee members (including chairman and co-chairman) should be at least five (5) and may be allowed in some special cases, to be seven (7).

More details can be found in the document: "A Guide to the Preparation and Administration of a M.S. Thesis or a Ph.D. Dissertation", available from the Deanship of Graduate Studies.

Note: The information presented in this chapter represents the implementation rules for KFUPM and it is based on the Unified Regulations for Graduate Studies document prepared by the Ministry of Higher Education. For full details of the unified regulations document, please visit the website of the Deanship of Graduate Studies at **http://www.kfupm.edu.sa/gs**

ADMISSION

ADMISSION REQUIREMENTS

The admission process involves acceptance of an application on three separate levels: university, department, and degree. Such acceptance does not normally take place at one point in time, and usually occurs at different stages in the student's academic career.

Securing departmental approval is the first step. For full-time graduate students, especially those who have taken their undergraduate degrees from KFUPM, this may often be secured at the out-set of graduate studies. Admission to the University's Graduate Studies Program with graduate status is the second step. This certifies that the student is qualified to take individual graduate courses for which he has the academic prerequisites. It does not necessarily imply that the candidate ~~is~~ qualified to follow a specific academic program nor that he meets the special qualification requirements of an individual academic department.

The third step is called "Admission to Candidacy", and consists of meeting certain formal requirements in the process of preparing for an advanced degree. Application for admission to candidacy cannot be filed until at least 50% of the semester-credit-hours in the student's approved program of study at KFUPM have been completed; it must be filed and approved at least three months before the degree is to be conferred.

It is important to note that the admission procedure is time-dependent and strictly bounded by deadlines. For a complete schedule for the submission of admission applications, please refer to the Graduate Studies Academic Calendar which can be found at DGS website:
http://**www.kfupm.edu.sa/gs/**

General University Requirements

Graduate students are subjected to the general regulations of the University, which apply to all students. In addition, various rules, which have been adopted specifically for graduate students on the recommendation of the Graduate Council and approved by the Vice-Rector for Graduate Studies are also applied.

An applicant for admission to the Graduate Studies Program must supply or arrange for the University to receive certain formal documents attesting to his good health and character, and certifying that he has graduated from a four-year university system with a bachelor's degree in a subject area which is pertinent to the graduate course offering at King Fahd University of Petroleum & Minerals, and that he has an adequate command of English, the language of instruction at KFUPM. For admission to the Ph.D. Program the applicant must hold a M.S. degree equivalent in quality and involving the same length of study duration as those granted at KFUPM. The specific documents required are cited in "Admission Procedures" (see page 55) and on the application forms. Inquiries should be directed to the Dean of Graduate Studies.

Students are admitted to the academic program and the area of specialization identified in their application. If this program differs from their previous program of study, they will be required to make up deficiencies after admission. A request for a change of academic program is required for any continuation beyond the original program requested or for a change to new program before an existing program is completed. A request for a change in program will be considered as if it were an entirely new application, subject to procedures and standards currently applicable at that time. A graduate student is eligible for one change of major during his study at an academic program.

All applicants whose credentials meet the stated minimum quantitative standards are considered for admission to Graduate Studies. The close relationship between a graduate student seeking an advanced degree and the faculty makes it necessary for a careful screening of applicants. Consideration, however, is given to the availability of facilities and to the array of professional specializations within the current graduate faculty. Priority is given to those students having the highest qualifications, with preference given to those whose previous academic record is from universities offering courses equivalent to those at KFUPM.

GRE and GMAT

Applicants to the Graduate Studies in Sciences and Engineering are normally required to take the general graduate record examination, whereas applicants to MBA are required to take the GMAT examination. KFUPM graduates with a GPA above 3.00 are exempted from the GRE requirements.

Language Requirements

The language of instruction at the University is English, and all courses in the College are in English. It is essential, therefore, that all candidates for admission demonstrate a high proficiency in this language before being admitted for graduate study. Standards and procedures for demonstrating this proficiency have been established by the Graduate Council and are administered by the Dean of Graduate Studies. The minimum scores required for admission as a Graduate Student are 520 (PBT), 190 (CBT) or 68 (IBT) for Masters and 550 (PBT), 213 (CBT) or 79 (IBT) for Doctoral programs in the TOEFL examination. Alternatively, IELTS with a band of 5.5 for Masters and 6.5 for Doctoral are considered as minimum scores accepted at the Deanship of Graduate Studies. KFUPM graduates who scored an average GPA 0f 3.00 or above in the University English Courses (ENGL 101, ENGL 102, and ENGL 214) are exempted from the TOEFL requirements.

A special English course, English 510, open to all graduate students pending for permission of the Dean of Graduate Studies with a score of 520 or better in TOEFL (or equivalent) is highly recommended for all graduate students. This course helps students prepare effective thesis proposals and theses.

Students repeating TOEFL Examination but could not secure the minimum scores required for their programs, can have the following options:

1. If the students secure a minimum of 450 (PBT) in their TOEFL Examination, they may be allowed to register for ENGL 510 Course and secure a minimum Grade of "B" or better. This has to be completed by the students by the second semester of their enrollment.
2. Otherwise, they have to repeat the TOEFL Examination until they secure the minimum scores required by their programs.

⌘ Admission Requirements for Programs Leading to a Master's Degree in Engineering, Science, or City & Regional Planning

The minimum requirements for possible admission as a regular graduate student to pursue an approved program leading to an advanced degree in engineering and science are:

1. A Bachelor's Degree in engineering or science from an institution, whose undergraduate programs are substantially equivalent in length, content, and quality to those of KFUPM, with a major in the proposed field or evidence of suitable background for entering the proposed field.
2. A Grade-Point Average (GPA) of 2.50 or higher on a scale of 4.00 or equivalent, and a GPA of 3.00 in the subject of the major field. Official transcripts and degree certificates are required for final admission.
3. Completion of TOEFL with a minimum score for MS admission of 520 (PBT), 190 (CBT) or 68 (IBT). The TOEFL score must be sent directly to the Deanship of Graduate Studies (University Code is 0868). IELTS is also accepted with a minimum score of 5.5.
4. Acceptable General Graduate Record Examination (GRE) score. The GRE score must be sent directly to the Deanship of Graduate Studies (University Code is 0868).
5. Three letters of recommendation from the faculty who taught the applicant university-level courses.
6. Satisfactorily meeting any additional departmental or university admission requirements.

Provisional Admission

An applicant whose academic credentials do not meet the minimum regular admission requirements may be admitted on a trial basis as a "provisional student", pending some provisions such as TOEFL and/or GRE scores or deficiency courses. Provisional students should clear their provisions within the first semester of their enrolment in the graduate program.

Failure to satisfy the provisions mentioned in the admission letter within the first semester will result in holding the student registration in subsequent semester until the required provisions are met.

⌘ Admission Requirements for the Master of Business Administration Program

An applicant for admission to the MBA program should have the following minimum requirements:

1. A four-year Bachelor's (B.A., B.S. or B.E.) Degree from a recognized institution (for MBA), or a Bachelor's Degree in Accounting or Business Administration with a major in Accounting from a recognized institution (for Accounting).
2. A Grade-Point Average (GPA) of at least 2.5 on a scale of 4.0 or equivalent. Official transcripts and degree certificates are required for final admission.
3. Completion of TOEFL with a minimum score for MS admission of 520 (PBT), 190 (CBT) or 68 (IBT). The TOEFL score must be sent directly to the Deanship of Graduate Studies (University Code is 0868). IELTS is also accepted with a minimum score of 5.5.
4. Completion of the Graduate Management Admission Test (GMAT) with a minimum score of 450. The GMAT scores must be sent directly to the Deanship of Graduate Studies (University Code is 0868).
5. Three letters of recommendation from the faculty who taught the applicant university-level courses.
6. At least one course in college level calculus which covers both differentiation and integration.
7. A working knowledge of computers as evidenced by at least one course in that area (e.g. data processing, programming, information systems, etc.).
8. At least one-year of full-time work experience. This requirement may be waived for graduate assistants, research assistants, and applicants with exceptional academic records.
9. Satisfactorily meeting any additional departmental or university admission requirements.

A student may be permitted to begin his studies as a Provisional Student even though he has not taken the GMAT if he provides evidence that he has initiated action to take the GMAT test during the first semester of his enrollment at KFUPM.

⌘ Executive MBA Program Admission Requirements

Applicants should possess the following minimum requirements:

1. A bachelor degree from a recognized institution of higher education with a minimum GPA of 2.5 out of 4.0

2. Satisfactorily meeting the University's language requirements i.e. a score of 520 (PBT), 190 (CBT) or 68 (IBT) in the TOEFL examination, or alternatively, IELTS with a band of 5.5 or other proof of English Language proficiency;
3. A minimum of 8 years work experience including 3 years at mid or upper level managerial positions.

Application procedures & personal interview

ALL candidates must submit an admission application to the EMBA Committee. All admission applications must be supported by:

- Three Letters of Recommendation
- A current résumé
- A letter of endorsement from the applicant's employer (if applicable) which should clearly demonstrate the employer's understanding of the demands of the program and his willingness to support the applicant's admission to the EMBA.

All applications will be evaluated and potential candidates will be invited for a personal interview. The interview is aimed at evaluating the candidate's personal attributes deemed necessary for success in the EMBA. These attributes include, among others, ambition, motivation, commitment, communication and interpersonal skills.

Admission Requirements for Doctoral Programs

With Full Standing

Applicants will be considered for admission to the Doctorate Program, provided they satisfy the following minimum requirements:

1. An M.S. degree in engineering or science from an institution whose graduate programs are equivalent to those of KFUPM, with a major in the proposed field or evidence of suitable background for entering the proposed field.
2. A minimum GPA of 3.00 on a scale of 4.00 or equivalent. Official transcripts and degree certificates are required for final admission.
3. Completion of TOEFL with a minimum score for Ph.D. admission of 550 (PBT), 213 (CBT) or 79 (IBT). The TOEFL score must be sent directly to the Deanship of Graduate Studies (University Code is 0868). IELTS is also accepted with a minimum score of 6.5.
4. Acceptable General Graduate Record Examination (GRE) score. The GRE score must be sent directly to the Deanship of Graduate Studies (University Code is 0868).
5. At least two letters of recommendation from the faculty who taught the applicant university-level courses.
6. Satisfactorily meeting any additional departmental or university admission requirements.

With Deficiencies

An applicant may be admitted with course deficiencies in any of the above degree options following departmental recommendation. However, he must complete a specified number of credits in the field of his proposed graduate study or in related fields as indicated by the department. Such credits will not be counted as part of the student's graduate program, and students are required to make up deficiencies by the end of the second semester of enrollment.

- **Preliminary Examination if Needed**

Upon the recommendation of the Department's Graduate Program Committee, a Ph.D. student may be required to take a preliminary examination which is mainly used to determine his areas of deficiency. This examination will be organized and administered by the Department Graduate Program Committee at a time no later than two semesters after enrollment. A clearly unsatisfactory performance in the preliminary examination may also form the basis for dismissal of the student from the program.

- **Special Departmental Requirements**

Besides the minimum requirements for admission to the Graduate Studies Program, individual academic departments may set additional or higher standards for certain areas of specialization. Inquiries should be directed to the Dean of Graduate Studies or to the chairman of the department concerned.

- **Classification of Admission Status**

Admission to Graduate Studies is in one of the following four categories: Regular, Provisional, Pre-Graduate, and Auditing.

"Regular Admission" is the status granted to a student who meets the minimum established admission requirements. This admission status is granted, in general, to those students who have a record of high scholarship in their major fields and show promise of excellence in graduate study, research, and professional development. As previously indicated, meeting the minimum standards does not automatically guarantee admission.

"Provisional Admission" is the status granted to a student who does not qualify for immediate admission as a regular student, but who has demonstrated professional promise. In all cases minimum admission requirements must be met. This admission status may be granted for a trial period not exceeding two semesters.

"Pre-Graduate Admission" is a special admission type in which students not eligible for Regular Admission can officially be admitted to the Pre-Graduate Program. It is mainly designed to serve the students with one of the following conditions:

1. A GPA ranging from 2.0 to less than 2.5.
2. A major background deficiency.
3. A requirement of taking English courses at KFUPM.

The details of the Pre-Graduate Program is described under the Academic Regulation section.

"Auditing Admission" is the status granted to any person to audit an undergraduate or graduate course by official action of the University. No academic credit is given while the student occupies that status nor subsequently if his status is changed. Students admitted with this status cannot take courses for credits; they can take courses as "Audit". Permission to register in courses as "Audit" is given by formal approval of the Dean of Graduate Studies. No academic credit can be earned by auditing courses. A limited number of qualified candidates may be admitted with this status. This status is limited to exceptional cases.

⌘ Admission of Undergraduates to Graduate Courses

A student having a GPA of 3.00 or higher may, with the approval of the Dean of Graduate Studies, pursue one or more graduate courses during his final undergraduate year. The total undergraduate and graduate semester-credit-hours taken in any one semester shall not exceed fifteen (15).

No duplication of credit is permitted, and no course whose credit is applied to meet the requirements for the undergraduate degree may subsequently be used to meet the course requirements of a graduate degree. Graduate courses taken in excess of the course requirements for the undergraduate degree, if suitable to the approved graduate program of the student, may be credited towards the graduate degree. Courses taken to remove a deficiency in the graduate admission prerequisites may not be credited towards an advanced degree.

Transfer with Advanced Standing

Graduate students with previous graduate academic credit from another university may request admission with advanced standing and transfer of credit towards an advanced degree in the University. A maximum of 30% registered semester-credit-hours of graduate credits may be accepted for transfer provided that after completion of these credit hours no more than four (4) years will have elapsed before the remaining credits required to fulfill the total requirements towards the advanced degree will have been completed. In addition, any such course must be relevant to the student's approved graduate program at the University, and the credits must have been earned at an institution of higher learning with academic standards equivalent to those of King Fahd University of Petroleum & Minerals. A request for such a transfer of credit will be considered by the Dean of Graduate Studies only in exceptional cases and only after such a request has first been evaluated by the departmental graduate committee concerned and approved by that department's chairman.

The student should initiate the request for transfer of credit through the Deanship of Graduate Studies and must furnish official transcripts of the academic grades from all universities where the credits have been earned.

ADMISSION PROCEDURES

Application

Complete application for admission to Graduate Studies Program must be received at least four months in advance of the registration date for the semester or term in which admission is sought. Registration dates are listed in the University's academic calendar and University website.

Prospective candidates should direct their requests for application forms and information to the Office of the Dean of the Graduate Studies not later than the first week of scheduled classes. All applicants will be notified in advance of the results of their application and, where relevant, their admission status and reporting date at the University.

Documentation

The following documents are required of all candidates for admission and should be submitted at the time of application:

1. A KFUPM Graduate Studies application form, accurately completed and signed by the applicant;
2. Official, certified transcripts of academic records from all universities where the candidate has previously taken undergraduate and graduate courses; these transcripts should also specify the undergraduate and graduate degrees granted;

   Note: The candidate should request the universities concerned to forward these transcripts directly to the Office of the Dean of Graduate Studies.

3. An official record of scores achieved in the TOEFL or IELTS;
4. An official record of the score achieved on the GMAT test (for candidates for admission to the M.Acc., M.B.A. Programs), and GRE (for M.S., M.E./Ph.D. programs in Science and Engineering);
5. Three confidential letters of recommendation attesting to the student's academic performance, character, and professional potential;
6. A Statement of Purpose, which is a one page summary outlining the student's previous research and/or practical experience; he should also indicate his academic and research interest at King Fahd University of Petroleum & Minerals and his work interest after obtaining his degree.

Special Procedures for International Applicants

Non-Saudi students should apply at least nine months prior to the beginning of the semester. They are also required to obtain a Saudi Arabian entry visa. The University assists admitted candidates with visa formalities.

- **Tuition Fees and Financial Aid**

Full-time graduate students receive stipend fellowships, including a tuition-waiver, textbooks, an air-ticket, accommodation and a subsidy on meals and basic medical-care, in accordance with the terms of their grant.

Full-Time graduate students have the chance to participate in projects funded by the university through the Deanship of Scientific Research (DSR) or in contractual research projects through the Research Institute (RI) after securing the approval of the concerned Department Chairman and the Dean of Graduate Studies. More details on such funds are available at the websites of the DSR and RI.

In addition to the cost of books, all part-time graduate or pre-graduate students pay a tuition fee. The tuition fee for part-time graduate students is SR 150 per credit hour for all programs except MBA program whose tuition fee is SR 450 per credit hour. The tuition fee for part-time pre-graduate students is SR 550 per credit hour. This tuition fee covers only tuition and the use of essential university facilities required for that instruction or research. It does not cover costs of transportation, room and board, uniforms, or specialized equipment. Students in need of supplementary financial aid should direct their requests to the Dean of Student Affairs.

⌘ Student Assistantships

Two types of assistantships are available to graduate students of exceptional professional promise.

Saudi graduate students are eligible to apply for positions as graduate assistants (master programs) or lecturers (Ph.D. programs). Since these positions are intended to develop future faculty members for the University, the appointments are normally made for an indefinite period. Ideally a student qualifying for such an appointment is expected to pursue Masters and Doctorate degree programs at KFUPM or from an a recognized international institution.

A second type of student assistantship for graduate students is available in the form of a research assistantship for master students and lectureship (Lecturer-B) for Ph.D. students. Research Assistants and Lecturers-B are expected to spend up to 50% of their time supporting teaching and research activities of the University with other 50% devoted to their respective graduate programs. Such employment offers the student a professionally rewarding experience as well as a modest stipend during graduate study.

Application for either type of appointment should be directed to the Dean of Graduate Studies for evaluation. The awards will be made upon committee recommendation by the Vice-Rector for Graduate Studies and Scientific Research.

Note: The information presented in this chapter represents the implementation rules for KFUPM and it is based on the Unified Regulations for Graduate Studies document prepared by the Ministry of Higher Education. For full details of the unified regulations document, please visit the website of the Deanship of Graduate Studies at http://**www.kfupm.edu.sa/gs**

REGISTRATION

REGISTRATION PROCESS

Formal registration of students intending to follow an approved academic program takes place during the registration day at the beginning of each semester. The registration process consists of four steps:

1. Securing career guidance in selecting an area of specialization compatible with the professional goals of the student;
2. Selection of appropriate courses for the semester or academic term which are consistent with the approved degree plan, in consultation with the student's academic advisor;
3. Adding approved selection of academic courses thru office of the University Registrar website.
4. Submitting Registration confirmation thru office of the University Registrar website completes the registration process.

For continuing graduate students, an early registration (step 2) is usually carried out in a period which is ahead of time of the particular semester.

General instructions on registration procedures are posted on the Office of the University Registrar website shortly before the date indicated in the academic calendar for registration. Students must submit registration confirmation thru Office of the University Registrar website in order to formally register for the term.

Late registration, adding new course(s), dropping courses without being noted in the permanent record, partial dropping with a grade "W" and dropping the entire semester with a grade of W, WP or WF are permitted according to the deadlines included in the academic calendar. If a student registers but fails to appear for classes, he is held responsible for all courses he has formally registered for, and appropriate grades for such courses will be made a part of his permanent academic record.

Courses for Graduate Credit

A student must be admitted to a graduate program and must register during the regular registration period in accordance with procedures prescribed by the Deanship during the regular registration period in order to receive graduate credit. Any transfer of credits earned while the student had non-degree status must be recommended by the departmental graduate committee and approved by the Dean of Graduate Studies. A maximum of nine (9) semester-credit-hours may be counted in this way.

Non-Credit Courses

If a student's previous undergraduate or graduate preparation is considered inadequate in one or more subjects of importance to his approved graduate program, certain prerequisites are normally prescribed by the academic department concerned. Such courses must be taken as early as possible in the program, preferably during the first semester or academic term after admission to the program. No graduate credit is earned by taking these courses and removing the deficiency, and the undergraduate credit-hours for such courses cannot be credited towards as advanced degree.

Transferred Credit

A maximum of 30% registered credit hours of graduate credit may be transferred from another university towards a graduate student's program at KFUPM (see "Transfer with Advanced Standing", under the Admissions section).

Registration Without Course Credit

A student working on his thesis/ dissertation or preparing for graduate examination, but not taking formal course work, must register at the regular registration period and, when appropriate, pay registration fees. This applies to a graduate student working on his thesis, whether in absentia or on campus, as well as to a student who desires to use the facilities of the University to confer or consult with his thesis advisor or other faculty members regarding any aspect of his program. Graduate students with GPA less than 3.00 are not allowed to register for M.S. Thesis or Ph.D. Dissertation.

Auditing Courses

Registration in a course for the privilege of auditing is permitted in exceptional cases (see "Classification of Admission Status", under the Admissions section). No academic credit can be earned by auditing courses. A graduate student wishing to audit a course must secure approval from the departmental graduate coordinator, the instructor of the course, and the Dean of Graduate Studies. A student cannot register for any previously audited course.

Academic Records

A permanent computer record of all academic work for each course completed is maintained at the Office of the University Registrar and this data may be drawn on in order to print an official record or transcript at any time in the future. No part of the student's academic record may be omitted for any reason as it is an official document from the Office of the University Registrar.

Prerequisite for Ph.D. 710 and M.S. 610

1. All departments offering Ph.D. programs include XXX 699 as a prerequisite for 710 be taken by Ph.D. students; for MS program, XXX 599 as prerequisite for 610.
2. The Ph.D. degree plan need not be divided by semesters but only to include the number of credit hours for the major area, minor area, electives, and free elective courses.

Masters and Ph.D. Programs

Deanship of Graduate Studies Offers Graduate programs leading to the

- Doctor of Philosophy (Ph.D.)
- Master of Science (M.Sc.)
- Master of Engineering (M. Engg.)
- Master of City & Regional Planning (M.C.R.P.)
- Master of Business Administration (M.B.A.)
- Executive Master of Business Administration (E. M.B.A.)
- Master of Accounting (M. Acct.)
- Master of Medical Physics (M. Med. Phys.)
- Master of Science in Environmental Sciences (M.Sc. Env. Sci.)
- Master of Science in Geology (M.Sc. in Geology)
- Master of Science in Geophysics (M.Sc. in Geophysics)
- Master of Geology (M. Geology)
- Master of Geophysics (M. Geophysics)

DISCIPLINES	DEGREES
▪ Accounting	M.Acct.
▪ Architectural Engineering	M.Sc., M. Engg.
▪ Business Administration	M.B.A., E.M.B.A
▪ Chemical Engineering	Ph.D., M.Sc.
▪ Chemistry	Ph.D., M.Sc.
▪ City & Regional Planning	M.C.R.P.
▪ Civil Engineering	Ph.D., M.Sc., M.Engg.
▪ Computer Engineering	M.Sc.
▪ Computer Science and Engineering	Ph.D.
▪ Computer Networks	M.Sc.
▪ Construction Engineering & Management	M.Sc., M.Engg.
▪ Electrical Engineering	Ph.D., M.Sc.
▪ Environmental Science	M.Sc.
▪ Geology	M.Sc., M. Geol.
▪ Geophysics	M.Sc., M. Geoph.
▪ Information and Computer Science	M.Sc.
▪ Mathematics	Ph.D., M.Sc.
▪ Mechanical Engineering	Ph.D., M.Sc.
▪ Medical Physics	M. Med. Phys.
▪ Petroleum Engineering	Ph.D., M.Sc.
▪ Physics	M.Sc.
▪ Systems Engineering	Ph.D., M.Sc.
▪ Telecommunication Engg.	M.Sc.

General University Requirements for Admission to Master Program

- Graduate students are subject to the general regulations of the University, which apply to all students; apart from this, all the rules and regulations which have been adopted specifically by the University Administration, will also apply.
- In addition to the regular application forms for admission and other documents, the candidate must also supply other formal documents attesting to his good health and character and also a certificate that he has graduated from a four-year university system with a bachelor degree in a subject area, which is pertinent to the graduate course offering at KFUPM.
- He must also submit his TOEFL (or IELTS) & GRE reports.

General University Requirements for Admission to Ph.D. Program

In addition to the items mentioned above, he must hold a M.S. degree equivalent in quality and involving the same length of study duration as those granted at KFUPM.

General Rules

- Students are admitted to the academic program and the area of specialization identified in their application.
- If this program differs from their previous program, they will have to take make up deficiency courses after admission.
- Any request for a change of academic program to a new program will be entertained before the existing program is completed, as if it were an entirely new application, subject to procedures and standards currently applicable at that time.

Note: The information presented in this chapter represents the implementation rules for KFUPM and it is based on the Unified Regulations for Graduate Studies document prepared by the Ministry of Higher Education. For full details of the unified regulations document, please visit the website of the Deanship of Graduate Studies at **http://www.kfupm.edu.sa/gs**

ACADEMIC REGULATIONS

GENERAL REGULATIONS

Graduate students are subject to the general rules of the University governing appropriate conduct, discipline, professional ethics, and personal integrity. They are also governed by the specific academic rules and regulations adopted by the Graduate Council. It is the personal responsibility of the individual student to know and follow these guidelines. Faculty advisors assist and advise students in planning their programs, in the preparation of their thesis/dissertation, and in their professional development, but they are not expected to relieve students of this primary responsibility.

⌘ Integrity of Scholarship and Grades

The principles of truth and honesty are recognized as fundamental to any community of scholars. King Fahd University of Petroleum & Minerals expects that both faculty and students will honor these principles and, in so doing, protect the validity of the University's academic grades and degrees, current and past. This means that all academic work will be done by the student to whom it is assigned, without unauthorized aid of any kind. Instructors, on their part, will exercise care in the planning and supervision of academic work so that honest effort will be positively encouraged.

Failure to observe these principles will be viewed with extreme seriousness. Such action will result in immediate disciplinary procedures being taken against the individual or individuals concerned.

⌘ Class Attendance

Graduate students are subject to the same rules governing class attendance, the performance of assigned tasks, and course examinations as undergraduate students at the University. Regular and punctual attendance is both a University regulation and a mark of courtesy to the instructor.

⌘ Academic Standing and Probation

A graduate student working toward an advanced degree on a "Regular" or "Provisional" status must maintain a cumulative and major GPA of 3.00 or above. Failure to attain a cumulative or major GPA of 3.00 will result in him being placed on academic probation. A graduate student will not be permitted to apply for admission to candidacy for an advanced degree while on academic probation. The status of being on academic probation must be removed by raising the cumulative and major average for all work taken to a GPA of 3.00 or higher, by the end of the semester following that in which probation was incurred. Failure of a student to do so will result in his being suspended and/or dismissed from the University.

⌘ Removal of Provisional Status

To qualify for reclassification as a regular student the graduate student must make up all admission requirements, deficiency courses and attain a GPA of

3.00 or above in his first six (6) credit hours of graduate work attempted at the University. This requirement must be met within the first semester following admission. Failure to do so will result in his being suspended/dismissed from the University.

⌘ Credit for 400-Level Courses

Under certain conditions courses carrying identification codes in the 400-level may be taken for graduate credit (towards a Master's program only). No more than two (2) courses of 400-level may be counted for credit towards the requirements of an advanced degree provided that they are permitted in the approved graduate program. Also, these two courses must be approved by the student's graduate advisor, the department chairman, and the Dean of Graduate Studies.

Grades Below 'C'

Individual course grades below C are included in computing the cumulative GPA, but they do not carry credit towards a degree, nor do they satisfy the student's graduate course requirements. With the approval of the graduate coordinator, withdrawal from courses is permitted. Such withdrawal, if it is within the first week of classes, will not appear on the student's permanent academic record; if it is within the first six weeks, a withdrawal grade will be given (see "Registration", page 60). Full-time graduate students who withdraw from all courses, or who do not maintain satisfactory progress towards a degree, may be subject to special action by the University, including possible dismissal.

⌘ Regulations for Recalculations of Graduate Students GPA

A graduate student is eligible to drop a course from his GPA calculation, if the following conditions are met: the GPA is less than 3.00; the student is graduating; and the grade of the course subject of the recalculation is C+ or below. The maximum number of credit hours for recalculation is 6 credit hours. After the recalculation, the old grade of the course must remain in his academic record (transcript) although it will not be considered in the recalculation of his GPA.

Regulations for Pre-Graduate Program

The Pre-Graduate program is designed to serve the following classes of students:

- **Type I:** Students with a GPA ranging from 2.0 to less than 2.5.
- **Type II:** Admissible graduate students with a major background deficiency.
- **Type III:** Admissible graduate students who are required to take English courses.

The following guidelines will govern the Pre-Graduate Program:

Type I:

Eligibility: Part-time MS students with GPA ranging from 2.00 to 2.49 on a scale of 4. A work experience of at least two years is required for admission in the Pre-Graduate Program.

Regulations:

1. The student file goes through the normal admission process.
2. The department should recommend a list of 3 graduate courses, with at least one of which is a core course.
3. The student is required to register the 3 courses recommended by the department within 2 semesters.
4. The tuition fee for the Pre-Graduate courses is similar to the Continuing Education (SR. 550 per credit hour + SR 200 registration fee).
5. The student will be admitted to the Graduate Program after he fulfills the following:
   a. Pass each of the 3 assigned courses with a minimum grade of B.
   b. Submits acceptable TOEFL/ IELTS & GRE/GMAT as required.
6. During the Pre-Graduate Program, the student has only one chance of re-admission provided the following:
   a. Get the approval of his department and the Deanship Graduate Studies for discontinuation of one semester.
   b. The Pre-Graduate Program should be finished within a period of 3 semesters including the dropped semester.

Type II:

Eligibility: Graduate students with major background deficiency in the intended program as recommended by the department.

Regulations:

1. The student file goes through the normal admission process.
2. Upon the recommendation of the department of major background deficiency, the DGS will admit the student in the Pre-Graduate Program.
3. The student is allowed to register only for the deficiency courses recommended by the department except in the semester in which he is finishing the deficiency courses.
4. The student will be admitted to the Graduate Program after he fulfills the following:
   a. Pass each of the deficiency courses with a minimum grade of B.
   b. Submit acceptable TOEFL & GRE/GMAT as required.

Type III:

Eligibility Graduate students who are required to take English courses (The previous study was not in English).

Regulations:

1. The student file goes through the normal admission process.

2. The Deanship of Graduate Studies will recommend a list of English courses based on the performance of the student on the English Test.
3. The student is allowed to register only for the English courses.
4. The student will be admitted to the Graduate Program after he fulfills the following:
   a. Pass each of the English courses with a minimum grade of B and/ or submits acceptable TOEFL score.
   b. Submit acceptable GRE/GMAT as required

DEGREE REQUIREMENTS

General Requirements

Advanced degree is awarded primarily in recognition of the professional development of a graduate student, rather than for completing prescribed list of courses is common with undergraduate degrees. Thus, the requirements for graduate degree are "learning oriented", rather than "teaching oriented". The graduate student is required to demonstrate competence in a series of professional requirements expected of members of his profession, and responsibility for acquiring that level of competence is primarily his own.

The Deanship of Graduate Studies has established certain check points in the process of a graduate student's professional development, and the departmental graduate coordinator and various committees advise and assist him to meet the standards required at these checkpoints. A major responsibility is that of scheduling the entire program so that it is completed in a period of time considered normal for that degree.

Degree Sequencing

The following checklists indicate the normal sequence in meeting degree requirements:

Master's Degree

1. Admission process completed, including: evaluation of transcripts, tests, if required, completed (TOEFL or IELTS, GRE, GMAT, etc.), transfer credit, if any, evaluated and approved, major selected;
2. Degree plan prepared and approved with the second semester of enrollment at maximum;
3. Thesis topic and advisor selected;
4. Student's thesis committee appointed;
5. Application for admission to candidacy filed (after completing 50% of the credit hours, must include thesis proposal*);
6. Admission to candidacy approved (at least three months before degree conferred);
7. Completion of formal course work, and grades reported to Registrar;
8. Thesis oral defense (two weeks before degree conferred);

9. Proof of completion of degree requirements;
10. Graduation and award of advanced degree.

*** Not applicable for students pursuing Master of Engineering or Master Programs that do not require a thesis.**

Ph.D. Degree

1. Admission process completed, including: evaluation of transcripts, tests, if required completed (TOEFL or IELTS, GRE, etc.); transfer credit, if any, evaluated and approved; major selected;
2. Degree plan prepared and approved with the second semester of enrollment at maximum;
3. Fulfillment of course requirements; and remedial courses; if any;
4. Dissertation topic and advisor selected;
5. Comprehensive examination passed within the fourth semester at maximum;
6. Student's dissertation committee appointed; Dissertation proposal defended in public;
7. Application for admission to candidacy filed;
8. Admission to candidacy approved;
9. Dissertation defense (two weeks before degree conferred);
10. Proof of completion of degree requirements;
11. Graduation and award of Ph.D. degree;

All candidates for advanced degrees must meet certain basic minimum requirements established by the University. In addition, the academic colleges and departments may have additional requirements for advanced degrees in certain areas of specialization. Graduate students are referred to the departmental graduate committee of their major department for details on these special requirements.

⌘ Basic Requirements for the Master's and Ph.D. Degrees

All candidates for Master and Ph.D. degrees must meet the following minimum requirements:

1. Satisfactorily complete the minimum semester-credit-hours of course work prescribed for the degree;
2. Maintain a cumulative and major GPA of 3.00 or better in all graduate work;
3. Satisfactorily remove any special conditions and meet any special requirements connected with admission or with departmental requirements;
4. Satisfactorily pass all examinations approved for the program of study;
5. If applicable, satisfactorily complete a thesis or dissertation, on an

approved topic and based on candidates original research, which has been supervised by the student's thesis or dissertation committee;

6. Maintain high standards of professional ethics and personal conduct;
7. Satisfactorily complete all special requirements of the candidate's academic college and department which are approved for that advanced degree.

Basic requirements for the master's and doctoral degrees are further elaborated in sections pertaining to individual departments (refer to "A guide to the preparation and administration of an M.S. thesis and Ph.D. dissertation").

Approval of Degree Plan

Within the limitations established by the overall requirements for an advanced degree, the graduate program is intended to be individually planned for the professional development of each graduate student. This permits a considerable degree of choice among courses. The degree plan must be submitted within the first two semesters from enrollment in the program; and must confine to the approved degree plan of the intended program. The degree plan must be reviewed by the student advisor; and approved by the Graduate Coordinator, Department Chairman and Dean of Graduate Studies. Modifications may be made later, but only when authorized and approved by the same authorities.

Admission to Candidacy

Admission to Graduate Studies does not automatically admit a graduate student to candidacy for an advanced degree. It only admits the student to the process of preparing for such a degree. Initially this implies the right to enroll in graduate courses.

Formal admission to candidacy is a step in the total process and implies that the graduate student has the intention of qualifying for the degree and has demonstrated sufficient preparation to pursue the graduate study and research required for that degree. Admission to candidacy is contingent upon the recommendation of the student's departmental graduate coordinator and the chairman of the department, and upon the approval of the Dean of Graduate Studies. This may be granted only after completion of certain formal requirements. In particular an application for admission to candidacy for all master programs may be filed after satisfactorily completing at least 50% of the semester-credit-hours of graduate credit in courses included in the student's approved degree plan of study. These credits must have been earned at King Fahd University of Petroleum and Minerals. Deficiency courses required for admission in a degree program will not be included and have no bearing upon the decision to grant admission to candidacy. Approval for this candidacy must be secured three months before the degree is conferred. Candidacy for the Ph.D. degree will only be granted after successful completion of the comprehensive examination. Candidacy for the M.S. degree will only be granted after the preparation of a satisfactory thesis proposal.

Approval of admission to candidacy will generally depend upon three factors:

1. The quality of the applicant's graduate work to date (see "General Regulations");
2. The removal of any special conditions of the academic department related to admission;
3. Formal certification by the student's major academic department that the student is well qualified to continue work toward the advanced degree and has fulfilled all requirements. Application forms and instructions may be secured from the Academic Affairs Office at the Dean of Graduate Studies or from its website.

⌘ Major and Minor Areas

The Ph.D. program as a whole must be rationally unified and all courses must contribute to an organized program of study and research. Courses must be selected from groups embracing one principal subject of concentration, called the major; and from one or two related fields, called the minor. The major field is normally co-extensive with the work of a single department or with one of the subjects under which certain programs have been formally arranged, but may involve course work in more than one department. The minor is intended to represent a coherent body of work in one or two related disciplines which are selected for their relevance to the major according to the regulations of the department concerned.

Ph.D. COMPREHENSIVE EXAMINATION

1. The student has to pass a comprehensive examination not later than the end of the second year from the student's enrolment in the Ph.D. Program.
2. The purpose of the comprehensive examination is to ensure that a student advancing to candidacy for Ph.D. degree has sufficient knowledge in his subject area that enables him to undertake Ph.D. research in his field of specialization.
3. The comprehensive examination shall have a written component, where having an oral component is left as an option to the individual departments.
4. The comprehensive examination should be on the student field of specialization (graduate level). The exam is expected to cover topics from 4-6 graduate-level courses.
5. The comprehensive examination will be administered by the Department Graduate Committee. This includes examination scheduling, nominating faculty members for examination preparation, etc.
6. The comprehensive examination is graded as a unit – pass or fail. If a student fails the comprehensive

examination, he may be allowed to take it again in the next semester. In the case of failure in the second attempt, the student will be dismissed from the program.

7. A student will be admitted to Ph.D. candidacy after he passes the comprehensive examination, in addition to other candidacy requirements.

8. The comprehensive examination is the only university required examination for Ph.D. students before the Ph.D. proposal defense. The preliminary examination is kept as an option for the individual departments to be administered for some students, as the departments consider appropriate.

⌘ Application for the Degree

Each candidate for the advanced degree must make a formal application for the degree through the Office of the Dean of Graduate Studies not later than two (2) months before the end of the semester in which requirements for the degree are expected to be completed. At this time, a preliminary review will be made to ascertain whether the candidate has completed all his requirements. Failure to make a formal application by this date will delay graduation until the following graduation convocation.

⌘ Thesis/Dissertation Requirement

A thesis or dissertation is required of all candidates for the Master of Science (M.S.) or Doctor of Philosophy (Ph.D.) degrees regardless of the area of specialization. It is not normally required of candidates for the Master of City & Regional Planning (M.C.R.P.), Master of Accountancy (M.Acc.), Master of Business Administration (M.B.A.), or Master of Engineering (M.Engg.) Degrees, which involve heavier course loads. The student's departmental graduate coordinator and the student's thesis/dissertation committee must be formally approved by the chairman of the department or program and the Dean of Graduate Studies.

The thesis or dissertation is considered as primary evidence of the student's capacity for research and independent thought and of his ability to write professionally in the language of instruction. The topic chosen for a graduate thesis or dissertation must be in the major field of the student, and must be formally approved by the student's graduate coordinator, his graduate thesis or dissertation committee, the academic department chairman, and the Dean of Graduate Studies. These approvals should be obtained as early as possible in the student's graduate program and concurrently with the establishment of his graduate thesis or dissertation committee.

Completion of the thesis or dissertation depends upon securing results from a program of independent research, not upon a predetermined amount of time involved in the research. Because research results are not predictable, it is desirable that work on the thesis or dissertation begin early in the student's graduate program. Guidance by the graduate coordinator and graduate thesis or dissertation committee on the choice of topic and the design of the research is essential to ensure that the problem selected is of manageable proportions.

Upon completion of the research, the written report of the findings must be prepared and approved. This document is often referred to as the thesis or dissertation, although the term also refers to the contents or findings of the research. This thesis or dissertation document must be prepared in conformity with the general publication regulations of the University, including correct use of the English language, and must conform to any special publication regulations established by the Deanship of Graduate Studies for thesis and dissertations. This office should be consulted regarding the manual which specifies the style that must be adopted in thesis writing.

Only in very exceptional cases may an M.S. thesis be completed in absentia, under the careful supervision of the Deanship of Graduate Studies. The professional demands upon the in absentia student are inevitably much greater than when the full resources of the University are immediately available to him. Formal written permission for in absentia thesis completion must be secure in advance from the student's graduate coordinator, his graduate thesis committee, his academic department chairman, and the Dean of Graduate Studies. Before leaving the university for research in absentia, the student must also submit and secure formal approval of his plan of research and of his proposed thesis outline from the same authorities. Periodic progress reports to the graduate coordinator are required.

Completed copies of the thesis/dissertation document must be submitted to the thesis/dissertation advisor, thesis/dissertation committee, and academic department not less than four (4) weeks prior to the date when the candidate expects to receive his degree. The student will be examined on his thesis dissertation and on the research which produced it in a public examination scheduled not less than two (2) weeks before the graduation convocation. Five (5) copies of thesis or dissertation, incorporating ten (10) CDs and any necessary revisions and corrections and formally approved by the graduate thesis or dissertation committee and the chairman of the academic department, must be submitted to the Deanship of Graduate Studies not less than ten (10) days before the graduation convocation.

⌘ Oral Thesis/Dissertation Defense

An oral defense of the M.S. degree thesis or Ph.D. dissertation is required of all candidates for a Master of Science (M.S.) or Doctor of Philosophy (Ph.D.) Degree. This defense is not normally required for the Master degrees that do not require a thesis.

The student is required, following consultation with his thesis or dissertation committee and upon securing the approval of the Dean of Graduate Studies, to arrange a time and a place for the public defense of his thesis or dissertation. A faculty representative from the Graduate Studies may attend the defense as an observer.

The oral thesis/dissertation defense covers the student's thesis or dissertation and the research involved in that study. It is conducted by the student's graduate thesis or dissertation committee. The students must secure approval from Deanship of Graduate Studies and coordinate the time of his oral defense. A written notice is sent by the department to each member of the committee and to the student, indicating the time and place of the examination. A public notice is also sent to all members of the Graduate Faculty, and university community inviting them to attend the thesis/dissertation defense. Faculty and graduate students enrolled in the University are invited to attend but not to participate in the examination. The graduate thesis or dissertation committee records its vote in closed session and formally reports its verdict to the Dean of Graduate Studies within four (4) days. Degrees will be conferred upon recommendation of the majority vote of the committee (excluding supervisor(s)). Successful completion of the examination requirement must be registered not later than ten (10) days before graduation if the student is to be awarded his degree at the Graduation Convocation. It is important to note that thesis/dissertation defense can not be scheduled during the period of final examinations, registration period and Summer semester.

A student may take this oral thesis defense only twice and upon two unsuccessful attempts, he shall be dismissed from the University.

Submission of Thesis/Dissertations

After the student has successfully defended his thesis, he is given at most one (1) semester of final preparation for submission of his thesis/dissertation.

When submitting the final thesis/dissertation for signature, the student is required to attach five (5) of original signature page for the signature of the concerned.

Four (4) volumes (hardbound), one unbound clean copy and one (1) CD copies of the thesis will be submitted to the Graduate Studies in addition to uploading the thesis files in the e-print system available at the University Library website.

Proof of Requirement Completion

Advanced degrees are officially conferred at the end of the Fall, Spring, and Summer Terms and bear that date. Formal graduation exercises are held once each year, in the Graduation Convocation at the end of the Spring Semester. Students who have fully met all requirements for graduation by the official dates of any of the three terms are considered to have been awarded the degree as of that date. All are invited to participate in the graduation exercises at the Spring Convocation, at which time the diploma for the degree is presented.

Students who complete their degrees in the Summer and Fall Terms may wish evidence of this prior to receipt their diplomas. Upon request, such students will be furnished an official document certifying that the student has completed the requirements for a specific degree and stating the date on which the degree will be conferred.

Time Limit for Degree Completion

Work pursued towards an advanced degree must be reasonably current. This is especially necessary for studies in technical fields where changes take place rapidly. To ensure this, two time limitations applied for courses and degrees will be as follows:

- All requirements for any master's degree must be completed within a period of three (3) years for Graduate/Research Assistants, four (4) years for full-time graduate students and five (5) years for part-time graduate students. However, under exceptional circumstances and upon the recommendation of the student's advisor and the concurrence of the chairman of the department concerned, a request for an extension may be considered by the Dean of Graduate Studies for not more than one additional year.
- All requirements for any full-time Ph.D. degree (also for Lecturer-B's) must be completed within period of five (5) years however, for part-time PhD students the limit is seven (7) years. Under exceptional circumstances and upon the recommendation of the student's advisor and the concurrence of the chairman of the department concerned, a request for an extension will be considered by the Deanship of Graduate Studies for not more than one additional year.
- Part-time PhD candidates must spend at least one (1) year of residency period in full-time status with a No-Objection letter from the employer after admission to candidacy.
- Credit for graduate courses taken at KFUPM or transferred from another university (see "Transfer with Advanced Standing" under the Admission section) may be applied to meet the requirements of a master's degree within four (4) years from the completion of such courses provided the other credits for the advanced degree at KFUPM have already been completed.

  Note: Part-time students enrolled in majors other than MBA, EMBA and Pre-Grad. are requested to pay tuition fees of SR 150 per credit hour. MBA and Pre-Grad. students pay SR 450 and SR 550 per credit hours respectively. However, EMBA pay SR 130,000 for the whole program.

✱ Credit Loads & Completion Time Limits

Details about minimum and maximum allowed Graduate Studies work loads are summarized in the following table:

Admission Types	Credit Hour per Semester Min - Max	Minimum Credit Hours per Year	Time Limit for Completion
Graduate/Research Assistant	6 - 12	12	4 years
Lecturer B	6 - 12	15	5 years
Full-time Graduate Student (M.S.), (M.E.)	9 - 12	18	4 years
Full-time Graduate Student (Ph.D.)	9 - 12	18	5 years
Part-time Graduate Student (M.S.), (M.E.)	3 - 6	6	5 years
Part-time Graduate Student	3 - 6	6	6 years
Part-time Graduate Student (Ph.D.)	3 - 9	9	7 years

Note

The information presented in this chapter represents the implementation rules for KFUPM and it is based on the Unified Regulations for Graduate Studies document prepared by the Ministry of Higher Education. For full details of the unified regulations document, please visit the website of the Deanship of Graduate Studies at **http://www.kfupm.edu.sa/gs**

TIME TABLES FOR GRADUATE DEGREES COMPLETION

The flow diagrams given below show a typical time tables for the completion of full-time and part-time MS degrees and full-time Ph.D. degree.

A typical degree time table for full-time MS students

Admission

↓

1st Semester
- Register 2-3 courses

↓

2nd Semester
- Register 2-3 courses
- Submit degree plan
- Select thesis advisor
- Select preliminary thesis topic

↓

3rd Semester
- Register 2-3 courses
- Select thesis committee
- Submit thesis proposal

↓

4th Semester
- Thesis defense and degree completion

A typical degree time table for part-time MS students

Admission

↓

1st Semester
- Register 2 courses

↓

2nd Semester
- Register 2 courses
- Submit degree plan

↓

3rd Semester
- Register 2 courses
- Select thesis advisor
- Select preliminary thesis topic

↓

4th Semester
- Register 2 courses
- Select thesis committee
- Submit thesis proposal

↓

5th Semester
- Work on thesis

↓

6th Semester
- Thesis defense and degree completion

A typical degree time table for full-time Ph.D. students

Admission

↓

1st Semester
- Register 2-3 courses

↓

2nd Semester
- Register 2-3 courses

↓

3rd Semester
- Register 2-3 courses

↓

4th Semester
- Register 2-3 courses
- Pass Comprehensive Exam
- Select dissertation supervisor
- Select preliminary dissertation topic

↓

5th Semester
- Work on dissertation proposal

↓

6th Semester
- Select dissertation committee
- Submit and defend the dissertation proposal

↓

7th Semester
- Work on dissertation

↓

8th Semester
- Dissertation defense and degree completion


POWDER

RESEARCH SUPPORTING UNITS

INTRODUCTION

All graduate students join the Deanship of Graduate Studies and enroll in the graduate programs operated originally in the KFUPM academic departments. Academic departments host a large number of research facilities in all areas. However, faculty members involved in the graduate programs and their graduate students can benefit from all research facilities and research avenues available in various research units at KFUPM. These research units are administered by three Vice Rectors, namely, Vice Rector for Scientific Research, Vice Rector for Applied Research, and Vice Rector for Technology Development and Industrial Relations. A brief description of the functionality of the units under these Vice Rectorships is given below.

VICE RECTOR FOR GRADUATE STUDIES & SCIENTIFIC RESEARCH

The units administered by VRSR include the Deanship of Scientific Research and the academic departments.

The Deanship of Scientific Research

Introduction

The Deanship of Scientific Research (DSR) at King Fahd University of Petroleum & Minerals (KFUPM) was originally established as part of the Deanship of Graduate Studies in the year 2000, and then became an independent Deanship in September, 2005. The DSR is responsible for the planning, management, promotion and support of research activities that are carried out by the academic departments through internal and external funding. The Deanship is managed by the Dean of Scientific Research. The functional responsibilities of DSR include research activities such as funded research projects, professional conference attendance, sabbatical leaves, release time, research scholarship programs and research awards. In addition, the Deanship manages a central workshop that serves research needs of KFUPM faculty. The Deanship plans and manages research and other scholarly activities through the Scientific Research Council, the Research Committee, the Arabic Research Committee and the Conference Committee.

The Scientific Research Council is a regulatory body chaired by the Dean of Scientific Research and the members are selected from various academic departments. The Research Committee is an executive body composed of 11 members that represent the different University Colleges and the Research Institute. The Arabic research committee concentrates on the review and support of Arabic book authoring and translation in addition to Arabic research projects and studies. The Conference Committee is dedicated to the evaluation of applications submitted by faculty to attend regional and international scientific and professional conferences and meetings. All committees are chaired by the Dean of Scientific Research with members selected/elected from the different academic departments of the University.

Research Grants

The Deanship of Scientific Research provides support grants for research in all areas of science, engineering, environmental design and management with the aim of promoting productive research and creative scholarship. This support includes:

(*i*) monthly compensation for faculty, graduate students and technicians contributing to the project,

(*ii*) per diem support to attend internationally recognized conferences to present papers,

(*iii*) purchase of equipment, stationary and all expendable items,

(*iv*) reimbursement of costs related to stationery and miscellaneous items and

(*v*) sabbatical and summer scholars programs support.

All proposals are evaluated by two to three international reviewers selected by the University Research Committee from well known experts in the fields of the proponents. The final decision either to accept or reject the proposal is based upon the reviewers' evaluation of the proposal and a formal presentation. Research grants include *Internal Project Grants, SABIC and Fast Track Grants, Junior Faculty Grants, Societal Grants, Book-Writing Grants, Sabbatical Leave Grant.* Grants details and submission guidelines and forms are available at the Deanship website:

http://www.kfupm.edu.sa/dsr

Conference Attendance Support

The University encourages and supports its faculty members to participate in "high-quality" conferences and professional meetings sponsored by leading professional societies and held both regionally and abroad. Attending such conferences or meetings permits a free exchange of new ideas, concepts and developments, and enables the faculty member to develop and execute his own research, and the University to be recognized as a center of academic excellence.

A faculty member may apply for a travel grant to attend a conference provided he meets any of these criteria:

(*i*) attending a conference to present a paper,

(*ii*) attending a conference on the basis of a published paper, (*iii*) attending a conference based on invitation, or

(*iv*) attending a conference based on an approved research or book writing project.

Faculty can be supported to attend as many as three conferences a year. Graduate students can be supported to attend one international conference per academic year based on the preceding criteria. Conference attendance support details and submission guidelines and forms are available at the Deanship website: **http://www.kfupm.edu.sa/dsr**

International Scholar Programs

Two major scholar programs are open to Saudi faculty from all the universities within the Kingdom. A brief description of both programs is presented in the following paragraphs.

The British Council Summer Research Program is a Post-Doctoral research program designed to encourage Saudi faculty members to execute their research projects in British universities. The program carries a fixed financial grant by the British Council in addition to financial support from KFUPM.

The Fulbright Scholarship Program, which is jointly funded by the University and the United States Information Service, is also a Post-Doctoral research grant designed to encourage Saudi faculty members to execute their research projects in reputable US universities. The grant includes financial support for a limited number of Saudi faculty members to spend between three months and one year in host institutions in the U.S.A. The scope of research includes a wide range of subjects in the fields of science and engineering.

Research Awards

In recognition of active and quality researchers, the Deanship of Scientific Research awards a number of awards University-wide which includes the Distinguished University Professorship Award, Distinguished Researcher Award, and Best Research Project Award.

The Central Research Workshop

The DSR manages a central research workshop that is capable of fabricating and fixing research equipment and instruments for research projects. The workshop has machining, assembly and instrumentation capabilities that can be utilized by all KFUPM faculty and students to support their research needs.

VICE RECTOR FOR APPLIED RESEARCH

The research units administered by VRAR include the Research Institute and the Research Excellence Centers.

THE RESEARCH INSTITUTE

Research at the university can be classified into personal, sponsored, and client-funded. The first two categories involve faculty members who may follow their personal interest or participate in research sponsored by the university or other funding agencies. Client-funded research is administered by the Vice Rector for Applied Research and involves academic departments and the Research Institute (RI). The RI is the focus of client-funded research at the university and its full time researchers together with faculty members with the appropriate expertise form teams to undertake research projects. Graduate students participate in suitable projects and RI research faculty serve on thesis committees from time to time.

The mission of the RI is "to serve the nation by conducting client-driven research and development utilizing university resources." Among its objectives are: serve the nation as a professional problem solver; adapt imported technologies to the Saudi environment; serve the needs of government organizations, local industry, and businesses for research and development; develop local expertise and extend the Kingdom's knowledge base; support graduate and undergraduate programs at KFUPM; and contribute to the high quality education and training of students.

The first step in the process of client-funded research is often a technical memorandum submitted to prospective client(s) describing the university's applied research capabilities. In other cases, an organization may approach the RI to seek help in dealing with a problem it is facing. Alternatively, the RI may receive a request for proposal (RFP) to quote and undertake particular applied research work. The response in all cases will be a proposal describing the approach, scope, duration, and cost, with milestones and deliverables.

Clients normally contract the RI for very specific studies. A project team is formed consisting of faculty members of appropriate background and experience together with selected RI full time researchers. This arrangement reflects the manpower pool for applied research consisting of RI professionals and faculty members. As mentioned, students participate in suitable projects.

The technical expertise for applied research available in the RI is focused in the following main units:

- Center for Communications & Information Technology: Communications and Information Technology.
- Center for Economics & Management Systems: Business Incubators, Economic Studies, and Management & Quality Control.

- Center for Engineering Research: Materials, Urban Areas Engineering, Engineering Analysis, Energy Systems, Material Characterization Laboratory, and Metrology Standards Laboratory.
- Center for Environment & Water: Water, Environment, and Marine Studies.
- Center for Petroleum & Minerals: Petroleum & Gas Engineering, Petroleum Geology & Geophysics, Minerals Resources, and Remote Sensing.
- Center for Refining & Petrochemicals: Refining, Petrochemicals, and Petrochemical Products Development.
- Applied research support for the whole university is provided by the Research and Innovation Support Office, and the Support Services Office.

The activities encompassed by the RI include:

- Studies in the areas of communications, computers, and information technology;
- Management organization, economic forecasting and database development;
- Studies related to mechanical, civil, and electrical engineering such as corrosion, traffic, pavement, electric power, simulation of engineering systems, and materials characterization;
- Atmospheric pollution monitoring, landfill waste disposal and groundwater quality, marine pollution, and water resources and irrigation system analysis and modeling;
- Optimization of production of oil and gas via appropriate drilling and extraction techniques, maximization of knowledge of oil and gas bearing stratigraphy, enhancement of oil exploration through remote sensing, and mineral resource studies;
- Development and improvement of catalysts, processes, and products. Improvement of polymer production processes, enhancement of use of polymers and plastics.

Typically some 50 client-funded projects are active at any time, and about 100 project reports produced annually. Many hundreds of laboratory services are completed each year, and the number of clients served in a year is about 150. In addition, RI researchers produce over 100 publications in the open literature annually. Several patents have been generated and others are in process.

The manpower of the RI as of June 30, 2008 were 213 full-time and part-time (faculty, staff, and students) of which 102 were faculty and researchers, 86 were full-time support staff, 14 were project staff, and 11 were students.

CENTERS OF RESEARCH EXCELLENCE

Center of Research Excellence in Petroleum Refining and Petrochemicals (CORE-PRP)

The Center of Research Excellence in Petroleum Refining and Petrochemicals (CoRE-PRP) was established in February 4, 2007.

Mission

Conduct patentable, technology developmental basic and applied research in petroleum refining, petrochemicals, catalysis, and polymer science and technology which verily make the essential constituents of the strategic and major areas of research concentration for Saudi Arabia.

Vision

Achieve, preferably in five years, such a research level that will increasingly attract the concerned national and international industries, and especially draw talents worldwide for quality graduate and post-graduate education and training.

Objectives

- Establish and grow highly focused research programs that will generate novel concepts and intellectual properties, leading to produce higher value-added and improved products, and reduce production costs.
- Broaden undergraduate and graduate education in the areas of the center's research concentration, providing a strong workforce base and more highly skilled manpower for the local refining, petrochemical, and polymer industries.
- Enhance international competitiveness of Saudi Arabian refining, petrochemicals, and polymer industries.
- Promote cooperation and efficiencies in research by strengthening domestic and international research linkages, and particularly by significantly increasing the current industrial affiliations.

Specific Focused Research Topics

Petroleum Refining

- Clean transportation fuels: Removal of sulfur, aromatics, and olefins
- Fluid catalytic cracking (FCC): Development of additives and formulations for FCC catalysts
- Heavy residual upgrading

Petrochemicals

- Benzene, toluene, and xylene (BTX) aromatics
- Selective oxidation of lower alkanes
- Reaction kinetic and process simulation
- Process synthesis and control

Polymers

- Polyolefin research: Polyolefin synthesis and production
- Novel supports (nano-support and polymeric support) and catalysts
- Additives/formulations
- Nanocomposites/blends
- Plastics recycling
- Polyolefin processing
- Development of models capable of predicting the end-product properties
- Identification and solution of problems facing the local plastics industries
- Polyolefin end-products performance evaluation

Center of Research Excellence in Nanotechnology

Center of Excellence in Nanotechnology (CENT) was established in 2007 with a generous support from the Custodian of the Two Holy Mosques King Abdullah Ibn Abdulaziz Al-Saud. CENT is meant to be the platform through which KFUPM shall develop a Nanotechnology Program that enables its scientists and faculty members to carry out Nanoscience and Nanotechnology based research in areas of strategic importance for the Kingdom. CENT will also support the same through teaching at KFUPM.

CENT aims at building world class research capacity including highly qualified scientists and staff in the field of nanomaterials synthesis and their applications. CENT accesses state-of-the-art facilities including TEM, FE-SEM, AFM/STM, RF Sputtering system, CVD and PVD reactors, lasers, and more. CENT is committed to developing innovative nanotechnology-based solutions in strategic areas for the Kingdom such as water purification, petrochemicals, renewable energy and corrosion.

Objectives of CENT include:

1. To build a world class research capacity including highly qualified scientists and staff in the field of nanomaterials synthesis and their applications.
2. To develop a research infrastructure including state of the art facilities that enables the Center to achieve its goals.

3. To develop innovative nanotechnology-based solutions in strategic areas for the Kingdom such as water purification, petrochemicals, renewable energy and corrosion.
4. To contribute to the development of teaching graduate programs and training students in the field of nanotechnology.
5. To promote public awareness regarding the benefits and the risks of nanotechnology.

The graduate program in nanotechnology is also being co-developed by CENT.

Center of Research Excellence in Renewable Energy

The Center of Research Excellence in Renewable Energy (CoRE-RE) at KFUPM is created under the vision statement "***Empower the Kingdom to continue as the world energy leader***". It is Saudi national center on renewable energy. It aspires to prepare the Kingdom for the fast approaching hydrogen and methanol economies and help harnessing solar and wind energies.

The center aims at conducting R&D activities at the cutting edge of the technologies, facilitate technology transfer, help advancement and dissemination of knowledge, provide training, create awareness of renewable energy, strengthen graduate research and help nucleating industries at national and international levels.

The center has five branches, namely,

- Hydrogen, methanol and fuel cell
- Solar and wind energy
- Advanced energy storage system
- Electrical infrastructure and control systems
- Economics of the renewable energy

Center of Research Excellence in Corrosion

Introduction

The impact of corrosion on industry in terms of safety, cost and reliable provision of services is undeniable. Likewise, potential costs of corrosion to the environment and society as a whole can be enormous. Due to this reason, corrosion mitigation has been increasingly perceived as one of the priority areas in the Kingdom of Saudi Arabia. The Center of Research Excellence in Corrosion (CoRE-C) was established at King Fahd University of Petroleum and Minerals to advance research in this field for the benefit of academic institutions and industry alike and form a nucleus for deriving a working strategy to combat corrosion to serve both short- and long-term needs of the Kingdom.

The Center of Research Excellence in Corrosion has substantive ties with academic institutions and industries within the Kingdom and other countries. The Center, in collaboration with the government and industrial sector, formulates research programs that cater to the local needs. It will also develop strategies to define, improve, measure and monitor the quality of corrosion research programs in the Kingdom. It would act as a platform to invite world leaders in the field of corrosion to transfer latest knowledge and develop collaboration with professionals in the Kingdom. It will provide support for the development and use of new technologies.

Vision

The vision of the Center is to advance research in the field of corrosion with the ultimate aim of developing solutions and facilities for mitigating related problems in the Kingdom of Saudi Arabia.

Mission

The mission of the center is as follows:

- To utilize the available pool of human resources and facilities in conducting basic and applied research in corrosion consistent with the requirements of the Kingdom of Saudi Arabia.
- Develop a strategy to combat corrosion and reduce its effect on the environment, industry and civil society.
- Provide nationwide support to the industry in solving the corrosion problems from its state-of-the-art corrosion laboratories.
- Share knowledge on corrosion prevention with other organizations in the Kingdom.
- Build critical technological and information resources.
- Support the development of creative and innovative activities in the area of corrosion prevention and monitoring.
- Define strategies to improve, implement and monitor the quality of corrosion research in the Kingdom.

Center of Research Excellence for Scientific Research Cooperation with Massachusetts Institute of Technology

The Mechanical Engineering Department at Massachusetts Institute of Technology and the Mechanical Engineering Department at King Fahd University of Petroleum and Minerals agreed to form a seven year joint collaboration in research and educational programs. The collaboration agreement is composed of two main components: research programs and education. Faculty and students involved in this collaboration, from both institutions, will conduct research and develop academic programs through projects in areas of strategic importance to Saudi Arabia and to disseminate knowledge, and transfer technologies for tackling problems associated with the progress of knowledge based economy. In addition, an applied aspect of this effort will focus on solving current problems facing today's industry. The education component allows for an exchange of students and faculty to improve teaching and enhance academic programs.

Collaboration Programs

The center will focus on three areas for research and education.

1. Clean Water
2. Clean Energy
3. Design, Manufacturing and Nano-technology.

The research projects in each program will lead to a better understanding of the fundamentals/basic knowledge which will address questions concerning the related technologies including the development of tools for innovative new technology development.

The education component of the center aims to develop new multidisciplinary courses at KFUPM also and will involve faculty and students from both KFUPM and MIT conducting joint educational projects. It will include the opportunity for graduate students to be advised by faculty from both institutions; allow for the exchange of students and faculty.

The Office of Cooperation with King Abdullah University of Science and Technology

KFUPM and King Abdullah University of Science and Technology (KAUST) share an appreciation for the value of research, graduate education, and technology development in fundamental and applied science and engineering. With this in mind, the Office of Cooperation with King Abdullah University of Science and Technology was established in November 2008.

The mission of this office is to establish collaboration avenues between KFUPM and KAUST that help improve the standing, research, and academic functions of both universities. The initial areas of cooperation will include:

1. Joint research, including collaborations that involve other partners on research of common interest.
2. Faculty visits, exchange, and sabbatical leaves
3. Graduate students' supervision
4. Research facilities sharing.

The office is actively working on bringing cooperation in these areas into its full potential and is exploring other areas of cooperation.

VICE RECTOR FOR TECHNOLOGY DEVELOPMENT AND INDUSTRIAL RELATIONS

The research units administered by VRTDIR comprise Dhahran Techno-Valley and its associated units.

Dhahran Techno-Valley

The Dhahran Technology-Valley (DTV) is a major undertaking that is initiated by King Fahd University of Petroleum & Minerals (KFUPM) during the year 2006. It is envisioned to be Middle East's most prestigious, industrial research and development (R&D) and technology nucleus. The valley also provides development, production, and marketing support services for innovation that originates from academic research, but under business environment. It is being set up to provide infrastructure for industrial R&D to flourish in the Kingdom. It will mainly consist of six entities, namely:

1. King Abdullah Bin Abdulaziz Science Park (KASP)
2. Sultan Bin Abdulaziz Science and Technology Center (SciTech)
3. Innovation Center
4. Technical and Business Incubator
5. Liaison Office
6. Consultancy Services Center (CSC)

Mission of DTV is to provide total business environments that inspire people to excel and make available a focal point for industrial R&D and technical innovation in the Kingdom and the region in general. It is designed similar to the leading international facilities at Singapore, Hong Kong, Cambridge, Oxford, Aston, Warwick, Cambridge, Aberdeen, St. Louis, Purdue, North Carolina and Silicon Valley.

Flourishing landscaped surroundings will create the ideal ambience and environment where innovations transform into successful business ventures. It is expected that value-added services plus recreational activities will add to the vibrancy and networking amongst tenants in the valley community. Simply, it could be said that DTV has ***"a local mission with a global vision"***.

Major corporations such as Schlumberger, USA, Intel Corp., USA, Yokogawa, Japan, Aker Solutions, Norway, and others share such mutually beneficial relationships with DTV. Academia support from KFUPM will serve as a catalyst in this R&D bee hive. Other leading technological and scientific institutions in the area can also be fully utilized.

Objectives of Dhahran Techno-Valley

- Commercialization of research, both in terms of focusing the university's endeavors towards commercially feasible areas of study as well as minimizing the transition period between technological innovation and its commercial deployment.
- Presenting the Kingdom to the international community as a significant player in high-end research and innovation programs.
- Providing a strong point of presence for major international companies and enterprises; thereby channeling world-class technology and practice into local and regional businesses.
- Providing incubator programs to promote emerging small-businesses and enterprises with the much-needed technical, financial and administrative support.
- Utilizing the industrial presence for the benefit of students, thereby providing
- Generating employment opportunities for students during their course of study and upon graduation, and thus contributing to these business enterprises.

Expected Role of Commercial Companies at DTV

The role of the valley should go beyond that of day-to-day operation of the companies, in terms of strategic issues dealing with oil production, economics, energy water and environment, and most importantly address technical and socio-economic problems of our societies. One can cite examples of giant companies like, Microsoft, Intel, GM, General Electric, Shell Oil Companies which are dealing not only with their core businesses, but are also spending a significant amount of R&D money in the areas not directly relevant to their main activities. For example, these companies are extensively spending R&D resources for areas such as education, health care, energy and environment, etc.

We in the Kingdom need to further move from consumer-oriented society to the society that care more towards Quality Education and R&D culture to tackle issues related to Water, Energy and Environment. We have to encourage local small-scale industry to be more competitive in an international competitive environment especially after becoming a member in WTO. A sense of responsibility needs to be created in our future generation to develop professionally to meet the emerging challenges of our society.

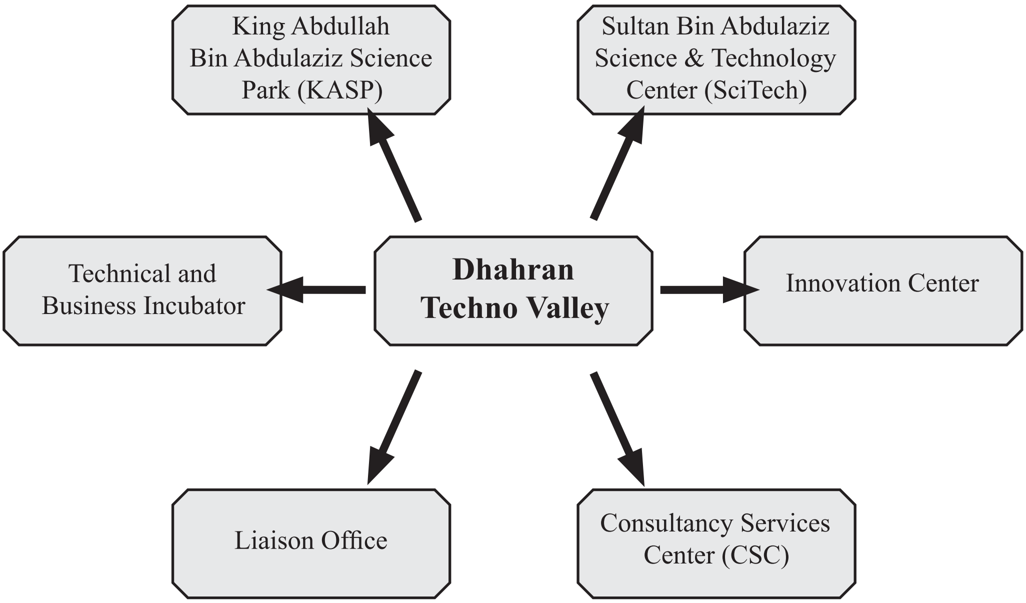
R&D spending is essential for the development of new innovative technologies, which in turn leads to greater productivity and economic success. Looking at the current situation and level of R&D support can give an accurate assessment on the expected future outcomes. Organization of Economic Cooperation and Development (OECD) countries spend on average about 2.0% of their GDP on R&D. The developed countries spend much more. For example, Korea spends 2.7%, the US spends 2.9% and Japan 3.5% of their GDP on R&D activities. This is in sharp contrast with the R&D expenditure in the Arab countries which ranges from 0.05 to 0.40% of their GDP.

Major national companies have a pivotal role to play in order to meet the forthcoming challenges of our societal issues dealing with both technological and socio-economic problems. It is pleasing to realize the awareness and willingness of the leaders of these companies toward supporting R&D activities in the Kingdom.

This awareness and support; which is sometimes vividly expressed in the strategic plans of these companies; is the driving force that would help DTV reaches its objectives and impact on the national economy. KFUPM is also committed to fulfilling its duties. Fostering a strategic alliance with the industry is a prerequisite for this endeavor. DTV is a major challenge that the university has undertaken. We are confident that our leaders in the industrial sector are in agreement with us on this issue. Together we can move forward in developing a science and technology base society. Together we can be more effective and successful in shaping our future.

Dhahran Techno-Valley — *A Local Mission With A Global Vision*

Dhahran Techno-Valley Divisions



Companies at DTV:

Partners & Tenants:

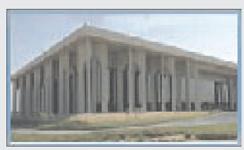
Schlumberger, USA
Yokogawa, Japan
Ingenia Polymers, USA
Inter Corp, USA
Arabian Fuel Tech, SA
Naizek, SA
MSSAK, SA
Al-Malaz Group, SA
Futureware Techn., SA
Aker Kaverner, Norway

Intel Lab

In-Line:

Saudi Aramco, SA (3 Centers)
Halliburton
TENARIS
GE, USA
Amiantite, SA
Microsoft, USA
In-Q-Tel, USA
Total Petrochemicals, France
Power well services, SA
Teclusion, SA
Alzahid Group, SA
Alturki Group, SA
Gilanis, USA
Euroconsultants Greece

Schlumberger Building



Yokogawa Building
(Under Construction)

College of COMPUTER SCIENCES & ENGINEERING

51
SAUDI TELECOM
SAUDI TELECOM
50
44

COMPUTER ENGINEERING

Chairman

Adnan Abdul-Aziz Gutub

Professors

Abdel-Aal, Radwan

Mohammed, Sadiq

Al-Mouhamed, Mayez

Associate Professor

Amin, Alaaeldin

Gutub, Adnan Abdul-Aziz

Assistant Professors

AbuAmara, Marwan	Al-Madani, Basem
Baroudi, Uthman	Al-Mulhem, Ahmad
Bouhraoua, AbdulHafid	Al-Najjar, Atef
Al-Kharobi, Talal	Elrabaa, Muhammad
El-Maleh, Aiman	Sqalli, Mohammed
Mahmoud, Ashraf	Sheltami, Tarek
Mudawar, Mohamed	Al-Yamani, Ahmad

Adjunct Professors

Abd-El-Barr, Mostafa, Kuwait University, Kuwait

El-Shaer, Ehab, DePaul University, USA

Lecturers

Adiche, Hakim	Raad, Muhammad
Chenaoua, Kamal	Selmi, Hazem
Garba, Isa	Sarif, Bambang
Hassan, Masudul	

GRADUATE PROGRAMS IN COMPUTER ENGINEERING

The Department of Computer Engineering offers two M.S. programs, namely, M.S. in Computer Engineering and M.S. in Computer Networks. Details of these programs are given below. The Department offers a Ph.D. program also in collaboration with the Information & Computer Science Department. The details of this Ph.D. program are given under the ICS Department.

M.S. PROGRAM IN COMPUTER ENGINEERING

INTRODUCTION

The increased interaction between computing and communication in recent years is changing the landscape of computer engineering. There is now an obvious shift in the role of computers from that of only computation to that of manipulation and communication of information. Computer networks and communications have revolutionized the way many industries conduct their business over cyberspace. We are truly witnessing major moves into the information society.

This shift brings with it new opportunities, but also new challenges. One of the main challenges is that computer engineering now covers a wide range of multidisciplinary topics, such as computer networks and communication, VLSI, hardware and software co-design, distributed and real time system design, data as well as multimedia communication, wireless networks and supercomputers.

The envisioned role of computer engineering is to study, analyze and utilize the interaction between its fast changing disciplines; hardware, software, and application domains. It is this fact that really differentiates the fast growing Computer Engineering field from the field of Electrical Engineering and that of Computer Science.

PROGRAM REQUIREMENT AND PLAN

The Computer Engineering MS program has three main elements. The first is the core courses, which establish the necessary common competence level for all students. The core courses are designed to equip students with sufficient knowledge to embark on a more in-depth study of any specific aspect of computer engineering. The second is the elective courses, which build upon the core. Students choose three COE electives in addition to two technical electives to further broaden their horizon in graduate level courses (in COE, or related disciplines). The third component of the curriculum is the thesis.

A typical program plan will take two years to be completed by a full-time student. The plan calls for at least one full semester to be dedicated to the thesis research work

Requirement of the MS Program in Computer Engineering

Number of Program Credit Hours	24
Number of Thesis Credit Hours	6
Core Courses	Three COE Core Courses COE 501: Computer Architecture COE 540: Computer Networks COE 561: Digital System Design and Synthesis
COE Electives	Three COE Electives from the Graduate Computer Engineering Course list
Technical Electives	Two Graduate-Level Technical Elective Courses
Seminar	COE 599: Seminar

Curriculum Design

Graduate COE courses have been grouped into the following four Computer Engineering areas

- ❑ Computer Architecture, and Parallel & Distributed Computing
- ❑ VLSI, Digital Systems Design & Automation
- ❑ Computer Networks
- ❑ Computer Systems and Applications

To ensure breadth of coverage, students are required to take three core courses one from each of the first three major areas: COE 501 Computer Architecture, COE 540 Computer Networks, and COE 561 Digital Systems Design and Synthesis. These courses cover, at an advanced level, the underlying key aspects of the above-identified major COE areas.

Students enrolled in the program must also satisfactorily pass three COE elective courses. Students may select these courses from course lists of the above four COE areas.

Students are also required to pass two other elective courses that may be chosen from outside the COE department according to the approved degree plan.

ACADEMIC PROGRAM

All candidates for the MS degree in Computer Engineering must satisfy the overall requirements of KFUPM in addition to the following:

1 All students enrolled in the MS program in Computer Engineering are required to complete 24-semester-credit hours of graduate courses, (not including thesis). These courses should be selected from the student's program of study which has been approved by the Graduate Committee, the Department Chairman, and the Deanship of Graduate Studies.

2 Three core courses (9 semester credit hours) are required of all students:

COE 501: Computer Architecture	(3-0-3)
COE 540: Computer Networks	(3-0-3)
COE 561: Digital System Design and Synthesis	(3-0-3)

3 Three COE graduate-level electives to be chosen from the following 4 subject areas of Computer Engineering. Students are allowed to take up to four courses, including the corresponding core course, from any of the first three subject areas. For the network area, it should be noted that network courses with ICS or CSE prefixes would count towards this upper bound. An ICS or CSE course is considered as a network course if it is listed in the Network courses in the COE-ICS joint Network MS Program.

Computer Architecture and Parallel Processing Systems

COE 502	Parallel Processing Architecture
COE 503	Message Passing Multiprocessing Systems
COE 504	Heterogeneous Computing
COE 505	Fault Tolerant Computer Systems
COE 509	Special Topics in Architecture and parallel processing.

Computer Networks Area

COE 541	Local and Metropolitan Area Networks
COE 542	High-Speed Networks
COE 543	Mobile Computing and Wireless Networks
COE 549	Special Topics in Computer Networking Technologies
CSE 551	Computer and Network Security
CSE 552	Network Management

CSE 553	Fault Tolerance and Reliability in Computer Networks
CSE 554	Modeling and Analysis of Computer Networks
CSE 555	Protocol Engineering
CSE 559	Special Topics in Computer Network Design and Management

Digital System Design and Automation

COE 562	VLSI System Design
COE 566	VLSI ASIC Design
COE 567	Digital System Modeling and Verification
COE 571	Digital System Testing
COE 572	Computer-Aided Design of Digital Systems
COE 579	Special Topics in Digital Systems Design and Automation

Computer Systems and Applications

COE 584	Robotics
COE 585	Switching Theory
COE 586	Computer Arithmetic
COE 587	Performance Evaluation and Analysis
COE 588	Modeling and Simulation
COE 589	Special Topics in Computer Systems and Applications
COE 591	Neural Networks
COE 592	Human Computer Interface Engineering
COE 593	Multimedia
COE 594	DSP Systems and Architectures
COE 595	Hardware/Software Co-design of Embedded Systems
COE 596	Intelligent Computing
COE 597	Real Time Systems

4 The two elective courses may be selected from within or outside the COE Department according to the approved degree plan. With the approval of the COE department, up to two senior undergraduate 400 level COE courses may be taken in place of the two elective courses when recommended by the student advisor. The total credit hours of elective courses taken from outside the COE Department should not exceed six.

5 The student must complete a thesis on an approved topic in Computer Engineering under the supervision of his graduate thesis committee.

6 The student should present a seminar that describes recent research findings in Computer Engineering as well as attend the technical seminar series organized by the COE department. This requirement is satisfied by the zero-credit hours seminar course COE 599 (1-0-0).

Degree Plan for the M.S. Program in Computer Engineering

Course No.	Title	LT	LB	CR
First Semester				
COE 5xx	COE Core I	3	0	3
COE 5xx	COE Core II	3	0	3
COE 5xx	COE Elective I	3	0	3
		9	**0**	**9**
Second Semester				
COE 5xx	COE Core III	3	0	3
COE 5xx	COE Elective II	3	0	3
XXX 5xx	Elective Course I	3	0	3
		9	**0**	**9**
Third Semester				
COE 5xx	COE Elective III	3	0	3
XXX 5xx	Elective Course II	3	0	3
COE 599	Seminar	1	0	0
		7	**0**	**6**
Fourth Semester				
COE 610	MS Thesis Work	0	0	**6**
Total Credit Hours				**30**

The two XXX xxx electives *may* be taken from the graduate courses from within or outside the Computer Engineering Department according to the approved degree plan. Students must obtain departmental approval for the selected courses.

COURSE DESCRIPTION

COE 501 Computer Architecture (3-0-3)

Classification of computer systems, architectural developments, computer performance. Linear and nonlinear pipeline design, instruction and arithmetic pipeline, superscalar. Memory hierarchy, cache and virtual memory, cache coherence, memory system performance. Parallel architectures, performance measures, SIMD and MIMD architectures, interconnection networks. The students are expected to carry out research projects in related field of studies.

Equivalent to: ICS 536

Prerequisite: COE 308 or Equivalent.

COE 502 Parallel Processing Architectures (3-0-3)

Introduction to parallel processing architecture, sequential, parallel, pipelined, and dataflow architectures. Vectorization methods, optimization, and performance. Interconnection networks, routing, complexity, and performance. Small-scale, medium-scale, and large-scale multiprocessors. Data-parallel paradigm and techniques. Multithreaded architectures and programming. The students are expected to carry out research projects in related field of studies.

Prerequisite: COE 308 or Equivalent.

COE 503 Message Passing Multiprocessing Systems (3-0-3)

Introduction to message passing multiprocessor systems. Message communication models and their correctness. Message passing system architecture & languages. Architectural support for message passing. Processor time allocation. Inter module message communication. Real time applications of message passing systems. Future trends and new technologies. The students are expected to carry out research projects in related field of studies.

Prerequisite: COE 344 or Equivalent.

COE 504 Heterogeneous Computing (3-0-3)

Taxonomy of heterogeneous computing. Introduction to mixed-mode and multimode heterogeneous systems. Network heterogeneous computing: design issues, architecture, programming paradigm and environment, mapping, load balancing and scheduling. Applications and Case studies. The students are expected to carry out research projects in related field of studies.

Prerequisite: COE 308 or Equivalent.

COE 505 Fault Tolerant Computer Systems (3-0-3)

Fundamental concepts in the theory of reliable computer systems Design. Hardware and software reliability techniques. Evaluation of fault-tolerant computer systems. The practice of reliable system design. Case studies. Fault-tolerant multiprocessor design. The students are expected to carry out research projects in related field of studies.

Prerequisite: COE 308 or Equivalent.

COE 509 Special Topics in Computer Architecture and PP (3-0-3)

Advanced topics selected from current issues in Computer Architecture and Parallel & Distributed Systems.

Prerequisite: Graduate Standing.

COE 540 Computer Networks (3-0-3)

Computer Networking concepts. Basic Terminology; Protocols; Communication Architectures; OSI Reference Model; Protocol suites. Data Link Layer; ARQ Strategies; Analysis of ARQ Strategies. Multi-access communication. Introduction to ATM. Delay Models in Data Networks; Introduction to performance analysis; Little's Theorem; Single queue models; Network of queues. Network layer. Routing in Data Networks. Flow and Congestion Control. Transport layer. Application Layers.

Equivalent to: EE 674

Prerequisite: COE 344 or ICS 343 or Consent of Instructor.

COE 541 Local and Metropolitan Area Networks (3-0-3)

Protocols and Network Architectures. Various Technologies for Local and Metropolitan Area Networks (LANs and MANs). Classes of LANs and MANs. LAN and MAN design issues and Standards. LAN and MAN performance modeling and analysis. Internetworking. Examples of LANs and MANs. Case studies. Emerging LAN/MAN technologies.

Prerequisite: COE 540 or Consent of Instructor.

COE 542 High-Speed Networks (3-0-3)

Protocols and Network Architecture. Local high speed networks. Broadband Metropolitan and Wide Area Networks. Impact of high speed on communication protocols and networks. Fiber optic networks. Design and performance issues of high speed networks. Standard high speed protocols and networks. Examples of high speed networks. Case studies. Emerging technologies for high speed networks.

Prerequisite: COE 540 or Consent of Instructor.

COE 543 Mobile Computing and Wireless Networks (3-0-3)

Introduction to mobile computing and wireless networks. Designing computer networks to support computer mobility. Wireless network architecture and ad-hoc networks. Mobility standards, e.g. mobile IP. Mobility systems issues (e.g. performance &bandwidth). Quality of Service guarantees, reliability, and security in mobile computing environment. Access protocols for wireless networks.

Prerequisite: COE 540 or Consent of Instructor.

COE 549 Special Topics in Computer Networking Technologies (3-0-3)

State-of-the-art topics from the areas of various transmission technologies.

Prerequisite: Consent of Instructor.

COE 561 Digital System Design & Synthesis (3-0-3)

Digital system design methodologies. Hardware Description Languages (HDLs). System design, modeling and verification at various levels of abstraction. Introduction to testing: Fault models and test generation strategies, DFT and BIST. Delay models and timing verification. Principles of High-Level Synthesis (HLS)-internal representation (DFG, SFG, etc); scheduling, allocation and binding. Controller and data path synthesis. Introduction to physical Design, logic synthesis and technology mapping.

Prerequisite: COE 308 or Equivalent.

COE 562 VLSI System Design (3-0-3)

Review: The MOS transistor, transistor sizing, circuit layout, static versus dynamic logic, combinational and sequential logic. Deep submicron device models and scaling, interconnect models. Clocking strategies, clock skew, setup, hold & propagation delays, self-timed logic, I/O design. Dynamic characteristics of MOS circuits: effects of signal slew rate on propagation delay. Dynamic logic circuits: domino, CVSL, charge sharing. Design considerations of regular structures: ROM's, PLA's, adder and multiplier architectures. CAD tools for layout and design capture. CMOS memories: architecture, design constraints. ROM, SRAM and DRAM cells. Single and double-ended bit line sensing. Multiport register files. The course is project-oriented stressing the use of CAD tools through class projects.

Prerequisite: COE 360 or Equivalent.

COE 566 VLSI ASIC Design (3-0-3)

Review: MOS transistor, transistor sizing, circuit layout, and static versus dynamic logic. MOS logic optimization of delay and area. ASIC design methodologies, full custom versus semi-custom. ASIC library design, cell characterization, design area and delay. Standard-cell design methodology, propagation delay, design area, critical path, placement and routing of cells, design optimization and back annotation. Gate arrays and silicon compilers. Programmable ASICs, programmable logic cells, and programmable I/O, programmable interconnect. Hardware description languages, technology mapping and synthesis. Test techniques of ASICs, fault models, boundary scan and DFT. The course emphasizes hands on experience through the use of available design tools for the design of ASIC VLSI.

Prerequisite: COE 360 or Equivalent.

COE 567 Digital System Modeling & Verification (3-0-3)

Introduction and approaches to digital system verification. Simulation versus Formal verification. Levels of hardware modeling (circuit, switch, gate, RTL, and Behavioral levels). Logic, RTL, and Behavioral level simulation. Principle of Formal hardware modeling and verification. Mathematical logic (First order logic, Higher Order Logic, Temporal Logic). Abstraction mechanisms for hardware verification. Automated theorem provers. Verification using Specific Calculus. Formal verification versus formal synthesis. Future trends in hardware verification.

Prerequisite: Consent of Instructor.

COE 571 Digital System Testing (3-0-3)

Issue of VLSI testing, test Economics. Fault models: Transistor level faults, Single and Multiple stuck at faults, Bridging faults, Functional faults, Delay faults. Automatic Test Pattern Generation for Combinational logic: Path sensitization, D-algorithm, Critical path, PODEM, FAN, CMOS testing. Sequential logic testing. Design For Testability. Built-in Self-test (BIST). Functional testing, Testing of regular architectures, Testability measures. Delay testing. Testing of systems on chip.

Prerequisite: (COE 308 and COE 360) or Equivalent.

COE 572 Computer-Aided Design of Digital Systems (3-0-3)

The VLSI Design Process. Layout Styles. Graph and Circuit Partitioning. Floorplanning Approaches. Placement Heuristics. Routing: Maze Routing, Line Search Algorithms, Channel Routing and Global Routing. Layout Generation. Layout Editors and Compaction.

Prerequisite: (COE 360 and ICS 353) or Equivalent.

COE 579 Special Topics in Digital Sys. Design and Automation (3-0-3)

Advanced topics selected from current issues in the area of digital system design and automation.

Prerequisite: Consent of Instructor.

COE 584 Robotics (3-0-3)

Morphological structures of robotics systems. Design and analysis of motion coordination systems for robot arms, geometric and variational approaches. Robot languages and programming, effector and object levels. Trajectory planning and collision avoidance. Force sensing and compliance. Robotic vision and intelligence. Space robotics and remotely controlled robotic systems.

Equivalent to: SE 532 and EE603

Prerequisite: COE 305 or Equivalent.

COE 585 Switching Theory (3-0-3)

Review of Switching Algebra, Complex Gates, Boolean Algebra, Multiple-Valued Logic, Switch Network, Transient Analysis, Symmetric Functions, Unate Functions, Threshold Functions, Multiple-Output Network, Programmable Arrays, Fault Models, Test sets, Multi-Stage Networks, Sequential-Circuit Analysis, Finite-state Machines, Multiple-Pulse and Non-Pulse Circuits, Asynchronous Circuit Design.

Prerequisite: COE 308 or Equivalent.

COE 586 Computer Arithmetic (3-0-3)

Fixed point arithmetic: addition, subtraction, multiplication, division, fixed point ALUs. Floating point arithmetic: normalization, rounding, addition, subtraction, multiplication, division, floating point ALU. Modeling of Arithmetic Processors. Elementary functions. Nonconventional Number Systems.

Prerequisite: COE 308 or Equivalent.

COE 587 Performance Evaluation and Analysis (3-0-3)

Simulation of the functions of a computer systems, Analytical and stochastic methods of performance, Graph models for multiprocessors and parallel processing. Performance measures. Performance evaluation techniques. Application areas. The modeling cycle. Flow analysis. Bottleneck analysis. Hierarchical modeling. Case studies.

Equivalent to: ICS 532

Prerequisite: STAT 319 or Equivalent.

COE 588 Modeling and Simulation (3-0-3)

The simulation cycle. Discrete-event simulation approaches. Probability and statistics in simulation. Random number generation. Building valid and credible simulation models. Output data analysis. Simulation software. Distributed and parallel simulation. Applications to computer systems. Case studies.

Equivalent to: ICS 533, SE518

Prerequisite: ICS 202, STAT 319 or SE 205 or Consent of Instructor.

COE 589 Special Topics in Computer Systems and Applications (3-0-3)

Advanced selected topics in computer systems and applications.

Prerequisite: Graduate standing and Consent of Instructor.

COE 591 Neural Networks (3-0-3)

Fundamental concepts of neural computing. Terminology. Main neural networks architecture single/multilayer perceptrons, feedback (recurrent)/feedforward information flow; and their supervised/unsupervised learning models. Backpropagation, self -organizing, adaptive resonance, auto/heteroassociation neural memory models. Neurocomputing implementation, applications, performance evaluation. Literature survey of the most recent neural networks development.

Equivalent to: ICS 586 and EE560

Prerequisite: Graduate standing and Consent of Instructor.

COE 592 Human Computer Interface (HCI) Engineering (3-0-3)

Components of Human Computer Interaction, Human - Computer interaction theories, Mental Models, Conceptual Models, Principles and Methods of User-Centered Design, User-information processing capabilities and limitations, Graphics User-Interface GUI, Guidelines, Prototyping, Standards, Evaluation.

Equivalent to: SE 569

Prerequisite: Graduate standing and Consent of Instructor.

COE 593 Multimedia (3-0-3)

Time-Frequency Representation, Predictive Coding, Speech Analysis and Synthesis, Image Understanding and Modeling, Image Compression Techniques, Color Models and Color Applications, 3-D Representation, Illumination Models, Graphics Systems, MPEG Standards, Video Compression, Video Conferencing.

Equivalent to: ICS 538

Prerequisite: Graduate standing and Consent of Instructor.

COE 594 DSP Systems and Architectures (3-0-3)

Classification of DSP Functional Units, Programmable DSP Architectures, Video Processors, Fine Grain Image Processors, Application Specific DSP Architectures, DSP Linear Array Architectures and their Synthesis, Mapping of DSP Algorithms, Algorithmic and Architectural Transformation for DSP, VLIW DSP Architectures, Multimedia Processor Architectures, Memory Architecture for DSPs, Programmability of Advanced Architectures.

Prerequisite: COE 308 or Equivalent.

COE 595 Hardware/Software Co-design of Embedded Systems (3-0-3)

Embedded System Design Considerations, Classical Design Methods, co-representation, Performance Modeling, Co-design Trade-offs, Functional Decomposition, Partitioning, Design methodologies, Co-design Environments, Abstract Models, Recent Techniques in Co-design, Case Studies.

Prerequisite: COE 308 or Equivalent.

COE 596 Intelligent Computing (3-0-3)

Prepositional Logic, Predicate Logic, Modal Logic, Context-dependant computations, Situated Representation, Spatial-Temporal Knowledge, Spatial-Temporal Models, Spatial-temporal Reasoning, Situated Concepts, Situated Logic, Situated Decision Making, Architectures for Intelligent Computing, Case Studies.

Prerequisite: Graduate standing and Consent of Instructor.

COE 597 Real Time Systems (3-0-3)

Introduction, System Specifications and Architecture, Modeling and Analysis with Time Constraints, Real-Time Systems Design, Performance metrics, Performance evaluation under extreme conditions, Hardware/Software trade-off for Real Time Systems, Applications and Case Studies.

Prerequisite: Graduate standing and Consent of Instructor.

COE 599 Seminar (1-0-0)

Graduate students are required to attend the seminars by faculty members, visiting scholars, and fellow graduate students. Additionally, each student must present at least one seminar on a timely research topic. Among other things, this course is designed to give the students an overview of research in COE, and a familiarity with research methodology, journals and professional societies in his discipline. Graded on a Pass or Fail basis.

Prerequisite: Graduate standing.

COE 610 Computer Engineering Master Thesis (0-0-6)

The student has to undertake and complete a research topic under the supervision of a faculty member in order to probe in depth a specific problem in Computer Engineering.

Prerequisite: COE 599.

M.S. PROGRAM IN COMPUTER NETWORKS

This program is offered jointly by the Department of Computer Engineering and Department of Information & Computer Science

The joint program on Computer Networks has been designed to give a balanced curriculum that covers three complementary areas in Computer Networks:

1. Technology group courses that will be offered mainly by the COE department
2. Distributed and Software courses that will be offered mainly by the ICS department program
3. Design and management courses that can be offered by either department, and will be double listed.

The curriculum includes a core course from each of these areas. These courses cover, at an advanced level, the underlying key aspects of computer networks, their design and the software issues.

PROGRAM MANAGEMENT

The proposed joint program on Computer Networks will be managed in an identical manner to that practiced in the management of the already approved joint Ph.D. Program that is offered jointly by the same two departments. Each student will register in one of the two departments. The student will be awarded the Degree of Computer Networks by his home department. A joint committee with members from the two departments will administer issues related to the joint program and will report to the two department in an identical manner to that practiced in the administration of the current joint Ph.D. program.

ADMISSION REQUIREMENTS

Applicants for the joint MS program on Computer Networks must hold a BS degree in Computer Science, Computer Engineering, or its equivalent from a reputable university. In addition, all applicants must satisfy the general admission requirements of the Graduate School.

ACADEMIC PROGRAM

In addition to the KFUPM requirements, all candidates for the MS degree in Computer Networks must satisfy the following requirements:

1. All students enrolled in the proposed MS program in Computer networks are required to complete 24-semester-credit hours of courses, (not including thesis) for graduate credits. These courses should be selected from his program of study which has been approved by his Graduate Committee, the Department Chairman, and the Dean of Deanship of Graduate Studies.
2. There are three required core courses in this program:
   - COE 540: Computer Communication Networks .... (3-0-3)
   - CSE 550: Computer Network Design .... (3-0-3)
   - ICS 571: Client Server Programming .... (3-0-3)
3. Five elective courses (15 semester credit hours) are to be chosen from graduate level courses as follows:

   A. Three electives must be chosen from the following three areas of the Computer Networks:

   Network Technology

   - COE 541: Local and Metropolitan Area Networks .... (3-0-3)
   - COE 542: High-Speed Networks .... (3-0-3)
   - COE 543: Mobile Computing and Wireless Networks .... (3-0-3)
   - CSE 554: Modeling and Analysis of Computer Networks .... (3-0-3)
   - COE 549: Special Topics in Computer Networking Technologies .... (3-0-3)

   Network Design and Management

   - CSE 551: Computer and Network Security .... (3-0-3)
   - CSE 552: Network Management .... (3-0-3)
   - CSE 553: Fault Tolerance and Reliability in Computer Networks .... (3-0-3)
   - CSE 559: Special Topics in Computer Network Design and Management .... (3-0-3)

   Network Software and Protocols

   - ICS 572: Distributed Computing .... (3-0-3)
   - ICS 573: High Performance Computing .... (3-0-3)
   - CSE 555: Protocol Engineering .... (3-0-3)

ICS 575: Application Development for Internet Based Services .... (3-0-3)

ICS 579: Special Topics in Computer Network Software and Protocols .... (3-0-3)

B. Two electives to be selected from a list of approved graduate courses from within or outside the Computer Engineering Department, and Information and Computer Science Department, provided the student's advisor also approves these two courses. Moreover, the total credit hours of electives courses taken by a student from departments other than the two Departments mentioned above should not exceed six.

4. In addition to the course requirements described above, a student must satisfy the thesis requirement. He should complete a thesis on an approved topic in Computer Networks under the supervision of his graduate thesis committee.
5. The student should present a seminar that describes new research findings in Computer Networks.
6. The student should satisfy any special conditions (such as some remedial courses satisfactorily), connected with his admission.

Degree Plan for the M.S. Program in Computer Networks

Course #		Title	LT	LB	CR
First Semester					
CSE/COE/ICS	5xx	Network Core I	3	0	3
CSE/COE/ICS	5xx	Network Core II	3	0	3
CSE/COE/ICS	5xx	Network Elective I	3	0	3
COE 599/ICS	599	Seminar	1	0	0
			10	**0**	**9**
Second Semester					
CSE/COE/ICS	5xx	Network Core III	3	0	3
CSE/COE/ICS	5xx	Network Elective II	3	0	3
XXX	xxx	Elective Course I	3	0	3
XXX	xxx	Elective Course II	3	0	3
			12	**0**	**12**
Third Semester					
CSE/COE/ICS	5xx	Network Elective III	3	0	3
COE 610/ICS	610	MS Thesis Work	0	0	IP
			3	**0**	**3**
Fourth Semester					
COE 610/ICS	610	MS Thesis Work	0	0	6
			0	**0**	**6**
Total Credit Hours					**30**

The two XXX xxx Electives are to be taken from the graduate courses from within or outside the Computer Engineering Department and Information and Computer Science Department according to the approved degree plan. See Appendix A for a list of possible course from outside the two departments.

COURSE DESCRIPTION

CSE 550 Computer Network Design (3-0-3)

Types of computer networks: LANs, VLANs, and WANs. Routing algorithms and routing protocols. The network development life cycle. Network analysis and design methodology. Network design issues: Manageability; Node placement and sizing; Link topology and sizing; Routing; Reliability. Data in support of network design. Structured enterprise network design. Hierarchical tree network design: Terminal assignment; Concentrator location. Mesh topology optimization. Traffic flow analysis. Analysis of loss and delay in networks. Network reliability issues.

Prerequisite: (COE 540 and (ICS 353 or Equivalent)) or Consent of Instructor.

CSE 551 Computer and Network Security (3-0-3)

Principles and practice of network and internetwork security. Mathematical principles of cryptography and data security. Conventional and modern crypto systems. Secure communication protocols. Authentication and Digital Signatures. Secure IP and SSL. Modern applications like digital cash and secure distributed computing. Operational aspects of computer and network security.

Prerequisite: (COE 540 and Good Math Background) or Consent of Instructor.

CSE 552 Network Management (3-0-3)

Management Protocols. Remote Management. Configuration for Data Collection. Monitoring and Reconfiguration. Operational Issues in Managing Heterogeneous Networks under Different Operating Systems.

Prerequisite: (COE 540 and (ICS 431 or Equivalent)) or Consent of Instructor.

CSE 553 Fault Tolerance and Reliability in Computer Networks (3-0-3)

Fundamental concepts in the theory of reliable computer systems design. Hardware and software reliability techniques. Evaluation of fault-tolerant computer communication systems. The practices of reliable system design. Case studies. Fault-tolerant topology design. Computer networks reliability and fault-toler-ance. Fault tolerant high-speed networks.

Prerequisite: (COE 540 and (ICS 431 or Equivalent)) or Consent of Instructor.

CSE 554 Modeling and Analysis of Computer Networks (3-0-3)

Modeling. General concepts. Performance measures. Performance evaluation techniques. Model Validation. Introduction to Queuing Networks and Stochastic

Processes. Simulation. The modeling cycle. Queuing network modeling. Flow analysis. Bottleneck analysis. Hierarchical modeling. Introduction to Analysis driven Design. Case studies with applications to different aspects of computer network systems.

Prerequisite: COE 540 or Consent of Instructor.

CSE 555 Protocol Engineering (3-0-3)

Protocols and languages. Protocol structure. Structured protocol design. Fundamentals of Protocol Engineering. Specification and modeling. State Machines and Reachability Analysis. Formulation of desirable properties of protocols. Formal Logic and Deduction. Verification techniques. Formal description languages. Protocol synthesis. Protocol Design. Validation and conformance testing. Computer aided design tools for protocol engineering (simulation and validation tools). A major project involving comprehensive design and verification of a non-trivial protocol.

Prerequisite: (COE 540 and (ICS 252 or Equivalent)) or Consent of Instructor.

CSE 559 Special Topics in Computer Network Design and Management (3-0-3)

State of art topics from the areas of various computer network design and management, security and reliability.

Prerequisite: Consent of Instructor.

Information & Computer Science

Chairman

Kanaan A. Faisal

Associate Professors

Al-Darwish, N.	Al-Suwaiyel, M.	Sabri, M.
Al-Mulhem, M.	Ahmed, M.	Salah, K.

Assistant Professors

Ahmed, A.	Azzedin, F.	Maghrabi, T.
Al-Ghamdi, J	El-Alfy, E.	Mahmood, S.
Al-Khatib, W.	El-Bassuny, T.	Mohammed, S.
Al-Muhammadi, S.	Elish, M.	Shafique, M.
Al-Shayeb, M.	Faisal, K.	Yahyaoui, H.
Al-Sukairi, A..	Ghouti, L.	

Lecturers

Ahmed, E.	Balah, M.	Said, A.
Ahmad, I.	Elish, K.	Waheed Aslam, M.
Al-Muhtaseb, H.	Garout, Y.	Yazdani, J.
Alvi, F	Raharja, P.	

INTRODUCTION

The proliferation and the ever-increasing dependencies on computers have initiated the need for new developments in Information & Computer Science to fuel the advances in almost every area of our lives, from nanotechnology to biotechnology, and from business to education. This makes Information & Computer Science one of the most exiting disciplines to study and has generated a long term demand for experts in the field of Information & Computer Science throughout the world. The Computer Science Master Program in the Information & Computer Science Department at KFUPM is established to meet such demand in Saudi Arabia.

The Department of Information & Computer Science at KFUPM has a wide range of graduate program offerings, all of which are intended to be challenging and dedicated to the evolution of Computer Science. The Computer Science Program at KFUPM came into existence in 1982. In 1986, the Department of Information & Computer Science became one of the three departments of the newly established College of Computer Sciences & Engineering. The other two departments are Computer Engineering and Systems Engineering.

The Computer Science Master Program was established to provide the advanced knowledge in all fields related to computer and information sciences such as programming languages, software engineering, computer networks, computer and network security, information systems, distributed systems, artificial intelligence, and theoretical computer science. The Program is designed to support academic and professional interests covering both theoretical and practical aspects.

The main objectives of the graduate programs are the following:

- To provide information & computer professionals needed in the country's development plans.
- To prepare students for further research in their field of specialization.
- To provide specialized expertise through which advanced technologies and their applications can be enhanced, transferred, and utilized.

COMPUTING FACILITIES

The main departmental hardware resources are utilized in various teaching and research laboratories.

DATABASE LAB

The aim of this lab is mainly to serve students and support their research in the field of databases and related areas. This lab is equipped Linux, windows, and Intel XEON multi-core processors machines. Though some of the work is performed through widely available open-source frameworks and libraries, several propriety software packages and state-of-the-art database software and tools are also available at the researcher's disposals

SECURITY LAB

The security research lab was established in 2005 and is used for conducting variety of research experiments related to computer and network security. The lab is equipped with numerous state-of-the-art security network appliances which include Cisco firewalls, IPS, routers, switches, network taps, rogue WiFi AP in addition to Linux and Windows machines with uni- and multi-core processors. The lab also has many commercial and open-source software utilities related to application and network security auditing, penetration testing, software reverse engineering, password cracking, metasploit framework, Snort IDS, rootkits, and AV products.

GRAPHICS AND VISUALIZATION LAB

Visualization research lab provides equipment and facilities to support research by graduate student and faculty members. Research in Visualization and Human Computer Interface (HCI) are the primary fields this lab serves. The lab is equipped with high-end visual and graphic computing systems with dual Quad-Core processor, high memory workstation with high-end SLI-ready multiple Graphic Processing Units. The configuration provides the ideal environment to develop high-level and low-level graphics code and test visualizations of large data.

COMPUTER NETWORK LAB

The computer network lab is aimed to support undergraduate and graduate students with their teaching as well as research material. The lab is a suitable environment for students to carry learn and investigate network features such as VLANs, STP, VoIP, Security, Layer 3 routing, Etherchannels, trunking, etc. This lab has a capacity of 30 PCs along with Routers, Switches, and Hubs.

SOFTWARE ENGEERING LAB

The software engineering lab provides a teaching and research environment to undergraduate and graduate students to conduct high-quality experiments and research in software engineering related areas such software metrics and measurement , software design, empirical software engineering, and software quality predictive models. The lab is equipped with Linux and Windows machines with uni- and multi-core processors. The lab is also equipped with many popular software engineering software and tools.

SYSTEMS LAB

The aim of the Systems Laboratory is to provide teaching and research support for systems related undergraduate and graduate students. In particular, it provides tools for courses on operating systems, compilers, and other system software topics. The lab consists of a LINUX installation server and a number of other machines. The machines here are primarily used to experiment with system software.

MULTIMEDIA LAB

This lab is used by faculty, graduate students, and senior undergraduates working on research and development of multimedia & hypermedia applications such as computer-based learning, games, and reference systems. The lab has several state-of-the-art PC based workstations with multimedia equipment, color scanner, video and audio card.

ARTIFICIAL INTELLIGENCE LAB

The Artificial Intelligence Lab is a multifaceted research facility being used for research on natural language processing, knowledge representation, Expert system tools and applications, and other aspects of Artificial Intelligence. In addition to the software packages and tools, the lab includes several workstations, and several state-of-the-art PCs.

PC LAB

The Personal Computer Lab has more than ninety state-of-the-art PCs which are networked to the College of Computer Science & Engineering network. The PC lab provides Dual Quad-Core processor, high memory workstations. The configuration provides the ideal environment for graduate students to use Windows-based applications, terminal sessions to connect to UNIX/LINUX machines, as well as Electronic mail service linking to the rest of the world.

GRADUATE PROGRAMS IN COMPUTER SCIENCES

The Department of Information & Computer Science offers two graduate programs: M.S. in Computer Science and Ph.D. in Computer Science & Engineering (The Ph.D. program is offered in collaboration with the Computer Engineering Department). Details of these two programs are given below.

M.S. PROGRAM IN COMPUTER SCIENCE

1. ADMISSION REQUIREMENTS

In addition to the minimum admission requirements set by the Deanship of Graduate Studies, all MS applicants should have a satisfactory background in the following core areas of computer science: Data Structures, Computer Organization, Algorithms, Programming Languages, Database Systems, Computer Networks, Operating Systems, and Software Engineering. Unsatisfactory background in any of these areas is considered a deficiency. Provisional admission may be granted to otherwise qualified students with core background deficiencies. Students with deficiencies must take the appropriate course(s) at KFUPM. Such deficiencies cannot exceed four courses, and all such courses must be completed with a grade of B or better before a change of status to regular is realized.

2. ACADEMIC PROGRAM

All candidates for the MS degree in Computer Science must satisfy the overall requirements of KFUPM in addition to the following:

1 All students enrolled in the revised M.S. program are required to successfully complete 30 credit-hours of coursework and a thesis. The coursework must include a total of 24 credit hours and a thesis of 6 credit-hours.

2 The coursework must consist of 8 courses (3 credits each). Four of these eight courses must be core courses to satisfy the breadth requirement. The remaining four courses are elective courses. All of these courses must be of either the 500 or 600 level.

3 The four core courses must be taken as follows:

- ICS 553 (required by all students).
- The other three core courses must be taken such that each course is from a different subject area. The qualified subject areas and their qualified core courses are as follows:

Subject Area	Core Course
Software Engineering	ICS 511, ICS 512, ICS 513, ICS 514, ICS 515
Systems	ICS 531, ICS 532, ICS 533, ICS 535, ICS 536
Net-Centric Computing	ICS 570
Artificial Intelligence	ICS 581, ICS 583, ICS 584

4 The four elective courses must include at least two ICS courses. Under certain conditions, courses carrying identification codes in the 400 level may be taken for graduate credit (towards a Master's program only). No more than two (2) courses of 400 level may be counted for credit towards the requirements of an advanced degree. These two courses must be approved by the student's graduate committee, the Department chairman, and the Dean of Graduate Studies.

5 Other elective courses can be graduate-level courses from Departments of related disciplines such as COE, SE, MATH, and EE. Graduate courses from other Departments are also allowed. Students must seek ICS Departmental approval prior to taking any non-ICS elective courses.

6 Students are required to attend and pass ICS 599 Seminar course which carries no credit hours.

7 Each student must complete the ICS 610 Thesis of 6 credit hours on an approved research topic under the supervision of his graduate thesis committee.

8 The approved thesis research topic must be related to a subject area in which the student has taken at least two graduate courses.

9 A cumulative and major GPA of 3.0 or better must be maintained in all graduate and deficiency courses.

10 All requirements of the Master's degree for a full-time student must be completed during a total elapsed period of three calendar years.

3. Degree Plan for the M.S. Program in Computer Science

COURSE #		TITLE	LT	LB	CR
First Semester					
ICS	553	Advanced Computer Algorithms	3	0	3
ICS	5XX	ICS Core I	3	0	3
ICS	5XX	ICS Elective I	3	0	3
			9	**0**	**9**
Second Semester					
ICS	5XX	ICS Core II	3	0	3
ICS	5XX	ICS Core III	3	0	3
XXX	XXX	Free Elective I	3	0	3
			9	**0**	**9**
Third Semester					
ICS	5XX	ICS Elective II	3	0	3
XXX	XXX	Free Elective II	3	0	3
ICS	599	Seminar	1	0	0
			7	**0**	**6**
Fourth Semester					
ICS	610	Thesis	0	0	6
Total Credit Hours:					**30**

(1) ICS Core I, II, and III must be chosen according to item 3 of Academic Program section.

(2) A free elective (XXX XXX) can be selected from courses within or outside the ICS department according to the approved degree plan. ICS departmental approval is required for non-ICS courses.

(3) Any CSE course is considered as an ICS elective.

COURSE DESCRIPTION

Area 1: SOFTWARE ENGINEERING

ICS 511 Principles of Software Engineering (3-0-3)

Software Requirements: Modern SRS for Enterprise Application and Performance-Critical Systems. Software Process: Personal Software Process, Team Software Process. Software Design: Architecture Tradeoff Analysis, Enterprise Architecture, COTS Architecture, Service Oriented Architecture, RAD. Software Planning: Software Acquisition, Software Engineering Measurement and Analysis (SEMA). Software Quality Assurance: 6-Sigma. Software Integration: Enterprise Application Integration, COTS Integration.

Prerequisite: ICS 413 or Equivalent

ICS 512 Software Requirements Engineering (3-0-3)

The course gives state of the art and state of the practice in software requirements engineering. In-depth research-oriented study of methods, tools, notations, and validation techniques for the analysis, specification, prototyping, and maintenance of software requirements. Topics include study of object-oriented requirements modeling, using state of the art modeling techniques such as the Unified Modeling Language (UML). The course work includes a project investigating or applying approaches to requirements engineering.

Prerequisite: ICS 413 or Equivalent

ICS 513 Software Design (3-0-3)

Concepts and methods for the architectural design of large-scale software systems. Fundamental design concepts and design notations are introduced. Several design methods are presented and compared. In-depth research-oriented study of object-oriented analysis and design modeling using state of the art modeling techniques such as Unified Modeling Language (UML). Students participate in a group project on object-oriented software design.

Prerequisite: ICS 413 or Equivalent

ICS 514 Software Validation, Verification, and Quality Assurance (3-0-3)

In-depth research-oriented study of Verification and Validation throughout the development lifecycle. Techniques for validation and verification. Quality assurance at the requirements and design phases. Software testing at the unit, module, subsystem, and system levels. Automatic and manual techniques for generating and validating test data. Testing process: static vs. dynamic analysis, functional testing, inspections, and reliability assessment.

Prerequisite: ICS 413 or Equivalent

ICS 515 Software Project Management (3-0-3)

Lifecycle and process models; process metrics; planning for a software project; mechanisms for monitoring and controlling schedule, budget, quality, and productivity; and leadership, motivation, and team building. Topics cover quantitative models of the software lifecycle, process improvement techniques, cost-effectiveness analysis in software engineering, multiple-goal decision analysis, uncertainty and risk analysis, software cost estimation, software engineering metrics; and quantitative lifecycle management techniques.

Prerequisite: ICS 413 or Equivalent

ICS 519 Special Topics in Software Engineering (3-0-3)

Advanced topics selected from current journals of Software Engineering that deal with theoretical development or applications in the field. Topic include: Reusable Software Architectures, Software Engineering, Experimentation, Concurrent Software Systems, Software Metrics Software Engineering for the World Wide Web, Formal Methods and Models in Software Engineering, etc.

Prerequisite: Consent of Instructor

Area 2: SYSTEMS

ICS 531 Advanced Operating Systems (3-0-3)

Structural design aspects of an operating system: process model, inter-process communication, synchronization mechanisms, resource management, and scheduling. Protection issues. Implementation issues of modern operating systems. Distributed operating systems. Deadlock detection, recovery, and avoidance. Case studies. Project(s).

Prerequisite: ICS 431 or Equivalent

ICS 532 Performance Analysis & Evaluation (3-0-3)

Performance measures. Modeling methodologies: queuing models, graph models, dataflow models, and Petrinet models. Mathematical models of computer systems: CPU and computer subsystems such as memory and disks. Bottleneck analysis. Modeling multi-server systems. Model validation methods. Case studies. Project(s).

Equivalent to: COE 587
Prerequisite: STAT 319 or Equivalent

ICS 533 Modeling and Simulation of Computing Systems (3-0-3)

Basic probability and statistics. Review of discrete-event simulation tools and methodologies. Simulation languages. Random Number generation. Developing Simulation Models. Simulation Validation. Output Data Analysis. Applications to computer systems. Project(s).

Equivalent to: COE 588
Prerequisite: STAT 319 or Equivalent

ICS 535 Design and Implementation of Programming Languages (3-0-3)

Principles of functional, imperative, object-oriented and logic programming languages. Semantic specification including axiomatic, operational and denotational semantics. Fundamentals of type systems such as abstract data types, polymorphism, and inference. Concurrent systems. Case studies of contemporary programming languages.

Prerequisite: ICS 313 or Equivalent

ICS 536 Real-Time Systems (3-0-3)

Overview of real-time systems. Design and implementation issues. System interfacing basics. Embedded software design constraints under size, performance, and reliability. Software timing and functional validation. Applications and case studies of real-time hardware and software systems.

Equivalent to: COE 597
Prerequisite: ICS 431 or Equivalent

ICS 539 Special Topics in Systems (3-0-3)

Advanced topics selected from current journals in the field that deal with theoretical development and applications of computer systems.

Prerequisite: Consent of Instructor

Area 3: THEORY

ICS 552 Theory of Computation (3-0-3)

Introduction to various models of computation. Machines, languages and grammars. Turing-computability. Universal Turing Machines. Recursive functions. Church's thesis. Godel's completeness and incompleteness theorems. Closure properties and complexity classes of languages. Decidability, undecidability and partial decidability.

Prerequisite: ICS 353 or Equivalent

ICS 553 Advanced Computer Algorithms (3-0-3)

Review of RAM model of computation, complexity measures of time and space. Graph Algorithms for minimum spanning trees, shortest paths, matroids, the planar separator theorem. Planarity and planarization. network flow algorithms. Graph matching and coloring. Establishing lower bounds. NP Completeness: Cook's theorem. Various complexity classes and their relationships. Techniques for establishing completeness. Approximation and probabilistic algorithms to NP-hard problems.

Prerequisite: ICS 353 or Equivalent

ICS 554 Applied Combinatorics and Graph Theory (3-0-3)

A study of combinatorial and graphical techniques for complexity analysis including generating functions, recurrence relations, Polya's theory of counting, planar directed and undirected graphs, NP complete problems. Application of these techniques to analysis of algorithms in graph theory.

Prerequisite: ICS 553

ICS 555 Data Security and Encryption (3-0-3)

Mathematical principles of cryptography and data security. A detailed study of conventional and modern cryptosystems. Zero knowledge protocols. Information theory, Number theory, complexity theory concepts and their applications to cryptography.

Prerequisite: Consent of Instructor

ICS 556 Parallel Algorithms (3-0-3)

Introduction to parallel computational models (PRAM, Meshes, Trees, Hypercubes, Shuffle-Exchange, Mesh-of-Trees) and complexity measures. Parallel algorithms design techniques: divide-and-conquer, parallel prefix, pointer jumping, list ranking, Euler's path technique, and ear decomposition. Parallel algorithms for selection, merging, sorting, searching, and graph problems. Computational geometry. Graph embedding.

Parallel computational complexity: equivalence of Boolean circuits and the PRAM models, the NC class, and P-complete problems.

Prerequisite: ICS 553

ICS 559 Special Topics in Theoretical Computer Science (3-0-3)

Advanced topics selected from current journals of Theoretical Computer Science that deal with theoretical development or applications of computer systems.

Prerequisite: Consent of Instructor.

Area 4: NET-CENTRIC COMPUTING

ICS 570 Advanced Computer Networking (3-0-3)

Examination of modern computer networking and data communications. Contemporary concepts, facilities, practices, implementations, and issues. Data Link and media access layer protocols. Introduction to Gigabit Ethernet, ATM and Frame Relay. Protocols of TCP/IP suite. IP routing, flow and congestion control. Application Layer. Introduction to modeling and analysis of data networks: Queueing theory, Little's Law, Single Queues, and Jackson Networks.

Equivalent to: COE 540 or EE 674
Prerequisite: ICS 432 or Equivalent

ICS 571 Client Server Programming (3-0-3)

Introduction to Clients, Servers, and Protocols. Client-Server Architectures. Software Architectures for Clients and Servers. Network and Operating System Support for Client-Server Applications. Programming language support. Standard interfaces and API. Examples of clients and servers for several popular protocols such as X, POP3, news, ftp, and http. Project(s).

Prerequisite: (ICS 570 and ICS 431) or Consent of Instructor

ICS 572 Distributed Computing (3-0-3)

Introduction to parallel and distributed computation models. Mapping a parallel solution to a distributed computing platform. Programming issues. Operating system support for distributed computing. Message passing environments such as PVM and MPI. Load balancing. Migration. Agent architectures. Performance and complexity measures. Services. Service driven design of distributed applications. Timing and Synchronization. Remote procedure invocation. Project(s).

Prerequisite: (ICS 570 and ICS 431) or Consent of Instructor

ICS 573 High-Performance Computing (3-0-3)

Theory and practice of parallel computing. Analytical models of parallelism and performance evaluation. Parallel architectures. Software tools for parallel programming. Design and implementation methodologies for parallel high performance applications. Design, analysis, and implementation of parallel solutions for various scientific problems such as linear algebraic problems, fast Fourier transform, Monte Carlo techniques, boundary value problems, finite element techniques, and iterative systems. Project(s).

Prerequisite: (ICS 353 or Equivalent) or Consent of Instructor

ICS 575 Application Development for Internet Based Services (3-0-3)

Application Development for Deployment over the WWW. Application protocols. Connection and Session Objects. Authentication Services. Integrating Database Services. Component Architectures. Scripting Languages. Modern applications and application architectures such as Digital Cash and E-Commerce. Making use of the state-of-art tools, a major project will be developed by the students.

Prerequisite: ICS 571

ICS 576 Concurrent and Parallel processing (3-0-3)

Concepts and foundation of parallel processing. Computational models. Parallel algorithms. parallelization techniques. Parallel software characteristics and requirements: languages, compilers, operating systems, and inter-process communication support. Parallel computer architectures. Case studies. Project(s).

Prerequisite: ICS 431 or Equivalent

ICS 579 Special Topics in Net-Centric Computing (3-0-3)

State-of-the-art topics from the general area of Computer Network Software and Protocols.

Prerequisite: Consent of Instructor.

Area 5: ARTIFICIAL INTELLIGENCE

ICS 581 Advanced Artificial Intelligence (3-0-3)

This course introduces advanced issues and approaches of artificial intelligence topics, including logic programming, computational learning theory, machine learning (supervised, unsupervised, and reinforcement learning), search-oriented problem solving techniques, computer perception and robotics, speech understanding, knowledgebase systems and reasoning about Knowledge, planning and temporal reasoning, inference and theorem proving, reasoning under uncertainty, principles of intelligent agents, reactive, goal-based, and utility-based agents.

Prerequisite: ICS 381 or Consent of Instructor

ICS 582 Natural Language Processing (3-0-3)

This course examines a range of issues concerning computer systems that can process human languages. Among the issues to be discussed are morphological and syntactic processing, semantic interpretation, discourse processing and knowledge representation. Components of a natural languages processing system, Natural language models: Mathematical, psychological, Lexical, syntactic, and semantic analysis, Phrase-structured grammars, Transformational grammars, Transition networks, Semantic networks, Conceptual parsing, Conceptual dependency, Systemic and case grammars, Scripts, plans and goals, Knowledge representation, Sentence generation. Course projects give the students knowledge in how to use recent trends in Natural Language Processing.

Prerequisite: ICS 381 or Consent of Instructor

ICS 583 Pattern Recognition (3-0-3)

Introduction to pattern recognition, feature extraction, and classification. Bayesian decision theory, maximum likelihood and Bayesian parameter estimation, Nonparametric pattern classification techniques, density estimation. Pattern Classification using linear discriminant functions. Unsupervised machine learning, clustering, vector quantization, K-means. Various methods of pattern recognition, extraction methods, statistical classification, various classifiers and case studies.

Prerequisite: Consent of the Instructor

ICS 584 Automated Theorem Proving (3-0-3)

Survey of proof theory and model theory of first-order predicate calculus, natural deduction, Herbrand's procedure, resolution methods, induction principles, rewrite rules, theorem-provers for algebraic systems.

Prerequisite: Consent of the Instructor

ICS 585 Knowledge-Based Systems (3-0-3)

Overview of Artificial Intelligence disciplines. Architecture of expert systems: including the structure of knowledge bases and the various knowledge representation methods, inference engines and reasoning techniques, search and exploitation of domain-specific knowledge through heuristics, knowledge acquisition. Discuss examples of expert systems shells, their capabilities and limitations. Assign projects in specific discipline using available shells.

Prerequisite: ICS 581

ICS 586 Neural Networks (3-0-3)

Fundamental concept of neural computation. Main neural network models. Perceptions and back-propagation, Hopfield and feedback models. Fault-tolerance in neural networks. Parallel processing in neural networks. Potential and limitations of neural networks. Applications of neural computing. Project(s).

Equivalent to: COE 591 and EE 560

Pre-requisites: ICS 581

ICS 589 Special Topics in Artificial Intelligence (3-0-3)

Advanced topics selected from current journals of Artificial Intelligence that deal with theoretical development or applications of computer systems.

Prerequisite: Consent of Instructor

Area 6: APPLIED COMPUTING

ICS 541 Database Design and Implementation (3-0-3)

Database development life cycle. Data modeling. Database design theory. Query processing. Concurrency control and transaction management. Recovery. Security. Database applications: data warehousing, data mining, web pages, and others. Various types of database systems: object relational, object-oriented, distributed, client/server, and others. Current trends in database research. Project(s).

Prerequisite: ICS 334 or Equivalent

ICS 542 Multimedia Computing (3-0-3)

Multimedia data representation and management in the context of content-based retrieval, audio, image and video data representation, Information retrieval from text. Content based retrieval of audio, image and video data, Similarity measures. Query formulation and evaluation, Multi-dimensional indexing algorithms and data structures. Multimedia compression. Multimedia data mining.

Equivalent to: COE 593
Prerequisite: Consent of Instructor

ICS 543 Advanced Computer Graphics (3-0-3)

Graphics systems. Two dimensional concepts and methods. Geometrical transformations. Modeling 3D scenes. Curve and surface design. Approaches to infinity. Rendering faces for realism. Color theory. Visible-surface determination. Illumination models and shading. Project(s).

Prerequisite: ICS 435 or Equivalent

ICS 544 E-Commerce Technologies (3-0-3)

Fundamentals of E-Commerce: B2B and B2C models. Internet networking: TCP/IP, IIOP, SOAP. Internet Security: firewalls, viruses, hacking. Design issues of E-Commerce: n-tier technology, Object Oriented paradigm such as Common Object Request Broker Architecture and Component Object Model. Web Servers. Data transactions between database servers and web servers using XML. Project(s).

Prerequisite: ICS 313 or Equivalent

ICS 545 Arabic Computing (3-0-3)

Contemporary concepts and research in the field of Arabic Computing. Arabic characteristics and standardization. Arabic systems and tools. Arabic programming languages. Arabic character recognition. Arabic speech synthesis and recognition. Natural Arabic processing.

Prerequisite: Consent of Instructor

ICS 549 Special Topics in Applied Computing (3-0-3)

Advanced topics selected from current journals on various IT and CS applications that deal with theoretical and practical development in various enterprises.

Prerequisite: Consent of Instructor

OTHER COURSES

ICS 591 Independent Study (3-0-3)

The course can be taken under the supervision of a faculty member to conduct an in-depth study of a subject.

Prerequisite: Consent of Instructor

ICS 599 Seminar (1-0-0)

Graduate students are required to attend the seminars given by faculty members, visiting scholars, and fellow graduate students. Additionally, each student must give at least presentation on a timely research topic. Among other things, this course is designed to give the student an overview of research, research methodology, journals and professional societies. Graded on a Pass or Fail basis.

Prerequisite: Graduate standing

ICS 610 Master Thesis (0-0-6)

The student has to undertake and complete a research topic under the supervision of a faculty member in order to probe in depth a specific problem in Computer Science.

Prerequisite: ICS 599 or Consent of Instructor.

PH.D. PROGRAM IN COMPUTER SCIENCE AND ENGINEERING

Computer science and engineering (CSE) is a discipline that covers all aspects of design and integration of computer systems. CSE is highly interdisciplinary, in the sense that there is hardly any branch of knowledge where computers have not penetrated as major tools in simplifying and obviating low-level, well-understood, automated procedures.

Computer science and engineering refers to the study of theoretical computer science, software engineering, languages and systems, computer networks, parallel and distributed systems, artificial intelligence, computer architectures and design, VLSI systems, and their applications.

The computer science and engineering Ph.D. program prepares engineers and scientists to carry out independent research and to analyze, design, and improve algorithmic and/or hardware solutions to practical problems. It draws on faculty from the Computer Engineering and Computer Science Departments.

TEACHING AND RESEARCH FACILITIES

Teaching and research are supported in the College of Computer Sciences and Engineering by a large heterogeneous network of workstations, servers and PCs that provide all standard IT facilities including data storage and backup, web publishing, etc. to faculty and students on 24 hour basis throughout the week. Workstations are equipped with all major office and scientific applications such as MATLAB, OPNET, mentor graphics; application development packages (IDEs) and database applications. Currently there are 20 labs equipped with 500 workstations. Most of the workstations are based on the Intel dual core platform for windows and Linux based labs, in addition to 20 UNIX workstations based on the SunFire platform.

The college promotes the use heterogeneous computing environment, so that students get trained on all major computing platforms. Separate network/ computing domains are used for UNIX and Windows network. The Windows domain acts as a basis for administering PC labs. Windows 2K3 operating system is used on HP Proliant and Dell PowerEdge servers for this purpose. The UNIX domain hosts a traditional Unix-based computing facility, with services like UNIX based home directories, web publishing and support for various Unix-based applications and tools. The UNIX setup consists of Solaris and Linux on more than 20 servers which are based on different hardware platforms such as Sun Ultra Enterprise, SunFire, Sun Blade Center, HP Proliant, Dell PowerEdge, IBM Blade Center and IBM XSeries servers. Storage servers are based on advanced storage technologies, such as NAS and SAN.

The college has its own state-of-the-art networking infrastructure with optical fiber backbone and high speed Ethernet, which employs modern routers and switches to control the network traffic.

ADMISSION REQUIREMENTS

Applicants for the Ph.D. program in Computer Science and Engineering must hold an M.S. degree in Computer science, Computer Engineering, or its equivalent from a reputable university. In addition, all applicants must satisfy the general admission requirements of the Graduate School.

ACADEMIC PROGRAM

The primary emphasis of the Ph.D. program is to develop quality computer professionals capable of serving as faculty at various colleges and universities, advancing the state of the art in their respective field of expertise, as well as designing and integrating computer systems for constructive use in society.

The Ph.D. degree in computer science and engineering will be awarded to candidates who successfully complete all the requirements of the degree, which consist of:

1. Completion of 30 credit hours of course work with a GPA of at least 3.0 (on a scale of 4.0),
2. Satisfactory performance in the written and oral comprehensive examinations,
3. Successful completion and defense of original work documented as a dissertation, and
4. Other requirements specified by the Deanship of Graduate Studies.

The program provides specialization in one of the following areas:

Area 1: Computation and Artificial Intelligence,

Area 2: Languages and Systems,

Area 3: Parallel Processing and Networking, and

Area 4: Computer Architecture and VLSI.

A full-time Ph.D. student is expected to spend about two years completing his required course work. The dissertation work is also expected to require about two years. The maximum period permitted for a full-time Ph.D. student to complete the Ph.D. is 5 years and 7 years for a part-time student. A student must spend a minimum of one year in residence doing his Ph.D. dissertation work.

CURRENT RESEARCH INTERESTS

Computer Science and Engineering faculty are actively involved in many contemporary research areas in their fields. The current research interests of the faculty include:

> Wireless and mobile computing (mesh, ad-hoc, and sensor networks); Network design; Network performance analysis and evaluation; Network management; Network resource management; Next generation networks; Pervasive computing; Network topology control; Web service technology; Optical networks; Distributed real-time systems; IT security systems, including biometrics and forensics; Applied cryptography and steganography; Encryption and authentication technologies; Computer network security; Autonomous intelligent systems (Robotics); Multimedia systems; Computer vision; Access technology (smart cards and RFID technology); Design and analysis of algorithms; Neural networks; Software engineering; Machine learning; Natural language processing and machine translation; Computer graphics; VLSI design automation; Synthesis and verification of hardware systems; Testing, verification and design for testability; Software-hardware co-design; Application-specific and mixed-signal Systems; Systems on chips; Configurable computing; Parallel computing and distributed processing; High performance architecture/processing; Fault-tolerant computing.

COURSE REQUIREMENTS

The completion of at least 30 credit hours of course work beyond the M.S. course work and beyond the remedial courses is required for all Ph.D. students. In addition to the courses listed below, any COE 5xx, CSE 5xx, or ICS 5xx course can be counted toward the required 30 credit hours given that no such course has been counted towards the requirement of another degree. A list of these courses, classified by area, is available at the COE and ICS departments.

Area 1: Computation and Artificial Intelligence

CSE 611	Approximation and Probabilistic Algorithms
CSE 612	Combinatorial Algorithms & Optimization
CSE 613	Computational Complexity
CSE 650	Advanced Neural Networks
CSE 651	Robotics Programming
CSE 652	Advanced Computer Vision

Area 2: Languages and Systems

CSE 620	Systems Development Methodologies
CSE 621	Information Systems Planning
CSE 622	Formal Derivation of Programs
CSE 630	Semantics of Programming Languages
CSE 631	Compiler Optimization
CSE 632	Distributed Operating Systems

Area 3: Parallel Processing and Networking

CSE 632	Distributed Operating Systems
CSE 640	Parallel Computation
CSE 641	Reliability and Fault Tolerance of Computer Systems
CSE 642	Computer Systems Performance
CSE 661	Parallel and Vector Architectures

Area 4: Computer Architecture and VLSI

CSE 660	Non-Conventional Computer Arithmetic
CSE 661	Parallel and Vector Architectures
CSE 662	VLSI Array Processors
CSE 670	Design Issues of VLSI Programmable ASICs
CSE 671	Silicon Compilation and High-level Synthesis
CSE 672	Advanced Digital System Testing

Should it be necessary for a student to take courses beyond this list, appropriate graduate courses from other departments could be taken, at the discretion of the dissertation advisor and the Joint Doctoral Program Committee.

Each student will have a major and a minor area of concentration. A major area must be one of the four areas of specialization mentioned above. A minor area can be selected by the student in consultation with his dissertation advisor. A minor area can be from a single department or from a number of departments, if the topic is a coherent one. It is recommended that the minor area should be selected keeping in view the background of the student. It is desirable that a minor area be orthogonal and complementary to the major area.

Composition of Credit Requirements

Course Requirements	Credit Hours
Two courses from each of 2 areas out of Areas 1–4	12
3 courses from one (dissertation) area (at least two CSE 6XX courses)	9
3 other courses from minor area(s)	9
Total	**30**

Degree Plan for the Ph.D. Program in Computer Science and Engineering

Course #	Title	LT	LB	CR
First Semester				
COE/ICS/CSE xxx	Course from Area A	3	0	3
COE/ICS/CSE xxx	Course from Area A	3	0	3
COE/ICS/CSE xxx	Course from Area B	3	0	3
COE/ICS/CSE xxx	Course from Area B	3	0	3
		12	**0**	**12**
Second Semester				
CSE 6xx	Course 1 from Dissertation Area	3	0	3
CSE 6xx	Course 2 from Dissertation Area	3	0	3
XXX xxx	Course 1 from Minor Area	3	0	3
XXX xxx	Course 2 from Minor Area	3	0	3
		12	**0**	**12**
Third Semester				
COE/ICS/CSE xxx	Course 3 from Dissertation Area	3	0	3
XXX xxx	Course 3 from Minor Area	3	0	3
		6	**0**	**6**
Comprehensive Examination				
Fourth Semester				
CSE 699	Seminar	1	0	0
CSE 710	Ph.D. Dissertation Work	0	0	IP
Fifth Semester				
CSE 710	Ph.D. Dissertation Work	0	0	IP
Sixth Semester				
CSE 710	Ph.D. Dissertation Work	1	0	12
Total Credit Hours				**42**

*Only after completing deficiency courses will a student's status be changed to "Regular Ph.D. student." The semesters are numbered after regular standing status is achieved.

IP: Dissertation in progress.

COURSE DESCRIPTION

CSE 611 Approximation & Probabilistic Algorithms (3-0-3)

Approximation algorithms to combinatorial problems like scheduling, bin-packing, knapsack, vertex cover, TSP, clique partitioning, graph compression, Steiner problem on networks. Randomized algorithms: Monte-Carlo, Las-Vegas, and simulated annealing. Genetic algorithms. Graph matching and applications. Network flows and applications.

Prerequisite: ICS 553 or Consent of the Instructor

CSE 612 Combinatorial Algorithms & Optimization (3-0-3)

Representation and generation of combinatorial objects. Searching: exhaustive search and its approximations and fast search techniques. Sorting and related problems. Graph algorithms. Greedy method and the theory of materials. NP-Hard and NP-Complete combinatorial problems.

Prerequisite: ICS 554 or Consent of the Instructor

CSE 613 Computational Complexity (3-0-3)

Computational complexity. Time-space complexities. Speedup, hierarchy theorems. Time-Space Tradeoff. Translational Lemmas. Gap and Union theorems. Intractable problems — polynomial time and space. Theory of NP-Completeness — Classes P, NP, Co-NP, PSPACE. Poly-Time and Log-Space transformations. Proof techniques for establishing NP-Completeness. Turing Reducibilities and polynomial hierarchy. Using NP-Completeness to Analyze problems. NP-Hardness. Introduction to Approximation algorithms to hard problems.

Prerequisite: ICS 552 or Consent of the Instructor

CSE 620 Systems Development Methodologies (3-0-3)

Information analysis. Information systems planning. Various approaches to Systems development: Participative, Prototyping, Phenomenological, Evolutionary, etc. Systems development methodologies: Soft systems methodology, information engineering, SSADM, ISAC, etc. Systems development environments. Deliverables. Project management and control.

Prerequisite: ICS 513, ICS 514, or Consent of the Instructor

CSE 621 Information Systems Planning (3-0-3)

Concepts of organizational planning. The Planning process. Computational support for planning. Understanding information systems planning: functions, processes, information groups, subject databases. Information systems planning methodologies.

Information needs analysis. Strategic planning of information systems. IS planning for competitive advantages. Students should complete an IS plan real life situation of reasonable complexity as a term project.

Prerequisite: ICS 513, ICS 514, or Consent of the Instructor (Students are expected to have sufficient background in Information Systems planning)

CSE 622 Formal Derivation of Programs (3-0-3)

Predicate calculus. Program semantics of guarded commands. Postconditions and specifications. Weakest preconditions. Weakest liberal preconditions. Loop invariants. Termination and non-termination. Partial and total functions. Non-determinacy. Standard techniques in program derivation. Examples of program derivation.

Prerequisite: Consent of the Instructor

CSE 630 Semantics of Programming Languages (3-0-3)

Formal methods for the description of programming languages. Operational, axiomatic and denotational semantics, attribute grammar, two-level grammars. Fixed-point theory of computation. Verification techniques.

Prerequisite: ICS 535 or Consent of the Instructor

CSE 631 Compiler Optimization (3-0-3)

Program optimization for speed and size. Reducing redundancy. Register allocation optimization. Data flow analysis and code optimization. Fast optimization algorithms. Optimization methods in existing compilers. Optimization problems for special languages.

Prerequisite: Consent of the Instructor

CSE 632 Distributed Operating Systems (3-0-3)

Distributed system architectures and distributed processing. Communication primitives: remote procedure call and message passing methods. Resource sharing. Distributed deadlock management. Naming. Load balancing. Fault tolerance. File service. Protection issues. Design issues. Projects on important aspects of distributed and network operating systems. Case studies.

Prerequisite: ICS 571 or Consent of the Instructor

CSE 640 Parallel Computation (3-0-3)

Various Parallel Computation Models, such as: PRAM Models, CRCW, CREW, ERCW, EREW. Simulations of PRAM models. Alternation. Boolean Circuits. Parallel

Computation Thesis. Cellular Automata. Parallel Complexity Measures; NC Class. Simulations of Different Parallel Computation Models.

Prerequisite: ICS 556 or Consent of the Instructor

CSE 641 Reliability and Fault Tolerance of Computer Systems (3-0-3)

Reliability and fault-tolerance of computer networks such as FDDI, double loop, hypercube, multi-stage interconnection network, multiprocessor systems, etc. Reliable and fault-tolerant routing, Reliability evaluation algorithms, Availability and survivability of computer systems, Reliability models of JPL-STAR, FTMP,

ESS No. 1, PLURIBUS, etc. Software fault tolerance and reliability. Projects using network reliability evaluation tools such as SYREL, SHARPE and SPNP.

Prerequisite: COE 523 or Consent of the Instructor

CSE 642 Computer Systems Performance (3-0-3)

Queuing theory. Stochastic Petrinets and Markov Chains. Separable queuing networks. Priority queuing systems. Evaluation studies: monitoring techniques, modeling methods and model validation. Application of queuing theory to computer time-sharing & multi-access systems, multiprocessor systems, interconnection networks. Computer communication networks. Case studies of several distributed and network system configurations.

Prerequisite: COE 532, SE 541, or Consent of the Instructor

CSE 650 Advanced Neural Networks (3-0-3)

Introduction to neural computation. Biological neurons. Fundamental concepts behind various models of neural networks. Functional equivalence and convergence properties of neural network models. Adaptation and learning in neural networks: associative, competitive, inhibitory, and adaptive resonance models of learning. Back-propagation, Hopfield Nets, Boltzmann machines, Cauchy machines, ART, and feature map (Kohonen model). Cognitron and neocognitron. VLSI, optical, and software implementations. Potentials and limitations of neural networks. Applications to vision, speech, motor control and others. Projects.

Prerequisite: COE 580 or Consent of the Instructor

CSE 651 Robotics Programming (3-0-3)

Review of issues in robotics programming. In depth study of robotic programming languages. Design and implementation of robotic programming languages and environments. Single and multi-robot environments. Case studies. Project.

Prerequisite: COE 552 or Consent of the Instructor

CSE 652 Advanced Computer Vision (3-0-3)

The physics of vision and its computational modeling. Applications to Robot vision. Image formation and sensing. Basic image processing: edge finding, image segmentation, and texture analysis. Reflectometry: brightness, color and reflectance map. Shape from shading. Photogrammetry and stereo. Motion fields and optic flow. Passive navigation and structure from motion. Active vision. Representations, primer sketch, 2.5-D map, 3D map. Human visual system.

Prerequisite: ICS 581, ICS 583, or Consent of the Instructor

CSE 660 Non-Conventional Computer Arithmetic (3-0-3)

Mixed base number systems. Negative base arithmetic. Logarithmic based arithmetic. Residue number systems. P-adic numbers. Signed digit arithmetic. Representation of Complex numbers. Relational number arithmetic. Examples.

Prerequisite: COE 522 or Consent of the Instructor

CSE 661 Parallel and Vector Architectures (3-0-3)

Parallel models of computation. Concept of pipelining at different levels of architecture. Pipelined functional units. Pipelined vector processors. Vectorizing compilers and software. Operating system support for vector scheduling and load balancing. Parallel languages. Parallel algorithms. Concurrentization and Vectorization.

Prerequisite: ICS 573 or Consent of the Instructor

CSE 662 VLSI Array Processors (3-0-3)

Impact of VLSI on computer architecture. Mapping algorithms onto array structures: dependency graphs, signal flow graphs. Design and analysis of systolic arrays. Wave front array processors. Retiming and systolicization. Implementation and verification of array processors. Examples.

Prerequisite: COE 520 or Consent of the Instructor

CSE 670 Design Issues of VLSI Programmable ASICs (3-0-3)

ASIC design methodologies. Programmable ASICS. Field Programmable Gate Arrays: Architecture, Programming technologies, Design parameters and models. FPGA technology mapping techniques, Routing techniques, Placement techniques and Testability.

Prerequisite: COE 542 or Consent of the Instructor

CSE 671 Silicon Compilation and High-level Synthesis (3-0-3)

Levels of abstraction: behavioral, structural, and physical levels. Design description. Module generation (functional cell generation, gate matrix layout, PLAs, etc.) and Module optimization. High level synthesis: Intermediate forms (data flow and control flow graphs), Scheduling algorithms, data flow and control flow synthesis, resource allocation, and module binding. Knowledge based and expert system approach to Design Automation.

Prerequisite: COE 542 or Consent of the Instructor

CSE 672 Advanced Digital System Testing (3-0-3)

Fault Modeling. Test Generation. Built-in test and Self-test concepts for hierarchical circuit models. Complex microprocessors and semiconductor memories.

Prerequisite: COE 545 or Consent of the Instructor

CSE 690 Independent Study (3-0-3)

A specialized topic that may not be broad enough to be offered as a regular course. To be arranged with the instructor.

Prerequisite: Consent of the Instructor

CSE 692 Special Topics in Computer Science (3-0-3)

Any state of the art topics or topics of recent interest in any areas in computer science that may not fit well with the description of the previously mentioned courses.

Prerequisite: Consent of the Instructor

CSE 693 Special Topics in Computer Engineering (3-0-3)

Any state of the art topics or topics of recent interest in any areas in computer engineering that may not fit well with the description of the previously mentioned courses.

Prerequisite: Consent of the Instructor

CSE 699 Seminar (1-0-0)

This involves attending the regular departmental seminars, presenting one's work in one of the seminars, and producing a final report to the satisfaction of the seminar co-ordinator. This course carries no credit.

Prerequisite: Consent of the Instructor

CSE 710 Ph.D. Dissertation Work (0-0-12)

This is intended to document the effort that would have to be put into the original work conducted by a potential Ph.D. aspirant.

Prerequisite: Ph.D. Candidacy

Systems Engineering

Chairman

Fouad Al-Sunni

Professors

Al-Fares	Ben-Daya	Magdi
Al-Haboubi	Doraiswami	Selim
Al-Sunni	Duffuaa	Shabaik
Andijani	El-Shafei	

Associate Professors

Al-Turki	Darwish
Cheded	Haroun

Assistant Professors

Al-Amer	Al-Salamah	Fedjki
Al-Dajani	Ayar	Khoukhi
Al-Ghamdi	El-Ferik	Mysorewala
Al-Saif		Ndiaye

Adjunct Professors

Boukas	Murthy	Rahim

Lecturers

Ameenuddin	Arifusalam

INTRODUCTION

The Department of Systems Engineering, King Fahd University of Petroleum & Minerals offers graduate programs leading to the Master of Science and Doctor of Philosophy in Systems Engineering. The programs cover analysis, design and control of engineering systems. Particular attention is devoted to both the physical processes involved and the components of decision making in the industrial environment.

The objective of the Systems Engineering programs is to prepare engineers who can function well in large-scale, interdisciplinary projects and who can do independent research to analyze, improve, design, and install engineering systems. Then monitor and control to improve systems productivity.

The programs reflect the importance of interdisciplinary endeavors in the solution of real problems. The composition of the faculty exhibits this aspect as does the policy of admitting qualified students from various technical backgrounds upon completion of a B.S. and Master degrees. Both programs have two options:

1. Automation and Control
2. Industrial Engineering and Operations Research.

The primary thrust of these options is to graduate engineers who can carry out modern automation technology tools of industrial systems existing in all engineering disciplines and industries such as oil industry, petrochemical industry, steel industry, power systems etc., as well as nonmanufacturing systems. At the Ph.D. level, graduates should be able to conduct necessary research and development work in process industries, government ministries as well as military establishments in addition to teaching at the University level.

1. AUTOMATION AND CONTROL

This option emphasizes the analysis, design, synthesis, and optimization of systems in order to provide the best means of controlling their dynamic behavior to produce specified outputs. Automation, Control theory, Process control, etc. are essential parts of the program.

2. INDUSTRIAL ENGINEERING AND OPERATIONS RESEARCH

This option is concerned with the design, optimization, installation, and improvement of integrated systems of people, materials, and equipments. In this option, the scientific methods applied to decision-making, allocation of resources and optimization of systems will be emphasized. Operations Research models and techniques such as Linear Programming, Non-Linear Programming, Dynamic Programming, Queuing theory, Network, Scheduling and Simulation are studied. In the Industrial Engineering part, Quality, Reliability, Production and Inventory, Maintenance, Human Factors and Work Measurements are essential elements of the program. The overall emphasis is to integrate knowledge to operate, optimize, and improve systems productivity.

TEACHING AND RESEARCH FACILITIES

The College and the Department maintain well equipped laboratories. The department has established a Computer Control Laboratory Honeywell Distributed Computer Control, TDC-3000 and a PC-based Process control laboratory. Recently, the Instrumentation and Measurement Laboratory and the Feedback Control Laboratory have been upgraded with very up-to-date equipment. The department has also established another laboratory in advanced instrumentation. Additionally, the department established a new system optimization laboratory with personal computers, workstations, access to the University Mainframe, and equipped with the latest software packages. Other laboratories are: Digital Logic, Microprocessor-based System, Analog Computer, Industrial Automation, Robotics and a Human Performance Laboratory.

GRADUATE PROGRAMS IN SYSTEMS ENGINEERING

The Department offers both M.S. and Ph.D. in Systems Engineering in two options, namely, Automation & Control option and Industrial Engineering & Operations Research option. Details of these programs are given below.

DEPARTMENT ADMISSION REQUIREMENTS

Graduates in engineering, Computer Science and Mathematics from recognized institutions are eligible to apply for admission as regular students to the Master's Program provided they satisfy the Graduate School admission requirements.

Graduate students with a Master degree in the above-mentioned disciplines from recognized institution are eligible for admission to the Ph.D. provided they satisfy the Graduate School admission requirements.

M.S. PROGRAM IN SYSTEMS ENGINEERING

The program consists of a total of 30 credit hours: 12 credit hours of core courses, 12 credit hours of elective courses plus 6 credit hours of thesis. The student must choose automation and control *or* industrial engineering and operations research as an option.

Lists of core courses for each option are given below.

List A: Automation/Control Option core courses

1. SE 507 Linear Systems
2. SE 513 Introduction to System Identification
3. SE 514 Optimal Control
4. SE 543 Stochastic Processes -I

List B: IE/OR Option core courses

1. SE 503 Linear Programming and Applications -I
2. SE 508 Advanced Production systems and Inventory Control
3. SE 521 Nonlinear Programming and Applications -I
4. SE 543 Stochastic Processes -I

An MS student is required to take four core courses from the above lists. The four courses must contain courses number 1 and 2 from his chosen option's list and at least one course from the other option list.

Also a student is required to take four more elective courses. The policy for selecting electives is as follows: at least two of these electives should be taken from the graduate offerings of the SE department, while a maximum of two of them may be taken outside the SE department as free technical electives from the colleges of CCSE, Engineering and Sciences according to the approved degree plan.

Degree Plan for the M.S. Program in Systems Engineering

(Automation and Control option)

Course #	Title	LT	LB	CR
First Semester				
SE 507	Linear Systems	3	0	3
SE 513	Modeling and System Identification I	3	0	3
SE xxx	Core Course from List B	3	0	3
		9	**0**	**9**
Second Semester				
SE xxx	SE Elective I	3	0	3
SE xxx	Core Course from List A or B	3	0	3
XX xxx	Free Elective I	3	0	3
SE 599	Seminar	1	0	0
		10	**0**	**9**
Third Semester				
SE xxx	SE Elective II	3	0	3
XX xxx	Free Elective II	3	0	3
		6	**0**	**6**
Fourth Semester				
SE 610	Thesis	0	0	6
		0	**0**	**6**
Total Credit Hours				**30**

Degree Plan for the M.S. Program in Systems Engineering

(Industrial Engineering & Operations Research option)

Course #	Title	LT	LB	CR
First Semester				
SE 503	Linear Programming & Applications-I	3	0	3
SE 508	Advanced Production Systems & Inventory Control	3	0	3
SE xxx	Core Course from List A	3	0	3
		9	**0**	**9**
Second Semester				
SE xxx	Core Course from List A or B	3	0	3
SE xxx	SE Elective I	3	0	3
XX xxx	Free Elective I	3	0	3
		9	**0**	**9**
Third Semester				
SE xxx	SE Elective II	3	0	3
XX xxx	Free Elective II	3	0	3
SE 599	Seminar	1	0	0
		7	**0**	**6**
Fourth Semester				
SE 610	Thesis	0	0	6
		0	**0**	**6**
Total Credit Hours				**30**

AUTOMATION AND CONTROL COURSES

SE 505	Real-Time Computer Systems	3-0-3
SE 507	Linear Systems	3-0-3
SE 509	Large Scale and Hierarchical Systems	3-0-3
SE 511	Computer-Aided Design	3-0-3
SE 512	Microprocessor Architecture and Interfacing	3-0-3
SE 513	Modeling and System Identification I	3-0-3
SE 514	Optimal Control	3-0-3
SE 515	Distributed Computer Control	3-0-3
SE 516	Microcomputer-Based Measurements	3-0-3
SE 517	Non-Linear System Theory	3-0-3
SE 518	Deterministic Modeling and Simulation	3-0-3
SE 524	Digital Signal Processing	3-0-3
SE 532	Industrial Robots	3-0-3
SE 537	Adaptive Control	3-0-3
SE 590	Special Topics in Systems Engineering	3-0-3

INDUSTRIAL ENGINEERING AND OPERATIONS RESEARCH COURSES

Production and Quality Control

SE 508	Advanced Production system and Inventory Control	3-0-3
SE 520	Analytical Methods in Facility Location and Layout	3-0-3
SE 529	Advanced Maintenance Planning & Control	3-0-3
SE 530	Computer-Aided Manufacturing	3-0-3
SE 531	Systems Reliability / Maintainability	3-0-3
SE 533	Advance Work Measurement Analysis	3-0-3
SE 534	Advanced Quality Control	3-0-3

Operations Research

SE 501	Survey of Operations Research Models and its Appls.	3-0-3
SE 503	Linear Programming and Applications -I	3-0-3
SE 521	Nonlinear Programming & Applications-I	3-0-3
SE 525	Network Modeling and Algorithms	3-0-3
SE 527	Decision Making	3-0-3
SE 548	Sequencing and Scheduling	3-0-3
SE 570	Optimization Methods for Engineering Design	3-0-3
SE 571	Heuristic Search Methods	3-0-3

Simulation and Applied Probability

SE 518	Deterministic Modeling and Simulation	3-0-3
SE 522	Advance Stochastic Simulation	3-0-3
SE 523	Forecasting Systems	3-0-3
SE 535	Design of Experiments	3-0-3
SE 541	Queuing Models and Theory-1	3-0-3
SE 543	Stochastic Process - 1	3-0-3

Man–Machine Systems

SE 533	Advanced Work Measurement & Analysis	3-0-3
SE 536	Human Factors Engineering	3-0-3

PH.D. PROGRAM IN SYSTEMS ENGINEERING

The Ph.D. Program consists of a total of 30 course credit hours: 21 credit hours taken from the major area of specialization, 9 credit hours to be selected from other allied areas or other departments (which constitute a minor), plus 12 credit hours of thesis. The minimum time requirement to complete the Ph.D. is three years. The Ph.D. program has two major areas of specialization:

1. Automation and Control
2. Industrial Engineering and Operations Research.

1. AUTOMATION AND CONTROL OPTION

In order to prepare the Ph.D. graduates to work in the rapidly developing fields of Systems Science and Automation Technology, the Automation and Control Option is structured to offer a wide selection of courses and seminars. The Ph.D. courses are built on the M.S. courses, and are broadly clustered on the system-theory course area and two application oriented course areas. The student course load requirement is a minimum of 10 courses from the 500/600 level courses. A student may take up to 3 courses outside the department with the approval of his advisor.

Following is a brief description of the various course areas:

Systems & Control Theory

The purpose of this set of courses is to provide fundamentals of control and systems theory. This set includes:

SE 507	Linear Control Systems
SE 509	Large Scale and Hierarchical Systems
SE 513	Modeling and System Identification I
SE 514	Optimal Control
SE 517	Nonlinear Systems Theory
SE 524	Digital Signal Processing
SE 537	Adaptive Control
SE 613	Modeling and System Identification II
SE 624	Advanced Techniques in Digital Signal Processing
SE 650	Theory of Robust Feedback Systems
SE 652	Input–Output Feedback Theory
SE 654	Advance Methods for Control System Synthesis
SE 658	Filtering and Estimation
SE 690	Special Topics in Systems and Control

Robotics and Machine Intelligence

The objective here is to provide the foundations for study and research in the field of Intelligent Automation Systems. Courses include:

SE 502	Industrial Automation
SE 508	Advanced Production Systems & Inventory Control
SE 532	Industrial Robots
SE 632	Robot Arms Dynamics and Control
SE 656	Speech Processing & Recognition
SE 660	Artificial Intelligence and Expert Systems in Control
SE 662	Image Processing and Pattern Recognition in Automation
SE 666	Remote Control Systems
SE 692	Special Topics in Robotics and Intelligent Systems.

Control Applications & Distributed Computer Control

The objective of this area is to provide the training and background to handle specific applications which depend on the student's interests and thesis. Courses include:

SE 505	Real Time Computer Control Systems
SE 512	Microprocessor Architecture and Interfacing
SE 515	Distributed Computer Control
SE 518	Deterministic Modeling and Simulation
SE 522	Stochastic Simulation and Queuing Models
SE 525	Network Modeling & Algorithm
SE 530	Computer Aided Manufacturing
SE 615	Distributed Process Control Systems
SE 668	Guided Systems Control
SE 694	Special Topics in Control Applications & DCS Systems.

Degree Plan for the Ph.D. Program in Systems Engineering

(Automation & Control Option)

Course #		Title		LT	LB	CR
FIRST SEMESTER						
SE	5xx	Elective I-	SE	3	0	3
SE	5xx	Elective II-	SE	3	0	3
SE	5xx	Elective III-	SE	3	0	3
				9	**0**	**9**
SECOND SEMESTER						
SE	5xx	Elective IV -	SE	3	0	3
SE	5xx	Elective V -	SE	3	0	3
SE	6xx	Elective VI -	SE	3	0	3
XXX	5xx	Elective VII -	(Minor area)	3	0	3
				12	**0**	**12**
THIRD SEMESTER						
SE	6xx	Elective VIII -	SE	3	0	3
XXX	5xx	Elective IX –	(Minor area)	3	0	3
XXX	5xx	Elective X -	(Minor area)	3	0	3
				9	**0**	**9**
FOURTH SEMESTER						
SE	599	Seminar		1	0	0
SE	710	Ph.D. Dissertation		0	0	IP
FIFTH SEMESTER						
SE	710	Ph. D. Dissertation (Continued)		0	0	IP
SIXTH SEMESTER						
SE	710	Ph. D. Dissertation (Continued)		0	0	12
				1	**0**	**12**
Total Credit Hours						**42**

IP: Dissertation in Progress

2. INDUSTRIAL ENGINEERING & OPERATIONS RESEARCH OPTION

This option consists of three sub-areas. These sub-areas are: Operations Research & Applications; Production & Quality Control; and Man–Machine Systems. The courses in each area are built on the M.S. courses. A student is required to take a minimum of 10 courses from 500/600 level courses. A student may take 3 courses outside the department with the approval of his advisor. The following is a list of the various courses in each area:

Operations Research & Applications

SE 501	Survey of Operations Research Models and its Applications
SE 503	Linear Programming and Applications-I
SE 520	Analytical Methods in Facility Location
SE 521	Non-Linear Programming and Applications-I
SE 522	Advanced Stochastic Simulation
SE 523	Forecasting Systems
SE 525	Network Modeling & Algorithms
SE 527	Decision-Making
SE 541	Queuing Models and Theory-I
SE 543	Stochastic Process-I
SE 548	Theory of Scheduling
SE 570	Optimization Methods for Engineering Design
SE 571	Heuristic Search Methods
SE 603	Linear Programming and Applications-II
SE 621	Non-Linear Programming and Applications-II
SE 623	Global Optimization Using Interval Analysis
SE 625	Advanced Network Programming
SE 627	Multiple Criteria Decision-Making
SE 641	Queuing Models & Theory-II
SE 643	Stochastic Process-II
SE 651	Integer Programming
SE 653	Dynamic Programming
SE 657	Stochastic Programming
SE 694	Special Topics in Operations Research

Production and Quality Control

SE 502	Industrial Automation
SE 508	Advanced Production System and Inventory Control
SE 529	Advanced Maintenance Planning & Control
SE 530	Computer-Aided Manufacturing
SE 531	System Reliability and Maintainability
SE 534	Advanced Quality Control
SE 535	Design of Experiments
SE 608	Advanced Production Systems
SE 659	Advanced Material Management
SE 661	Manufacturing Costs and Production Economics
SE 663	Productivity Measurement, Evaluation, Planning, and Improvement
SE 665	Advanced Manufacturing Processes
SE 693	Special Topics in Production Systems & Quality Control

Man–Machine Systems

SE 533	Advanced Work Measurement and Analysis
SE 536	Human Factor Engineering-I
SE 567	Work Physiology
SE 569	Human Factor in Computing Systems
SE 636	Human Factor Engineering-II
SE 695	Special Topics in Man–Machine Systems

Degree Plan for the Ph.D. Program in Systems Engineering

(Industrial Engineering & Operational Research Option)

Course #		Title		LT	LB	CR
FIRST SEMESTER						
SE	5xx	Elective I -	SE	3	0	3
SE	5xx	Elective II -	SE	3	0	3
SE	5xx	Elective III -	SE	3	0	3
				9	**0**	**9**
SECOND SEMESTER						
SE	5xx	Elective IV -	SE	3	0	3
SE	5xx	Elective V -	SE	3	0	3
SE	6xx	Elective VI -	SE	3	0	3
XXX	5xx	Elective VII -	(Minor area)	3	0	3
				12	**0**	**12**
THIRD SEMESTER						
SE	6xx	Elective VIII -	SE	3	0	3
XXX	5xx	Elective IX -	(Minor area)	3	0	3
XXX	5xx	Elective X -	(Minor area)	3	0	3
				9	**0**	**9**
FOURTH SEMESTER						
SE	599	Seminar	1	0	0	
SE	710	Ph.D. Dissertation		0	0	IP
FIFTH SEMESTER						
SE	710	Ph. D. Dissertation (Continued)		0	0	IP
SIXTH SEMESTER						
SE	710	Ph. D. Dissertation (Continued)		0	0	12
				1	**0**	**12**
Total Credit Hours						**42**

IP: Dissertation in Progress

COURSE DESCRIPTION

SE 501 Introduction to Operations Research Models & its Application (3-0-3)

The Linear programming problem. The simplex method. The transportation and assignment models. Branch and bound and cutting planes algorithms for Integer programming. Steepest descent, Introduction to unconstrained and constrained nonlinear problem. Dynamic Programming. Introduction to Stochastic processes. Introduction to single server queuing systems. Applications of the above models are emphasized through formulation exercise Case studies, and term projects.

Prerequisite: Graduate Standing (Not open to Credit for SE Majors)

SE 502 Industrial Automation (3-0-3)

Industrial instrumentation: measurement techniques in industrial processes. Computer data acquisition. NC and CNC machine tools. Computer process interfacing and control. Feedback control systems. Group technology. Flexible manufacturing systems. Automated assembly. Industrial robots. Computer-aided inspection and testing. Automated factories. Case studies.

Prerequisites: Graduate Standing and SE 401

SE 503 Linear Programming and Applications-I (3-0-3)

Review of linear programming, revised simplex method, product form of the inverse, duality, dual simplex method, primal dual simplex method, sensitivity analysis, parametric programming, bounded variable linear programs, decomposition principle, classical networks, shortest path problem, maximal flow problem, multicommodity networks. Additional topics may be selected from complementarity, fractional programming and computational efficiency of linear programming algorithms. Case studies.

Prerequisite: SE 303 or MATH 280 or equivalent

SE 505 Real-Time Computer Systems (3-0-3)

The course explores in detail the interrelationships between the architecture and systems software of a modern minicomputer: configuration; real-time operating systems; memory management; interactive editor, program scheduling; priority levels; swapping; input/output control; resource management. Real time programming languages.

Prerequisite: Graduate Standing

SE 507 Linear Systems (3-0-3)

An integrated treatment of continuous linear systems and control theory. Both input/output and state space methods are discussed with more emphasis on state space methods.

Topics include: input/output and state space representations of dynamic systems. Canonical forms, transformation, and equivalent systems. Stability/stabilizability, controllability/reachability, and observability/detectability. State feedback controllers. Full and reduced order observer. Output feedback controllers.

Prerequisite: Graduate Standing (crosslisted with EE 550)

SE 508 Advanced Production Systems and Inventory Control (3-0-3)

Analysis of production and inventory systems, forecasting, single and multi-period deterministic inventory models, stochastic inventory models, deterministic and stochastic production planning, Multistage and dynamic production planning models, MRP systems, Pull, Push and Just-in-Time Systems.

Prerequisites: SE 402 or consent of instructor

SE 509 Large Scale and Hierarchical Systems (3-0-3)

Characteristic of large scale systems. Analysis and design procedures. Model aggregation. Model perturbation. Time and frequency domain techniques. System de-composition and multilevel optimization techniques. The maximum principle and Hamilton–Jacobi theory. Linear regulator problem. Singular control. Open loop and closed loop hierarchical control of continuous-time systems. Hierarchical control of discrete-time linear and nonlinear systems.

Prerequisite: SE 435 or equivalent

SE 511 Computer Aided Design (3-0-3)

Geometric modeling. Engineering Analysis. Design Review and evaluation. Automated drafting. Hardware in CAD. Computer graphics software. Functions of a graphics package. Data base structure and content for CAD/CAM integration. Applications such as (N/C, electronics design, piping, mechanical design, control system).

Prerequisite: Graduate Standing

SE 512 Microprocessor Architecture and Interfacing (3-0-3)

Microprocessor architecture. Memory. I/O interface components and their characteristics. Designing Interface circuits. Interfacing to standard buses and peripherals. Interface software design and implementation. Applications.

Prerequisite: SE 417 or equivalent

SE 513 Modeling and System Identification I (3-0-3)

Fundamentals of stochastic processes; review of modeling from the first principle (energy/mass balance, momentum preservation etc.); process identification from step response, first, second and higher order processes; frequency response identification; correlation methods; least squares identification; determining model orders; model validation; recursive least squares identification; AR, MA modeling of system, linear prediction; application and case studies.

Prerequisite: Gradaute Standing

SE 514 Optimal Control (3-0-3)

Performance measures for dynamic optimal control problems. Variational approach and the maximum principle. Dynamic programming and Hamilton–Jacobi theory. Singular control. Optimal control systems, e.g. minimum time, regulator, servo mechanisms, minimum energy etc. Inter-active numerical techniques for finding optimal trajectories. Case Studies.

Prerequisite: SE Graduate Standing, crosslisted with EE 552

SE 515 Distributed Computer Control (3-0-3)

Distributed control systems configuration. Communications networks. Operator Interface Stations. Control algorithms in distributed control systems. Economic justification of distributed control. Evaluation of distributed computer control systems. Microcomputer control networks. Future trends in distributed computer control.

Prerequisite: SE 401 or equivalent

SE 516 Microcomputer-Based Measurement Techniques (3-0-3)

Principles of intelligent measurement devices. Special purpose sensors; installation; maintenance. Analytical instrumentation: gas chromatography; mass spectroscopy; infrared spectroscopy. Calibration. Industrial measurements such as online analysis of process streams; weight; pH meters, engine monitoring and tuning; machine alignment; noise and vibration. Inferential measurement. Estimation of efficiency, wear, fouling, creep.

Prerequisite: SE 312 or consent of instructor

SE 517 Non-Linear System Theory (3-0-3)

Introduction to nonlinear systems. Phase plane techniques. describing function approach. Liapunov method. Popov criterion. Hilbert spaces and nonlinear operators. Input/Output feedback theory. Passivity and positivity of nonlinear operators. Circle criterion. Multipliers and the small gain theorem. Robustness of feedback systems. Unbounded operators. Applications.

Prerequisite: SE 435 or equivalent

SE 518 Deterministic Modeling and Simulation (3-0-3)

Mathematical models and deterministic modeling generalities, model building methodology for differential and difference equations (lumped processes); partial differential equations (distributed processes). Methodology for model information storage and integration. Support languages for simulation. Hardware trends and their impact on simulation. Case studies.

Prerequisite: SE 301 or equivalent

SE 520 Analytical Methods in Facility Location and Layout (3-0-3)

Application of mathematical programming to the facility location, and layout. Point and area location and layout problems in continuous discrete space are examined.

Prerequisite: SE 422 or equivalent

SE 521 Non-Linear Programming & Applications-I (3-0-3)

Formulation of engineering problems as nonlinear programs; Optimality conditions for nonlinear programs; Algorithms for unconstrained optimization; algorithms for constrained non-linear program; methods of feasible directions (Sequential unconstrained minimization techniques), comparison of algorithms for nonlinear programs. Case Studies.

Prerequisite: SE 305 or (MATH 280 and Advanced Calculus)

SE 522 Advanced Stochastic Simulation (3-0-3)

Fundamental concepts of mathematical and simulation models; efficient generation of random variates, construction of discrete event simulation models, discussion of available computer languages, variance reduction techniques, Jacknifying and classical methods, output analysis.

Prerequisite: SE 405 or equivalent

SE 523 Forecasting Systems (3-0-3)

The course covers the nature, scope, and importance of forecasting, with techniques for forecasting and time series analysis. Topics include regression, moving averages, exponential smoothing, correlation and least square technique, analysis of forecast errors, Box–Jenkins models and Bayesian methods in forecasting. The design of forecasting systems will be emphasized with application oriented examples.

Prerequisite: Graduate Standing

SE 524 Digital Signal Processing (3-0-3)

Review of 1-D time- and frequency-domain representation of signals and systems, including sampling and reconstruction, convolution and correlation, DFT and FFT, z-transforms and random signals. Transformation representation of LTI systems. Digital filter (FIR and IIR) Design and structures. Analysis of finite-length effects in Digital filters. Spectral Analysis, Introduction to multirate DSP. DSP applications and hardware.

Prerequisite: SE 432 (or equivalent) or consent of Instructor.
Cross listed with EE 563

SE 525 Network Modeling and Algorithms (3-0-3)

Modeling with graphs and networks, data structures for network and graphs, shortest path algorithms, properties of the matrix, label setting and label correcting algorithms, spanning tree algorithms, maximum flow algorithms, maximum flow minimum cut theorem, algorithms for the assignment, semi-assignment and the transportation problems, minimum-cost flow algorithms, the simplex method on a graph, out-of-kilter algorithm, embedded networks, constrained network and generalized network, multi-commodity network. Modeling with network includes cases from production, facility location, distribution and inventory and human resource planning.

Prerequisite: SE 501 or equivalent

SE 527 Decision Making (3-0-3)

Structuring decision problems: single criterion versus multiple criteria, certainty versus risk and uncertainty versus conflict, criteria and attributes, payoffs and losses. Utility for decision making. Decision making with single and multiple criteria under certainty: selected discrete MCDM models. Decision making under risk: decision trees, single and multiple stages. Value of information. Decision making under uncertainty. Decision making under conflict: game theory. Decision support systems. Case studies.

Prerequisites: SE 205 and Consent of the Instructor

SE 529 Advanced Maintenance Planning & Control (3-0-3)

Design aspects of maintenance systems, maintenance strategies, maintenance control systems, maintenance planning and scheduling, models of preventive maintenance and condition monitoring, models of the effect of maintenance on production systems, new trends in maintenance strategies and modeling.

Prerequisite: SE 429 or consent of instructor

SE 530 Computer-Aided Manufacturing (3-0-3)

Numerical control. Computer control in NC machine tool. Group technology. Computer aided planning, computer integrated production management. Shop floor control and computer process monitoring systems. Computer integrated manufacturing systems. CAD/CAM implementation.

Prerequisite: SE 502 or Consent of the Instructor

SE 531 Systems Reliability/Maintainability (3-0-3)

Maintainability, fault trees and failure mode analysis. Combinatorial reliability; series, parallel and r-out-of-n configuration; general computation techniques. Catastrophic failure models: hazard rate models. System reliability: approximation methods and reliability bounds. Repairable systems: methods based on renewal theory, system availability. Reliability models identification and parameter estimation. Design for maintainability.

Prerequisite: Graduate Standing

SE 532 Industrial Robots (3-0-3)

Basic concepts in robotics. Architecture of an industrial robot. Robot drives and sensors. Computer control of industrial robots. Programming of industrial robots. Intelligent robots. Applications of industrial robots.

Prerequisite: SE 502

SE 533 Advanced Work Measurement and Analysis (3-0-3)

Design of industrial operations with emphasis on the effective uses of the human body. An examination of the problems of establishing time standards and proposed solutions. Learning curves, fatigue allowances, variations of the MTM system, computerized work measurement systems, staffing problems. Term project on industrial methods design.

Prerequisites: SE 323 and Graduate Standing

SE 534 Advanced Quality Control (3-0-3)

Statistical methods in the design and analysis of quality control systems: sampling inspection, attributes and variables; comparison of sampling plans; control charts; adaptive quality control; total quality control. Machine and process capability studies; organizing for quality; machine case studies/projects with local industries.

Prerequisites: SE 320 and Graduate Standing

SE 535 Design of Experiments (3-0-3)

A scientific and engineering approach to experimentation and analysis of data. Single-factor experiments; Latin squares etc., factorial experiments. Missing data analysis; nested factorial design; multifactor design; fractional replications. Case studies.

Prerequisite: SE 325 or equivalent

SE 536 Human Factors Engineering (3-0-3)

Design of man–machine systems utilizing results from various disciplines including anthropometric data and engineering research. Emphasis is placed on making optimal use of human capabilities. Includes consideration of research techniques in human factors engineering.

Prerequisite: Graduate Standing

SE 537 Adaptive Control (3-0-3)

General approach to controller design; Adaptive control methods; Model reference Adaptive systems, parametric optimization methods, Liapunov function method, hyperstability and positivity concepts; self-tuning controllers, minimum variance selftuner, explicit and implicit algorithms, pole assignment regulators; variable structure systems, sliding motion, choice of control function, control of phase canonic models. Applications.

Prerequisites: SE 435 and Graduate Standing (crosslisted with EE 651)

SE 539 Systems Safety Engineering (3-0-3)

A basic methodology course in Occupational Safety and Health. Topics cover a spectrum of contemporary safety and risk management problems drawn from process as well as manufacturing industries. Problems will be handled using methods of Operations Research and Simulation. A project is a part of the course.

Prerequisites: Graduate Standing and Consent of the Instructor

SE 541 Queuing Models & Theory-I (3-0-3)

Queuing Systems; some important random processes, birth–death queuing systems in equilibrium; markovian queues in equilibrium.

Prerequisite: SE 205, or STAT 315 or Equivalent

SE 543 Stochastic Processes-I (3-0-3)

Introduction to stochastic process, stationarity, ergodicity, Poisson process, linear models, Markov chains, renewal theory, Markov renewal processes, semi-Markov processes and Applications in queuing and other areas

Prerequisite: Graduate Standing

SE 548 Sequencing and Scheduling (3-0-3)

Variety of sequencing and scheduling problems in O.R., job shop and flow shop scheduling, discussion of performance measures, dynamic programming, integer programming, computational complexity and NP-completeness results, discussion of well solved problems, branch and bound methods, variety of heuristic approaches for intractable practical problems, guaranteed accuracy heuristics.

Prerequisites: Graduate Standing and Consent of the Instructor

SE 567 Work Physiology (3-0-3)

An evaluation of various factors affecting human physical performance in industrial environment. Topics include anthropometry, bio-mechanics, energy expenditure, heat stress fatigue.

Prerequisite: Graduate Standing

SE 569 Human Factors in Computing Systems (3-0-3)

User characteristics, Design of keyboards, Controls, and VDT's; Human factors in personal computers, Computer aided design, Computer-aided manufacturing and Control rooms; Human error in computer systems.

Prerequisite: Graduate Standing

SE 570 Optimization Methods for Engineering Designs (3-0-3)

Examples of optimization problems in engineering design: flexural systems, stressed systems, mechanical systems, digital filters. Optimality conditions. Single and multivariable unconstrained optimization. Constrained optimization. Survey of global optimization: exact and non-exact methods. Each student is expected to solve an optimal design problem related to his background.

Prerequisite: Graduate standing and a background in vector calculus. (Not open to credit for SE majors)

SE 571 Heuristic Search Methods (3-0-3)

Examples of combinatorial optimization problems in engineering. Simulated annealing, genetic algorithms, tabu search, evolutionary methods and neural networks. Hybrid methods. Application to large engineering optimization problems. Term project.

Prerequisite: graduate standing (Both SE 571 and EE 556 can not be taken for credit)

SE 590 Special Topics in Systems Engineering (Variable Credit)

SE 599 Seminar (1-0-0)

Graduate students working towards either M.S. or Ph.D. degrees, are required to attend the seminars given by faculty, visiting scholars, and fellow graduate students. Additionally each student must present at least one seminar on a timely research topic. Among other things, this course is designed to give the student an overview of research in the department, and a familiarity with the research methodology, journals and professional societies in his discipline. Graded on a Pass or Fail basis.

SE 603 Linear Programming and Applications-II (3-0-3)

Large scale LP, decomposition principle, computational complexity of the simplex method, the ellipsoid method, review of penalty methods in nonlinear programming, numerical solution of large scale positive definite linear system of equation, interior point methods for linear programming and their efficient implementation for large scale LP, computer project.

Prerequisite: SE 503

SE 608 Advanced Production Systems (3-0-3)

Advanced forecasting models including Box and Jenkins approach. Advanced aggregate production planning models includes linear, quadratic and nonlinear programming models. Desegregation schemes. Lot sizing techniques for material requirement planning. Nervousness and freezing just-in-time manufacturing philosophy. Group technology. Algorithms for part family formation. Flexible manufacturing systems. World-class manufacturing. Effects of maintenance and quality on production. Research papers from various journals in the field are covered. Term projects.

Prerequisite: SE 508.

SE 613 Modeling and System Identification II (3-0-3)

Fundamentals of stochastic processes; review of least squares identification; properties of least squares estimators; prediction error and instrumental variable methods; recursive estimation; maximum likelihood estimator; Cramer-Rao inequality; model structure determination; identification of closed loop systems; model validation; extension to MIMO and nonlinear plants; applications and case studies.

Prerequisite: SE 507 and SE 513.

SE 610 Thesis (0-0-6)

Prerequisite: SE 599.

SE 615 Distributed Process Control Systems (3-0-3)

Synthesis and implementation of digital control systems for complex systems; control configurations; process modeling and identification; dynamic matrix control and internal model control; adaptive control systems; Supervisory and optimizing control; applications and case studies for distillation, combustion, heat exchangers, and flow reactors; recent developments in computer process control.

Prerequisite: SE 515 or Equivalent

SE 621 Advanced Nonlinear Programming & Applications-II (3-0-3)

Elements of Convex analysis, optimality conditions for smooth optimization problems, formulation of quadratic programs as linear complementarity problems (LCP), successive linear programming or quadratic programming methods for NLP, convergence of nonlinear programming algorithms, complementary pivot method for LCP, complementary pivot methods for fixed point computing and their application to NLP, survey of other methods for constrained NLP (Frank–Wolte method, methods of feasible directions, reduced gradient methods, penalty and barrier methods, gradient projection methods, active set methods and others), case studies.

Prerequisite: SE 521 or MATH 412

SE 623 Global Optimization Using Interval Analysis (3-0-3)

Interval arithmetic. Functions of intervals. Systems of interval linear and nonlinear equations and inequalities. Unconstrained global optimization. Inequality and equality constraints global optimization problems.

Prerequisite: SE 501 or equivalent.

SE 624 Advanced Techniques in Digital Signal Processing (3-0-3)

2-D time- and frequency-domain representation of signals and systems, discrete random process. Linear prediction. Least squares (LS) and Recursive Least (RLS) Techniques with applications to Filter Design, System Modeling and array signal processing. Power spectrum Estimation. Cepstral Analysis, Selective Coverage of latest tools used in signal processing such as Neural nets, Higher-Order Statistics and Wavelets. Applications.

Prerequisite: SE 524 or consent of instructor

SE 625 Network Algorithms (3-0-3)

Extension to the classical network problem formulation including constrained, multi-commodity and nonlinear networks. Uni-modularity property, assignment and matching, Lagrangian relaxation and network optimization. The decomposition approach for solving constrained and multi-commodity network. Traveling salesman problem, routing models, branch and bound and heuristics for routing problems. Polynomial time scaling algorithms, strongly polynomial algorithm for network problems. Algorithms for nonlinear networks. Complexity of network algorithms.

Prerequisite: SE 503 or SE 525

SE 626 Stochastic Programming (3-0-3)

Different formulations of the stochastic programming problem. Chance constrained problems, the recourse problem, linear programming under uncertainty. Decision rules in chance constrained programming, deterministic equivalence in stochastic programming, multi-stage stochastic programming, Duality and Computational issues in stochastic programming, Problems of existence of solution and optimality conditions in stochastic programming, stability of solutions in stochastic programming.

Prerequisites: SE 503 or Equivalent and Consent of the Instructor

SE 627 Multiple Criteria Decision Making (3-0-3)

Structuring decision problems with multiple criteria. Fundamentals and recent advances in multiple criteria decision making (MCDM) models. Selected approaches for discrete MCDM. Multiple criteria optimization: schemes for generating efficient solutions selected approaches: Goal programming, interactive approaches, surrogate worth tradeoff. Group decision making and negotiation. MCDM support systems. Case studies.

Prerequisites: SE 503 or Equivalent and Consent of the Instructor

SE 632 Robot Arms Dynamics and Control (3-0-3)

Dynamic and Kinematic analysis of robot manipulators; sensors (position, velocity, force, vision, tactile) actuators and power transmission; direct drive and indirect drive; point to point control; straight and curved path following; industrial practice in servo control; application of optimal linear quadratic control; nonlinear control and compliance control; collision avoidance; modeling and control of robots in the manufacture environment.

Prerequisite: SE 532 or Equivalent

SE 636 Human Factor Engineering-II (3-0-3)

Advanced concepts in the identification, design, analysis, development and implementation of human operated systems; existing and emerging systems identified from industry. Case examples of theories of communication, decision and control.

Prerequisite: SE 443 or equivalent

SE 641 Queuing Models and Theory-II (3-0-3)

The queue G/M/m, the method of collective marks, the queue G/G/1. Bounds, inequalities and approximation, priority queues. Application in computers.

Prerequisite: SE 541

SE 643 Stochastic Processes-II (3-0-3)

Characterization and Specification of stochastic processes, stationarity and ergodicity, correlation function and power spectra, wiener, Poisson, Markov and Gaussian processes; Martingales; orthogonality principle and mean square estimation;stochastic integrals. Introduction to stochastic differential equations and stochastic calculus.

Prerequisite: SE 543

SE 650 Theory of Robust Feedback Systems (3-0-3)

Argument principle; Rouche's Theorem; chordal metric; Concepts of uncertainty and robustness in control systems design; unstructured uncertainty; structured uncertainty; real parameter uncertainty; necessary and sufficient conditions for robust stability; structured singular value (μ, time varying uncertainty, etc.).

Prerequisite: SE 435 or equavelent

SE 651 Integer Programming (3-0-3)

Formulation examples, computational complexity of algorithms and problems, P, NP-complete and NP-hard classes of problems, cutting plane theory, branch and bound, knapsack problem, Bender decomposition, partial enumeration and implicit enumeration methods, Lagrangian relaxation, local search and other heuristic approaches, simulated annealing, computer project.

Prerequisite: SE 421 or Equivalent

SE 652 Input–Output Properties of Feedback System (3-0-3)

Metric spaces, Banach and Hilbert spaces, introduction to operator theory; systems as operators; small gain theorem; linear systems; stability and instability; invertibility and causality; passivity properties of feedback systems.

Prerequisite: SE 435 or Equivalent

SE 653 Dynamic Programming (3-0-3)

Multi-Stage problems and recursive algorithms, application in a variety of areas, Markov renewal programming and discrete dynamic programming, applications to optimal control.

Prerequisite: SE 421 or Equivalent

SE 654 Advanced Methods for Control Systems Synthesis (3-0-3)

Introduction to Hilbert Spaces; Banach Spaces; and Hardy Spaces; Laurent, Hankel, and Toeplitz Operators; parameterization of all stabilizing controllers (Youla's parameterization); factorization theory; model matching problem; Nehari's Theorem; Wiener–Hopf optimal controllers; H_∞ optimization problem; model reduction; l_1-optimal control and other state of the art control system synthesis methods.

Prerequisites: SE 514 & SE 652 or Equivalent

SE 656 Speech Processing and Recognition (3-0-3)

Speech production models; acoustical properties of vocal tract; classification of speech sounds, application to Arabic speech; time and frequency domain models for speech production; linear prediction methods; pitch detection algorithms; formant frequency trajectories; homomorphic speech processing; acoustic properties of Arabic sounds; allophone and diphone techniques for speech synthesis; speech coding techniques; speech VOCODERS; vector quantization; CELP vocoders; speech recognition; distance measures; dynamic programming for template matching; hidden markov model HMM techniques, application to phonetics based Arabic speech recognition. (Cross List with EE 613).

Prerequisite: SE 624 or Consent of the Instructor

SE 658 Filtering and Estimation (3-0-3)

Stochastic state space model; properties of Wiener process; stochastic differential equation; linear optimal filtering and prediction; Kalman filter and Wiener–Hopf filter; fixed lag smoothing and fixed point smoothing; filtering and prediction using stochastic ARMA model; extended Kalman filter; parameter estimation for stochastic dynamic systems; adaptive filtering and prediction.

Prerequisites: SE 435, SE 463, SE 514

SE 659 Advanced Materials Management (3-0-3)

Analysis of production and inventory systems, deterministic inventory models, stochastic inventory models, deterministic and stochastic production planning, process selection, multistage and dynamic production planning models, modern materials management techniques like Just-in-Time, Kanban etc., single and multiple source models.

Prerequisite: SE 402 or Equivalent

SE 660 Application of Artificial Intelligence and Expert Systems in Control (3-0-3)

Basic problem and methods; pattern classification; feature extraction and learning methods; heuristic search techniques; goal directed and ordered search; representation techniques; production systems; semantic networks and frames; input/output systems; problem solving and expert systems; expert systems in automation systems, CAD/CAM, material handling, scheduling, and process control.

Prerequisite: Graduate Standing

SE 661 Manufacturing Costs and Production Economics (3-0-3)

Analysis of costs of manufacture and discussion of the economics of low, medium, and high volume manufacture with emphasis on the factors of production. Economics of replacement.

Prerequisite: SE 508

SE 662 Image Processing and Pattern Recognition in Automation (3-0-3)

Computer processing and recognition of pictorial data; mathematical description of images and human perception picture digitization and encoding; image processing hardware; unitary transforms and image compression; image enhancement, restoration, and segmentation; shape description and pattern recognition; application to motion estimation. Robot automatic guidance, image tracking systems, feature extraction similarity measures, clustering techniques, syntactic methods in pattern recognition and applications.

Prerequisite: SE 656

SE 663 Productivity Measurement, Evaluation, Planning, and Improvement (3-0-3)

Systematic presentation of conceptual and pragmatic metrologies, tools, and techniques for productivity measurement, evaluation, planning, and improvement. Focus is on productivity engineering and management as ongoing, consistent process through a formalized, rational, and unified treatment of the productivity four-phases cycle.

Prerequisite: SE 323 or Equivalent

SE 665 Advanced Manufacturing Processes (3-0-3)

Quantitative study of the non-traditional material removal and forming processes. Economic aspects as well as theory and industrial applications. Electro–chemical machining, electrical discharge machining, high energy forming, and laser and electron beam machining.

Prerequisite: SE 322 (cross listed with ME 572)

SE 666 Remote Control Systems (3-0-3)

Remote control systems architecture; introduction to network layers structure; transmission media, infrared, transmission lines, ultrasonic, laser, radio propagation. Signal modulation and coding, communication protocols, radio transmitter/receivers, microcomputer based systems, data acquisition and telemetry, servomechanisms, manipulators, image feedback systems; advanced, communication, command, and control systems; unmanned aircraft and space vehicles control systems.

Prerequisites: SE 401, SE 435 or Equivalent

SE 668 Guided Systems Control (3-0-3)

Dynamic equations of rigid bodies; missile dynamic equations; introduction to missiles aerodynamics; linearization of the equations of motion; gain scheduling techniques; longitudinal equations of motion, longitudinal autopilot; missiles lateral dynamics; lateral autopilot; inertia cross coupling; advanced control systems; measurement of missile motion, gyros, laser gyros; guidance systems techniques and design.

Prerequisite: SE 416 or Equivalent (cross listed with ME 552)

SE 690 Special Topics in Systems & Control (3-0-3)

The objective of this course is to select a specific area in Systems & Control and study cases and research papers in it to enable the student to conduct research at the frontier of the area. The specific contents of the special topic will be given in detail at least one semester in advance of that in which it will be offered. It is also subject to the approval of the graduate council.

SE 691 Special Topics in Operations Research (3-0-3)

The objective of this course is to select a specific area in Operations & Research and study cases and research papers to enable the student to conduct research at the frontier of this area. The specific contents of the special topics will be given in detail at least one semester in advance of that in which it will be offered. It is also subject to the approval of the graduate council.

SE 692 Special Topics in Robotics & Intelligent System (3-0-3)

The objective of this course is to select a specific area in Robotics and Intelligent System, and study cases and research papers in it to enable the student to conduct research at the frontier of the area. The specific contents of the special topic will be given in detail at least one semester in advance of that in which it will be offered. It is also subject to the approval of the graduate council.

SE 693 Special Topics in Production Systems & Quality Control (3-0-3)

The objective of this course is to select a specific area in Production Systems and Quality Control, and study cases and research papers in it to enable the student to conduct research at the frontier of the area. The specific contents of the special topic will be given in detail at least one semester in advance of that in which it will be offered. It is also subject to the approval of the graduate council.

SE 694 Special Topics in Distributed Computer Control and Control Applications (3-0-3)

The objective of this course is to select a specific area in Distributed Computer Control & Control Applications, and study cases and research papers in it to enable the student to conduct research at the frontier of the area. The specific contents of the special topic will be given in detail at least one semester in advance of that in which it will be offered. It is also subject to the approval of the graduate council.

SE 695 Special Topics in Man–Machine Systems (3-0-3)

The objective of this course is to select a specific area in Man–Machine Systems, and study cases and research papers in it to enable the student to conduct research at the frontier of the area. The specific contents of the special topic will be given in detail at least one semester in advance of that in which it will be offered. It is also subject to the approval of the graduate council.

SE 699 Seminar (1-0-0)

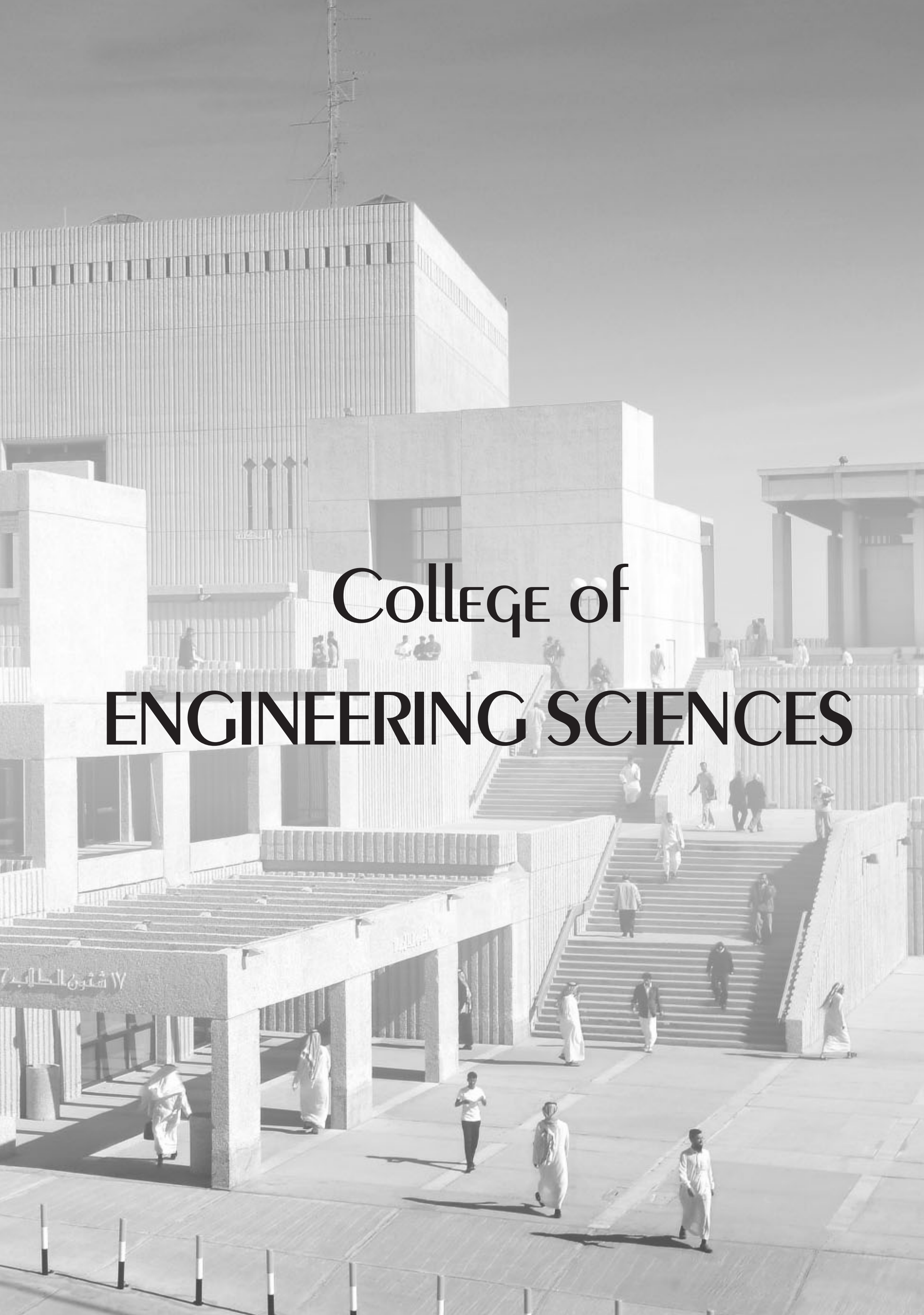
Graduate students working on their Ph.D. degree are required to attend seminars and contribute to the general area of their dissertation research. Grades will be Pass or Fail.

Prerequisite: Admission to Ph.D. Program

SE 710 Dissertation (0-0-12)

Prerequisite: SE 699

College of ENGINEERING SCIENCES



AEROSPACE ENGINEERING

Chairman

Ahmed Z. Al-Garni

Professors

Al-Garni

Associate Professors

Kassem

Assistant Professors

Abdelrahman

Al-Garni

Omar

Saeed

Lecturers

Tozan

M.S. PROGRAM IN AEROSPACE ENGINEERING

The Aerospace Engineering Department offers a well-established graduate program leading to Master of Science (M.S.) in Aerospace Engineering. The Department started its Master of Science program in 1425-26 (2004-05). The program focuses on academic excellence, as well as, the professional development of graduate students, rather than just completing a prescribed set of courses. The graduate students are expected to demonstrate competence in a series of professional requirements that need creativity. The AE M.S. program emphasizes the application of theoretical principles to practical problems in the field of Aerospace Engineering and helps in providing KSA with high caliber professional engineers, who are needed for the development of the country. The graduate (M.S.) program offers specialization in four major fields of Aerospace Engineering:

- Aerodynamics and Gas Dynamics
- Flight Dynamics and Control
- Aerospace Structures
- Propulsion.

In addition, the M.S. Program offers a wide selection of graduate courses and research activities with a flavor of aviation, which is needed by the local industry. Thereby, the student can fulfill his degree requirements, and complete and defend his thesis based on the original work in one of the major areas of Aerospace Engineering.

The AE M.S. Program has been designed to continually evolve by taking account of modern trends and the latest developments in the area of Aerospace Engineering. The graduate courses are designed to provide the student with the opportunity to deepen and broaden his knowledge base in the respective subjects that becomes the source of motivation for the student to sharpen his skills in problem solving, creative thinking, research, technical report writing and presentation. The graduate courses are listed on the next page:

Course #	Title
AE 520	Aerodynamics of Compressible Flow
AE 524	Aerodynamics of Viscous Flow
AE 528	Aerospace Computational Fluid Dynamics
AE 530	Aerospace Structures I
AE 534	Aerospace Structures II
AE 540	Flight Dynamics and Control I
AE 544	Flight Dynamics and Control II
AE 546	Fundamentals of Helicopter Flight
AE 548	Aerospace Avionics, Navigation and Guidance
AE 550	Aircraft Propulsion
AE 554	Rocket Propulsion
AE 560	Aerospace and Aviation Maintenance
AE 564	Air Traffic Control
AE 566	Flight and Aviation Safety
AE 568	Flight and Aviation Law
AE 570	Fundamentals of Astronautics
AE 590	Special Topics
AE 599	Seminar
AE 610	M.S. Thesis

TEACHING AND RESEARCH FACILITIES

The research activities of the department of Aerospace Engineering are exceptionally diverse and broad. Research is conducted in the following major Aerospace fields: Aerodynamics and Gas Dynamics, Aerospace Structures, Flight Dynamics and Control, Propulsion, and Aviation. The Aerospace Engineering Department has the following laboratories with advanced equipment for teaching and research purposes:

1. Aerodynamic and Flight Dynamic Laboratory

The laboratory is equipped with several small-scale sub-sonic wind tunnels and is primarily used to complement the concepts covered in Aerospace Engineering courses. The lab can be used for teaching and research in many aspects, such as measurements of lift and drag for an airfoil, smoke visualization of flow over variously shaped bodies, and static pressure measurements. The lab also has a pulse jet test unit to study the concepts of jet propulsion and reaction power and a wind tunnel to demonstrate flight simulation.

2. Wind Tunnel Laboratory

The laboratory is primarily designed to carry out both fundamental and applied research in shear flows, aerodynamics of streamlined and bluff bodies, super-sonic flow, etc. The laboratory has a sub-sonic wind tunnel with a 0.8 m × 1.1 m test-section with a maximum flow speed of 40 m/s, an internal six-component wind tunnel strain gauge balance, with attitude mechanisms, computerized software operation & calculation and graphical analysis; a shock tube and a Ludwig-tube supersonic-tunnel capable of producing a jet of a Mach number 2.57; measurement equipment includes a multi-channel hot-wire anemometer system, an intelligent flow analyzer, frequency analyzers, filters, correlators, a data acquisition and storage system, a remote controlled traverse system, load cells, oscilloscopes, manometers, scanivalves, and a flow visualization system with a laser light source.

3. Airplane Laboratory

AE Department is equipped with a Royal Saudi Air Force aircraft BAC-167 (Strike Master). The students use this lab to become familiar with the principles of the real aircraft and to do several measurements related to aerodynamic performance, Flight Dynamics & Control, Flight Structures, Propulsion and avionics system.

4. Aerospace Structures and Materials Laboratory

This laboratory contains several equipment, such as different structures of different materials, engine, landing gears and other aircraft parts that are used for demonstration, inspection and experimental purposes.

5. PC Applications Facility

The Department has a good number of state-of-the-art computers and enjoys highly sophisticated LAN (Local Area Network) system through which all the computers are inter-connected inside the KFUPM.

6. Other Facilities Inside and Outside the University

- Inside the University, the Department has links and cooperation with different departments in the College of Engineering and other colleges, such as Mechanical Engineering Department, which has many laboratories, such as Advanced Materials Science Laboratory, Dynamics Laboratory, Fluid Mechanics Laboratory, Heat Transfer Laboratory and Materials Science Laboratory. Moreover, the AE Department has cooperation with the Research Institute of the University, which is an excellent and well established research center.
- Outside the University, the Department has close working cooperation with the aerospace and aviation industry. The University is located next to King Abdul-Aziz Air Force Base and Dhahran Airport and a few kilometers from King Fahd International Airport and Saudi Aramco Aviation. The AE Department utilizes the wide spectrum of technical facilities offered by these excellent organizations.

The Aerospace Engineering Program at KFUPM is conducting and promoting scientific research in terms of publications, patents and research projects. The AE Department faculty have on their credit several research awards, such as Distinguished Researcher Award in

KFUPM, Distinguished Engineering Scientist Award in KSA and the American Romanian Academy of Arts and Sciences Book Award; and also they have many publications in the **top leading reputable journals in AE**, such as AIAA (published in 6 out of 6 major AIAA journals), British, Canadian and Japanese AE leading journals in the areas of Aerodynamics, Aerospace Structures, Flight Dynamics and Control, Propulsion and other areas. The faculty of AE Department has by far the **highest percentage of publications in the AE field in the whole Arabian region** with over **160 publications** (most of them are in **reputable international journals**) in the last **10 years**. The following represent some of the current research activities in the Department:

Hypersonic Plane Cooling;
Reliability Study in Aviation;
Airfoil performance Analysis;
Inverse Airfoil Design Methods;
Optimization in Aircraft
Performance; Hybrid Airfoil Design;
Aerospace System Maintenance;
Aerodynamics; Satellite Engineering;
Flight Dynamics and Control;
Computational Fluid Dynamics;
Propulsion; and Guidance and
Navigation.

ADMISSION REQUIREMENTS

In addition to the minimum requirements of the Deanship of Graduate Studies, the applicant for possible admission to the M.S. program in Aerospace Engineering must have:

a Bachelor's degree in Aerospace Engineering or other engineering or sciences from an institution whose undergraduate program is equivalent in length, content and quality to that of KFUPM. An applicant whose academic credentials do not meet regular admission requirements may be given some deficiency courses depending on individual cases.

ACADEMIC PROGRAM

In addition to meeting the overall requirements of KFUPM, AE M.S. students must satisfy the following requirements:

1. A student should satisfactorily complete a minimum of **30 credit** hours including 8 courses, AE 599 (seminar) and AE 610 (M.S. Thesis). The distribution of the courses is mentioned in the next items 2 to 6.
2. **Two core courses: AE 520 and AE 540**
3. **One mathematics core course** (MATH 513/514/550) depends on the emphasis of the Program, other math courses can be considered with the approval of AE Department.
4. **Two AE elective courses** from AE courses.
5. **Two technical elective courses** from AE courses or from any other Department (such as engineering depts., Mathematics Dept., Systems Engineering Dept. and others). These technical electives must be taken from technical fields such as: Engineering and sciences according to the approved degree plan.
6. **One free elective course** from AE Department or any other Department. **The AE elective courses and the technical/free elective courses require the approval of AE Department.**
7. Graduate courses are strongly encouraged for the M.S. Program. However, under certain conditions, a maximum of two senior level undergraduate courses (one as AE elective course and the other as technical elective course from AE Department or any other department) may be taken for graduate credit towards M.S. degree. These two courses must be approved by the AE Department.
8. The student has to maintain a minimum GPA of 3.00 (out of 4.00) throughout the course of study.
9. The expected duration of the M.S. Program is two years.

Degree Plan for the M.S. Program in Aerospace Engineering

Course #		Title	LT	LB	CR
First Semester					
AE	520	Aerodynamics of Compressible Flow	3	0	3
AE	xxx	AE Elective I*	3	0	3
MATH	5xx	Advanced Mathematics**	3	0	3
			9	**0**	**9**
Second Semester					
AE	540	Flight Dynamics and Control I	3	0	3
AE	5xx	AE Elective II*	3	0	3
XX	xxx	Technical Elective I*	3	0	3
AE	599	Seminar	1	0	0
			10	**0**	**9**
Third Semester					
XX	xxx	Technical Elective II*	3	0	3
XX	5xx	Free Elective***	3	0	3
			6	**0**	**6**
Fourth Semester					
AE	610	Thesis	0	0	6
			0	**0**	**6**
Total Credit Hours					**30**

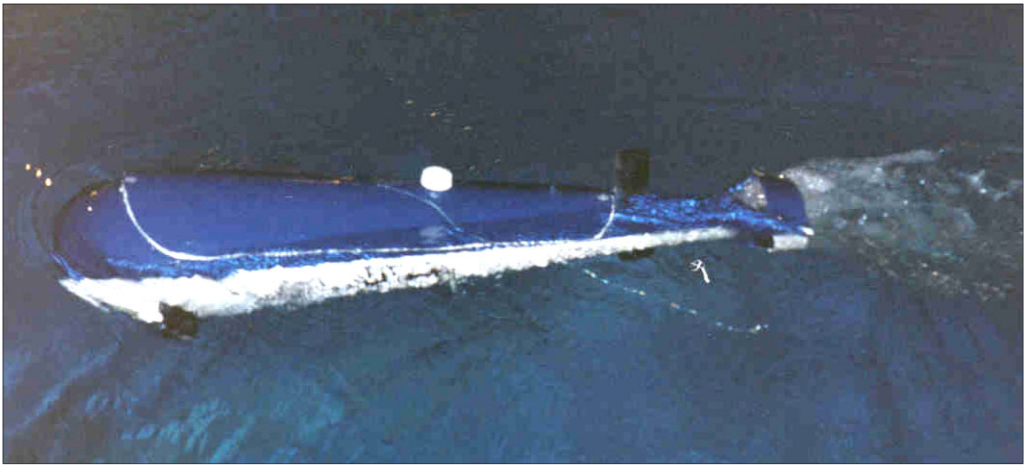
* AE xxx (AE Elective I) and XX xxx (Technical Elective I) are 500 level. However, maximum of two undergraduate courses can be taken for credit with approval of AE Department.

** MATH 513/514/550 depends on the emphases of the Program; other math courses can be considered with the approval of AE Department.

*** One free elective course from AE Department or any other Department according to the approved degree plan.

TRANSFER FROM OTHER UNIVERSITIES

The number of credit hours to be acknowledged for transfer students of other universities should not exceed 6 and they can only be considered as elective courses. These courses must be those approved by the Aerospace Engineering Department.



COURSE DESCRIPTION

AE 520 Aerodynamics of Compressible Flow (3-0-3)

Review of compressible inviscid gas dynamics. Unsteady wave motion, linearized flow. Numerical techniques for steady supersonic flow, three-dimensional flow, transonic flow, hypersonic flow, high-temperature flow. Introduction to computational aerodynamics.

Prerequisite: AE 325 or Equivalent

AE 524 Aerodynamics of Viscous Flow (3-0-3)

Review of potential flow. Dynamics of viscous flow, laminar boundary layer for incompressible and compressible flows, flow instabilities and transition flow, turbulent flow. Airfoil design and flow about three-dimensional bodies. Navier-Stokes equation. Numerical solutions of viscous flow with aerospace application.

Prerequisite: AE 333 or Equivalent

AE 528 Aerospace Computational Fluid Dynamics (3-0-3)

Introduction to computational fluid dynamics. Partial differential equations impact on CFD. Grids, discretization and transformation with CFD techniques. Numerical solutions in aerospace applications.

Prerequisite: AE 325 or Equivalent and Graduate Standing

AE 530 Aerospace Structures I (3-0-3)

Analysis of stress and strain; constitutive relations of elastic materials, isotropic and anisotropic; beam, plate and shell theories. Introduction to composite structures. Modeling of thermal stresses and practical applications in aerospace structures. Numerical solutions in aerospace structures.

Prerequisite: AE 328 or Equivalent

AE 534 Aerospace Structures II (3-0-3)

Discrete systems structural vibration; dynamics of continuous structures; vehicle structural dynamics; flutter of elastic structures exposed to aerodynamic loading. Introduction to aero-elastic phenomenon and methods of analysis. Case studies of aerospace structural vibration and flutter. Numerical solutions in aerospace structures.

Prerequisite: AE 530

AE 540 Flight Dynamics and Control I (3-0-3)

Review of the equation of motion, static and dynamic stability. Response to control or inputs. Classical approach for automatic control theory. Modern control theory and application to auto pilot design. Numerical solutions in flight dynamics and control.

Prerequisite: AE 426 or Equivalent

AE 544 Flight Dynamics and Control II (3-0-3)

Review of atmospheric flight. Dynamic effects of structural flexibility. Flying and handling qualities. Parametric optimization and optimal control design. Altitude, flight path and tracking, active, digital adaptive control systems. Helicopter flight control. Application on atmospheric and space vehicles. Numerical solutions in flight dynamics and control.

Prerequisite: AE 540

AE 546 Fundamentals of Helicopter Flight (3-0-3)

Introduction to hovering theory; hovering and axial flight performance; concepts of blade motion and control; aerodynamics and performance of forward flight. Introduction to aeroacoustis. Methods to solve rotor dynamics problems. Helicopter stability and control.

Prerequisite: ME 201 or Equivalent and Graduate Standing

AE 548 Aerospace Avionics, Navigation and Guidance (3-0-3)

Principles of avionics, navigation and guidance. Deterministic and stochastic linear perturbation theory. Position fixing and celestial navigation with redundant measurements. Recursive navigation and Kalman filtering. Pursuit guidance, proportional navigation, ballistic guidance and velocity-to-be-gained guidance. Hardware mechanization.

Prerequisite: Graduate Standing and Consent of the Instructor

AE 550 Aircraft Propulsion (3-0-3)

Advanced analysis of aircraft propulsion; gas turbine cycles for aircraft propulsion. Engine off-design performance. The environmental impact. Aircraft propulsion case study design. Numerical solutions in aircraft propulsion.

Prerequisite: AE 422 or Equivalent

AE 554 Rocket Propulsion (3-0-3)

Advanced analysis of rocket propulsion; multi stage rockets, trajectories in power flight; electric propulsion, space propulsion. The environmental impact. Rocket propulsion case study design. Numerical solutions in rocket propulsion.

Prerequisite: AE 422 or Equivalent

AE 560 Aerospace and Aviation Maintenance (3-0-3)

General regulations for aerospace and aviation maintenance. Hydraulic, power, electrical and electronic, instrument landing and support systems maintenance. Troubleshooting procedures, evaluation, repair, installation and inspection techniques. Aviation maintenance systems management, maintenance planning, forecasting and cost control, reliability; safety and flight schedule. Field project.

Prerequisite: Graduate Standing

AE 564 Air Traffic Control (3-0-3)

Fundamental of air traffic control (ATC) system. Federal aviation administration (FAA). Navigational aids, airspace, communication, federal aviation regulations (FARs), ATC procedures control tower operations; non-radar operations, radar operations. Instrument flight rules (IFR) in the enroute and terminal ATC facilities; human factors; air traffic safety and management. Aviation weather. Field Project.

Prerequisite: Graduate Standing

AE 566 Flight and Aviation Safety (3-0-3)

Personal and organizational safety procedures and goals; safety philosophies, human factors. Principles of accident investigation, aircraft accident reports; accident prevention programs and accident statistics; impact of accident on aviation industry. Air traffic control factors. Aviation and airport securities. Field project.

Prerequisite: Graduate Standing

AE 568 Flight and Aviation Law (3-0-3)

Bilateral and multilateral agreements and security interest in aircraft; international conferences; airline dispatch operations; federal aviation regulations; flight management for aviation/aerospace systems; airport planning and design standards; airport administration and finance; airline management; international aviation management; airline/airport marketing; role of transportation engineering. Field Project.

Prerequisite: Graduate Standing

AE 570 Fundamentals of Astronautics (3-0-3)

Introduction to the solar system, launching. Fundamental law of astrodynamics (space mechanics); orbit maneuvering and determination. Applications in rocket trajectories; optimal trajectories. Communication satellite and spacecraft altitude. Re-entry and hypersonic heating consideration.

Prerequisite: Graduate Standing and Consent of the Instructor

AE 590 Special Topics (3-0-3)

Advanced topics are selected from the broad area of aerospace engineering to provide the student with knowledge of recent advances in the analysis and design in aerospace engineering and in aviation including optimization of aerospace engineering designs, aerodynamics and gas dynamics, aerospace structures and materials, flight dynamics and control, propulsion, helicopter flight, avionics, navigation and guidance, aircraft maintenance, flight and aviation safety, air traffic control, aviation law, astronautics and other related fields, such as marine engineering. The contents of the course will be provided in detail one semester before the offering. Approval of the department graduate committee and the graduate council must be secured before offering this course.

Prerequisite: Graduate Standing

AE 599 Seminar (1-0-0)

Graduate students working towards the M.S. degree in any emphasis area of aerospace engineering (aerodynamics and gas dynamics, aerospace structures, flight dynamics and control, and propulsion) and aviation are required to attend the seminars given by faculty, visiting scholars and fellow graduate students. Additionally, each student must present at least one seminar on a timely research topic. Among other things, this course is designed to give the student an overview of research in the department, and a familiarity with the research methodology, journals and professional societies in his discipline. This course is graded on a pass or fail basis.

AE 610 M.S. Thesis (0-0-6)

Involves individual studies by students in the field of aerospace engineering and aviation. The work should be original and the concept, data and the conclusions should contribute new knowledge to the field of aerospace engineering. The quality of the work should reflect the student's proficiency in research and creative thinking. Following preliminary studies and a literature survey on the thesis subject, each student will present his proposed thesis subject orally, and also submit a written proposal to the college of graduate studies for approval. On satisfactory completion of his thesis work, the student is required to make a formal defense of his research thesis.

CHEMICAL ENGINEERING

Chairman

Adnan M. Al-Amer

Professors

Abul-Hamayel, M A	Al-Shalabi, M A	Ma'adhah, A G
Abu-Sharkh, B F	Amin, M B	Redhwi, H H
Al-Amer, A M	Faqir, N M	Shaikh, A A
Al-Saleh, M A		

Adjunct Professors

Karimi, I A	Soares, J

Associate Professors

Al-Ali, H H	Hussein, I A	Shawabkeh, R
Al-Khattaf, S S	Rahman, S U	Zaidi, S M J

Assistant Professors

Abussaud, B	Al-Juhani, A A	Atieh, M A
Al-Baghli, N A	Al-Mubaiyedh, U A	Ba-Shammakh, M
Al-Harthi, M A	Al-Mutairi, E.	

Lecturers

Mahgoub, K A	Suleiman, M A

INTRODUCTION

The mission of the department is to provide quality education to students at both the undergraduate and graduate levels in the field of chemical engineering, so that they can effectively contribute in the development and operation of the Saudi chemical and petroleum industries. The Department strives to provide the most advanced technical knowledge to its students in all classical and allied fields of chemical engineering, i.e. in transport phenomena, separation processes, chemical and analytic reactor design, and process control. The Department conducts basic and applied research relevant to the needs of the Kingdom. Furthermore, the department has a major responsibility to disseminate knowledge by

1. Publishing the research of its faculty and graduate students.
2. Offering continuing education short courses for the private and public sectors, and
3. Providing technical services and consultations to the local industry.

TEACHING AND RESEARCH FACILITIES

The department has 350 graduate and undergraduate students and maintains well equipped teaching and research laboratories. University facilities available include an excellent information technology center, a central analytical laboratory complex, a sophisticated surface science laboratory and a modern computerized library. A research institute is also attached to the University.

The department has 28 faculty members involved in research in the following areas: Adsorption and Ion Exchange, Catalysis and Kinetics, Corrosion Inhibition, Fluid Mixing, Reaction Engineering, Materials Characterization, Mathematical Modeling, Petrochemicals and Petroleum Technology, Polymers, Separation Processes, Simulation and Computer Applications, Thermal Cracking of Hydrocarbons, Thermodynamics, Transport Phenomena, Process Control, and Electrochemical Reaction Engineering.

GRADUATE PROGRAMS IN CHEMICAL ENGINEERING

The Department offers graduate programs leading to the degrees of Master of Science and Doctor of Philosophy. The graduate degrees are designed to strengthen and broaden the scientific and engineering skills of the students and to prepare them for professional careers in advanced engineering practice in the areas of research, development and process design.

The Master's degree requires successful completion of 24 course credits and a thesis. The Doctoral degree program requires successful completion of 30 course credits, comprehensive written and oral examinations, and submission of an original dissertation subsequent to the Master's degree.

M.S. PROGRAM IN CHEMICAL ENGINEERING

The Master of Science program is designed to provide a strong background in fundamental subjects, including scientific and mathematical principles, as well as the opportunity to define and investigate novel and challenging research problems through experimental and computational techniques.

M.S. ADMISSION REQUIREMENTS

Applicants who have a Bachelor's degree in engineering or science from an institution whose undergraduate programs are substantially equivalent in length, content and quality to those of King Fahd University of Petroleum & Minerals, are invited to apply for admission as regular graduate students in the Department of Chemical Engineering at King Fahd University of Petroleum & Minerals. Applicants should also satisfy the general admission requirements of the Graduate School.

M.S. DEGREE REQUIREMENTS

The chemical engineering Master's Program includes a series of courses in thermodynamics, transport phenomena, kinetics, applied mathematics and numerical methods in chemical engineering. The program allows for nine credit hours of technical electives to be selected in advanced chemical engineering or other fields of science and engineering with appropriate consultation and approval of the Graduate Advisor. Graduate students are also obliged to participate in all departmental seminars and present a seminar after two terms in the program. In addition, an approved research thesis of six credit hours is required. The normal completion time for graduate students ranges from four to five semesters.

Degree Plan for the M.S. Program in Chemical Engineering

Course #		Title	LT	LB	CR
First Semester					
CHE	501	Transport Phenomena	3	0	3
CHE	513	Advanced Thermodynamics	3	0	3
MATH	513	Mathematical Methods for Engineers	3	0	3
XXX	5xx	Elective I - CHE or Technical	3	0	3
			12	**0**	**12**
Second Semester					
CHE	530	Advanced Reaction Engineering	3	0	3
CHE	560	Numerical Methods in Chemical Engineering	3	0	3
CHE	5xx	Elective II - CHE	3	0	3
XXX	5xx	Elective III - CHE or Technical	3	0	3
CHE	599	Seminar	1	0	0
			13	**0**	**12**
Third Semester					
CHE	610	M.S. Thesis	0	0	IP
Fourth Semester					
CHE	610	M.S. Thesis (continued)	0	0	6
			0	**0**	**6**
Total Credit Hours					**30**

IP: Dissertation in progress.

PH.D. PROGRAM IN CHEMICAL ENGINEERING

The Doctor of Philosophy program is designed to prepare each student to take an active part in the development and growth of the field of chemical engineering at all levels in industry and research organizations or in research and teaching in a university. The awarding of a Ph.D. acknowledges an individual's ability to perform original and creative research. A candidate for a Ph.D. is expected to demonstrate the ability to make independent and critical review of literature in his field of study, be capable of proposing original ideas and translating these ideas into hypotheses that can be tested through experiments or theory. The candidate for a Ph.D. is also expected to communicate his original research through written articles in peer-reviewed publications and oral presentations at scientific conferences. To quality for the Ph.D. program, a student should demonstrate competence in graduate course work.

PH.D. ADMISSION REQUIREMENTS

Applicants who have an M.S. degree from a university of recognized standing may be admitted to the doctoral program, provided they satisfy the Graduate School requirements for Ph.D. admission. Applicants should provide evidence of a suitable scientific background to enter the proposed field and should make up any deficiencies in their prior program within two semester of enrollment.

PH.D. DEGREE REQUIREMENTS

Towards the end of their first semester in residence, students should select their research topic and advisor. Students who demonstrate satisfactory proficiency in the entrance examination may proceed to complete the Ph.D. course requirements of 30 credit hours, maintaining a cumulative GPA of at least 3.00 at all times. Students shall select their course program in consultation with their advisor to prepare them to carry out their research in their chosen topic. Departmental requirements for the 30 course credits are:

(*a*) a minimum of 21 credit hours must be chemical engineering courses,

(*b*) a minimum of two 600 level courses in chemical engineering must be taken for credit,

(*c*) a maximum of 9 credit hours is allowed out of the core M.S. courses, and

(*d*) a minimum of 9 credit hours must be taken in a minor field or combination of fields in consultation with the students research advisor.

The minor should be in a field related to the professional activities of the chemical engineer and should be selected from specific areas in chemistry, physics, mathematics, computer science, civil engineering, mechanical engineering, petroleum engineering, or systems engineering.

Ph.D. students are required to present a seminar every year starting from the second year of the program.

A comprehensive examination both written and oral is held on completion of the course work in the major. For students majoring in chemical engineering, the subject areas for the written examination are:

Paper I Physical Rate Processes

Paper II Chemical Rate Processes and Control.

The oral Examination is given within one semester after the written examination to allow enough time for preparation of the research proposal by the student. On the basis of the comprehensive examination, a student may be admitted to the Ph.D. Degree Candidacy. A graduate student is permitted to take the Comprehensive Examination twice only.

A Dissertation Committee is formed within the Department to advise the candidate during his research. A Dissertation Examination Committee examines the candidate on the dissertation. The candidate, in consultation with his Examining committee, and after approval of the College of Graduate Studies, shall arrange a time and place for public defense of the dissertation.

Degree Plan for the Ph.D. Program in Chemical Engineering

Course #	Title	LT	LB	CR
FIRST SEMESTER				
CHE 5xx	Elective I - CHE	3	0	3
CHE 5xx	Elective II - CHE	3	0	3
CHE 5xx	Elective III - CHE	3	0	3
		9	**0**	**9**
SECOND SEMESTER				
CHE 5xx	Elective IV - CHE (core M.S. excluded)	3	0	3
CHE 5xx	Elective V - CHE (core M.S. excluded)	3	0	3
CHE 6xx	Elective VI - CHE	3	0	3
XXX 5xx	Elective VII - Technical	3	0	3
		12	**0**	**12**
THIRD SEMESTER				
CHE 6xx	Elective VIII - CHE	3	0	3
XXX 5xx	Elective IX - Technical	3	0	3
XXX 5xx	Elective X - Technical	3	0	3
		9	**0**	**9**
FOURTH SEMESTER				
CHE 599	Seminar	1	0	0
CHE 710	Ph.D. Dissertation	0	0	IP
FIFTH SEMESTER				
CHE 710	Ph. D. Dissertation (Continued)	0	0	IP
SIXTH SEMESTER				
CHE 599	Seminar	1	0	0
CHE 710	Ph. D. Dissertation (Continued)	0	0	12
		1	**0**	**12**
Total Credit Hours				**42**

*IP: Dissertation in progress.

GRADUATE COURSES IN CHEMICAL ENGINEERING

FLUID AND THERMAL SCIENCES

CHE 501	Transport Phenomena	(3-0-3)
CHE 503	Advanced Fluid Mechanics	(3-0-3)
CHE 505	Computational Fluid Dynamics	(3-0-3)
CHE 507	Advanced Heat Transfer	(3-0-3)
CHE 603	Turbulence Modeling	(3-0-3)
CHE 605	Process Heat Transfer	(3-0-3)

THERMODYNAMICS

CHE 513	Advanced Thermodynamics	(3-0-3)
CHE 515	Statistical Thermodynamics	(3-0-3)
CHE 517	Phase Equilibria	(3-0-3)
CHE 617	Non-Equilibrium Thermodynamics	(3-0-3)

SEPARATIONS

CHE 521	Diffusion Principles	(3-0-3)
CHE 523	Advanced Mass Transfer	(3-0-3)
CHE 525	Rate Controlled Separation Processes	(3-0-3)
CHE 625	Adsorption	(3-0-3)

REACTION ENGINEERING

CHE 530	Advanced Reaction Engineering	(3-0-3)
CHE 532	Heterogeneous Catalysis	(3-0-3)
CHE 534	Bioreaction Engineering	(3-0-3)
CHE 536	Process Analysis in Semiconductor Manufacture	(3-0-3)
CHE 637	Advanced Reactor Analysis	(3-0-3)

MATERIALS

CHE 541	Processing in the Materials Industry	(3-0-3)
CHE 543	Polymeric Materials	(3-0-3)
CHE 545	Corrosion Science and Engineering	(3-0-3)
CHE 547	Applied Surface Analysis	(3-0-3)

PROCESS MODELING & CONTROL

CHE 560	Numerical Methods in Chemical Engineering	(3-0-3)
CHE 561	Process Optimization	(3-0-3)
CHE 562	Advanced Process Dynamics and Control	(3-0-3)
CHE 564	Digital Process Control	(3-0-3)
CHE 565	Non-linear Dynamics in Chemical & Biochemical Systems	(3-0-3)
CHE 566	Process Synthesis	(3-0-3)
CHE 569	Simulation of Chemical Processes	(3-0-3)

GENERAL COURSES

CHE 571	Process Water Pollution Control	(3-0-3)
CHE 573	Process Air Pollution Control	(3-0-3)
CHE 575	Pollution Prevention in Process Industry	(3-0-3)
CHE 580	Research Report	(3-0-3)
CHE 590	Special Topics in Chemical Engineering	(3-0-3)
CHE 599	Seminar	(1-0-0)
CHE 610	M.S. Thesis	(0-0-6)
CHE 710	Ph.D. Dissertation	(0-0-12)

COURSE DESCRIPTION

CHE 501 Transport Phenomena (3-0-3)

Continuum theory of momentum, energy and mass transfer. Viscous behavior of fluids. Molecular transport mechanisms. General property balance. Laminar and Turbulent flow. Convective transport. Momentum, heat and mass applications of transport phenomena.

Prerequisite: Graduate Standing

CHE 503 Advanced Fluid Mechanics (3-0-3)

Laminar boundary layers and their solutions. Laminar stability and transition to turbulence. Basic equations of turbulent flow. Pipe turbulent flows and turbulent boundary layers. Non-Newtonian fluids. Pipe flow of power law fluids. Pipe flow of a Bingham plastic. Constitutive equations for viscoelastic fluids. Two phase flows. Computational fluid dynamics.

Prerequisite: CHE 501 or equivalent

CHE 505 Computational Fluid Dynamics (3-0-3)

Governing equations of fluid dynamics. Introduction to CFD. Grid generation, discretization. Numerical approximations: finite differencing and finite volume techniques. CFD tools: adapted programs and commercially available general purpose packages. Applications to incompressible and compressible fluid flow.

Prerequisites: CHE 501, CHE 560 or Consent of the Instructor

CHE 507 Advanced Heat Transfer (3-0-3)

Solution of steady and transient conduction and convection problems analytically and numerically. Fundamentals of convection boundary layer in laminar and turbulent flow. Free and forced convection in ducts and over surfaces. Heat transfer with phase change. Combined mechanisms of conduction and convection.

Prerequisite: CHE 501 or equivalent

CHE 513 Advanced Thermodynamics (3-0-3)

Basic postulates of classical thermodynamics. Applications to transient, open and closed systems. Properties of fluids and prediction of thermodynamic properties Criteria of equilibrium and stability. Single phase, simple systems of mixtures. Phase and chemical equilibria.

Prerequisite: Graduate Standing

CHE 515 Statistical Thermodynamics (3-0-3)

Probability and statistics of microscopic systems. A study of microcanonical, canonical and grand canonical ensembles. Ideal and non-ideal gases, distribution function and computer simulation of fluids applied to pure components and mixtures. Solution of electrolytes and non-homogeneous systems.

Prerequisite: Graduate Standing

CHE 517 Phase Equilibria (3-0-3)

Classical thermodynamics of phase equilibrium and stability. The phase rule. Ideal and non-ideal systems. Fugacity and activity. Phase equilibrium at moderate and high pressure. Activity coefficient models of local composition and group contribution. Equation of states and phase equilibrium. Liquid-liquid equilibrium. Vapor-liquid-liquid equilibrium. Solid-liquid equilibrium. Solid-Vapor equilibrium. Phase equilibrium by simulation.

Prerequisite: Graduate Standing

CHE 521 Diffusion Principles (3-0-3)

The Maxwell-Stefan relations, generalized Maxwell-Stefan formulation of irreversible thermodynamics, Fick's law, estimation of diffusion coefficients, solution of multicomponent diffusion problems by the linearized rate theory and effective diffusivity methods. Diffusion as a random walk; Monte Carlo simulation and molecular dynamics.

Prerequisite: CHE 501

CHE 523 Advanced Mass Transfer (3-0-3)

Advanced coverage of laminar and turbulent mass transfer theory and applications for binary and multicomponent systems. The coupling between mass transfer, heat transfer, fluid flow and chemical reactions. Interphase mass transfer coefficients in different equipment. The applications for mass transport drawn from various fields shall be discussed from the viewpoint of transport equations single or coupled.

Prerequisite: CHE 501

CHE 525 Rate Controlled Separation Processes (3-0-3)

Study of traditional as well as contemporary rate controlled separation processes such as crystallization, chromatography, sorption, membranes, etc. Rate based models for distillation. Selective coupled rate processes will be discussed.

Prerequisite: Graduate Standing

CHE 530 Advanced Reaction Engineering (3-0-3)

A study of the effect of temperature on conversion, stability, and product distribution in complex homogeneous reactions. Analysis of flow and mixing patterns and residence time distributions in chemical reactors. kinetics of catalytic gassolid reactions, mass and heat transport effects in catalysis. Design of catalytic fixed-bed reactors.

Prerequisite: Graduate Standing

CHE 532 Heterogeneous Catalysis (3-0-3)

Molecular theories of adsorption and catalysis. Solid-state and surface chemistry of catalysts. Diffusion and reaction in porous catalysts. Design, preparation and characterization of catalysts. Catalyst deactivation and regeneration. Catalytic process engineering: examples and case studies.

Prerequisite: Graduate Standing

CHE 534 Bioreaction Engineering (3-0-3)

Enzyme kinetics and immobilized enzymes systems. Cellular growth, bioreactions, transport processes, intracellular reactions, stoichiometry of microbial reactions. Analysis of bioreaction rates. Bioreactors modeling and design. Immobilization and immobilized packed bed bioreactors. Inhibitory effects in bioreactors and the use of selective membranes. Extractive fermentation. Optimization and on-line control of bioreactors.

Prerequisite: Graduate Standing

CHE 536 Process Analysis in Semiconductor Manufacture (3-0-3)

Solids device fabrication, process modeling, cleanliness of the process environment, designing the architectured of crystal fabrication including oxidation, doping by diffusion, chemical vapor deposition etc.

Prerequisite: Graduate Standing

CHE 541 Processing in the Materials Industry (3-0-3)

Principles of processing materials into components. Technology, theory and analysis of the major unit processing operations for metals, polymers, ceramics and composite materials.

Prerequisite: Graduate Standing

CHE 543 Polymeric Materials (3-0-3)

The structure, morphology, and properties of polymers. Polymerization reactions, molecular weight and polymer rheology. Rubber elasticity and mechanical properties. Thermodynamics of polymer solutions.

Prerequisite: Graduate Standing

CHE 545 Corrosion Science and Engineering (3-0-3)

Fundamentals of electrochemical thermodynamics and kinetics pertinent to corrosion processes. Corrosion inhibition, passivity, anodic and cathodic protection, pitting, stress corrosion and hydrogen embrittlement.

Prerequisite: Graduate Standing

CHE 547 Applied Surface Analysis (3-0-3)

Principles of electron and mass spectroscopy. Major elemental and/or structural surface analysis techniques, such as Electron Spectroscopy for Surface Analysis, X-ray Photoelectron Spectroscopy, Auger Electron Spectroscopy, Secondary Ion Mass Spectroscopy, Thermal Desorption Spectroscopy, Infrared Spectroscopy and Electron Energy Loss Spectroscopy. Recent advances in surface analysis techniques. Practical applications using Research Institute equipment.

Prerequisite: Graduate Standing

CHE 560 Numerical Methods in Chemical Engineering (3-0-3)

Visualization of profiles, analysis of models of chemical processes, normalization of models, non-linear finite difference techniques, orthogonal collocation, non-linear algebraic equations, initial value and final value problems in chemical engineering, software packages for solving such problems.

Prerequisite: Graduate Standing

CHE 561 Process Optimization (3-0-3)

Review of computerized material and energy balances, modeling of chemical and biochemical processes, Formulation of optimization problems, nature and organization of optimization problems in the process industry, optimization theory and techniques (basic concepts, optimization of unconstrained functions, unconstrained multivariable optimization, constrained optimization, linear programming and nonlinear programming), Real Time Optimization (RTO) Calculus of variation and Pontryagin maximum principle, Energy Integration (EI), Mass Integration (MI) and Pinch Technology.

Prerequisite: Graduate Standing

CHE 562 Advanced Process Dynamics and Control (3-0-3)

This course examines advanced non-linear dynamics of chemical/biochemical reacting and non-reacting systems and their practical implications on different processes and their control systems design. A number of advanced control topics will be covered, e.g.: model predictive control, non-linear supervisory and expert control, MIMO control systems design, stabilization and regulation control problems and their interaction, analogue vs. digital control systems, structural design of modern computer control systems.

Prerequisite: Graduate Standing

CHE 564 Digital Process Control (3-0-3)

Components of digital control systems, stability theorem and its application to digital control systems, Digital control of simple distillation columns and CSTR's, Z-transform and the design of digital control systems, sampled-data systems, tools for discrete-time systems analysis, Typical digital control designs for chemical and biochemical separation units and reactors, Structure of digital control systems for petrochemical and petroleum refining complexes.

Prerequisite: Graduate Standing

CHE 565 Non-linear Dynamics in Chemical & Biochemical System (3-0-3)

Review of elementary dynamics of chemical & biochemical systems. Modeling and non-chaotic dynamics. Chaotic behavior in chemical & biochemical systems. Case studies: fluid catalytic cracking (FCC), carbon monoxide oxidation, fermenters, etc.

Prerequisite: Graduate Standing

CHE 566 Process Synthesis (3-0-3)

Computerized material and energy balances for actual industrial process flow diagrams. Use of spreadsheets and commercial simulators for conceptual developments of process flow sheets and process calculations with special emphasis on down stream petrochemical industries. Use of computer packages for process synthesis and optimization.

Prerequisite: Graduate Standing

CHE 569 Simulation of Chemical Processes (3-0-3)

Mathematical modeling of a chemical plant. Sparse matrices techniques. Tearing of matrices. Construction of a steady state simulator. In depth discussion of the available simulators including application of these simulators to local industry. Simulation of unsteady state processes.

Prerequisite: CHE 560

CHE 571 Process Water Pollution Control (3-0-3)

Wastewater treatment objectives and methods. Design of facilities for physical and chemical treatment of wastewater. Ecology of biochemical reactors, kinetics of biochemical systems, modeling of ideal biochemical reactors, design of facilities for the biological treatment of wastewater.

Prerequisite: Graduate Standing

CHE 573 Process Air Pollution Control (3-0-3)

Production, emission and transfer of contaminants through the atmosphere from stationary sources. Mathematical models of air pollution. Control concepts. Theory and design of control devices. Integration of pollution control in chemical engineering processes. Current research and development in air pollution control.

Prerequisite: Graduate Standing

CHE 575 Pollution Prevention in Process Industry (3-0-3)

Main characteristics of pollution problem in the process industry. End of pipe versus in-process modifications. Pollution Prevention (P2) strategy and its applications in: Chemical, Biochemical, Petrochemical and Petroleum Refining Industries. Pollution Prevention (P2) methodologies for energy generation, separation, process reactors, bioreactors, complete plants and entire industrial complexes.

Prerequisite: Graduate Standing

CHE 580 Research Report (3-0-3)

Overview of research methodology: documentation; statistics, experimental design, library and database use CD-ROM and internet search, oral presentation skills with videotape review. Students will focus on a specific research topic and produce a comprehensive technical report of publishable quality for a reputable journal. Seminar presentation to all faculty and graduate students is required.

Prerequisite: Must complete two CHE graduate courses first or equivalent.

CHE 590 Special Topics in Chemical Engineering (3-0-3)

Advanced topics are selected from the broad area of chemical engineering. The contents of the course are given in detail one semester in advance of that in which it is to be offered. The approval of the Graduate Council will be necessary for offering this course.

Prerequisite: Graduate Standing

CHE 599 Seminar (1-0-0)

Graduate students working towards either M.S. or Ph.D. degrees, are required to attend seminars given by faculty, visiting scholars and fellow graduate students. Additionally each student should present at least one seminar on a timely research topic. Among other things, this course is designed to give the student an overview of research in the department, and a familiarity with the research methodology, journals and professional societies in his discipline. Graded on a Pass or Fail basis.

Prerequisite: Graduate Standing

CHE 603 Turbulence Modeling (3-0-3)

Introduction to turbulence. The equations of motion. Scaling laws for mixing layers, jets and wakes. Description of turbulent shear flows. Turbulence modeling: constant eddy viscosity, mixing length, k-epsilon models. Reynolds stresses models. Application using CFD packages.

Prerequisite: CHE 503

CHE 605 Process Heat Transfer (3-0-3)

Topics in heat transfer of interest to both students and faculty will be considered in depth. As examples, conduction, composite regions, non-linear bound-ary-value problem of heat conduction; convection, heat transfer in packed or fluidized beds, techniques to augment heat transfer; combined phase change problems such as, condensation, heat pipes, cooling towers and ponds; radiation, such as furnaces, radiant interchange between surfaces separated by non-absorbing and non-emitting media.

Prerequisite: CHE 507

CHE 610 M.S. Thesis (0-0-6)

Involves individual studies by students in the field of chemical engineering. The work should be original and the concept, data and the conclusions should contribute new knowledge to the field of engineering. The quality of the work should reflect the student's proficiency in research and creative thinking. Following preliminary studies and a literature survey on the thesis subject, each student will present his proposed thesis subject orally, and also submit a written proposal to the College of Graduate Studies for approval. On satisfactory completion of his thesis work, the student is required to make a formal defense of his research thesis.

CHE 617 Non-equilibrium Thermodynamics (3-0-3)

Foundations of non-equilibrium thermodynamics. Linear non-equilibrium thermodynamics. Postulate of local thermodynamic equilibrium. Linear phenomenological equations. Balance equations of mass, momentum, energy, and entropy. Dissipation function. Second law analysis. Exergy analysis. Heat and mass transport. Diffusion and reaction. Extended non-equilibrium thermodynamics.

Prerequisite: CHE 501

CHE 625 Adsorption (3-0-3)

Adsorptive separation processes, structure and physical properties of adsorbents. Classical and statistical thermodynamic equilibrium models for pure and multicomponent sorption. Study of individual and combined kinetic resistances in sorption on single adsorbent particles. Classification of adsorption column dynamic systems. Models for isothermal, non-isothermal, single and multicomponent, linear and non-linear sorption in columns. Asymptotic behavior in columns. Discussion of adsorptive separation processes involving kinetic and equilibrium selectivity, cyclic two bed processes optimization, and continuous counter-current both moving and simulated moving bed type.

Prerequisite: CHE 501

CHE 637 Advanced Reactor Analysis (3-0-3)

Macro- and micro-mixing effects in homogenous reactors. Steady-state multiplicity & stability in homogeneous reactors. Transport/reaction interactions in gas-liquid, liquid-liquid reactions, and design of two-phase reactors. Theory of gas-solid fluidization and fluidized-bed reactors. Three-phase slurry and tricklebed reactors.

Prerequisite: CHE 530 or Consent of the Instructor

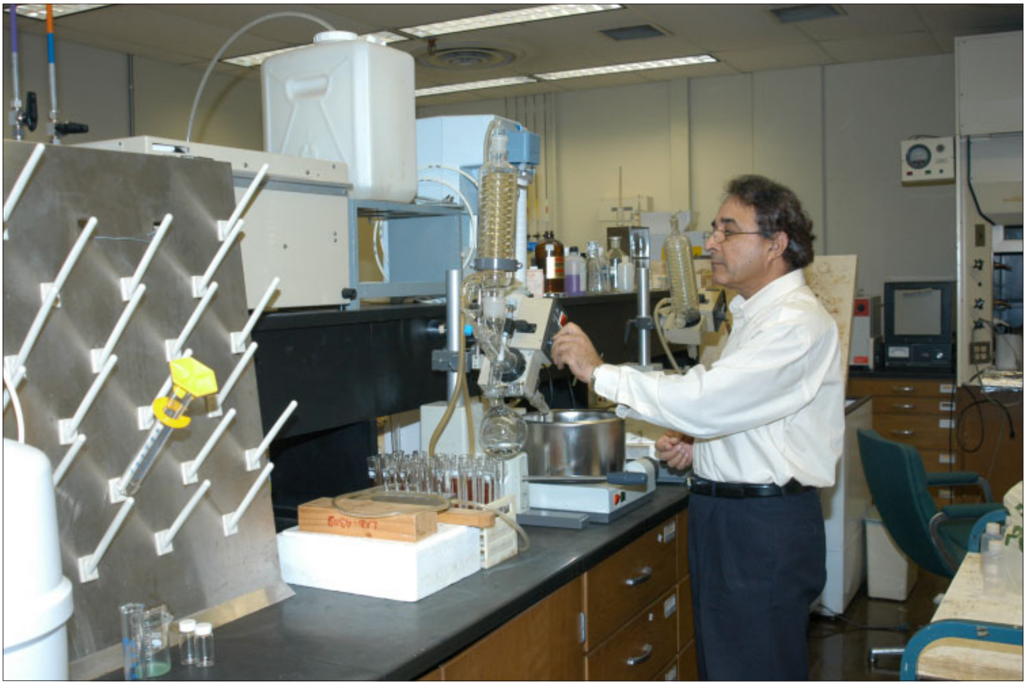
CHE 690 Special Topics in Chemical Engineering (3-0-3)

The contents of this course will be in one of the specific areas of interest in Chemical Engineering. The specific contents of the special topics course will be given in detail at least one semester in advance of that in which it is offered. It is also subject to the approval of the Graduate Council..

Prerequisite: Graduate Standing; another graduate course may be required if needed.

CHE 710 Ph.D. Dissertation (0-0-12)

Involves in-depth analysis of a particular branch of chemical engineering. The quality of the work should be original, creative and should be a significant contribution in the areas of the topic selected. The work should have an original experimental component. In addition, departmental regulations and those of the College of Graduate Studies should be satisfied.



CIVIL ENGINEERING

Chairman

Husain J. Al-Gahtani

Professor

Al-Abdul Wahhab	Al-Amoudi	Abduljauwad
Alfarabi sharif	Aiban	Azad
Baluch	Allayla	Al-Malack
Almusallam	Al-Shayea	Al-Tayyib

Associate Professor

Ahmadi	Al-Ghatani, A.	Al-Suwaiyan
Bukhari	Al-Mandil	Al-Zahrani, M. A
Al-Gadhib	Ratrout	Al-Zahrani, M. M.
Al-Gahtani, H.	Al-Senan	
Al-Ghamedy, H.	Shamshad	

Assistant Professor

Bader, M.	Khathlan	Al-Sughaiyer
Bader, T.	Al-Mana	Vohra
Alghamdi, S.	Al-Ofi	

Lecturer

Baig, M.	Bouchama	Al-Mana
Al-Yousef		

INTRODUCTION

The graduate program in civil engineering at KFUPM aims at advanced professional preparation in a planned range of choices, developing the individual's intellect for creative thinking and inculcating skills for a ready adaptation of new knowledge and techniques. The program derives its strength from a qualified faculty, students of superior ability, excellent laboratory, computer and library facilities. These facilities sustain continuing growth in research in a number of areas strongly related to the graduate program.

The Department of Civil Engineering offers graduate programs leading to Master of Science, Master of Engineering and Doctorate Degrees in Civil Engineering in four options:

- Structural Engineering
- Water Resources and Environmental Engineering
- Geotechnical Engineering
- Transportation Engineering

The master of science was the first graduate program and it started in Fall 1972-73. This was followed by the doctorate program in Fall 1985-86. Finally to provide an opportunity for practicing engineers to enhance and update their knowledge and skills, the master of engineering program was initiated in Fall 1988-89.

Individual programs are designed and updated in Fall 2007/08 to suit a student's particular interest beyond undergraduate study. In addition to the mandatory courses in each option, students can select topics which contribute substantially to their major field in order to develop a certain level of specialization. The graduates of this program not only become well versed in one of the four recognized option areas of civil engineering but also achieve proficiency in subject areas that have evolved as a result of the unique environmental conditions prevalent in the Kingdom that require the use of innovative methods and materials for an optimal solution. The department has sponsored faculty research in all specialty areas.

Recent and current research in the environmental engineering area emphasizes municipal sludge management, fuel fly-ash management, application of membrane technology in wastewater treatment, electrochemical oxidation of organics in industrial wastewaters, evaluation of wastewater treatment plants, applications of anaerobic membrane bioreactors in wastewater treatment, and application of advanced oxidation processes in wastewater treatment.

Research in the geotechnical engineering area includes soil-structure interaction, local soil and foundation problems, mineralogy and fabric of soils, constitutive modeling of soil, nonlinear numerical analysis, soil stabilization, soil dynamics and geoenvironment.

Research in structures and materials focuses on concrete behavior with a blend of computational and experimental modeling to characterize diversified phenomena such as corrosion, computational durability modeling, shrinkage, creep, repair and fatigue. Other areas of research include concrete durability; finite and boundary element modeling of structures for assessment, strengthening and/or repair, strut and tie modeling, failure modes of prestressed hollow core slabs, study of new generation concretes, , steel connections, structural optimization, structural dynamics, and nondestructive testing.

Research in transportation includes areas of highway safety, intersection safety, pedestrian safety, signal optimization, intercity transportation demand modeling, disaggregate behavior modeling, pavement materials specification, modification, modeling, analysis and pavement management system, and quality control and quality assurance.

Water-resources projects include recharge problems, groundwater contamination problems and sea water intrusion, numerical techniques, remote sensing applications in water resources, watershed modeling of rainfall-runoff relationships, evapotranspiration studies in arid zones, and urban hydrology.

TEACHING AND RESEARCH FACILITIES

The department has the following laboratories which are all equipped with state-of-the-art equipment.

1. Structural Laboratories, Concrete testing laboratory, stress analysis laboratory, structural mechanics laboratory, heavy structures laboratory, building research station, and corrosion laboratory
2. Highway Materials Laboratory
3. Graphics Laboratories
4. Water Resources / Environmental Laboratories, Open channel laboratory, hydraulics laboratory, and environmental & sanitary laboratory
5. Traffic Engineering Laboratory
6. Photogrammetry Laboratory
7. Surveying Laboratory
8. Geotechnical Engineering Laboratory

GRADUATE PROGRAMS IN CIVIL ENGINEERING

The Department offers three graduate programs: M.S. in Civil Engineering, M.Engg. in Civil Engineering, and Ph.D. in Civil Engineering.

The M.S. options require 24 credit hours of approved course work and an acceptable thesis. The M.Engg. program requires 42 credit hours. A student becomes a doctoral candidate by passing an entrance examination, satisfying residence requirements, fulfilling 30 credit hours of course work beyond the M.S. and passing a comprehensive examination. The Ph.D. is conferred after successful completion of the dissertation. The details of the academic programs are given below:

ADMISSION REQUIREMENTS

Graduates in engineering and science from recognized institutions are eligible to apply for admission as regular students in the Master program. To be considered for admission to the doctoral program, an applicant must hold a Master of Science degree from a university of recognized standing in Civil Engineering. Holder of Master of Engineering degree (non-thesis) can be considered for admission for doctoral program with certain deficiency courses. For admission into either program, the general University admission regulations must also be satisfied.

M.S. PROGRAM IN CIVIL ENGINEERING

The objective of Master of Science program is to enable the bright and talented graduate engineers to further intensify their training by specializing in their field of interest. The program, offering a healthy balance of design, laboratory and computer experience, offers an accelerated opportunity for attaining professional competence.

The Master of Science in Civil Engineering is available to students who meet the requirements for admission to the university with a Bachelor's Degree in Civil Engineering Science or equivalent. A candidate fulfills the requirements for the M.S. degree by successful completion of a minimum of 24 credit hours of graduate course work plus six credit hours of research toward the preparation of an acceptable thesis. Of the 24 course credits, 18 must be in Civil Engineering. Of the 18 credit hours in Civil Engineering, 15 are expected to be in one of the four options namely: Structures, Water Resources and Environmental Engineering, Geotechnical Engineering, and Transportation.

Under certain conditions courses carrying identification codes in the 400 level may be taken for graduate credit (towards a Master's program only). No more than two (2) courses of 400 level may be counted for credit towards the requirements of an advanced degree. These two courses must be approved by the student's graduate committee, the department chairman, and the Dean of Graduate Studies.

M. ENGG. IN CIVIL ENGINEERING

The objective of Master of Engineering program is to prepare professional empowered with knowledge and skills to take leadership role in the development of the Kingdom in the fields of engineering science, environmental design and business. The program is an outstanding opportunity for the practicing civil engineers to develop professionally and to earn higher degrees without relinquishing their jobs. Four options of civil engineering namely: Structures and Materials, Geotechnical, Transportation, and Water Resources and Environmental Engineering are available for M.Engg. degree.

The Master of Engineering in civil engineering is available to students who meet the requirements for admission to the university with a Bachelors Degree in Civil Engineering or equivalent. A candidate fulfills the requirement for the MEng. Degree by successful completion of a minimum of 36 credit hours of graduate course plus six credit hours of engineering work towards completion of a project (CE 598) and a master of engineering report (CE 600). Of 36 credit hours, 30 credit hours must be in civil engineering with 12 credit hours allocated to core courses. A total of 6 credit hours must be earned in elective courses taken outside the department.

PH.D. PROGRAM IN CIVIL ENGINEERING

The objective of the Doctor of Philosophy program is to identify and train young scholars with an aptitude for research and teaching. The program is intended to serve as a catalyst for promoting not only fundamental research, but also research aimed at ameliorating some of the pressing problems faced by the construction industry in the Kingdom. Such an approach helps fulfill the objective of attaining self-reliance in dealing with the multitude of civil engineering problems arising as a result of accelerated development in an environment not conducive to conventional design and construction.

The program leading to the degree of Doctor of Philosophy involves advanced studies in Civil Engineering and related areas. Formal study in terms of advanced courses coupled with independent research prepares the student for leadership in the option of Structures, Water Resources and Environmental Engineering, Geotechnical Engineering or Transportation. The program is administered under the general regulations of the Deanship of Graduate Studies with regard to admission, residence, examinations, and the dissertation.

The Departmental Graduate Program Committee will decide whether or not the student has to take the Preliminary Examination. This examination covers the student’s major area to demonstrate his competence and identify his deficiencies. The results of the Preliminary

Examination are used in drawing up the student's program and to remedy certain deficiencies if the need arises. This examination will be offered twice a year, one each semester. Students with full standing, must take the examination no later than the second semester following their admission to the Ph.D. program.

Students who perform satisfactorily in the Entrance Examination may proceed with their approved program which requires the completion of a minimum of 30 credit hours of courses, beyond the M.S. degree, with a cumulative GPA of 3.00 or more at all times. Of the 30 credit hours, 18 should be in his major area of interest and 12 in related minor area(s). Within the minor area(s), at least six credit hours should be completed outside the Civil Engineering Department.

Upon successful completion of all course work, a candidate will be required to take a written and oral Comprehensive Examination. On the basis of the Comprehensive Examination, a student may be admitted to the Doctorate Degree Candidacy. A graduate student will only be allowed to take the Comprehensive Examination twice. A candidate who successful passes the Comprehensive Examination may proceed with his research work under the supervision of his dissertation advisor and in consultation with his dissertation committee. Independent research in one of the declared options in Civil Engineering or related applied science is the central requirement of the Doctoral Program. The candidate, upon completion of his research work, will defend his dissertation before the thesis committee and in public. The Ph.D. degree will be conferred only upon the recommendation of his dissertation committee.

The next sections detail the proposed modifications to the graduate course offerings in the various options areas.

Degree Plan for the M.S. Program in Civil Engineering

Geotechnical Engineering Option

Course#		Title	LT	LB	CR
FIRST SEMESTER					
MATH	5XX	Advanced Mathematics*	3	0	3
CE	550	Nature and Behavior of Soils	3	0	3
CE	551	Advanced Geotechnical Engineering	2	3	3
CE	599	Seminar	1	0	0
					9
SECOND SEMESTER					
CE	552	Foundation Engineering	3	0	3
CE	5xx/6xx	Geotechnical Elective	0	0	3
CE	5xx/6xx	Geotechnical Elective	0		3
					9
THIRD SEMESTER					
CE	5xx/xx	CE Elective**	0	0	3
CE	610	Thesis	0	0	6
					9
FOURTH SEMESTER					
XX	5xx/x	Technical Elective***	0	0	3
					3
Total Credit Hours					**30**

* Math 513 or Math 560.

** From Civil Engineering courses (including Geotechnical option).

*** From relevant graduate courses offered university wide with consent of the Department.

Degree Plan for the M.S. Program in Civil Engineering

Structures Option

Course#		Title	LT	LB	CR
FIRST SEMESTER					
CE	501	Concrete Materials	2	3	3
CE	510	Advanced Structural Mechanics	3	0	3
CE	511	Advanced Structural Analysis	3	0	3
CE	599	Seminar	1	0	0
					9
SECOND SEMESTER					
MATH	5xx	Advanced Mathematics	3	0	3
CE	521	Advanced Reinforced Concrete Design	3	0	3
CE	5xx/6xx	Structures Elective	0	0	3
					9
THIRD SEMESTER					
CE	5xx/6xx	CE Elective*	0	0	3
CE	610	Thesis	0	0	6
					9
FOURTH SEMESTER					
XX	5xx/6xx	Technical Elective***	0	0	3
					3
Total Credit Hours					**30**

* From Civil Engineering courses (including Transportation Engineering option).

** From relevant graduate courses offered university wide with consent of the Department.

*** From relevant graduate courses offered university-wide with consent of the Department.

Degree Plan for the M.S. Program in Civil Engineering

Transportation Engineering Option

Course#		Title	LT	LB	CR
FIRST SEMESTER					
MATH	560	Applied Regression and Expt. Design	3	0	3
CE	574	Pavement Structures	3	0	3
CE	571	Urban Transp. Planning and Modeling	3	0	3
CE	599	Seminar	1	0	0
					9
SECOND SEMESTER					
CE	5xx/6xx	Transportation Elective	0	0	3
CE	5xx/6xx	Transportation Elective	0	0	3
CE	5xx/6xx	Transportation Elective	0	0	3
					9
THIRD SEMESTER					
CE	5xx/6xx	CE Elective*	0	0	3
CE	610	Thesis	0	0	6
					9
FOURTH SEMESTER					
XX	5xx/6xx	Technical Elective**	0	0	3
					3
Total Credit Hours					**30**

* From Civil Engineering courses (including Transportation Engineering option).

** From relevant graduate courses offered university wide with consent of the Department.

Degree Plan for the M.S. Program in Civil Engineering

Water Resources and Environmental Option

Course#		Title	LT	LB	CR
FIRST SEMESTER					
MATH	5xx	Advanced Mathematics*	3	0	3
CE	533	Groundwater Flow & Cont. Transport	3	0	3
CE	541	Chemistry in Environmental Eng.	2	0	3
CE	599	Seminar	1	0	0
					9
SECOND SEMESTER					
CE	5xx/6xx	Water Resources/Env. Elective [1, 2]	3	0	3
CE	5xx/6xx	Water Resources/Env. Elective	0	0	3
CE	5xx/6xx	CE Elective**	0	0	3
					9
THIRD SEMESTER					
CE	5xx/6xx	Water Resources/Env. Elective	0	0	3
CE	610	Thesis	0		6
					9
FOURTH SEMESTER					
XX	5xx/6xx	Technical Elective***		0	3
					3
Total Credit Hours					**30**

* MATH 513 or 560.

** From Civil Engineering courses (including Water Resources & Environmental Engineering option).

*** From relevant graduate courses offered university wide with consent of the Department.

1. CE 531 is mandatory for candidates pursuing research in Water Resources.
2. CE 547 is mandatory for candidates pursuing research in Environmental Engineering.

Degree Plan for the M.Engg. Program in Civil Engineering

Course #		Title	LT	LB	CR
FIRST SEMESTER					
CE	XXX	CE Core $	3	0	3
CE	XXX	CE Core $	3	0	3
CE	500	Concept of Engineering Practice	3	0	3
					9
SECOND SEMESTER					
CE	XXX	CE Core $	3	0	3
CE	XXX	CE Elective *	3	0	3
XX	XXX	Elective **	3	0	3
					9
SUMMER					
CE	598	Master Design Project	0	6	3
					3
THIRD SEMESTER					
CE	XXX	CE Elective *	3	0	3
XX	XXX	Elective **	3	0	3
XX	XXX	Elective **	3	0	3
					9
FOURTH SEMESTER					
CE	XXX	CE Elective *	3	0	3
XX	XXX	Elective **	3	0	3
XX	XXX	Elective **	3	0	3
					9
SUMMER					
CE	600	Master of Engineering Report	0	6	**3**
Total Credit Hours					**42**

$ From the list of CE core courses.

* From the list of major electives

** Two of which should be from outside the department according to the approved degree plan.

Ph.D. PROGRAM

ALL OPTIONS

A typical breakdown of credit hours is given for each of the available four options of study, namely:

1. Structures
2. Water Resources and Environmental Engineering
3. Geotechnical
4. Transportation.

Areas	Course	Credits
Major Area	Six CE courses (CE 5xx/CE 6xx)	18
Minor Area(s)	Minimum two graduate courses from outside CE Department	12
	Seminar (CE 699)	0
	Ph.D. Dissertation (CE 710)	12
Total		**42**

All courses must be selected in consultation with the Graduate Advisor.

The minimum time requirement for completion of the Ph.D. program is three years.

Degree Plan for the Ph.D. in Civil Engineering

Course #		Title	LT	LB	CR
FIRST SEMESTER					
CE	5XX/6XX	Core Elective I	3	0	3
CE	5XX/6XX	Core Elective II	3	0	3
CE	5XX/6XX	Core Elective III	3	0	3
			9	**0**	**9**
SECOND SEMESTER					
CE	5XX/6XX	Core Elective IV	3	0	3
CE	5XX/6XX	Core Elective V	3	0	3
CE	5XX/6XX	Core Elective VI	3	0	3
			9	**0**	**9**
THIRD SEMESTER					
XX	5XX/6XX	Technical Elective I*	3	0	3
XX	5XX/6XX	Technical Elective II*	3	0	3
XX	5XX/6XX	Free Elective I+	3	0	3
			9	**0**	**9**
FOURTH SEMESTER					
XX	5XX/6XX	Free Elective II+	3	0	3
CE	599	Seminar	1	0	0
CE	710	PhD Dissertation	0	0	IP
FIFTH SEMESTER					
CE	710	PhD Dissertation	0	0	IP
SIXTH SEMESTER					
CE	710	PhD Dissertation	0	0	**12**
Total Credit Hours					**42**

* must be from outside CE Department (non-CE courses) to establish a minor area

\+ can be chosen from CE or non-CE courses.

IP: Dissertation in progress.

COURSE DESCRIPTION

CE 500 Concept of Engineering Profession (3-0-3)

The role of civil engineering profession in society, professional ethics and code of conduct; building odes, bylaws and regulations, professional responsibilities and liabilities; sustainable design and development and their impact on environment and ecology; project management including management of human resources and finance; professional societies and membership, and the need of lifelong learning.

Prerequisite: Graduate Standing

CE 501 Concrete Materials (2-3-3)

Properties of concrete constituents; types of cements and their composition; cement hydration; microstructure of hydrated cement paste and its influence on strength, shrinkage and creep; chemical admixtures; alternate cement matrices; concrete durability and sustainability; introduction to repair materials.

Prerequisite: Graduate Standing

CE 502 Evaluation and Testing of Concrete Structures (2-3-3)

Introduction to in-situ testing and planning of test programs; various nondestructive tests (NDT), tests for concrete strength, quality, composition and durability; measurement of corrosion activity; chemical tests for cement, chloride and sulphate contents; cracking of concrete; in-situ load tests; condition assessment with case studies; types of concrete repair, repair strategy, compatibility and selection of repair materials, patch repair, corrosion repair and crack repair.

Prerequisite: Graduate Standing

CE 504 Corrosion in Reinforced Concrete (2-3-3)

Corrosion mechanisms including corrosion cells, electrochemical reactions, polarization and passivity; forms of corrosion, corrosion mechanisms of reinforcing steel in concrete structures; environmental effects; effect of concrete properties; corrosion testing; corrosion protection including cathodic protection, corrosion inhibitors, chloride extraction, re-alkalization, and protective coatings.

Prerequisite: CE 501

CE 510 Advanced Structural Mechanics (3-0-3)

Unsymmetrical bending of beams; shear center; torsion of prismatic bars; beams on elastic foundations; introduction to Cartesian tensors; tensorial transformation of stress; dyadic symbols; finite and infinitesimal strain tensors; Mohr's circle for 3-D strain;

constitutive equations for anisotropic materials and application to composite laminates; theories of yield and fracture; plane elasticity.

Prerequisite: Graduate Standing

CE 511 Advanced Structural Analysis (3-0-3)

Matrix algebra, solution of equations, review of energy principles, virtual work; degree of redundancy, choice of redundants, flexibility method, kinematic indeterminacy, development of element stiffness matrices, stiffness method of analysis of structures, computer applications and software development, axial force effects and eigenvalue analysis, introduction to the finite element method.

Prerequisite: Graduate Standing

CE 512 Elasticity and Plasticity I (3-0-3)

Basic equations of continuum mechanics; plane elasticity; Airy's stress function; polynomial and generalized Fourier series solution to biharmonic equation; plane elasticity in polar coordinates; general foundation of plasticity theories including yield criteria, plastic flow rule, and generalized elasto-plastic shear strain relations; application of finite elements in elasticity and plasticity.

Prerequisite: Graduate Standing

CE 513 Plates and Shells (3-0-3)

Static analysis of elastic plates, including rectangular and circular geometry; energy methods; finite difference for plates with straight and curved boundaries; introduction to finite element for plate bending; thermal stresses in plates; application of ANSYS to plate bending; membrane theory of shells of surface of revolution; bending theory of circular cylindrical shells; discontinuity stresses in pressure vessels; axisymmetric bending of spherical shells.

Prerequisite: CE 510

CE 514 Structural Stability (3-0-3)

Introduction to common areas of stability problems in structures, conservative and nonconservative loads, elastic and inelastic buckling of columns; stability of members under combined bending and axial loads; buckling of frames; torsional buckling of open sections; lateral stability of beams and buckling of thin plates and shells; design consideration for stability; computer applications.

Prerequisite: CE 511

CE 515 Structural Dynamics (3-0-3)

Equations of motion; free and forced vibrations of single degree of freedom systems; multi-degree of freedom systems; free vibrations, forced vibrations by harmonic, generalized, impulsive and random loadings; numerical solution of dynamic problems; introduction to earthquake engineering; introduction to probabilistic vibrations; linear and nonlinear problems; computer applications.

Prerequisite: CE 511 or equivalent

CE 516 Numerical Methods of Structural Analysis (3-0-3)

Introduction to finite difference calculus; applications in computing bending moments; shear force and deflection of beams, critical loads for columns and analysis of beams on elastic foundations; plate bending by finite difference; finite difference software development; introduction to modeling and applications with emphasis on software development.

Prerequisites: CE 510, CE 511

CE 517 Finite Element Methods (3-0-3)

Basic equations of elasticity; virtual work; stiffness properties of structural elements; variational and weighted residual methods, applications to trusses, beams, plane frames, two-dimensional axi-symmetric and three-dimensional solids; higher order and isoparametric elements; field and time-dependent problems of fluid and heat flow; software development.

Prerequisites: CE 510, CE 511, or Consent of the Instructor

CE 518 Continuum Mechanics (3-0-3)

Tensors, indicial notation, transformation of coordinates; analysis of stress, principal stresses; 3D Mohr’s circle; analysis of deformation and strain; velocity fields and compatibility conditions; constitutive equations; isotropy; mechanical properties of solids and fluids; field equations; applications to elasticity, viscoelasticity, plasticity, and fluid mechanics; introduction to continuum damage mechanics.

Prerequisite: Graduate Standing

CE 519 Boundary Element Method (3-0-3)

Weighted residual methods; weak formulations; inverse formulations, fundamental solutions; one-dimensional problems; two-dimensional problems of steady state potential flow; two-dimensional problems of elastostatics; time dependent problems; algorithm design and software development; application in various engineering fields.

Prerequisite: Graduate Standing

CE 521 Advanced Reinforced Concrete (3-0-3)

Moment-curvature for RC members; plastic hinges and moment redistribution in beams, yield line analysis of slabs, design of two-way floor systems; design of slender columns; beam-column joints; deflection of RC members; design for shear and torsion; computer modeling for analysis and design of RC structures; design of shear walls.

Prerequisite: Graduate Standing

CE 522 Prestressed Concrete (3-0-3)

Prestressing systems; materials; behavior of prestressed concrete beams; criteria for analysis and design; losses; analysis of stresses; flexural design; shear; end blocks; deflection; composite members; continuous beams; partial prestress, design applications; introduction to segmental construction.

Prerequisite: Graduate Standing

CE 523 Behavior and Design of Steel Structures (3-0-3)

Elastic-plastic concepts of structural behavior; plastic design of beams and frames; design of plate girders, compression member with large width-thickness ratio, stiffened plate, composite design and behavior, behavior of rigid and semi-rigid connections; design considerations for fracture and fatigue; design of rigid frames; behavior of multistory frames and second-order analysis.

Prerequisite: CE 408 or equivalent

CE 530 Experimental Hydraulics (1-6-3)

Experiments for model calibration and verification; flow characteristics of weirs, flumes, spillways, self-regulated siphons, roughened beds, and cylindrical piles; determination lift and drag on models; model study approaches to diffusion in transport problems; experiment in groundwater flow and well hydraulics.

Prerequisite: Graduate Standing

CE 531 Advanced Engineering Hydrology (3-0-3)

Introduction to the elements of the hydrologic cycle; frequency analysis of precipitation and runoff; relationship between rainfall and runoff; flood routing; watershed modeling and urban hydrology.

Prerequisite: Graduate Standing

CE 532 Hydrodynamics (3-0-3)

Kinematics of fluid; continuity: plane flow, axi-symmetric flow, streamflow functions, circulation, velocity potential; dynamics of frictionless fluids: Eulerian equations of motion, irrotational incompressible flow, some elementary symmetric and axisymmetric flow, rotational flow, equations in a moving coordinate system, flow past spheres and cylinders; two-dimensional complex variables and applications.

Prerequisite: Graduate Standing

CE 533 Groundwater Flow & Contaminant Transport (3-0-3)

Properties of porous media, fluid storage and flow in saturated media, transport equations in porous media, equation of motion, Darcy's law, continuity & conservation equation, well hydraulics, principle of superposition, transport of contaminants by advection, modeling of advective transport.

Prerequisite: Graduate Standing

CE 534 Hydraulics of Closed Conduits (3-0-3)

Concept of water hammer and unsteady flow through conduits; method of characteristics; algebraic water hammer; flow through highly flexible tubing; transients caused by pumps and turbines; computer models; case studies.

Prerequisite: Graduate Standing

CE 535 Design of Dams and Hydraulic Structures (3-0-3)

Types of hydraulic structures; classification of dams; problems of foundation; selection of sites; feasibility studies; design of gravity, arch, earth and rockfill dams; barrages and dams on permeable foundation and their design criteria; spillway types; energy dissipation devices; syphon aqueducts; design criteria for transitions from trapezoidal to rectangular flumes.

Prerequisite: Graduate Standing

CE 537 Water Resources and Environmental Systems Analysis (3-0-3)

Applications of system engineering techniques to water and environmental problems; optimization techniques, linear programming, integer programming, goal programming, non-linear programming, dynamic programming; multi-objective decision analysis; simulation methods.

Prerequisite: Graduate Standing

CE 538 Advanced Open Channel Flow (3-0-3)

Basic concepts of fluid flow; the energy and momentum principles in open channel flow; critical flow; flow resistance in uniform and non-uniform flow; normal depth analysis; flow profiles in gradually varied flow; rapidly varied flow; channel controls and channel transitions; flow of waves and equation of motion in unsteady flow; computer applications in open channel.

Prerequisite: Graduate Standing

CE 539 Coastal Engineering (2-3-3)

An introduction to the mechanics of coastal environment; linear wave theory, kinematics, dispersion, mass transport radiation stress, energy flux, current; shoaling, refraction, diffraction; real sea states; wind wave prediction; wave climate; wave loading; tides and tidal circulation; storm tides; limited laboratory experiments.

Prerequisite: Graduate Standing

CE 541 Chemistry in Environmental Engineering (2-3-3)

Environmental aspects of physical, organic, and inorganic chemistry including applications in environmental engineering of the phenomena of precipitation, buffering capacity, chemical equilibria, and adsorption.

Prerequisite: Graduate Standing

CE 542 Microbiology in Environmental Engineering (2-3-3)

Role of microorganisms in wastewater treatment; aerobic and anaerobic digestion of municipal sludges, and degradation of water quality in drinking water systems; disinfection of wastewater and drinking water for removal of viruses, bacteria and protozoa that cause waterborne diseases.

Prerequisite: Graduate Standing

CE 543 Air Pollution Engineering (3-0-3)

Introductory course in air pollution and its control; air pollution and effects, sources, dispersion models, engineering controls, and air quality legislation.

Prerequisite: Graduate Standing

CE 544 Unit Operations and Processes Laboratory (1-6-3)

Analytical methods utilized for assessment of water and wastewater quality; laboratory evaluation for the design of physical, chemical, and biological unit operations and processes in water and wastewater treatment.

Prerequisites: CE 541, CE 542 (can be taken concurrently)

CE 546 Industrial Water and Wastewater Treatment (3-0-3)

Water quality and quantity for industrial uses, characteristics of wastewater; application of standard and special treatment processes; effluent quality and water reuse; conditioning and disposal of sludges; case studies.

Prerequisite: CE 541 or equivalent

CE 547 Physical and Chemical Processes (3-0-3)

Theory and applications of physical and chemical processes in water treatment; coagulation; softening; desalting; stabilization; filtration; adsorption; fluoridation; gas transfer.

Prerequisite: CE 541

CE 548 Biological Processes (3-0-3)

Theory and applications of biological processes in wastewater treatment; kinetic models; aeration and oxygen transfer; suspended-growth and fixed-film processes; aerobic and anaerobic digestion; sludge thickening, dewatering and disposal.

Prerequisite: CE 542 (can be taken concurrently)

CE 549 Selected Topics in Environmental Engineering (2-3-3)

Study of the dynamic role of environmental engineering in maintaining environmental quality. A comprehensive study of any phase of environmental engineering.

Prerequisite: Graduate Standing

CE 550 Nature of Behavior of Soils (3-0-3)

Soil formation, composition, crystallography, and mineralogy; soil-water-electrolyte system; physio-chemical nature of soil; soil fabric and structure; relationship between soil composition and mechanical behavior; time-deformation processes; compressibility and volume change in clay soils; conduction phenomena.

Prerequisite: Graduate Standing

CE 551 Advanced Geotechnical Engineering (2-3-3)

Introduction to testing (instrumentation, data collection, precision, analysis and interpretation); triaxial and plane strain testing taking into account dilation, back pressure, pore pressure parameters, stress path, permeability testing and flow nets; oedometer testing and consolidation; subsurface investigation; in-situ investigation methods (CPT, SPT, pressuremeter, vane shear, geophysical and plate bearing tests).

Prerequisite: Graduate Standing

CE 552 Foundation Engineering (3-0-3)

Bearing capacity of shallow foundations; factors affecting bearing capacity; immediate and consolidation settlement of shallow foundations; mat foundations; analysis, design, and installation of pile foundations; capacity and settlement of piles and pile groups; drilled piers and caissons.

Prerequisite: CE 551 or Consent of the Instructor

CE 553 Soil and Site Improvement (3-0-3)

Behavior of natural soils; shallow and deep mechanical modifications; improvement by admixtures; grouting; hydraulic modifications; thermal and electrical treatments; modifications by inclusions and confinement; development of marginal lands; treatment of local problematic soils; landfills.

Prerequisite: CE 551 or Consent of the Instructor

CE 555 Modeling in Geomechanics (3-0-3)

Stress and strain in soils; strength and stress-strain behavior of soils; critical state soil mechanics; constitutive laws for soils; soil plasticity including concept of yield surface, stress space, failure criteria, plastic potential, and normality; constitutive models and numerical implementation.

Prerequisite: CE 551

CE 556 Earth Structures (3-0-3)

Shear strength of soils and its relevance to earth structures; methods of analysis including limit analysis, limit equilibrium and numerical methods; earth pressure theories taking into account seepage and pore pressure dissipation; design and analysis of retaining structures (slopes, retaining walls, sheet piles, and braced excavation).

Prerequisite: CE 551 or Consent of the Instructor

CE 557 Designing with Geosynthetics (2-3-3)

Functions of geosynthetics (separation, reinforcement, filtration, drainage and liquid containment); geosynthetics properties and their measurements; design and construction using geotextiles, geogrids, geonets, geomembranes, geosynthetic clay linears and geocomposites.

Prerequisite: CE 556 or Consent of the Instructor

CE 558 Environmental Geotechnics (3-0-3)

Geotechnical engineering of land disposal of hazardous and nonhazardous wastes; fate and transport of contaminants; compacted clay and synthetic liners; leachate collection and removal system; landfill cover and gas venting systems; design and stability of landfill elements; construction quality assurance and control; performance monitoring; remediation technologies.

Prerequisite: Graduate Standing

CE 559 Rock Engineering (2-3-3)

Geological classification and index properties of rocks; strength and deformability behavior of intact and jointed rock masses; in-situ stresses; lab and field test methods; aspects of structural geology; stability of rock slopes; applications to surface excavations, underground openings and tunnels; foundations on rocks.

Prerequisite: Graduate Standing

CE 571 Urban Transportation Planning & Modeling (3-0-3)

Transportation planning processes, transportation land use interaction, travel evaluation and demand estimation, traffic generation theories and assignment models, and transit analysis.

Corequisite: Math 560 or CRP 505

CE 572 Methods of Analysis for Planners (3-0-3)

Some basic statistical properties; use of matrices in planning; linear regression analysis and analysis of variance with their applications; hypothesis testing; questionnaire design; sampling; factor, discriminant and logit analyses with applications; linear programming; applications to planning using computer packages.

Prerequisite: Math 560

CE 573 Transportation System Analysis (3-0-3)

Application of systems approach to transportation; the determination of transportation demand and supply; the equilibrium process; transportation system evaluation; cost-effectiveness techniques; use of optimization techniques in transportation.

Prerequisite: CE 571

CE 574 Pavement Structures (3-0-3)

Fundamentals of pavement-vehicle interaction and the mechanics of pavement response; stress analysis in flexible and rigid pavements; material characterization; design of flexible and rigid pavements for highways and airports; surface, base and subgrade courses evaluation and design; modern design techniques and their applications; cost analysis and pavement selection; computer applications in pavement analysis and design.

Prerequisite: Graduate Standing

CE 575 Pavement Evaluation, Maintenance and Rehabilitation (2-3-3)

New concepts, methods and practices for the evaluation, maintenance, and rehabilitation of highway and airport pavement systems; nondestructive techniques for structural evaluation of pavements to assess performance; back-calculation of pavement material properties for rehabilitation design; recycling and overlay design; quality control/assurance; computer applications in pavement evaluation and maintenance; selection of cost effective alternative.

Prerequisite: CE 574

CE 576 Geometric Design of Highways (2-3-3)

Geometric configuration of streets, expressways, busways to meet the characteristics of vehicle performance and operator limitations; level of service concept, roadside and guardrail design; safety issues. Application of road design softwares and laboratory assignments are included.

Prerequisite: Graduate Standing

CE 577 Airport Planning and Design (3-0-3)

Planning and design of airport facilities; aircraft geometric and operational characteristics; passenger demand analysis; air-traffic control procedures; configuration and orientation of runway; geometric and structural design of runways and taxiways; terminal design; airport capacity; airport noise; airport master planning.

Prerequisite: Consent of the Instructor

CE 578 Highway Capacity Analysis (2-3-3)

Capacity analysis of all highways and intersections; design and analysis of signalization including warrants, cycle length, timing, phasing and coordination; fundamentals and hand-on application of existing tools and softwares and laboratory assignment are included.

Prerequisite: Consent of the Instructor

CE 579 Pavement Materials (2-3-3)

The nature, engineering characteristics, and selection of materials for highway and airport pavements; composition, physical behavior, production and performance of bituminous materials and mixtures; concrete mixes for rigid pavements; durability of concrete and asphalt mixes; polymer materials and additives; recent developments in pavement materials.

Prerequisite: Graduate Standing or Consent of the Instructor

CE 580 Geometric Design of Highway Terminals (2-3-3)

Geometric configuration of highway terminals including intersections, interchanges, and parking facilities; level of service concept; and application of design softwares and hand-on laboratory assignments are included.

Prerequisite: CE 576

CE 581 Public Transportation System (3-0-3)

Mass transit operation and management; transit characteristics and vehicle technology; land-use impact. Public policy and financing.

Prerequisite: CE 571

CE 590 Advanced Topics in Structural Engineering (3-0-3)

Advanced topics selected from the broad area of structural engineering to provide the student with knowledge of recent applications and development in this specialty.

Prerequisite: Graduate Standing

CE 591 Advanced Topics in Water Resources and Environmental Engineering (2-3-3)

Advanced topics selected from the broad area of water resources and environmental engineering to provide the student with knowledge of recent applications and developments in the specialty.

Prerequisite: Graduate Standing

CE 592 Advanced Topics in Geotechnical Engineering (3-0-3)

Advanced topics selected from the broad area of geotechnical engineering to provide the students with knowledge of recent applications and developments in this specialty.

Prerequisite: Consent of Instructor

CE 593 Advanced Topics in Transportation Engineering (3-0-3)

Advanced topics selected from the broad areas of transportation engineering to provide the knowledge with the recent applications and development.

Prerequisite: Graduate Standing

CE 598 Masters Design Project (0-6-3)

Application of knowledge and skills acquired during the tenure of the graduate program in the solution of open-ended, advanced-level design problems from a technical, environmental and socio-economic viewpoint. Use of computer-aided engineering in a project environment will be emphasized. Students can work with senior engineers from industry on a specific design project. The project should be completed under the supervision of a faculty member and examined by a committee.

Prerequisite: Consent of the Advisor

CE 600 Master of Engineering Report (0-6-3)

This will be prepared as an informative report based on a professional work related to analysis, design or construction of a facility that has particular significance or interest. It may also include collection of data or methodologies for design & construction or application of innovative technology. The report will be completed under the supervision of a faculty member and examined by a committee.

Prerequisite: Consent of the Advisor

CE 601 Advanced Concrete Materials (3-0-3)

Special concretes including high strength, high performance, fiber reinforced, lights weight; local durability problems and various methods of protection; concept of durable design and code specifications. Emphasis will be placed on state of the art developments in the area.

Prerequisite: CE 501

CE 602 Environmental Effects on Concrete (3-0-3)

Macro and micro environmental factors affecting concrete strength and durability; local durability problems; performance of concrete under wet-dry and thermal cycles; cracking phenomena; mechanisms of deterioration due to salt-weathering, sulphate attack, carbonation and reinforcement corrosion; modeling of transport phenomena.

Prerequisite: CE 501

CE 603 Repair & Rehabilitation of Concrete Structures (3-0-3)

Characteristics and compatibility of repair materials; shrinkage and creep mechanisms in repair mortars; modeling of structural cracking due to constraints; design of steel and carbon fiber plate bonding for repair and strengthening; durability and fatigue resistance of plate-bonded RC members.

Prerequisites: CE 501, CE 521

CE 604 Instrumentation in Materials Research (1-6-3)

X-ray diffraction; scanning electron microscopy; absorption spectroscopy; IR and far IR absorption and Raman scattering spectroscopy; transmission electron microscopy; electron microprobe analysis; petrograph and thin sectioning analyses; emphasis on individual student projects.

Prerequisite: CE 501

CE 610 MS Thesis (0-0-6)

CE 611 Advanced Structural Dynamics (3-0-3)

Dynamic analysis of distributed parameter systems including beams, plates and shells; effects of shear deformations and rotary inertia; discretization of continuous systems; numerical solutions of eigen-value problems; nonlinear analysis of MDOF systems; probabilistic structural dynamics; earthquake engineering.

Prerequisite: Graduate Standing

CE 612 Elasticity and Plasticity II (3-0-3)

Plane thermoelasticity; three-dimensional elasticity, deformational theories versus incremental theories; application of Prandtl-Reuss equations to pure bending of beams, thick walled spheres and tubes; theorems of limit state analysis and their applications to plastic analysis of frames; theory of slip-line fields; ductile and brittle material models; application of finite elements in plasticity problems.

Prerequisite: CE 512 or CE 518

CE 613 Advanced Finite Element Methods (3-0-3)

Special isoparametric beam elements; plate and shell elements; introduction to geometric nonlinearities including buckling and large deformation; introduction to material nonlinearities (nonlinear elastic, plastic and fracture/cracks); accuracy, convergence, and errors.

Prerequisite: CE 517

CE 614 Advanced Computational Mechanics (3-0-3)

Application of computer/numerical procedures to advanced topics in mechanics; these include buckling of structures, large deformation and rotation, higher order theories, nonlinear elastic, plastic, and cracking materials; software development.

Prerequisites: CE 510, CE 517

CE 616 Fracture of Materials (3-0-3)

Stress intensity computations in linear elastic fracture mechanics (LEFM); finite element including singularity elements in LEFM, compliance calibration for critical energy release rate computations, mixed mode fracture criteria, elasto-plastic fracture principles, crack propagation under cyclic loading; fracture mechanics design process; applications of fracture mechanics to plain and reinforced concrete.

Prerequisite: CE 510

CE 618 Analysis of Bridge Systems (3-0-3)

Bridge loadings and bridge systems; deck structures and idealization; orthotropic plate theory and its application; use of finite difference and finite strip methods; composite bridges; pseudo slab, girder-slab and multi-beam type prestressed concrete bridges, design considerations for substructures; analysis of horizontally curved bridge decks; software applications in bridge analysis.

Prerequisite: CE 521

CE 622 Limit State Design of Concrete Structures (3-0-3)

Concept of limit state design; moment-curvature and load deflection characteristics; plastic analysis and rotational capacity of hinges; upper and lower bound theorems; limit state design of continuous beams and frames; rigid plastic theory, flow rule and applications; yield line and strip method for slabs; shear strengths of beams and slabs; limit states of serviceability; deflection and crack control.

Prerequisite: CE 521

CE 623 Constitutive Modeling of Materials (3-0-3)

Deviatoric stress and strain tensors; geometric representation of stress and concept of Pi-plane; strain energy and complementary energy density in elastic solids; non-linear elastic stress-strain relations; Cauchy and hyperelastic models; incremental (hypoelastic) model for isotropic materials; variable moduli incremental stress-strain models; multi-parameter failure criteria; elastic perfectly plastic fracture models; finite elements in elastoplastic problems.

Prerequisite: CE 510

CE 625 Mechanics of Composite Materials (3-0-3)

Stress-strain for orthotropic lamina, effective moduli and strength of a continuous fiber-reinforced lamina, laminate analysis, delamination, matrix cracking and durability; analysis of lamina hygrothermal behavior; analysis of laminated beams and plates, deflection and buckling of laminates; fracture mechanics of composite materials; finite element applications.

Prerequisite: CE 510

CE 630 Damage Mechanics (3-0-3)

Phenomological aspects of damage; manifestation of damage and measurement and mechanical representation of damage; thermodynamics and micromechanics of damage; potential dissipation function and strain-damage coupled constitutive equations; damage evolution equations; brittle versus ductile damage; anisotropic damage of concrete; fatigue damage; local and averaged damage; scale effect and characteristic length; elasto-plastic damage of concrete structures; finite element modeling of damage.

Prerequisite: CE 518

CE 633 Mechanics of Heterogeneous Fluids IN Porous media (3-0-3)

Characteristics of porous media and fluid mixtures; capillarity; heterogeneous fluids in static systems; mechanical equilibrium; Brooks-Corey and Van Genuchten models; hysteresis; relative permeability; soil-water-air system; flux equation; tortuosity; Kozeny-Carman equation; generalized Darcy’s equation; steady and unsteady two-phase flow; infiltration theory.

Prerequisite: CE 533

CE 635 Water Resources Planning (3-0-3)

Development of supply-demand relationships and projections; analysis of projects for water supply, flood control, irrigation, drainage or quality control; benefit-cost analysis; economic feasibility studies; multipurpose projects and cost allocation techniques.

Prerequisite: Graduate Standing

CE 637 Application of Numerical Methods in Water Resources Engineering (3-0-3)

Application of numerical methods to water resources engineering problems; computations of water surface profile; flood routing; flow resistance in conduits; water hammer; groundwater and contaminant migration.

Prerequisite: Graduate Standing

CE 638 Stochastic Hydrology (3-0-3)

Introduction to probabilistic hydrology; random variables correlated in time and space; applications to rainfall, streamflow, groundwater, water use and storage; time series analysis; and stochastic data generation models.

Prerequisite: CE 531

CE 639 Risk Analysis in Water Resources and Environmental Systems (3-0-3)

Risk and uncertainty; random variables and random events; CDF's and PDF's; population moments, moments of non-linear functions of random variables, first order analysis of uncertainty; methods of estimating parameters of distribution functions; goodness of fit tests; ANOVA; risk analysis applied to applied to hydrology, hydraulics, groundwater, water resources, and environmental engineering systems.

Prerequisite: Graduate Standing

CE 640 Advanced Contaminant Transport in Porous Media (3-0-3)

Advection with mixing, hydrodynamic dispersion; non-conservative solutes, field scale contaminant transport; groundwater contamination by LNAPLS and DNAPLS; containment and cleanup.

Prerequisite: CE 533

CE 641 Chemical Processes in Environmental Engineering (3-0-3)

Application of chemical equilibria; surface chemistry and kinetics to water and wastewater systems; reactor design and kinetics; chemistry and coagulation, corrosion; hardness reduction and disinfection; theory and applications of mass transfer in cocurrent and countercurrent operations.

Prerequisite: Consent of the Instructor

CE 645 Hazardous Waste Management (3-0-3)

Classification, chemistry, and toxicology of hazardous wastes will be presented; control technologies; regulatory policies and management strategies will be examined.

Prerequisite: CE 541 or equivalent

CE 646 Water Quality Modeling (3-0-3)

Evaluation and control of water quality in streams, lakes; and estuaries. Mathematical analyses of patterns of water movement and their relationship to water quality.

Prerequisite: Consent of the Instructor

CE 647 Municipal Solid Waste Management (3-0-3)

Problems, regulations, collection, handling, recycling and disposal of municipal solid wastes in the urban and rural sectors; integrated waste management system with resource recovery, composting, incineration, landfill disposal and their costs.

Prerequisite: Graduate Standing

CE 651 Dynamics of Soils and Foundations (3-0-3)

Theory of vibration; wave propagation in elastic media; dynamic properties of soils and their measurement; vibration transmission and attenuation through soils; foundation vibration theories; dynamic earth pressure; dynamic bearing capacity of shallow foundations; dynamic analysis of foundations; design of machine foundations; vibration isolation; soil liquefaction; introduction to geotechnical earthquake engineering .

Prerequisite: CE 555

CE 652 Advanced Foundation Engineering (3-0-3)

Soil-structure interaction; numerical methods for analysis of foundation; bearing capacity and settlement of foundation using in-situ tests; load-deformation behavior of axially-loaded piles; prediction of pile capacity during driving; beams and plates on foundations; laterally-loaded piles; foundation on difficult soils.

Prerequisite: CE 552 or equivalent

CE 656 Seepage Through Soil and Rocks (3-0-3)

Principles governing the flow of water through soils and rocks and their applications in geotechnical engineering; seepage through porous and jointed media; filter and drain design; foundation dewatering; seepage control in slopes; earth dams and levees.

Prerequisite: CE 551 or Consent of Instructor

CE 658 Geotechnics of Problematic Soils (3-0-3)

Types of problematic soil conditions and their local distributions; geological factors; site investigation; behavior of unsaturated soils; expansive soils; collapsing soils; sabkha soils; calcareous sediments; uncontrolled and deep fills; limestone solution cavities; case studies.

Prerequisite: CE 552 or Consent of Instructor

CE 670 Advanced Pavement Design (3-0-3)

Non-linear analysis; fatigue and permanent deformation; backcalculation of layer moduli; mechanistic empirical design methods; theories of pavement behavior; application of theory to the analysis and design of airport and highway pavement systems including rehabilitation design and computer applications; development of improved design and rehabilitation practices and procedures.

Prerequisite: CE 574

CE 671 Advanced Pavement Materials (3-0-3)

Pavement material characterization procedures; simulation of in-service conditions; experimental program for fatigue cracking modeling and plastic deformation modeling under repetitive loading; development of constitutive laws; advancement in accelerated environmental conditioning and loading simulation, durability testing, and material performance based evaluation.

Prerequisite: CE 579

CE 672 Pavement Maintenance Management (3-0-3)

Techniques of network and project level pavement management; introduction to mapping/facility management system; field evaluation methods and equipment; performance modeling; maintenance and rehabilitation strategies; priority ranking procedures; overlay design procedures; maintenance specifications; computer applications in pavement management.

Prerequisite: CE 575

CE 673 Optimization of Urban Traffic Flows (3-0-3)

Advanced traffic data measurement techniques and interpretation; traffic control devices and systems; freeway surveillance, metering and control; offline and online optimization of traffic signal timing; urban traffic management; intelligent transportation systems.

Prerequisite: Consent of the Instructor

CE 674 Advanced Transportation Modeling (3-0-3)

Introduction to the behavioral techniques and other new approaches to transportation planning. In-depth analysis of transportation modeling process, including probabilistic choice models, statistical estimation techniques, error propagation and parameters sensitivity analysis. Introduction to computer packages related to transportation planning & modeling.

Prerequisite: CE 571

CE 675 Advanced Traffic Engineering (3-0-3)

Macroscopic and microscopic characteristics of flow, speed and density; statistical distribution of traffic characteristics; shock wave analysis; queuing theory; application of theory of traffic flow to design and control of traffic; fundamentals and applications of existing tools and softwares.

Prerequisite: CE 571 or Consent of the Instructor

CE 676 Environmental Impacts of Transportation Facilities (3-0-3)

Effect of environmental impacts on transportation planning and design decisions are made; legislation; measurement and prediction of air, noise, and water pollution; vibrations; visual intrusion; assessment of environmental costs and benefits; assessment of social and economic impacts; environmental impact statements.

Prerequisite: CE 571 or Consent of the Instructor

CE 710 Ph.D. Dissertation (0-0-12)

ELECTRICAL ENGINEERING

Chairman

Ibrahim Habiballah

Chair Professors

Sheikh, A. Bugshan / Bell Labs

Mohamed Mohamed Syed Mansour / SEC

Professors

Abdur-Rahim	Al-Jamid	Hassan
Abuelma’atti	Dawoud	Ragheb
Al-Baiyat	El-Amin	Shwehdi
Al-Shehri	Abido	

Associate Professors

Abdul-Jauwad	Al-Semari	Deriche
Al-Sunaidi	Habiballah	Zummo
Landolsi	Al-Saggaf	Kousa
Al-Duwaish	Al-Zaher	Al-Shahrani
Al-Hamouz	Bakhashwain	Masoudi
Mohandes	Yamani	Zerguine

Assistant Professors

Abu-Al-Saud	Al-Naffouri	Maghrabi
Al-Absi	Al-Shaikhi	Masoud
Al-Ahmari	Al-Suwailem	Muqaibel
Al-Akhdar	Balghonaim	Sheikh, S
Al-Gahtani	Belhaj	Zidouri
Al-Ghadban	Hussein	
Al-Harthi	Kassas	

Lecturers

Bentrcia	Johar	Shafi
Hussain	Khan, A	Tassaduq
	Nuruzzaman	

GRADUATE PROGRAMS IN ELECTRICAL ENGINEERING

The Department of Electrical Engineering offers a wide selection of graduate courses and activities leading to the degrees of Master of Science (M.S.), Master of Science in Telecommunication Engineering (M.S.T.E.), and Doctor of Philosophy (Ph.D.).

These programs allow students to choose a program of study suited to their interests, individual needs and talents. The programs are broad in perspective and maintain a balance between scholarly excellence and practical relevance.

The programs are oriented towards strengthening the student's background in the area of their specialization but are so designed as to deepen their understanding in one or more selected areas in electrical engineering. Particular emphasis is placed on developing research potential, fostering and encouraging original research and professional competence in the field of concentration The Department of Electrical Engineering currently offers graduate courses and research activities in a variety of areas that span the full breadth of Electrical Engineering including power systems, electromagnetics, digital systems, electronics, control systems, signal processing, and communications.

For all three programs, the students are required to complete successfully a carefully selected sequence of courses and conduct supervised research where the results will culminate in a written M.S. thesis, M.S.T.E. thesis, or a Ph.D. dissertation, which must be defended by the student.

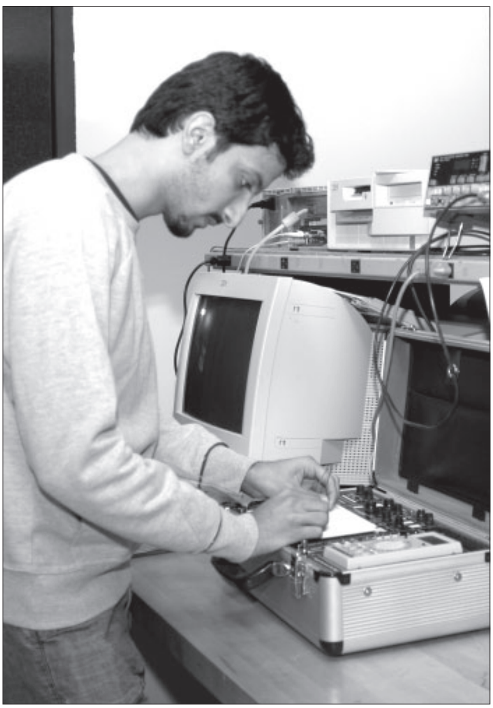
TEACHING AND RESEARCH FACILITIES

The Department has a variety of excellent laboratories facilities to support teaching and research in the areas of power systems, electromagnetics, digital systems, electronics, control systems, signal processing, and communications. The Department has special facilities for research which include a Telecommunications Research Laboratory (TRL), an indoor computer-controlled antenna test range, process control laboratory, programmable logic controller laboratory, and several computer laboratories.

Graduate students have opportunities to participate in existing research efforts in areas that include but not limited to, antennas and propagation; microwave; digital communication systems; digital and optical signal processing; information theory; image processing; pattern recognition; artificial intelligence; automatic control systems (adaptive, robust, non-linear, digital); process control; instrumentation; computer architecture; power systems; HVDC transmission; power electronics; power system reliability; power system protection; applied ultrasonic; fiber optic communications; numerical electromagnetics; VLSI systems; electromagnetic fields and wave; analog and digital electronics; computer communication networks; wireless communication; digital filtering; robot simulation and control.

ADMISSION REQUIREMENTS

In addition to the general requirements of the Deanship of Graduate Studies, applicants must hold a B.S. degree in electrical engineering or equivalent when applying for the master's degree or the master's degree in telecommunication engineering. Applicants for the Ph.D. must hold a master's degree.



M.S. PROGRAM IN ELECTRICAL ENGINEERING

The program leading to the degree of Master of Science in Electrical Engineering provides an opportunity for the student to pursue advanced studies in a particular field of major interest and an opportunity to engage in research and engineering design.

The master's program in electrical engineering consists of a total of 30 credit hours: 9 credit hours of core courses in the department's technical specialty areas to provide breadth, 3 credit hours of MATH elective courses at the 500 or 600 level offered by the Mathematics Department or EE 570, 12 credit hours of elective courses in one subject area to provide depth, at least nine of which are in Electrical Engineering, and 6 credit hours for the thesis.

The core courses include Power System Analysis, Radiation and Propagation of Electromagnetic Waves, Design of Digital Systems, Analog Integrated Circuits Design, Linear Control systems, Digital signal Processing I, and Digital Communication I.

Core Courses for M.S. Degree

All students are required to take at least three of the following seven courses:

Course #	Title	LT	LB	CR
EE 520	Power System Analysis	3	0	3
EE 530	Radiation and Propagation of Electromagnetic Waves	3	0	3
EE 541	Design of Digital Systems	3	0	3
EE 542	Analog Integrated Circuit Design	3	0	3
EE 550	Linear Control Systems	3	0	3
EE 562	Digital Signal Processing I	3	0	3
EE 571	Digital Communications I	3	0	3

A wide range of elective courses exists in all disciplines of electrical engineering including Communications, Electromagnetics, Electronics, Power Systems, Signal and Image Processing, Control Systems, and Digital Systems. In addition, the student can take one technical elective course from other departments.

Degree Plan for the M.S. Program in Electrical Engineering

Course #	Title	LT	LB	CR
First Semester				
EE 530	Radiation and Propagation of Electromagnetic Waves	3	0	3
EE 570	Stochastic Processes	3	0	3
EE 571	Digital Communications I	3	0	3
XX xxx	Free Technical Elective	3	0	3
		12	**0**	**12**
Second Semester				
EE 562	Digital Signal Processing I	3	0	3
EE xxx	EE Elective	3	0	3
EE xxx	EE Elective	3	0	3
EE xxx	EE Elective	3	0	3
EE 599	Seminar	1	0	0
		13	**0**	**12**
Summer Session and Following Semesters				
EE 610	Thesis	0	0	6
		0	**0**	**6**
Total Credit Hours				**30**

M.S. PROGRAM IN TELECOMMUNICATION ENGINEERING

The Master of Science in Telecommunication Engineering is a unique graduate program designed to prepare highly trained professionals to practice in the fast-changing telecommunications industry.

The program is open to students holding a BS degree in EE, COE or equivalent. Students enrolled in this program are required to complete 24 credit hours of courses (eight 3-credit hour courses), plus a 6 credit hour of thesis, in excess of any remedial courses to rectify possible deficiency in a student undergraduate education. The eight courses include four required courses, three technical elective courses, and a non-technical elective course. The following list enumerates courses in each of the three categories:

REQUIRED COURSES

All students are required to take the following four courses:

Course #	Title	LT	LB	CR
EE 570	Stochastic Processes	3	0	3
EE 571	Digital Communications I	3	0	3
EE 573	Digital Communication II	3	0	3
EE 674	Telecommunication Networks, **or**	3	0	3
COE 560	Computer Communication Networks	3	0	3
		12	**0**	**12**

TECHNICAL ELECTIVE COURSES

Each student must take three courses from the following list, which contains courses from the EE, COE and ICS Departments. Courses not in the list from these departments or courses from other departments are subject to the approval of the Graduate Program Committee.

EE COURSES

Course #	Title	LT	LB	CR
EE 532	Antenna Theory and Applications	3	0	3
EE 562	Digital Signal Processing I	3	0	3
EE 563	Speech and Audio Processing	3	0	3
EE 574	Detection and Estimation	3	0	3
EE 575	Information Theory	3	0	3
EE 576	Error Control Coding	3	0	3
EE 577	Wireless and Personal Communications	3	0	3
EE 578	Simulation of Communication Systems	3	0	3
EE 633	Optical Fiber Communication	3	0	3
EE 636	Theory and Applications of Antenna Arrays	3	0	3
EE 662	Adaptive Filtering and Applications	3	0	3
EE 663	Image Processing	3	0	3
EE 665	Signal and Image Compression	3	0	3
EE 672	Satellite Communications	3	0	3
EE 679	Special Topics in Communications	3	0	3

COE & ICS COURSES

Course #	Title	LT	LB	CR
COE 563	Design and Analysis of Local Area Networks	3	0	3
COE 590	Network Security[1]	3	0	3
COE 591	Communication Protocol Engineering[1]	3	0	3
ICS 555	Data Security and Encryption	3	0	3
ICS 583	Pattern Recognition	3	0	3

[1] (offered under special topics)

NON-TECHNICAL ELECTIVES

Each student must take one non-technical course from a set of courses related to the management of the telecommunication systems. The list of non-technical courses includes:

Course #	Title	LT	LB	CR
MIS 502	Management Information System	3	0	3
MIS 510	Information Ressource Management	3	0	3

Degree Plan for the M.S. Program in Telecommunication Engineering

Course #		Title	LT	LB	CR
FIRST SEMESTER					
EE	570	Stochastic Processes	3	0	3
EE	571	Digital Communications I	3	0	3
EE	5xx	Elective I - EE	3	0	3
			9	**0**	**9**
SECOND SEMESTER					
EE	573	Digital Communication II	3	0	3
EE	674	Telecommunication Networks	3	0	3
EE	5xx	Elective II - EE	3	0	3
			9	**0**	**9**
THIRD SEMESTER					
EE	6xx	Elective III - EE	3	0	3
MIS	502	Management Information Systems	3	0	3
EE	599	Seminar	1	0	0
			7	**0**	**6**
FOURTH SEMESTER					
EE	610	M.S. Thesis	0	0	6
			0	**0**	**6**
Total Credit Hours					**30**

PH.D. PROGRAM IN ELECTRICAL ENGINEERING

The program leading to the degree of Doctor of Philosophy in Electrical Engineering is intended for those exceptional individuals who plan to pursue a career in fundamental applied research. The program requires course work and the successful completion of a research dissertation, which is an original and significant contribution to knowledge in the discipline.

The Ph.D. Program consists of 30 credit hours of course work beyond the M.S. Degree, and 12 hours thesis dissertation. The student has to abide by the EE department policies regarding the distribution of the course work. The student must declare a major area and a minor area from the different research areas available in the department, namely power systems, electromagnetics, digital systems, electronics, control systems, signal processing, and communications. Minor areas can be declared from other departments as well (e.g. Math, COE, …).

A student admitted to the Ph.D. program may be asked to take a Preliminary Examination by the Departmental Graduate Program Committee.

The Preliminary Examination is a two-part written examination. Part I of the Preliminary Examination is based on undergraduate courses. Part II of the Preliminary Examination is based on graduate courses. The examination is intended to evaluate a student's qualifications and aptitude for Electrical Engineering, and to determine areas of weakness. Ph.D. students are required to take the Preliminary Examination during the first year of study.

A comprehensive exam is required for all Ph.D. students. The comprehensive exam should be taken by the second year of enrolment in the program. The purpose of this exam is to ensure that the student has a sufficient breadth and depth of knowledge and to evaluate a student's ability to research a specific topic and critique its

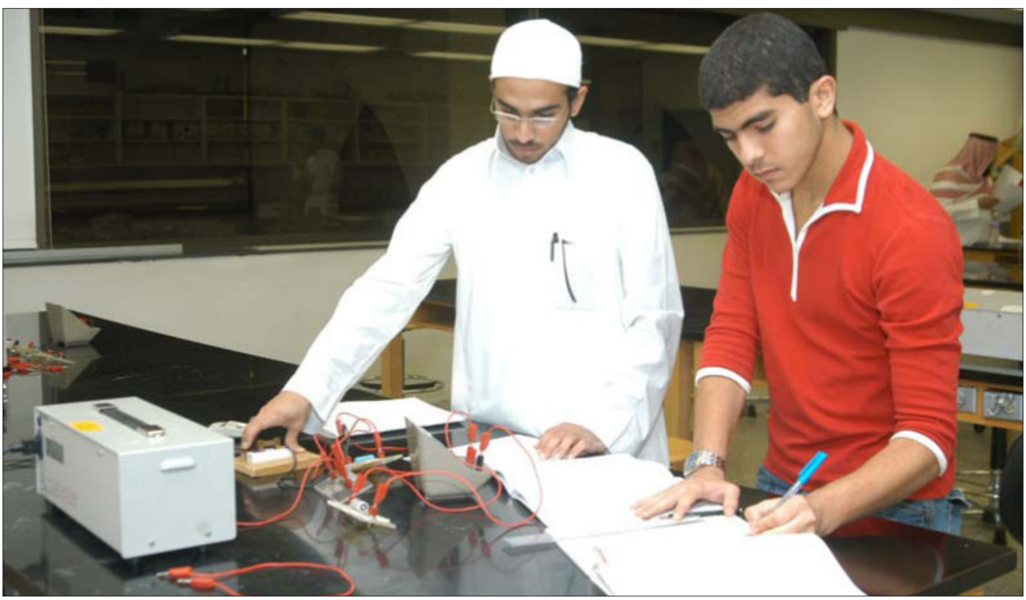
state of the art. The exam will be managed by an ad hoc departmental committee. Decisions of Pass/Fail are taken by the Graduate Program Committee based on the student's score, according to the policies of the department.

In case of failure in the Preliminary or Comprehensive exams, the examination may be attempted for a second time in the following semester. However, a second chance may be denied if the student's performance in the first attempt is clearly unsatisfactory.

A candidate who successfully passes the comprehensive examination may proceed with his research work under the supervision of his dissertation advisor. A dissertation committee having a minimum of five members must be formed for each candidate upon the recommendation of the chairman of the Electrical Engineering Department and approval of the Dean of Graduate Studies. The dissertation advisor chairs this committee.

The student, in consultation with his dissertation advisor, prepares a dissertation proposal that should contain (a) motivation for the research, (b) a concise statement of the proposed problem, (c) an outline of the methodology, and (d) a brief survey of relevant nature and submits it to the dissertation committee. The student incorporates the comments of the committee in preparing a dissertation proposal. The student must make a public defense of the dissertation proposal and must incorporate the comments raised during this defense in his proposal.

Upon completion of his research work, the candidate is required to defend his dissertation before the dissertation committee and in public.



TYPICAL DOCTORAL PROGRAM IN POWER

(Special interest in Control and Power)

Course #	Title	LT	LB	CR
EE 522	Power System Dynamic Analysis	3	0	3
EE 523	Analysis and Control of Electrical machines	3	0	3
EE 552	Optimal Control Theory and Applications	3	0	3
EE 556	Intelligent Control	3	0	3
EE 620	High Voltage Engineering	3	0	3
EE 622	Power System Operation	3	0	3
EE 651	Adaptive Control	3	0	3
EE 623	HVDC Transmission Systems	3	0	3
EE 654	Large Scale Systems	3	0	3
MATH 534	Complex Variables I	3	0	3

TYPICAL DOCTORAL PROGRAM IN COMMUNICATIONS

(Special interest in Communications and Signal Processing)

Course #	Title	LT	LB	CR
EE 573	Digital Communications II	3	0	3
EE 574	Detection and Estimation	3	0	3
EE 577	Wireless and Personal Communications	3	0	3
EE 661	Digital Signal Processing II	3	0	3
EE 662	Adaptive Filtering and Applications	3	0	3
EE 663	Image processing	3	0	3
EE 672	Satellite Communications	3	0	3
EE 674	Telecommunication Networks	3	0	3
MATH 571	Numerical Methods I	3	0	3
ICS 555	Data Security and Encryption	3	0	3

Note: Graduate students working towards M.S., M.S.T.E., or Ph.D. degrees are required to register for EE 599 (Seminars) once before finishing the degree requirements.

Degree Plan for the Ph.D. Program in Electrical Engineering

Course #		Title	LT	LB	CR
FIRST SEMESTER					
EE	5xx	Elective I - EE	3	0	3
EE	5xx	Elective II - EE	3	0	3
EE	6xx	Elective III - EE	3	0	3
			9	**0**	**9**
SECOND SEMESTER					
EE	5xx	Elective IV - EE	3	0	3
EE	6xx	Elective V - EE	3	0	3
XXX	xxx	Elective I - Technical	3	0	3
			9	**0**	**9**
THIRD SEMESTER					
EE	6xx	Elective VI - EE	3	0	3
EE	6xx	Elective VII - EE	3	0	3
XXX	xxx	Elective II - Technical	3	0	3
			9	**0**	**9**
FOURTH SEMESTER					
EE	6xx	Elective VIII - EE	3	0	3
EE	599	Seminar	1	0	0
EE	710	Ph.D. Dissertation	0	0	IP
			4	**0**	**3**
FIFTH SEMESTER					
EE	710	Ph. D. Dissertation (Continued)	0	0	IP
SIXTH SEMESTER					
EE	710	Ph. D. Dissertation (Continued)	0	0	12
			0	**0**	**12**
Total Credit Hours					**42**

IP: Dissertation in progress

COURSE DESCRIPTION

The description of all EE graduate courses in the six areas of research is presented next. All Courses' number starts with either a 5 or a 6. The second digit in a course number indicates the area.

Area	Code
Power Systems	EE 52x or EE 62x
Electromagnetics	EE 53x or EE 63x
Electronics and Digital Systems	EE 54x or EE 64x
Control Systems	EE 55x or EE 65x
Signal Processing	EE 56x or EE 66x
Communication Systems	EE 57x or EE 67x

EE 520 Power System Steady State Analysis (3-0-3)

Steady state modeling and simulation techniques. Large-scale power systems. Sparsity programming. Short-circuit and load-flow studies. Introduction to transient stability. Introduction to state estimation.

Prerequisite: EE 463 or equivalent

EE 522 Power System Dynamic Analysis (3-0-3)

Dynamic model of synchronous machines. Excitation and governor systems. Nonlinear and linear modeling of single machine infinite bus systems. Stability analysis and control design. Direct method of stability determination. Multimachine system modeling. Power system dynamic equivalents.

Prerequisite: EE 520 or equivalent

EE 523 Analysis and control of Electrical Machines (3-0-3)

Steady-state and dynamic analysis of electrical machines: direct and quadrature axis transformation. Linear and nonlinear state space representation. Regulation and control devices. Simulation of electromechanical subsystems.

Prerequisite: EE 462 or equivalent

EE 524 Power System Planning (3-0-3)

Mathematical methods and modern approaches to power system planning. Demand forecasting. Generation system planning: deterministic and probabilistic methods. Transmission system planning: heuristic and stochastic methods. Optimization methods for transmission planning. Route selection: environmental and other considerations. Distribution system planning: system layout, and choice of components.

Prerequisite: Consent of the Instructor

EE 525 Transmission of Electrical Energy (3-0-3)

Introduction to power system transients. Transmission lines/cable parameters, Propagation on loss-free lines, effects of termination and junctions. Transform methods of solution of T.L. Laplace transform and Fourier transform. Transients on T.L., potential and current distribution: standing waves. Traveling wave method: Lattice and graphical methods. Lighting and switching applications. Voltage limitation on power-handling capacity and T.L. effects. Transmission system protection.

Prerequisite: Consent of the Instructor

EE 527 Reliability Assessment of Power Systems (3-0-3)

Concepts of power system reliability: Review of basic techniques, modeling in repairable systems, network approach, Markov modeling, frequency and duration. Generation capacity: loss of load indices, loss of energy indices, frequency and duration. Interconnected systems. Operation reserve. Composite systems. Distribution systems. Substations and switching stations. Reliability cost/worth.

Prerequisite: Consent of the Instructor

EE 528 Advanced Power Electronics (3-0-3)

Review of power semiconductor devices: thyristors, GTO, power transistor, and MOSFET. Power control converters. Drive specifications. Rectifier control of DC motors. Fully controlled single-phase and three-phase drives. Multiquadrant operation of DC motors. Closed-loop control of DC motors. Induction motors by voltage controllers. Frequency controlled induction motor drives. Slip power control. Self-controlled synchronous motors. Current/voltage source inverter drives. Introduction to microcomputer control of AC and DC drives.

Prerequisite: EE 460 or equivalent

EE 530 Radiation and Propagation of Electromagnetic Waves (3-0-3)

Review of Maxwell’s equations and solutions. Electromagnetic waves in lossy, and anisotropic media. Waves at plane boundaries. Guided waves. Duality, uniqueness, image theory, equivalence principle, and reciprocity. Introduction to radiation and scattering. Problem formulation using Green’s function and integral equations.

Prerequisite: EE 340 or equivalent

EE 531 Applied Electromagnetic Theory (3-0-3)

Analytical solution of the wave equation in Cartesian, cylindrical and spherical coordinate systems. Applications to common boundary value problems (guidance, resonance, scattering and radiation). Perturbational and variational techniques. Numerical formulation and solution of selected boundary value problems.

Prerequisite: EE 530

EE 532 Antenna Theory and Applications (3-0-3)

Properties and characteristics of antennas. Polynomial representation of linear arrays. Pattern synthesis. Chebyshev array distributions. Thin linear antennas. Microstrip radiators and arrays. Huygen's principle. Radiation from apertures. Reflector type antennas. Frequency independent antennas. Reciprocity theorem and receiving antennas. Radar antennas. Antenna measurements.

Prerequisite: EE 340 or equivalent

EE 533 Microwave Integrated Circuits (3-0-3)

An overview of microwave integrated circuits (MIC). Hybrid and monolithic MIC. Analysis of microstrip lines. Slot lines and coplanar waveguides. Coupled microstrip and directional couplers. Microstrip circuit design: couplers, Hybrids and filters. Lumped elements. Ferrite components. Active devices for MIC: MESFET, Gunn diode, avalanche diode, Schottky-barrier diode and PIN diode. MIC modules: oscillators, amplifiers, mixers and phase shifters. TR modules.

Prerequisite: EE 407 or equivalent

EE 541 Design of Digital Systems (3-0-3)

Hardware organization of digital systems. Synchronous sequential machines. Arithmetic and logic units: high speed addition, multiplication and division algorithms and implementation. Control units: control, status, timing and clocking schemes and circuits. Digital memories. System controllers using RAMs, ROM, PAL, and FPLAs. Iterative networks and modular design procedures.

Prerequisite: EE 390 or equivalent

EE 542 Analog Integrated Circuit Design (3-0-3)

Review of device-level models. Basic equations and higher-order effects. Basic building blocks of bipolar, MOS and CMOS analog circuits: current mirrors, differential pairs, level-shift stages, gain stages, references and Op-Amp circuits. The translinear principle and applications. Typical examples of IC amplifier design.

Prerequisite: EE 303 or equivalent

EE 543 Computer Architecture (3-0-3)

Study of advanced microprocessors: instruction set and data format, architecture, register organization, programming aspects, CPU architecture, pipelining, etc. Memory hierarchy and management. I/O buses architecture.

Study of advanced microprocessors: instruction set and data format, architecture, register organization, programming aspects, CPU architecture, pipelining, etc. Memory hierarchy and management. I/O buses architecture. Microprocessor interfacing. RISC and CICS processors.

Prerequisite: EE 541 (crosslisted with COE 520)

EE 544 Embedded System Design and Applications (3-0-3)

Microprocessors, Microcontrollers and DSP hardware and software architectures. Advanced programming and interrupts. Interface to real-time systems. Applications and case studies including projects

Prerequisite: EE 541

EE 545 Advanced Analog Electronics (3-0-3)

Small-signal equivalent circuits and noise models of active devices. Design and analysis of linear wide-band low-noise feedback amplifiers. High frequency design using operational amplifiers and operational transconductance amplifiers. Application of specialized electronic systems in analog signal processors. Introduction to emerging technologies and advanced topics from recent literature.

Prerequisite: EE 303 or equivalent

EE 546 Semiconductor Device Theory (3-0-3)

Electronic states in semiconductors. Carrier transport models and current equations. Analysis of pn junctions, bipolar and FET transistors. Introduction to microwave devices and semiconductor optoelectronics.

Prerequisite: EE 403 or equivalent

EE 550 Linear Control Systems (3-0-3)

State space representation of systems. Theory of multivariable systems. Jordan canonical forms. Transformation matrices. Realization theory. Controllability and observability. Stability. State estimators. Output and state feedback. Compensation. Decoupling and model matching. Introduction to optimal control.

Prerequisite: EE 380 or equivalent (crosslisted with SE 507)

EE 551 System Identification (3-0-3)

Introduction to dynamic systems, models, and identification process. Models of linear time-invariant systems. Models of time-varying and nonlinear systems. Parametric estimation methods. Convergence and consistency of solutions. Asymptotic distribution. Recursive and non-recursive computation methods. Model selection and validation.

Prerequisite: EE 380 or equivalent

EE 552 Optimal Control Theory and Applications (3-0-3)

Nonlinear optimal control of continuous-time systems. Minimum time and constrained input problems. Linear quadratic regulator. Optimal output-feedback. Optimal state estimation. Linear quadratic Gaussian design. Case studies.

Prerequisite: EE 550 or equivalent (crosslisted with SE 514)

EE 554 Advanced Digital Control Systems (3-0-3)

Digital controller design. Pole-assignment design and state-estimation. Linear quadratic optimal control. Sampled-data transformation of Analog filters. Digital filter structures. Microcomputer implementation of digital filters.

Prerequisite: EE 432 or equivalent

EE 555 Neural Networks Theory and Applications (3-0-3)

Introduction, background and biological inspiration. Survey of fundamentals methods of artificial neural networks: single and multi-layer networks; Perceptions and back propagation. Associative memory and statistical networks. Supervised and unsupervised learning. Merits and limitations of neural networks. Applications.

Prerequisite: Consent of the Instructor (crosslisted with SE 507 and COE 591)

EE 556 Intelligent Control (3-0-3)

Intelligent control strategies: Expert systems, Fuzzy logic control, Neural networks. Optimization control techniques: genetic algorithms, simulated annealing, tabu search. Hybrid systems. Applications

Prerequisite: Consent of the Instructor (Not to be taken for credit with SE 571)

EE 562 Digital Signal Processing I (3-0-3)

Classification of discrete-time signals and systems. Basic and lattice structures, Finite-word length effects. Discrete Fourier Transform and its efficient implementations. Introduction to spectral analysis. FIR and IIR filter design techniques: Windowing techniques, Analog-to-Digital transformation techniques, Computer-aided design techniques.

Prerequisite: EE 406 or equivalent

EE 563 Speech and Audio Processing (3-0-3)

Speech analysis, Digital processing of wave forms, Wavelet transformation Waveform coding, Parametric coding of speech: linear predictive coding, Text-to-Speech synthesis, Recognition, Stochastic modeling of speech signals, Pattern recognition and its application to speech, Speech coding for Packet Networks, Echo removal.

Prerequisite: EE 562 or equivalent (crosslisted with SE 524)

EE 570 Stochastic Processes (3-0-3)

Review of fundamentals of probability, Sequences of random variables and convergence, Stationarity and ergodicity; second-order properties and estimation; Gaussian random processes, Poisson and renewal processes, Markov processes. Queuing Theory. Applications to communications and signal processing.

Prerequisite: EE 315 or equivalent (Not to be taken for credit with SE 543)

EE 571 Digital Communications I (3-0-3)

Time and frequency representation of signals. Spectral density and autocorrelation. A/D and D/A conversion. PAM and PCM systems. Detection of binary and M-ary signals in Gaussian noise. Matched filter and correlator receivers. Pulse shaping. Band pass modulation and demodulation techniques. Error performance for binary and M-ary systems. Spectral Analysis of digital signals. Communication link analysis.

Prerequisite: EE 370 or equivalent, EE 315 or equivalent

EE 573 Digital Communications II (3-0-3)

Review of digital transmission over AWGN channels. Spectral analysis of digital signals. Digital, transmission over band-Limited channels. Intersymbol Interference. Signal design for band-Limited channels. Channel equalization. Adaptive equalizers. Characterization of fading multipath channels. Performance of digital transmission over fading channels. Diversity techniques. Spread spectrum. Multi-user communication. Overview of Advanced Communications Systems (satellite, mobile, optical, ...)..

Prerequisite: EE 571

EE 574 Detection and Estimation (3-0-3)

Binary and M-hypotheses Detection techniques: Maximum likelihood, Newman Pearson, Minimum probability of error, Maximum a posteriori probability, Bayes decision and minimax detection. Parameter estimation: weighted least squares, BLUE, Maximum likelihood, Mean square estimation. Signal estimation and filtering: Wiener filtering, Kalman filtering and estimation. Simultaneous detection and estimation. Application to system identification and communication systems.

Prerequisite: EE 570

EE 575 Information Theory (3-0-3)

Measures of information, Entropy, Source Coding theory, Lossless data compression, Huffman Codes, Ziv-Lempel and Elias Codes, Arithmetic Codes, Run-length Encoding, Sources with memory, Lossy data compression, Rate distortion theory, Mutual Information, Memoryless channels, Channel capacity, Channel coding theory, Differential Entropy, Capacity of AWGN channels.

Prerequisite: EE 370 or equivalent, EE 315 or equivalent

EE 576 Error Control Coding (3-0-3)

Finite field arithmetic, Linear codes, Block codes, Cyclic codes, BCH and Reed-Solomon codes, Encoding and decoding methods, Performance analysis of block and cyclic codes, Convolutional codes, Trellis representation, The Viterbi algorithm, Performance analysis of convolutional codes, Coded modulation, Turbo codes.

Prerequisite: EE 370 or equivalent, EE 315 or equivalent

EE 577 Wireless and Personal Communications (3-0-3)

The Cellular concept, Propagation modeling, Digital transmission techniques, multiple access techniques, Cellular frequency planning, Link control, Handoffs, Power control, Traffic capacity, Wireless networking, Privacy and security of wireless systems, Examples of current wireless systems standards.

Prerequisite: EE 571

EE 578 Simulation of Communication Systems (3-0-3)

Generation of pseudo-random signals and noise, Basic techniques for bit error rate estimation, Simulation of a binary system, Simulation of Intersymbol interference, Channel modeling, Signal-to-Noise Ratio estimation, Multi-rate simulation, Adaptive equalization and Coded systems simulation, Importance sampling.

Prerequisite: EE 573

EE 599 Seminar (1-0-0)

Graduate students working towards either M.S. In Electrical engineering, M. S. In Telecommunication Engineering, or Ph.D. degrees, are required to attend the seminars given by faculty, visiting scholars, and fellow graduate students. Additionally, each student must present at least one seminar on a timely research topic. Among other things, this course is designed to give the student an overview of research in the department, and a familiarity with the research methodology, journals and professional societies in his discipline. Graded on a Pass or Fail basis.

EE 610 M.S. Thesis (0-0-6)

EE 620 High Voltage Engineering (3-0-3)

Breakdown in gases, solids and liquids. Analysis of high voltage transmission: switching and lighting surges. Insulation coordination in electrical power system. Basic impulse levels. System grounding and insulation designs. High voltage generation and measurement.

Prerequisite: EE 464 or equivalent

EE 622 Power System Operation (3-0-3)

Mathematical methods and tools applied to power system operation. Characteristics of power generation units. Economic dispatch of generating units and methods of solution. Transmission system effects. Unit commitment, dynamic programming, Heuristic methods. Hydrothermal coordination. Maintenance scheduling. Power interchange production cost models. Generation control. Reactive power dispatch and allocation.

Prerequisite: EE 463 or equivalent

EE 623 HVDC Transmission System (3-0-3)

Comparison between AC and DC transmission. Converter circuit configuration. Converter operation and analysis. Misoperation of converter. Harmonics and filters. Ground return. Integration of HVDC links into power systems. AC-DC load flow, short circuit and stability calculations.

Prerequisite: EE 460 or equivalent

EE 629 Special Topics in Power Systems (3-0-3)

The contents of this course will be in one of the areas of interest in power systems. The specific contents of the special topics course will be given in detail at least one semester in advance of that in which it is offered. It is also subject to the approval by the Graduate Council.

Prerequisite: Consent of the Instructor.

EE 631 Microwave Measurements (1-6-3)

Microwave signal sources. Waveguide components. Network analyzer measurements. Scattering parameters of microwave planar transistors. Doppler effect. Time domain reflectometry. Microwave links. Antenna impedance and pattern measurements. Microstrip transmission lines. Resonant cavities.

Prerequisite: EE 405 or equivalent

EE 632 Scattering and Diffraction of Electromagnetic Waves (3-0-3)

Radiation condition and radar cross section. Cylindrical wave functions. Field of a line source. Plane wave and line field scattering by conducting circular cylinders. Spherical wave functions. Plane wave scattering by conducting and dielectric spheres. Approximate techniques applied to Rayleigh scattering. Application to a conducting sphere. High frequency approximation. Geometric theory of diffraction. Diffraction by a slit.

Prerequisite: EE 530

EE 633 Optical Fiber Communication (3-0-3)

Dielectric slab waveguides. Classification of mode types. Parabolic two-dimensional media. Circular waveguides. Step-index and graded-index optical fibers. Effect of loss. Dispersion effects. Fabrication methods in integrated optics and optical fibers. Light sources. Couplers. Opto-electronic devices. Applications in communication systems.

Prerequisite: EE 420 or equivalent

EE 636 Theory and Applications of Antenna Arrays (3-0-3)

Antenna array fundamentals. Analysis and synthesis of discrete linear arrays. Two-dimensional arrays. Concept of adaptive arrays. Adaptive beam forming and nulling. Superdirective array functions. Suppression of side lobes in linear arrays.

Prerequisite: EE 422 or equivalent

EE 635 Computational Electromagnetics (3-0-3)

Review of basic electromagnetic theory and partial differential equations (PDEs). Finite-difference approximation of PDEs. The finite-difference time domain (FDTD) in 2D and 3D. The Yee's mesh. Scalar formulation of the FDTD method. Related topics including numerical stability and dispersion, boundary conditions, materials, etc. Introduction to other methods such as the finite-element method, the method of lines, beam propagation method, and the method of moments. Applications and case studies.

Prerequisite: Consent of the Instructor

EE 639 Special Topics in Electromagnetics (3-0-3)

The contents of this course will be in one of the areas of interest in electromagnetics. The specific contents of the special topics of course will be given in detail at least one semester in advance of that in which it is offered. It is also subject to the approval by the Graduate Council.

Prerequisite: Consent of the Instructor

EE 642 Analog VLSI Circuit Design (3-0-3)

MOS and CMOS technology: building blocks, devices, capacitors and limitations. Operational amplifiers and other analog systems. Application to filter design and data converters. Layout considerations and CAD tools.

Prerequisite: EE 542

EE 645 VLSI Architecture (3-0-3)

Review of MOS transistors: fabrication, layout and characterization. Review of CMOS circuit and logic design: fully complementary CMOS logic, pseudo-NMOS logic, dynamic CMOS logic, pass-transistor logic, clocking strategies. Subsystem design: ALUs, multipliers, memories, PLAs. Architecture design: iterative cellular design and systolic arrays. Application to system level designs.

Prerequisite: EE 541

EE 649 Special Topics in Digital Systems and Electronics (3-0-3)

The contents of this course will be in one of the areas that has the nature of research topics in digital and electronics systems. For example: VLSI architectures, Advanced analog ICs, Physics of ultra small devices, etc.

Prerequisite: Consent of the Instructor

EE 651 Adaptive Control (3-0-3)

Introduction to the various approaches of adaptive controller design. Real-time parameter estimation. Model reference adaptive control. Self-tuning controllers. Variable structure systems. Gain Scheduling. Robustness issues. Practical aspects and implementation. Typical Industrial applications.

Prerequisite: EE 550 or equivalent (crosslisted with SE 537)

EE 652 Nonlinear Systems (3-0-3)

Introduction to nonlinear dynamics and control. Overview of phase plane analysis, describing function and limit cycles. Lyapunov stability. Input/output stability. Input/output linearization. Stabilization and control of nonlinear systems.

Prerequisite: EE 550 or equivalent (crosslisted with SE 517)

EE 653 Robust Control (3-0-3)

Elements of robust control theory. Norms of signals and systems. Performance specifications. Stability and performance of feedback systems. Performance limitations. Model uncertainty and robustness. Parametrization of stabilizing controllers. Loop transfer recovery robust design. $H\infty$-control and filtering.

Prerequisite: EE 550 or equivalent (Not to be taken for credit with SE 654)

EE 654 Large Scale Systems (3-0-3)

Introduction to large scale systems. Classical Model reduction techniques. Component cost analysis method. L2 model reduction. Hankel norm approximation. Introduction to $H\infty$-model reduction. Relations between modeling and control. Closed loop model reduction. Decentralized control design schemes. System's interactions. Coordinated and hierarchical control. Case studies.

Prerequisite: EE 550 or equivalent (Not to be taken for credit with SE 509)

EE 655 Predictive Control (3-0-3)

Predictive control concept. Process models and prediction. Optimization criterion. Predictive control law. Performance and robustness. Minimum cost horizon. Disturbance model. Overview of well-known predictive controllers. Tuning of predictive controller design parameters. Predictive control with output constraints. Implementation issues. Industrial case studies.

Prerequisite: EE 550 or equivalent

EE 656 Robotics & Control (3-0-3)

Basic concepts of robotics. Mathematical description of industrial manipulator. Homogeneous transformation and the Denavit-Hartenberg notation. Transformation between frames. Forward, and inverse kinematics and dynamics. Newton - Euler and Lagrange formulations. Joint space, and Cartesian space trajectories and dynamic control. Trajectory planning. Advance control schemes.

Prerequisite: EE 550 or equivalent (crosslisted with SE 632)

EE 659 Special Topics in Control **(3-0-3)**

The contents of this course will be in one of the areas of interest in control. The specific contents of the special topics of course will be given in detail at least one semester in advance of that in which it is offered. It is also subject to the approval by the Graduate Council.

Prerequisite: Consent of the Instructor

EE 661 Digital Signal Processing II **(3-0-3)**

Optimal one- dimensional filter design techniques. Multidimensional digital signals and systems. Multidimensional Fourier transform. Analysis of multidimensional systems and digital filter design. Implementation issues. Parametric and non-parametric spectral estimation. Applications.

Prerequisite: EE 562 or equivalent

EE 662 Adaptive Filtering and Applications **(3-0-3)**

Introduction to adaptive Signal Processing. Fundamentals of Adaptive Filter Theory. The LMS Algorithm, LMS-based Algorithms. Conventional RLS Adaptive Filtering. Adaptive Lattice-based RLS Algorithms. Fast Algorithms. Implementation Issues. Adaptive IIR filters. HOS-based adaptive filtering. Introduction to nonlinear filtering. Applications to Echo cancellation, equalization, noise canceling and prediction.

Prerequisite: EE 570 or equivalent

EE 663 Image Processing **(3-0-3)**

Two-dimensional systems and mathematical preliminaries. Perception and human vision systems. Sampling and quantization. Image transforms. Image representation by stochastic models. Image data compression, enhancement, filtering, restoration. Reconstruction from projection. Analysis and computer vision.

Prerequisite: Consent of the Instructor (Not to be taken for credit with SE 662)

EE 664 Wavelet Signal Processing **(3-0-3)**

Cosine transform and short-time Fourier transform, Analysis of filter banks and wavelets, Sub-band and wavelet coding, Multirate signal processing, Wavelet transform, Daubechies wavelets, Orthogonal and biorthogonal wavelets, Time-frequency and time-scale analysis, Design methods. Applications of wavelets to audio and image compression, Medical imaging, Geophysics, Scientific visualization.

Prerequisite: EE 562 or equivalent

EE 665 Signal and Image Compression (3-0-3)

Principles and techniques of signal compression, Quantization theory, Linear prediction, Coding techniques: predictive, transform, entropy, and vector quantization, Fidelity, bit-rate, and complexity trade-offs. Compression standards, Applications to speech, audio, image, and video compression.

Prerequisite: EE 562 or equivalent

EE 669 Special Topics in Signal Processing (3-0-3)

The contents of this course will be in one of the areas of interest in signal processing.. The specific contents of the special topics of course will be given in detail at least one semester in advance of that in which it is offered. It is also subject to the approval by the Graduate Council.

Prerequisite: Consent of the Instructor

EE 672 Satellite Communications (3-0-3)

Introduction to satellite communication systems. Satellite orbits. The satellite channel. Satellite links. Earth stations. Modulation and multiplexing. Digital modulation. Multiple access and demand assignment. Satellite cross links. VSAT and mobile satellite systems.

Prerequisite: EE 571

EE 674 Telecommunication Networks (3-0-3)

Introduction to modern communication networks, Data traffic, Queuing models, Multi-access channels, Mutiplexing, Packet switching, Circuit switching, Datagrams, Protocols, Media access control, Resource allocation, SONET, ATM, Performance analysis, Product-form queuing networks, Local area networks, Ethernet, Fiber-Distributed-Data-Interface (FDDI), Token rings, Token busses, Polling systems, Optimal routing and flow controls.

Prerequisite: EE 570 (crosslisted with COE 540)

EE 679 Special Topics in Communication (3-0-3)

The contents of this course will be in one of the areas of interest in communication. The specific contents of the special topics of course will be given in detail at least one semester in advance of that in which it is offered. It is also subject to the approval by the Graduate Council.

Prerequisite: Consent of the Instructor

EE 690 Advanced Electrical Engineering Projects (3-0-3)

Individual research projects to be approved by the supervising faculty members before registering for the course. An approved written report must be filed with the Graduate Committee before credit is accepted. Credit of this course may not be used towards the fulfillment of the M.S. Degree.

EE 710 Ph.D. Dissertation (0-0-12)

MECHANICAL ENGINEERING

Chairman

Amro Al-Qutub

Professors

Abulhamayel	Khulief	Shuaib
Ahmad	Merah	Al-Sulaiman
Badr	Sahin	Yilbas
Eleiche	Said	Zubair
Gandhidasan	El-Shaarawi	
Habib	Sheikh	

Associate Professors

Al-Farayedhi	Arif	Mekid
Allam	El-Nakla	Mokheimer
Al-Nassar	Hawwa	Shuja
Al-Sarkhi	Khan, Z.	Sunar
Antar	Laoui	

Assistant Professors

Abu-Dheir	Al-Qahtani, H.	Jamjoom
Al-Aqeeli	Al-Qahtani, M.	Khan, S.
Al-Dheylan	Bahaidarah	Mezghani
Al-Dini	Ben-Mansour	Nouari
Al-Hadhrami	Gasem	
Al-Kaabi	Hassan	

Visiting Asst. Prof.

Al-Zaharnah		Bazoune

Instructors

Mahmood

Lecturers

Abdul Aleem	Inam	Raza
Ahmed	O'Brien	Yaqub
Anis	Patel	Younas

GRADUATE PROGRAMS IN MECHANICAL ENGINEERING

The Department of Mechanical Engineering has a well-established graduate program. The department started its Master of Science program in 1975 and Doctoral program in 1989. These programs lead to the Master of Science (M.S.) Degree, and the Doctor of Philosophy (Ph.D.) Degree in Mechanical Engineering. Such degrees are awarded essentially in recognition of academic excellence as well as the professional development of a graduate student, rather than for completing a prescribed set of courses. Therefore, the graduate students are expected to demonstrate competence in a series of professional requirements that require an element of creativity. Consequently, the graduate program in the Mechanical Engineering Department emphasizes the application of theoretical principles to practical problems in the field of mechanical engineering. It is hoped that this graduate program will help in providing the Kingdom of Saudi Arabia with the high caliber engineers needed for the development of the country.

The graduate program offers specialization in three important branches of mechanical engineering. These are, Thermofluid Sciences, Engineering Mechanics, Materials and Manufacturing. The graduate program has been designed to cope with the modern trends and developments in the area of mechanical engineering. The lower level (500-level) graduate courses are designed to provide the student with an opportunity to expand and broaden his knowledge-base in the respective subjects. However, the higher level (600-level) graduate courses are designed to challenge the student and to sharpen his skills in problem-solving, original thinking, researching, technical reporting and presentation. The graduate student is also provided with an opportunity to improve his skills in conducting technical experiments, performing conceptual analysis, and developing the related analytical models.

The Department of Mechanical Engineering offers a wide selection of graduate courses and research activities with the help of which the student can fulfill his degree requirements, and complete and defend a thesis or dissertation based on original work in one of the areas of mechanical engineering.

TEACHING AND RESEARCH FACILITIES

The Mechanical Engineering Department has several laboratories equipped with teaching and research facilities including a subsonic wind tunnel supported by a wide variety of measuring instrumentation, a supersonic jet impingement set up, shock tubes, hot wire and laser Doppler anemometers, a pulsating flow set up, heat transfer testing facilities, a solar cooling facility, gas emission analyzers, CFR gasoline test engine, an advanced material testing system, a potentiodyne analyzer, a vibration test rig, vibration meters, recorders, analyzers, amplifiers, accelerometers and transducers, laser measurement systems, electron and scanning electron microscopes, dimensional metrology equipment, and manufacturing engineering facilities equipped with conventional and CNC machine tools, and metal cutting dynamometry. The Department also has a central modern machine shop, supporting research activities.

The following represents some of the research activities in the Department:

Transient heat convection including heat convection in pulsating internal flows.

- Fouling in heat transfer equipment.
- Modeling of transient boundary-layer flows.
- Aerodynamics, flight dynamics and control.
- Wave propagation and scattering in elastic structures.
- Identification of non-linear systems and modal identification.
- Dynamic analysis and design of elastic multibody systems.
- Laser machining and other laser-related applications.
- Corrosion and material damage processes and reliability modeling.
- Manufacturing processes planning and system analysis, evaluation, and optimization.
- Automation and Computer Aided Manufacturing systems modeling and control.
- Reliability of extrusion and forging dies.

DEPARTMENTAL ADMISSION REQUIREMENTS

M.S. PROGRAM

In addition to the minimum requirements for possible admission to the M.S. program set by the Deanship of Graduate Studies, the applicants must have:

a Bachelor's Degree in Mechanical Engineering, or an equivalent degree of a suitable background for entering the field of Mechanical Engineering, from an institution whose undergraduate program is equivalent in duration, content, and quality to that of KFUPM.

PH.D. PROGRAM

Students applying to the doctoral program must provide evidence of exceptional scholastic ability, intellectual creativity, and research motivation.

In addition to the minimum requirements for possible admission to the Ph.D. program set by the Deanship of Graduate Studies, the applicants must have:

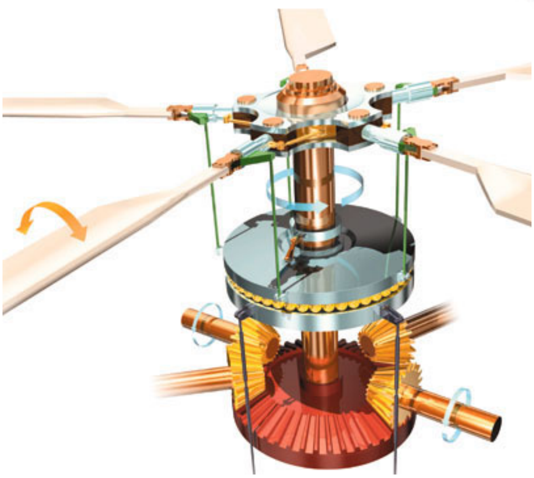
a Master's degree from a university of recognized standing in mechanical engineering or evidence of suitable background for entering the fields of mechanical engineering, such as thermofluid sciences, mechanics, materials and manufacturing, and Aerospace Engineering.

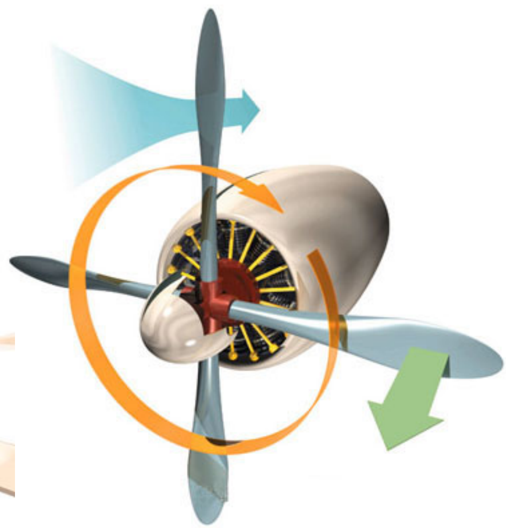
If the minimum requirement in one area is not exactly met, consideration is given for a provisional admission when other credentials are satisfactory.

M.S. PROGRAM IN MECHANICAL ENGINEERING

The M.S. degree requires the successful completion of core courses, elective courses, and a thesis. The requirements for the Master's Degree must be completed during a total elapsed period of three years.

Each student admitted to the M.S. program in Mechanical Engineering must select a research field from the four basic ME research fields, listed below. Every M.S. student must take two core courses (6 credit hours) coherent to his research area from the core courses listed below. Students, who have not taken MATH 301 or equivalent in their undergraduate program, should take this course or its equivalent as a deficiency course without any credit. In addition, the program of study requires three Mechanical Engineering elective courses (9 credit hours) related to his research area, and three Technical Elective courses (9 credit hours). The technical electives could be taken from courses offered by the Mechanical Engineering Department or other departments in the College of Engineering Science, College of Science, and College of Computer Science and Engineering. To complete the 30 credit-hour program of study, each student must also complete a research thesis (6 credit hours) and seminar requirements. Each student should have a degree plan consisting of courses, which are required to be taken. The degree plan should be approved by the Mechanical Engineering Department.





RESEARCH FIELDS FOR M.S. PROGRAM

The following are the four basic research fields in the M.S. program:

1. **Thermofluid Sciences:** This field covers thermodynamics, fluid mechanics, heat transfer, refrigeration and air-conditioning, energy conversion, and combustion areas.
2. **Engineering Mechanics*:*** This field covers solid mechanics, dynamics, vibrations, control, and design areas.
3. **Materials & Manufacturing*:*** This field covers manufacturing, materials science and engineering metallurgy, in service materials behavior, and tribology areas.

CORE COURSES REQUIRED FOR THE M.S. PROGRAM

	Field of Specialty	Course #	Courses
1	Thermo-Fluid Sciences	**ME 532**	Advanced Fluid Mechanics I
		ME 536	Convection Heat Transfer
2	Engineering Mechanics	**ME 552**	Advanced Dynamics
		ME 551	Continuum Mechanics
3	Materials & Manufacturing	**ME 572**	Analysis of Manufacturing Processes
		ME 574	Advanced Materials Science

ME GRADUATE COURSES OFFERED IN VARIOUS AREAS OF CONCENTRATION

THERMOFLUID SCIENCES

ME 501 Numerical Methods in Mechanical Engineering

ME 530 Advanced Compressible Fluid Flow

ME 531 Advanced Thermodynamics

ME 532 Advanced Fluid Mechanics I

ME 533 Ideal Fluid Flow

ME 534 Conduction Heat Transfer

ME 535 Radiation Heat Transfer

ME 536 Convection Heat Transfer

ME 537 Combustion and Emission

ME 539 Solar Energy Utilization

ME 546 Industrial Aerodynamics

ME 547 Thermal Environment and Energy Analysis

ME 548 Combustion Phenomena

ME 549 Thermal Design of Heat Exchangers

ME 591 Special Topics in Thermofluid Sciences I
ME 611 Statistical Thermodynamics
ME 612 Phase Change Heat Transfer & Two Phase Flow
ME 632 Advanced Fluid Mechanics II
ME 691 Special Topics in Thermofluid Sciences II

ENGINEERING MECHANICS

ME 543 Nonlinear Finite Element Analysis
ME 550 Fundamentals of Astronautics
ME 551 Continuum Mechanics
ME 552 Advanced Dynamics
ME 553 Advanced Vibrations
ME 554 Elasticity
ME 555 Plasticity
ME 557 Modern Control of Linear Systems
ME 558 Rotordynamics
ME 559 Random Vibrations
ME 560 Smart Materials and Structures
ME 562 Vibration Measurement and Analysis
ME 563 Ultrasonic Testing Techniques
ME 564 Noise and Vibration Control
ME 565 Dynamics of Multibody Systems I
ME 595 Special Topics in Engineering Mechanics I
ME 658 Fracture Mechanics
ME 661 Nonlinear Systems Dynamic Analysis
ME 665 Dynamics of Multibody Systems II
ME 666 Dynamics and control of Mechanical Systems
ME 695 Special Topics in Engineering Mechanics II

MATERIALS & MANUFACTURING

ME 543 Nonlinear Finite Element Analysis
ME 570 Experimental Methods in Materials and Processes
ME 572 Analysis of Manufacturing Processes
ME 573 Probabilistic Concepts in Design and Production
ME 574 Advanced Materials Science
ME 575 Advanced Corrosion Engineering
ME 576 Tribology
ME 578 Mechanical Properties of Engineering Polymers
ME 579 Advanced Mechanical Behavior of Materials
ME 580 Principles of Metal Forming
ME 581 Computer Integrated Manufacturing
ME 583 Fatigue and Fracture of Engineering Materials
ME 584 Quality Engineering

ME 585 Advanced Physical Metallurgy
ME 586 Finite Element Analysis in Metal Forming Processes
ME 597 Special Topics in Materials & Manufacturing I
ME 671 Electrode Kinetics
ME 672 Control of Manufacturing Processes
ME 673 Metallurgical Processes & Thermodynamics
ME 675 Phase Transformation in Metals
ME 697 Special Topics in Materials & Manufacturing II

Degree Plan for the M.S. Program in Mechanical Engineering

Thermofluid Sciences Option

Course #	Title	LT	LB	CR
First Semester				
ME 532	Advanced Fluid Mechanics I	3	0	3
ME XXX	Elective I	3	0	3
XX 5XX	Technical Elective I	3	0	3
		9	**0**	**9**
Second Semester				
ME 536	Convection Heat Transfer	3	0	3
ME XXX	Elective II	3	0	3
XX 5XX	Technical Elective II	3	0	3
ME 599	Seminar	1	0	0
		10	**0**	**9**
Third Semester				
ME XXX	Elective III	3	0	3
XX 5XX	Technical Elective III	3	0	3
		6	**0**	**6**
Fourth Semester				
ME 610	ME MS Thesis	0	0	**6**
Total Credit Hours				**30**

The ME XXX elective I course can be a graduate (500 level) or senior undergraduate (400 level) in the research field. The ME XXX elective II and III courses should be taken from the 500/600 level courses in the research field. The technical electives could be taken from courses offered by the Mechanical Engineering Department or other departments in Colleges of Engineering Sciences, College of Sciences, and College of Computer Sciences and Engineering.

One of the technical elective courses should be taken from other Departments according to the approved degree plan.

Degree Plan for the M.S. Program in Mechanical Engineering

Engineering Mechanics Option

Course #	Title	LT	LB	CR
First Semester				
ME 551	Continuum Mechanics	3	0	3
ME XXX	Elective I	3	0	3
XX 5XX	Technical Elective I	3	0	3
		9	**0**	**9**
Second Semester				
ME 552	Advanced Dynamics	3	0	3
ME XXX	Elective II	3	0	3
XX 5XX	Technical Elective II	3	0	3
ME 599	Seminar	1	0	0
		10	**0**	**9**
Third Semester				
ME XXX	Elective III	3	0	3
XX 5XX	Technical Elective III	3	0	3
		6	**0**	**6**
Fourth Semester				
ME 610	ME MS Thesis	0	0	**6**
Total Credit Hours				**30**

The ME XXX elective I course can be a graduate (500 level) or senior undergraduate (400 level) in the research field. The ME XXX elective II and III courses should be taken from the 500/600 level courses in the research field. The technical electives could be taken from courses offered by the Mechanical Engineering Department or other departments in Colleges of Engineering Science, College of Sciences, and College of Computer Science and Engineering.

One of the technical elective course should be taken from other Departments according to the approved degree plan.

Degree Plan for the M.S. Program in Mechanical Engineering

Materials & Manufacturings Option

Course #	Title	LT	LB	CR
First Semester				
ME 572	Analysis of Manufacturing Processes	3	0	3
ME XXX	Elective I	3	0	3
XX 5XX	Technical Elective I	3	0	3
		9	**0**	**9**
Second Semester				
ME 574	Advanced Materials Science	3	0	3
ME XXX	Elective II	3	0	3
XX 5XX	Technical Elective II	3	0	3
ME 599	Seminar	1	0	0
		10	**0**	**9**
Third Semester				
ME XXX	Elective III	3	0	3
XX 5XX	Technical Elective III	3	0	3
		6	**0**	**6**
Fourth Semester				
ME 610	ME MS Thesis	0	0	**6**
Total Credit Hours				**30**

The ME XXX elective I course can be a graduate (500 level) or senior undergraduate (400 level) in the research field. The ME XXX elective II and III courses should be taken from the 500/600 level courses in the research field. The technical electives could be taken from courses offered by the Mechanical Engineering Department or other departments in Colleges of Engineering Science, College of Sciences, and College of Computer Science and Engineering.

One of the technical elective courses should be taken from other Departments according to the approved degree plan.

PH.D. PROGRAM IN MECHANICAL ENGINEERING

The Ph.D. program is designed for full-time participation. The student is thus expected to engage himself in scholarly work on a full-time basis. The program consists of 30 graduate credit-hours of course work (beyond M.S. degree) in addition to the dissertation and seminar requirements. The maximum load for the Ph.D. student is 12 graduate credit-hours per semester and all the courses should be taken from 500 and 600 levels. Thus, the course work will require one and a half years, and the dissertation will require an additional year and a half. The maximum period allowed for obtaining the Ph.D. degree is six years.

Upon the recommendation of the Departmental Graduate Committee, a Ph.D. student may be required to pass a preliminary examination. Ph.D. student must complete additional course work beyond the M.S. degree, satisfactorily pass a comprehensive examination covering his area of study, and present a substantial research contribution manifested in a dissertation.

Each graduate student admitted to the Ph.D. program should select major and minor research areas related to his specialization and direction of research. Every Ph.D. student must take a minimum of seven courses (21 credit hours) from within the field of the selected major area. A major area is defined as one of the fields from the following three basic fields:

1. **Thermofluid Sciences:** Includes research areas in Thermodynamics, Fluid Mechanics, Heat Transfer, Aerodynamics, Combustion, Refrigeration and Air-Conditioning, and Energy Conversion.
2. **Engineering Mechanics:** Includes research areas in Solid Mechanics, Dynamics, Vibration, Control, and Design.
3. **Materials & Manufacturing:** Includes research areas in Manufacturing, Material Science, Corrosion and Tribology.

A minor area is defined as a relevant specialized area within any field related to the professional activities of the mechanical engineer. A minor area has to be constituted of a collection of three coherent courses (9 credit hours) that must be chosen from outside the field of the student's major area.

Prior to being granted their Ph.D. Degree, all students who have been admitted to the Ph.D. program with full standing are required to successfully complete the following:

a. **Preliminary Examination:** Students who are required to take this examination must demonstrate their competence and uncover minor deficiencies in the areas of thermofluid sciences, engineering mechanics, and materials and manufacturing. If applicable, the examination should be organized and administered by the Doctoral Program Committee at a time no later than the second semester after enrollment. A graduate student is allowed to take this examination only twice.

A clearly unsatisfactory performance in the examination will form a basis for dismissal of the student from the Ph.D. program. Failing to secure a GPA of 3.00 (out of 4 points) is considered as unsatisfactory performance the student will be dismissed. If a student's overall performance is equivalent to a GPA of 3.00 or more, but his grade in any course is C or less, he will be accepted as a Ph.D. student with deficiencies. The student will be required to take an undergraduate remedial course in the respective area of deficiency, and to maintain a minimum GPA of 3.00 (out of 4 points). The student has to remedy his deficiencies no later than the third regular semester following the preliminary examination.

b. **Course Requirement:** The results of the Preliminary Examination are then used in drawing up the student's program and to remedy whatever deficiencies may arise. The student's program should meet the approval of the departmental Graduate Committee. Students who perform satisfactorily in the Preliminary Examination may proceed to complete their approved program which requires the completion of a minimum of 30 credit hours, beyond the M.S. degree, with a cumulative GPA of 3.00 or more at all times.

c. **Comprehensive Examination:** By the fourth semester from enrolment in the Ph.D. program, a candidate will be required to take a written and oral Comprehensive Examination. The examination covers the courses taken in his major and minor areas, in addition to mathematics. The Comprehensive Examination will normally be given during the semester following the student's completion of all course work. The oral and written examinations must be conducted in the same semester. On the basis of the Comprehensive Examination, a student may be admitted to the Doctorate Degree Candidacy. A graduate student will be allowed to take the Comprehensive Examination only twice.

d. **Dissertation:** A candidate who successfully passes the Comprehensive Examination may proceed with his research work under the supervision of his dissertation advisor and in consultation with his dissertation committee. In consultation with the ME Graduate Coordinator, the Ph.D. student should select his Dissertation Advisor during the semester in which he takes the Preliminary Examination. A Dissertation Committee must be formed for each student upon the recommendation of the Chairman of the Mechanical Engineering Department and approval of the Dean of the College of Graduate Studies. The membership of committee is always an odd numbers. The committee include: the Dissertation Advisor

(Chairman), Mechanical Engineering faculty members from the specified area of research, and one faculty member from outside the Department in a related area of research. Upon completion of his research work, the candidate is required to defend his dissertation before the thesis committee and in public. The Ph.D. degree will only be conferred upon the recommendation of the dissertation committee.

Typical Breakdown of Credit Hours for the Ph.D. Program in Mech. Engg.

	Courses	Credits
Major area:	Seven ME courses (ME 5XX/ME 6XX)	21
Minor area(s):	Three Graduate courses	9
	Ph.D. Dissertation (ME 710)	12
ME 699	Seminar	0
	Total Credits	**42**

A minor area has to be constituted of a collection of three coherent courses (9 credit hours) that must be chosen from any field related to the professional activities of mechanical engineering and outside the field of the student's major area.

Degree Plan for the Ph.D. Program in Mechanical Engineering

Course #		Title	LT	LB	CR
FIRST SEMESTER					
ME	xxx	Elective I - ME	3	0	3
ME	xxx	Elective II - ME	3	0	3
ME	xxx	Elective III - ME	3	0	3
			9	**0**	**9**
SECOND SEMESTER					
ME	xxx	Elective IV - ME	3	0	3
ME	xxx	Elective V - ME	3	0	3
ME	xxx	Elective VI - ME	3	0	3
XXX	xxx	Elective VII - Technical	3	0	3
			12	**0**	**12**
THIRD SEMESTER					
ME	xxx	Elective VIII - ME	3	0	3
XXX	5xx	Elective IX - Technical	3	0	3
XXX	5xx	Elective X - Technical	3	0	3
			9	**0**	**9**
FOURTH SEMESTER					
ME	599	Seminar	1	0	0
ME	710	Ph.D. Dissertation	0	0	IP
FIFTH SEMESTER					
ME	710	Ph. D. Dissertation (Continued)	0	0	IP
SIXTH SEMESTER					
ME	710	Ph. D. Dissertation (Continued)	0	0	12
			1	**0**	**12**
Total Credit Hours					**42**

*All ME courses should be 500 level or above.

IP: Dissertation in progress

COURSE DESCRIPTION

ME 501 Numerical Methods in Mechanical Engineering (3-0-3)

Concepts of consistency, stability, and convergence of numerical schemes. Initial and boundary value problems for ordinary differential equations. Various finite difference and finite element methods and their applications to fundamental partial differential equations in engineering and applied sciences. Case studies.

Prerequisite: SE 301 or Equivalent (not to be taken for credit with MATH 574)

ME 530 Advanced Compressible Fluid Flow (3-0-3)

Oblique shock waves. Expansion waves. General features of multidimensional compressible flow. Introduction to small perturbation theory. The method of characteristics with applications to steady and unsteady flows.

Prerequisite: ME 425/AE 325 or Equivalent

ME 531 Advanced Thermodynamics I (3-0-3)

Axiomatic presentation of fundamentals of classical thermodynamics. First law, equilibrium, Euler and Gibbs-Duhem relations. Entropy production, thermodynamic cycles. Legendre transformations and extremum principle. Maxwell relations and thermodynamic derivatives. Stability. Phase transitions. Nernst postulate. Chemical equilibrium. Applications.

Prerequisite: ME 204 or Equivalent

ME 532 Advanced Fluid Mechanics I (3-0-3)

Conservation equations for viscous fluids. Boundary layer concept. Navier-Stokes equations and some exact solutions. Stokesian flow. Laminar boundary layer equations and methods of solution. von Karman momentum integral equation. Theory of stability of laminar flows. Introduction to turbulent flow.

Prerequisite: ME 311 or Equivalent

ME 533 Ideal Fluid Flow (3-0-3)

Kinematics and dynamics of inviscid fluids in steady and unsteady motion. Two-dimensional and axisymmetric potential flows. Singularities. Complex potential and various transformation techniques. Free-stream line flow. Airfoils and wings.

Prerequisite: ME 311 or Equivalent

ME 534 Conduction Heat Transfer (3-0-3)

Thermal conductivity and law of thermodynamic equilibrium. General heat conduction equation. Boundary conditions involving specified temperature and heat flux, convection and grey body thermal radiation. Thermal circuit concept. Steady one-dimensional conduction: composite walls, heat source systems, extended surfaces. Steady multi-dimensional conduction applications. Unsteady one – and multi-dimensional heat conduction applications. Phase change with moving boundaries. Numerical and classical analytical solution methods.

Prerequisite: MATH 301 & ME 315 or Equivalent

ME 535 Radiation Heat Transfer (3-0-3)

Radiation from a black body. Definitions and estimation of radiative properties of non-black surfaces. Radiative properties of real materials. Radiation exchange between black and gray surfaces. Thermal radiation between non-diffusion gray surfaces. Radiation exchange between gases and enclosures. Combined convection and radiation heat transfer. Radiative behavior of windows, coatings, and solids. Applications and numerical solution methods.

Prerequisite: ME 315 or Equivalent

ME 536 Convection Heat Transfer (3-0-3)

Convection systems. Derivation of conservation equations and solutions for laminar and turbulent boundary layer flows. Forced convection, internal and external flows. Natural convection. Special topics and applications.

Prerequisite: ME 532

ME 537 Combustion and Emission (3-0-3)

Fundamentals of emission formation in combustion systems. Wall quenching and imperfect combustion. Unburned hydrocarbons, carbon monoxide, aldehydes, nitrogen oxides, species stratification in the combustion chamber, particulates. Effect of design parameters and engine operating variables on emission formation. Emission controls and instrumentation.

Prerequisite: ME 204 or Equivalent

ME 539 Solar Energy Utilization (3-0-3)

Design consideration of various concentrating collectors for thermal and photovoltaic applications. Solar thermal/electric power conservation. Solar thermal energy storage. Solar thermal design methods: f-chart utilizability. Solar space conditioning design and computer simulation models such as TRNSYS. Economic considerations. Solar desalination and other applications. Design projects in selected areas.

Prerequisite: ME 439 or Equivalent

ME 543 Nonlinear Finite Element Analysis (3-0-3)

Introduction, Finite Element Formulation. Small-Deformation Elastic-Plastic Analysis. Finite –Strain Formulation. Implementation of the Finite-Strain Formulation. Practical applications in metal forming processes and structural component design.

Prerequisite: ME 489 or CE 517 or consent of the instructor.

ME 546 Industrial Aerodynamics (3-0-3)

Planetary boundary layer and atmospheric characteristics. Bluff body aerodynamics; separation, vortex shedding, wakes, static and dynamic wind forces. Response of structures to dynamic loading. Applications to buildings, structures, vehicles, etc.

Prerequisite: ME 311 or Equivalent

ME 547 Thermal Environment and Energy Analysis (3-0-3)

Requirement of thermal environment and its effects. Solar radiation measuring techniques and estimation methodology. Heat transmission in buildings. HVAC load and system analyses; computerized techniques. Effects of building configuration, orientation, and systems operation on energy consumption.

Prerequisite: ME 315 or Equivalent

ME 548 Combustion Phenomena (3-0-3)

Flame propagation theories, structure of premixed hydrocarbon flames, mathematical formulations for flame propagation. Diffusion flames, droplet combustion. Detonation and deflagration wave theory.

Prerequisite: ME 204 or Equivalent

ME 549 Thermal Design of Heat Exchangers (3-0-3)

Classification of a variety of heat exchangers, various methods for the exchanger analysis and performance evaluation, pressure drop analysis including header design and flow maldistribution, fouling and its impact on the exchanger performance and life-cycle analysis. Special design considerations for regenerators, plate-fin, tube-and-frame, shell-and-tube, reboilers, condensers, evaporators, and direct-contact heat exchangers.

Prerequisite: ME 315 or Equivalent

ME 550 Fundamentals of Astronautics (3-0-3)

Introduction to the solar system, launching, fundamental laws of astrodynamics (space mechanics), orbit maneuvering and determination, important applications in missile trajectories, optimal trajectories, communication satellite and spacecraft attitude, re-entry and hypersonic considerations.

Prerequisite: Graduate Standing

ME 551 Continuum Mechanics (3-0-3)

Tensors, indicial notation, transformation of coordinates. Stresses, principal stresses. Mohr's circles. Deformation and strain. Velocity fields and compatibility conditions. Constitutive equations. Isotropy. Mechanical properties of solids and fluids. Field equations: applications to elasticity, viscoelasticity, plasticity, and fluid mechanics.

Prerequisite: Graduate Standing (also offered under CE 518)

ME 552 Advanced Dynamics (3-0-3)

Fundamentals of Newtonian dynamics. Hamilton's Principle and Lagrange's equations. Relativistic dynamics. Central force motion, stability of circular orbits. Rigid body dynamics. Euler equations of motion, Euler angles, gyroscopic motion, spinning projectile, Hamilton's equations and phase space. Hamilton-Jacobi equation.

Prerequisite: Graduate Standing

ME 553 Advanced Vibrations (3-0-3)

Review of single degree of freedom oscillator: formulation using generalized stiffness, inertia and damping. Damping mechanisms: viscous, friction, and complex. Response to transient and general excitations. Multiple degrees of freedom systems: formulation and methods of solution. Direct stiffness, influence coefficients and variational approaches. Eigenvalue analysis. Vibration of continuous systems. Approximation methods of continuous systems. Modal reduction technique.

Prerequisite: Graduate Standing

ME 554 Elasticity (3-0-3)

Plane stress, plane strain, biharmonic solutions. Problem formulation in Cartesian and polar coordinates; polynomial, Fourier series and complex variable solutions. Energy theorems and variational techniques. Three-dimensional elasticity. Saint-Venant torsion and bending theory. Navier equation and Galerkin vector.

Prerequisite: ME 551

ME 555 Plasticity (3-0-3)

The physics of plasticity: Plastic deformation, Stress-Strain relations, temperature and rate dependence, crystal plasticity. Constitutive theory: Viscoplasticity, rate-independent plasticity, yield criteria, flow rules and hardening rules, uniqueness theorems, limit analysis. problems in contained plastic deformation: torsion of prismatic bars, thick walled cylinder, bending of beams. Problems in plastic flow and collapse. Large deformation plasticity. Numerical methods in plasticity.

Prerequisite: ME 551

ME 557 Modern Control of Linear Systems (3-0-3)

Overview of state space modeling of linear systems. Stability of time-invariant linear systems. Controllability and observability conditions. Formulation of tracking and regulator problems. Optimal linear state feedback control. The linear optimal regulator problems. Observers, full-order observers. The optimal observer design.

Prerequisite: ME 413 or Equivalent

ME 558 Rotordynamics (3-0-3)

The basic rotor components, disk, shaft, and bearings. Simple rotor models, natural frequencies, Campbell diagram, instability, and mass unbalance. Finite element modeling of rotor components. Dynamic modal characteristics of rotors, modal transformations, reduced-order equations. Numerical solution of the rotor equations.

Prerequisite: ME 552

ME 559 Random Vibrations (3-0-3)

Introduction to random vibrations and stochastic processes. Spectral analysis and frequency response methods. Auto correlation, Cross correlation, Power-spectral density. Random load transmission. Vibration data processing. Digital and fast Fourier transform. Response of continuous systems to random excitation. Wavelet analysis.

Prerequisite: ME 482 or Equivalent

ME 560 Smart Materials and Structures (3-0-3)

Analysis, design, and implementation of smart structures and systems: modeling of beams and plates with induced strain actuation, piezoelectric ceramics and polymers, shape memory alloys, electro-rheological fluids. Piezoelectric and magnetostrictive sensors and actuators, and fiber optic sensors. Integration mechanics. Damage detection and repair. Applications.

Prerequisite: Graduate Standing

ME 562 Vibration Measurement and Analysis (3-0-3)

Analysis of lumped and distributed parameter systems. Concepts of torsional vibration. Resonances. Frequency response and transfer function methods. Modal analysis. Mathematical modeling using experimental data. Digital Fourier analysis and Fast Fourier Transform. Signal processing. Data acquisition. Data formats. Transducer measurement considerations. Vibration data processing and instrumentation. Typical vibration problems. Fault diagnosis techniques of rotating machinery. Basic balancing of rotors. Resonance and critical speed testing. Machine analysis case studies.

Prerequisite: ME 413 or Equivalent

ME 563 Ultrasonic Testing Techniques (3-0-3)

Theory and principles of elastic wave propagation. Reflection, refraction, and transmission of plane waves. Dispersion and scattering. Guided wave modes. Signal processing. Ultrasonic transducers. Inspection principles of ultrasonic testing. Ultrasonic testing equipment. Material characterization. Ultrasonic flaw detection. Testing of metals. Inspection of non-metals and adhesive bonds. Case studies.

Prerequisite: Graduate Standing

ME 564 Noise and Vibration Control (3-0-3)

Analysis and measurement of sound and vibration as applied to noise control. Review of fundamentals and principles, noise generators. Measurement and analysis of noise and vibration. Noise control; noise criteria, sound absorption and insulation, noise barriers, acoustic enclosures, silencers. Vibration isolation criteria, damping materials, vibration isolating mounts. Studies of machine element noise, fan and flow induced noise, combustion and furnace noise. Fluid piping noise, compressor and pump noise, internal factory noise.

Prerequisite: Graduate Standing

ME 565 Dynamics of Multibody Systems I (3-0-3)

Definition of a multibody system; Mechanical joints and their kinematic constraints; Equations of motion for a multibody system, the constrained form of Lagrange's equation, Lagrange multipliers, joint reaction forces; Coordinate partitioning, the Lagrangian form with embedded constraints; Dynamics of spatial multibody systems, coordinate transformations using Euler parameters, formulation of the joint constraints, Dynamic equations of motion; Introduction to computational methods in dynamics.

Prerequisite: ME 552

ME 570 Experimental Methods in Materials and Processes (3-0-3)

Laboratory investigations of the mechanical, physical, and surface properties of materials. Experimental investigations of materials' behavior during processing and in various operating environments. Experimental design and evaluation of results.

Prerequisite: Graduate Standing

ME 572 Analysis of Manufacturing Processes (3-0-3)

Analytical treatment of the machining and metal-working processes. Metallurgical and economic considerations. Machine tools dynamics and vibration. Trends of current research.

Prerequisite: ME 206 or Equivalent

ME 573 Probabilistic Concepts in Design and Production (3-0-3)

Review of probabilistic concepts and distributions used in design and manufacturing engineering. Linear and nonlinear combination of random variables in probabilistic design. Error propagation and tolerance analysis. Stress-strength interference theory and reliability computations. Monte Carlo simulation . Products and systems failure rates and reliability models. Reliability testing and failure data analysis from complete and censored data using maximum likelihood estimation, method of moments, and graphical techniques using probability papers and computer software. Accelerated life testing, Reliability growth models and analysis. Preventive and corrective maintenance. Some applications in manufacturing.

Prerequisites: STAT 319 or Consent of Instructor.

ME 574 Advanced Materials Science (3-0-3)

Review on crystal structures of materials. Mechanical properties of materials. Solid solutions and phase diagrams. Influence of alloying on transformation and critical cooling rates of steels. Surface treatment of metals and alloys. Structure and mechanical properties of polymers. Structure and mechanical properties of ceramics. Special materials for biomedical and aerospace applications.

Prerequisite: Graduate Standing

ME 575 Advanced Corrosion Engineering (3-0-3)

Corrosion thermodynamics and kinetics. Effect of environmental factors on major forms of corrosion. Environmental conditioning. Mass transfer and corrosion. Anodic and cathodic protection of metals. Organic and nonmetallic coating. Design for corrosion prevention. Testing, monitoring and inspection. Materials selection for corrosion resistance.

Prerequisite: Graduate Standing

ME 576 Tribology (3-0-3)

Classification of wear modes. Adhesion. Abrasion. Rolling-sliding wear, Erosion, Corrosion, Combined wear modes. Friction and heat transfer calculations. Wear models and testing. Design of wear resistant systems. Selection of wear resistant materials.

Prerequisite: ME 307 or Equivalent

ME 578 Mechanical Properties of Engineering Polymers (3-0-3)

General introduction to polymers and their applications. Types of mechanical behavior. Hookean and rubber elasticity. Plastic deformation. Fracture. Linear viscoelasticity. Dynamic mechanical behavior and testing. Experimental methods. Mechanical properties of polymeric composites.

Prerequisite: ME 574

ME 579 Advanced Mechanical Behavior of Materials (3-0-3)

Description of stress, strain, strain rate and elastic properties of materials. Fundamental aspects of crystal plasticity. Theory and characteristics of dislocations. Strengthening mechanisms at low temperature. Deformation at elevated temperatures and deformation maps. Emphasizing the relationships between microscopic mechanisms and macroscopic behavior of materials.

Prerequisite: ME 574

ME 580 Principles of Metal Forming (3-0-3)

Stress-strain behavior of metals. Introduction to plasticity. Homogeneous and redundant works. Plastic anisotropy. Slab methods. Upper-bound analysis. Slip line field theory. Open and closed die forging. Extrusion of metals. Mechanics of wire drawing, hot and cold rolling, stretch forming, sheet bending. Analysis of deep drawing, tube drawing and tube making.

Prerequisite: ME 572

ME 581 Computer Integrated Manufacturing (3-0-3)

A study of the impact of computers and automation on discrete parts manufacturing. Flexible manufacturing and assembly equipment. CAD/CAM concepts and applications. Process planning and manufacturing scheduling. Materials handling. Robotics. Quality assurance. Tooling and fixtures for CNC systems.

Prerequisite: ME 572

ME 583 Fatigue and Fracture of Engineering Materials (3-0-3)

Stress/Strain controlled Fatigue-Life prediction laws. Continuum fracture mechanics. Fracture modes. Fracture mechanics and microscopic plastic deformation/fracture mechanics combined approach. Cleavage, ductile fracture, fatigue, creep-fatigue and environmental cracking phenomena.

Prerequisite: ME 307 or Equivalent

ME 584 Quality Engineering (3-0-3)

Statistical process control techniques for quality and productivity improvement in production processes. Quality control charts for variable data and attribute data. Process capability analysis. Acceptance procedures based on the quality of the product. Taguchi's ideas of quality. Experience with statistical quality control software. Case studies. The course will also address documentation using ISO 9000 and other quality standards.

Prerequisite: STAT 319 or Equivalent (not to be taken for credit with SE 534)

ME 585 Advanced Physical Metallurgy (3-0-3)

Review of structure of metals, analytical methods, dislocation and plastic deformations, diffusion, solidification of metals, nucleation and growth kinetics, phase diagrams, thermally activated plastic deformations, fracture and fracture mechanics.

Prerequisite: ME 574

ME 586 Finite Element Analysis in Metal Forming (3-0-3)

General introduction to FEM and metal forming processes. Basic formulation for elastic deformation. Introduction to plasticity and viscoplasticity. Introduction to finite element nonlinear analysis. Small-deformation elastic-plastic analysis. Finite-strain formulation for metal forming analysis. Implementation of the finite-strain formulation. Practical applications; plain strain problems of rolling and bending, axisymmetric isothermal forging, steady-state processes of extrusion and drawing. Sheet metal forming. Thermo-viscoplastic analysis. Future developments.

Prerequisite: ME 206 or Equivalent

ME 591 Special Topics in Thermofluid Sciences I (3-0-3)

Advanced topics are selected from thermofluid area of mechanical engineering. Contents of the course will be provided in detail one semester before its offering. Approval of the Departmental Graduate Committee and the Graduate Council must be secured before offering this course.

Prerequisite: Graduate Standing

ME 595 Special Topics in Engineering Mechanics I (3-0-3)

Advanced topics are selected from engineering mechanics area of mechanical engineering. Contents of the course will be provided in detail one semester before its offering. Approval of the Departmental Graduate Committee and the Graduate Council must be secured before offering this course.

Prerequisite: Graduate Standing

ME 597 Special Topics in Materials & Manufacturing I (3-0-3)

Advanced topics are selected from materials and manufacturing area of mechanical engineering. Contents of the course will be provided in detail one semester before its offering. Approval of the Departmental Graduate Committee and the Graduate Council must be secured before offering this course.

Prerequisite: Graduate Standing

ME 599 Seminar (1-0-0)

Graduate students working towards M.S. degree, are required to attend the seminars given by faculty, visiting scholars, and fellow graduate students. Additionally each student must present at least one seminar on a timely research topic. Among other things, this course is designed to give the student an overview of research in the department, and a familiarity with the research methodology, journals and professional societies in his discipline. Graded on a Pass or Fail basis.

Prerequisite: Graduate Standing

ME 610 MS Thesis (0-0-6)

ME 611 Statistical Thermodynamics (3-0-3)

Quantum mechanics and statistics. Kinetic description of dilute gases. Classical statistics of independent particles. Elementary kinetic theory of transport processes. Thermostatics, properties of ideal gases, kinetic theory of dilute gases. Statistical mechanical ensembles. Thermostatic properties of real substances. Applications.

Prerequisite: Graduate Standing

ME 612 Phase Change Heat Transfer and Two Phase Flow (3-0-3)

Fundamental mechanisms of evaporation and condensation. Bubble equilibrium, nucleation criteria. Pool and flow boiling models and correlations. Two-phase flow models and governing equations. Flow regime transitions. Pressure drop calculations. Measurement techniques. Drop-wise and film-wise condensation, flow and non-flow systems. Enhanced surface boiling and condensation.

Prerequisite: ME 536

ME 632 Advanced Fluid Mechanics II (3-0-3)

Stability of laminar flow and causes of transition to turbulence. Conservation equations and Reynolds stresses. Turbulent boundary layer equations, integral and other methods of solution. Free turbulence, wakes and jets. Statistical analysis; scales of turbulence, correlation functions, spectra. Measuring techniques.

Prerequisite: ME 532

ME 658 Fracture Mechanics (3-0-3)

Fracture modes and stress fields at the crack tip. stress intensity factors. Griffith and Irwin theories. Crack initiation and propagation. Fracture tests, fracture toughness. Fatigue crack growth. Elastic-plastic fracture mechanics. Numerical methods in fracture mechanics. Mechanisms and mechanics of fracture in engineering components.

Prerequisite: ME 551

ME 661 Nonlinear Systems Dynamic Analysis (3-0-3)

Fundamentals of quantitative and qualitative analysis techniques of nonlinear dynamic systems. Elements of nonlinear systems. Phase plane diagrams, stability and bifurcation of equilibrium and limit cycles, attractors, Lyapunov stability, Poincare' map. Harmonic balance, K-B averaging, Linstedt-Poincare' and multiple-time scales methods. Sub-harmonic, super-harmonic, combination and internal resonances. Parametrically excited systems, Mathieu's equation, and Floquet theory. One and two dimensional maps, structural stability and chaotic attractors, correlation dimensions, Lyapunov exponents and Melnikov's function. Trends in current research.

Prerequisite: MATH 301 or Equivalent

ME 665 Dynamics of Multibody Systems II (3-0-3)

Review of rigid multibody dynamics, kinematics joints, constraints, and transformation of generalized coordinates. Constrained and unconstrained equations of motion. The mechanics and deformable bodies; rods, beams, and blades. Formulation of the rigid-elastic multibody equations of motion and constrained equations. Computational techniques for deformable mechanisms and multibody flexible systems. Applications.

Prerequisite: ME 565

ME 666 Dynamics and Control of Mechanical Systems (3-0-3)

Dynamics of mechanical systems. Mechanics of ground and flight vehicles. Introduction to inertia guidance and navigation. Nonlinear control systems; fundamentals of Lyapunov theory, Describing function analysis, feedback linearization, Sliding control. Improving system response via control techniques. Optimal control design. Case studies by computer.

Prerequisite: ME 557

ME 671 Electrode Kinetics (3-0-3)

Application of principles of thermodynamics. Reversible and irreversible electrode processes. Interfacial phenomena. Principles of kinetics. Absorption. Field effects and gas-metal interface. Principles and applications of anodic and cathodic processes to electroplating and extraction of metals. Fuel cells. Case studies.

Prerequisite: ME 575

ME 672 Control of Manufacturing Processes (3-0-3)

Application of computer-based control system techniques to batch manufacturing processes. A brief review of control concepts and servomechanisms with an in-depth study of modeling and control problems associated with several manufacturing processes. These include, but not restricted to, metal cutting, metal forming and welding processes as well as the control problem associated with manipulated robotic arms in a manufacturing context.

Prerequisite: ME 572

ME 673 Metallurgical Processes and Thermodynamics (3-0-3)

Thermodynamic principles. Solutions. Heterogeneous reactions in metallurgy. Kinetics and catalysis. Physico-chemical principles as applied to extraction. Conversion and refining of metals. Applications of metallurgical processes.

Prerequisite: ME 574

ME 675 Phase Transformation in Metals (3-0-3)

Examines the thermodynamics and fundamentals of rate processes in metals. Phenomenological and atomistic points of view are considered. Kinetics of liquid-solid, solid-solid transformations and transport of matter in solids are discussed.

Prerequisite: ME 574

ME 691 Special Topics in Thermofluid Sciences II (3-0-3)

Advanced topics are selected from thermofluid area of mechanical engineering. Contents of the course will be provided in detail one semester before its offering. Approval of the Departmental Graduate Committee and the Graduate Council must be secured before offering this course.

Prerequisite: Graduate Standing

ME 695 Special Topics in Engineering Mechanics II (3-0-3)

Advanced topics are selected from the broad area of mechanical engineering. Contents of the course will be provided in detail one semester before its offering. Approval of the Departmental Graduate Committee and the Graduate Council must be secured before offering this course.

Prerequisite: Graduate Standing

ME 697 Special Topics in Materials & Manufacturing II (3-0-3)

Advanced topics are selected from the broad area of mechanical engineering. Contents of the course will be provided in detail one semester before its offering. Approval of the Departmental Graduate Committee and the Graduate Council must be secured before offering this course.

Prerequisite: Graduate Standing

ME 699 Seminar (1-0-0)

Graduate students working towards Ph.D. degree, are required to attend the seminars given by faculty, visiting scholars, and fellow graduate students. Additionally each student must present at least one seminar on a timely research topic. Among other things, this course is designed to give the student an overview of research in the department, and a familiarity with the research methodology, journals and professional societies in his discipline. Graded on a Pass or Fail basis.

ME 710 Ph.D. Dissertation (0-0-12)

PETROLEUM ENGINEERING

Chairman
Sidqi Ahmad Abu-Khamsin

Professor
Al-Marhoun

Visiting Professor
Hamada

Associate Professors
Al-Hashim
Al-Majed
Al-Yousef
Shirif

Lecturers
Al-Dhafeer
Muhammadain

GRADUATE PROGRAMS IN PETROLEUM ENGINEERING

The Department of Petroleum Engineering offers graduate study and research leading to the degree of Master of Science and Doctor of Philosophy. The M.S program in the Department was started in 1982-83 and the Ph.D. program in 1985. As of 4 June 2008, the Department graduated 69 students. The Department has a multinational enrollment of students in both its M.S. and Ph.D. programs.

The Department offers a wide selection of graduate courses directed towards broadening the scientific background of its student and, at the same time, deepening his understanding in one or more areas of petroleum engineering. The department places particular emphasis on developing student research potential and fostering original research.

The current areas of research and study include Drilling Engineering, Formation Evaluation, Production Engineering, and Reservoir Engineering.

TEACHING AND RESEARCH FACILITIES

The Department has the following modern well-equipped laboratories for teaching and advanced research in different areas of Petroleum Engineering, where the students are exposed to practical aspects of their theoretical studies and do experimental work.

1. Drilling Fluid Flow Loop Lab
2. Drilling Fluid Lab
3. Quantitative Analysis Lab
4. Core Preparation Lab
5. Rock Mechanics Lab
6. Enhanced Oil Recovery Lab
7. Fluid Properties Lab
8. Rock Properties Lab
9. Oil Well Cementing Lab
10. Production Lab
11. Thin Section Lab
12. Drilling Simulation Lab
13. Well Logging Lab

The Department's research is directed toward achieving excellence in the areas of Production Engineering and Reservoir Engineering which are vital for the development of petroleum resources in the Kingdom of Saudi Arabia.

M.S. PROGRAM IN PETROLEUM ENGINEERING

Admission Requirements

In addition to the Deanship of Graduate Studies requirements outlined in this bulletin, applicants must have:

a Bachelor of Science degree in Petroleum Engineering equivalent to the KFUPM current undergraduate program in length, content and quality, or a Bachelor of Science degree in other engineering or closely related engineering sciences. In the latter case, applicants will be required to take deficiency courses, with no graduate credit.

M.S. Degree Requirements

- The program requires a minimum of 30 credit hours: core courses of 12 credit hours, elective courses of 12 credit hours, and thesis work equivalent to 6 credit hours. The satisfactory presentation of a seminar is also required. A maximum of 6 credit hours in the elective courses may be taken from other engineering and science graduate courses.
- The elective courses should be chosen according to the approved degree plan in order to provide a coherent study of certain well-defined areas and also serve as a basis for personal interest, future graduate studies, or practice in the oil industry.

Degree Plan for the M.S. Program in Petroleum Engineering

Course #	Title	LT	LB	CR
First Year: First Semester				
PETE 532	Well Performance	3	0	3
PETE 544	Natural Gas Engineering	3	0	3
PETE 560	Mathematical Methods in Petroleum Engineering	3	0	3
		9	**0**	**9**
First Year: Second Semester				
PETE 545	Advanced Reservoir Simulation	3	0	3
PETE 599	Seminar	1	0	0
PETE 5xx	PETE Elective I*	3	0	3
XXX 5xx	Technical Elective I**	3	0	3
		10	**0**	**9**
Second Year: First Semester				
PETE 5xx	PETE Elective II*	3	0	3
XXX 5xx	Technical Elective II**	3	0	3
		6	**0**	**6**
Second Year: Second Semester				
PETE 610	Thesis	0	0	6
		0	**0**	**6**
Total Credit Hours				**30**

* From graduate courses offered in Petroleum Engineering.

** From relevant courses offered university-wide including the Petroleum Engineering Department.

PH.D. PROGRAM IN PETROLEUM ENGINEERING

The objectives of the program are: (1) to promote independent thinking and creative petroleum engineering methodology by developing original research, and (2) to prepare highly qualified personnel in the field of petroleum engineering such as researchers, senior engineers, and university faculty.

Admission Requirements

In addition to the Deanship of Graduate Studies requirements given in this bulletin, applicants should have:

an M.S. degree in Petroleum Engineering equivalent to the current KFUPM Petroleum Engineering Master's degree or an M.S. degree in other engineering or closely related sciences. In the latter case, applicants may be required to take deficiency courses, with no graduate credit.

Degree Requirements

- Completion of a minimum of 30 credit hours distributed as follows:
  - A minimum of 21 credit hours in 500-level, or higher, petroleum engineering courses.
  - A minimum of 9 credit hours in 500-level, or higher, courses in other engineering disciplines or sciences.
- Presentation of two satisfactory seminars.
- Maintaining a cumulative GPA of 3.00 or above in all graduate courses.
- Passing the Comprehensive Examinations in the major and minor fields in the fourth semester of enrolment.
- Successful completion of a dissertation and its defense.

Typical Breakdown of Credit Hours for the Ph.D. Program in Petroleum Engineering

	Course*	Credits
Major area:	Seven PETE courses (PETE 5xx/PETE 6xx)	21
Minor area(s):	Minimum three graduate courses from outside PETE Department	9
	Seminar (PETE 699)	0
	Ph.D. Dissertation (PETE 710)	12
Total		**42**

*All courses must be selected in consultation with the Graduate Advisor.

Degree Plan for the Ph.D. Program in Petroleum Engineering

Course #	Title	LT	LB	CR
FIRST SEMESTER				
PETE 5xx	Elective I - PETE	3	0	3
PETE 5xx	Elective II - PETE	3	0	3
PETE 5xx	Elective III - PETE	3	0	3
		9	**0**	**9**
SECOND SEMESTER				
PETE 5xx	Elective IV - PETE	3	0	3
PETE 6xx	Elective V - PETE	3	0	3
PETE 6xx	Elective VI - PETE	3	0	3
XXX 5xx	Elective VII - Technical	3	0	3
		12	**0**	**12**
THIRD SEMESTER				
PETE 6xx	Elective VIII - PETE	3	0	3
XXX 5xx	Elective IX - Technical	3	0	3
XXX 5xx	Elective X - Technical	3	0	3
		9	**0**	**9**
FOURTH SEMESTER				
PETE 599	Seminar	1	0	0
PETE 710	Ph.D. Dissertation	0	0	IP
FIFTH SEMESTER				
PETE 710	Ph. D. Dissertation (Continued)	0	0	IP
SIXTH SEMESTER				
PETE 599	Seminar	1	0	0
PETE 710	Ph.D. Dissertation (Continued)	0	0	12
		1	**0**	**12**
Total Credit Hours				**42**

A PETE elective course must not be identical or largely similar to another graduate course taken previously at KFUPM or elsewhere.

IP: Dissertation in progress

GRAUDATE COURSES

The graduate courses are grouped according to the recognized areas of petroleum engineering as follows:

Drilling Engineering		**LT**	**LB**	**CR**
PETE 512	Advanced Drilling Engineering I	3	0	3
PETE 513	Advanced Drilling Fluids	3	0	3
PETE 616	Offshore Drilling Engineering	3	0	3
PETE 617	Advanced Drilling Engineering II	3	0	3
Formation Evaluation				
PETE 523	Well Test Analysis	3	0	3
PETE 524	Advanced Well Logging	3	0	3
PETE 627	Automated Well Test Analysis	3	0	3
PETE 628	Reservoir Characterization	3	0	3
Production Engineering				
PETE 532	Well Performance	3	0	3
PETE 533	Surface Production Facilities	3	0	3
PETE 635	Well Stimulation	3	0	3
PETE 637	Applied Hydraulic Fracturing	3	0	3
PETE 638	Artificial Lift	3	0	3
Reservoir Engineering				
PETE 543	Advanced Waterflooding	3	0	3
PETE 544	Natural Gas Engineering	3	0	3
PETE 545	Advanced Reservoir Simulation	3	0	3
PETE 645	Fluid Flow in Porous Media	3	0	3
PETE 648	Enhanced Oil Recovery	3	0	3
PETE 649	Advanced Fluid Properties	3	0	3
Petroleum Economics				
PETE 551	Petroleum Economic Analysis	3	0	3
Other Courses				
PETE 560	Mathematical Methods in Petroleum Engineering	3	0	3
PETE 580	Virtual Petroleum Engineering	3	0	3
PETE 590	Special Topics in Petroleum Engineering	3	0	3
PETE 599	Seminar	1	0	0
PETE 610	M.S. Thesis	0	0	6
PETE 670	Reservoir Rock Mechanics	3	0	3
PETE 685	Artificial Intelligence in Pet. Engineering	3	0	3
PETE 699	Seminar	0	0	0
PETE 710	Ph.D. Dissertation	0	0	12

Technical Elective Courses

The student may select graduate courses, as required by the graduate program, from but not limited to the following recommended electives according to the approved degree plan:

Course #		Course Title
CHE	500	Advanced Transport Phenomena I
GEOL	503	Geology of the Middle East
GEOL	505	Geophysical Exploration
SE	501	Survey of Operations Research & its Application

COURSE DESCRIPTION

PETE 512 Advanced Drilling Engineering I (3-0-3)

This course provides the student with a thorough understanding of the drilling operations and the various factors affecting them. Topics covered include drilling fluid hydraulics, hole stability, penetration rate, buckling and bending of drilling strings, well trajectory control, and optimization of drilling operations.

Prerequisite: Graduate Standing

PETE 513 Advanced Drilling Fluids (3-0-3)

The course provides an in-depth coverage of drilling fluids chemistry and rheology. Coverage includes both classical and evolving drilling fluid systems, clay chemistry, shale stabilization, drilling fluid additives and contaminants, and addresses the various problems and solutions related to drilling fluids.

Prerequisite: Graduate Standing

PETE 523 Well Test Analysis (3-0-3)

The course provides students with the theoretical background and skills needed for well test design and analysis. Solutions of the fundamental flow equation including wellbore storage and skin for slightly compressible fluids are presented and discussed. The general buildup theory and its application to infinite and bounded reservoirs is addressed and discussed. Analysis of common well tests using recently developed methods and techniques to determine reservoir parameters of homogeneous and heterogeneous systems.

Prerequisite: Graduate Standing

PETE 524 Advanced Well Logging (3-0-3)

The course provides the students with the basic and advanced skills and techniques needed to interpret modern well logs. These skills and techniques are then used for identification and evaluation of potential hydrocarbon zones from a standard suite of logs. Clean and shaly formation interpretations are covered. Computer Applications are emphasized.

Prerequisite: Graduate standing and consent of instructor

PETE 532 Well Performance (3-0-3)

The course provides detailed study of the inflow performance relationships and the horizontal, vertical and inclined multiphase flow correlations and mechanistic models. These are then used to determine the current and future performance of the well and the optimum size of the tubing and flow line as well as the optimum production strategy for the whole life of the well. The course emphasizes computer applications through the utilization of student-developed and commercially available software.

Prerequisite: Graduate Standing

PETE 533 Surface Production Facilities (3-0-3)

The course provides a detailed description, performance analysis, and design of oil, water and gas handling facilities. Design of individual components of the production system using hand calculations is first emphasized to provide complete understanding of the physics of the various processes; then, computer programs are utilized. The course concludes with a term project. The project integrates learned material for the design of a complete surface production system.

Prerequisite: Graduate standing and consent of instructor

PETE 543 Advanced Waterflooding (3-0-3)

Detailed analysis of the theory, design, and performance prediction of waterflooding of oil reservoirs. Fundamentals of rock and fluid interactions. The fractional flow equation. Linear immiscible displacement. Prediction of areal sweep efficiency using the CGM method and stream-tube models. Water injectivity in various flood patterns. Heterogeneous reservoirs.

Prerequisite: Graduate Standing

PETE 544 Natural Gas Engineering (3-0-3)

The course is intended to provide students with the techniques needed to estimate gas reserves for normally and abnormally pressured gas reservoirs, water drive gas reservoirs, and gas condensate reservoirs. Production forecasting and decline curve analysis. Productivity enhancement through gas cycling. Fundamental gas flow equation and its solutions in terms of pressure, pressure squared and pseudo function. Gas well test design and analysis. Analysis of hydraulically fractured gas well tests. Gas field development including reservoir deliverability, total system analysis (inflow/outflow performance of gas wells), and optimum development patterns.

Prerequisite: Graduate Standing

PETE 545 Advanced Reservoir Simulation (3-0-3)

The theory of petroleum reservoir simulation with modern modeling and prediction techniques. Finite difference representation of flow equations. Construction of grid systems and time step selection. Modeling of multi-phase flow. Solution methods of a system of equations.

Prerequisite: Graduate Standing

PETE 551 Petroleum Economic Analysis (3-0-3)

The course covers the principles of economics as applied to the petroleum industry. Economic concepts such as time value of money, profitability measures, cash flow, depreciation, cost estimation, risk and uncertainty analysis are studied in detail. Applications for screening and evaluation of small and major projects are emphasized.

Prerequisite: Graduate Standing

PETE 560 Mathematical Methods in Petroleum Engineering (3-0-3)

The course covers selected topics on advanced mathematical and numerical methods and modeling in petroleum engineering. This includes numerical differentiation, integration, non-linear regression, and numerical inversion of Laplace transforms. Applications include analysis of rock properties, fluid properties, and reservoir engineering.

Prerequisite: Graduate Standing

PETE 580 Virtual Petroleum Engineering (3-0-3)

The course presents real problems and scenarios that simulate a petroleum engineering office environment. A multidisciplinary approach will be the dominant approach to all presented problems. Realistic office settings and simulation of field problems will be used to enhance the learning experience. The course will emphasize problem solving and learning through well-structured assignments and class discussions. Experienced industry experts may be utilized at certain stages of the course.

Prerequisite: Graduate standing and consent of instructor

PETE 590 Special Topics in Petroleum Engineerin (3-0-3)

Advanced topics selected from the major areas of petroleum engineering covering recent developments.

Prerequisite: Consent of instructor

PETE 599 Seminar (1-0-0)

Graduate students working towards the M.S. degree are required to attend the seminars given by faculty, visiting scholars, and fellow graduate students. Additionally, each student must present at least one seminar on a timely research topic. Among other things, this course is designed to give the student an overview of research in the department, and a familiarity with the research methodology, journals and professional societies in his discipline. Graded on a Pass or Fail basis.

PETE 610 M. S. Thesis (0-0-6)

Under the supervision of a graduate faculty member, the student selects a problem of interest to the petroleum profession. The student then researches the problem by analytical, numerical, and/or experimental means. The investigation should demonstrate adequate supervised-research skills and the ability to present results in a professional manner. The student should submit a thesis and defend it to a thesis committee.

Prerequisite: PETE 599

PETE 616 Offshore Drilling Engineering (3-0-3)

Offshore platforms and mobile vessels. Motion compensators and risers design. Offshore rigs and equipment. Offshore directional drilling. Wellhead and well control systems.

Prerequisite: PETE 512

PETE 617 Advanced Drilling Engineering II (3-0-3)

This course is intended to cover the recent advances and changes in drilling technology. Emphasis will be on the areas of horizontal and multilateral drilling and completion, slim holes and evolving drilling techniques. Optimization and cost-effective drilling practices are studied in detail with the utilization of available computer packages.

Prerequisite: PETE 512

PETE 627 Automated Well Test Analysis (3-0-3)

The course is intended to introduce the graduate student to the latest technology in well interpretation and design using interactive well test computer models. Common types of well tests and reservoir models, and the identification under various conditions of oil and gas wells are presented and discussed. The graduate student will demonstrate his understanding of the course material through development of a well test program to estimate reservoir parameters based on non-linear regression techniques for several reservoir models.

Prerequisite: PETE 523

PETE 628 Reservoir Characterization (3-0-3)

The course is intended to provide the student with advanced concepts in geostatistics. Spacial correlation, variograms, and covariograms of petrophysical variables. Static (cores, logs, seismic) and dynamic (flow) data are used to characterize the reservoirs. Estimation of spacial distribution of variables using kriging, cokriging, and conditional simulation. Applications of geostatistical techniques to construct reservoir simulation models.

Prerequisite: Graduate Standing

PETE 635 Well Stimulation (3-0-3)

The course starts with detailed discussions of the various types of formation damage, their causes and effect on well productivity. The various stimulation and damage removal methods are then introduced with detailed study of the theory, design and pre- and post-treatment analysis of sandstone and carbonate matrix acidizing. At the conclusion of the course, the student should be able to design a complete stimulation job starting from the selection of the candidate well and ending with the post-treatment performance evaluation.

Prerequisite: PETE 532 or consent of instructor

PETE 637 Applied Hydraulic Fracturing (3-0-3)

The course provides the student with the knowledge and tools needed to design and analyze hydraulic and acid fracturing jobs. An overview of the fundamentals of rock mechanics and its application to hydraulic fracturing will be presented. Then, the data requirements and various elements of massive hydraulic fracturing treatment design are covered in detail. Finally, the design of fracture treatment using analytical tools and commercial simulators is discussed in detail. The course concludes with a term project to design a fracturing treatment and evaluate the post treatment performance of the well.

Prerequisite: PETE 532

PETE 638 Artificial Lift (3-0-3)

This course is designed to enable the student to first make decisions on the need for artificial lift and the best artificial lift method for any given well and field conditions; then, to design and optimize the artificial lift installation. Students taking this course are expected to be familiar with well performance evaluation and analysis. Therefore, the course concentrates on discussing the various types and applications of artificial lift methods with detailed study of the theory, design and analysis of gas lift, electric submersible pump, sucker rod pump, downhole separations and hydraulic pump installations. Recent advances in artificial lift technology will also be highlighted.

Prerequisite: PETE 532

PETE 645 Fluid Flow in Porous Media (3-0-3)

The scope, objectives, and applications of the theory of fluid flow in permeable-rock media. The continuum approach to the description of pathways and barriers. Fluid flow equations for homogeneous fluids. Derivation and generalization of Darcy's law and its applications. Flow and distribution of heterogeneous fluids. Principles and applications of hydrodynamics.

Prerequisite: PETE 560

PETE 648 Enhanced Oil Recovery (3-0-3)

The theoretical and design aspects of enhanced oil recovery methods as practiced in post-waterflood oil reservoirs. Miscible displacement methods including dry, rich, and liquefied petroleum gas. Hot fluid injection. In-situ combustion. Chemical processes employing polymers and/or surfactants. EOR screening criteria.

Prerequisite: PETE 543

PETE 649 Advanced Fluid Properties (3-0-3)

Theoretical and empirical aspects of the properties of petroleum fluids relevant to petroleum reservoir calculations. Phase behavior. PVT tests and correlations. Phase equilibria. Equations of state and phase behavior calculations. Petroleum fluid characterization. Interfacial tension in multi-phase systems. Applications in reservoir simulation.

Prerequisite: Graduate Standing

PETE 670 Reservoir Rock Mechanics (3-0-3)

The course provides detailed coverage of the fundamentals of rock mechanics including the theories of elasticity and failure mechanics, borehole stresses and acoustic wave propagation. Laboratory and field methods of acquiring rock mechanics data relevant to field applications are discussed in detail. The course concludes with thorough discussions of the application of rock mechanics in studying borehole stability, sand control, reservoir compaction and fracturing.

Prerequisite: Graduate Standing

PETE 685 Artificial Intelligence in Petroleum Engineering (3-0-3)

The course provides coverage of both theoretical and programming aspects of artificial intelligence techniques with applications to the various areas of petroleum engineering. The basics of Expert Systems, Artificial Neural Networks, Fuzzy Logic and Genetic Programming will be covered with their applications in reservoir characterization, reservoir engineering, drilling engineering and production operations. The course is concluded with individual projects utilizing commercial software to solve real problems.

Prerequisite: Graduate Standing

PETE 699 Seminar (0-0-0)

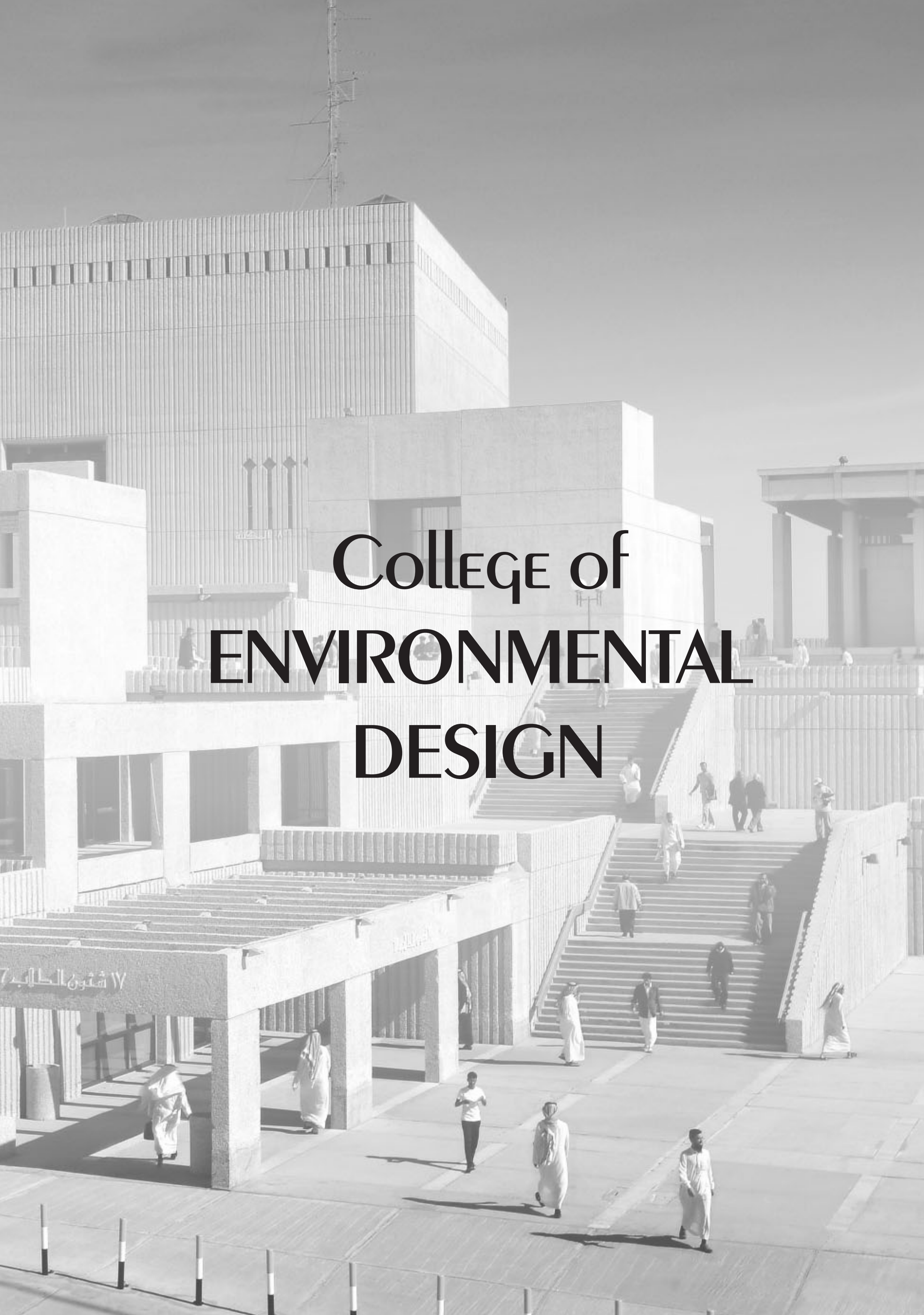
Attendance of departmental seminars given by faculty, graduate students and visiting scholars. A graduate (Ph.D.) student is expected to contribute seminars on literature searches of topics of current interest to Petroleum Engineering. Graded on a Pass or Fail basis.

PETE 710 Ph.D. Dissertation (0-0-12)

Under the supervision of a graduate faculty member, the student selects a problem of fundamental significance to the petroleum engineering science. The student should conduct a thorough survey of the literature and formulate a clear approach to achieve the objectives. In his investigation, the student should employ analytical, numerical, and/or experimental techniques, which should demonstrate originality and independent thinking. The results and conclusions of the research work should constitute a significant contribution to petroleum engineering knowledge. The student should submit a dissertation and defend it to a dissertation committee.

Prerequisite: PETE 699

College of ENVIRONMENTAL DESIGN



ARCHITECTURAL ENGINEERING

Chairman

Baqer Al-Ramadan

Professors

Abdulmohsen Al-Hammad

Associate Professors

Adel Abdou

Ismail Budaiwi

Mohammad Al-Homoud

Mohammad Hassanain

Assistant Professors

Hamoud Dehwah

Sami Khaiyat

Lecturers

Sabeer Hamid

Zulfikar Aliyu

OVERVIEW OF DEPARTMENT

Architectural Engineering is a discipline which is concerned with various engineering and economic aspects of design, construction, and maintenance and operation of buildings. The KFUPM graduate program in Architectural Engineering at the College of Environmental Design aims at meeting the needs of the building industry in the Kingdom, while maintaining quality education by incorporating academic, professional and international requirements.

EMPLOYMENT OPPORTUNITIES

Graduates with a Master Degree in Architectural Engineering have a wide choice of employment opportunities in the building industry and related areas. Graduates can work in the following sectors:

- With government or private agencies, dealing with buildings design and facilities operation and management.
- With Architectural/Engineering consulting firms, construction firms, or maintenance firms.
- With research institutions and national organizations dealing with building standards, facilities operation and maintenance, post occupancy evaluation, and indoor environmental quality and energy conservation.

Graduates interested in teaching and research can easily pursue their post-graduate education abroad. The Architectural Engineering graduate program is designed to offer a Master Degree equivalent to those offered by major engineering schools in the United States, thereby facilitating the acceptance of KFUPM graduates in Ph.D. programs throughout the world.

OBJECTIVES

The graduate program of the Architectural Engineering department is designed to prepare highly qualified professionals and researchers in the field with a specialized and in-depth knowledge related to the design, operation and management of the various buildings systems. The program offers students with in-depth study in one of the two specialized areas of Facilities Engineering and Management and Building Environmental Control Systems.

M.S. AND M.ENGG. PROGRAMS IN ARCHITECTURAL ENGINEERING

The graduate program includes two options namely: Master of Science (M.S., Thesis option) and Master of Engineering (M. Eng., Non-Thesis option). The M. S. program requires 30 credit hours: core courses of 9 credit hours, elective courses of 15 credit hours in addition to 6 credit hours of Thesis Work. The M.Eng. program requires 42 credit hours: core courses of 9 credit hours, elective courses of 30 credit hours and 3 credit hours of Research Project. The structure and options of the Master Degree program are illustrated in *Figure 1.*

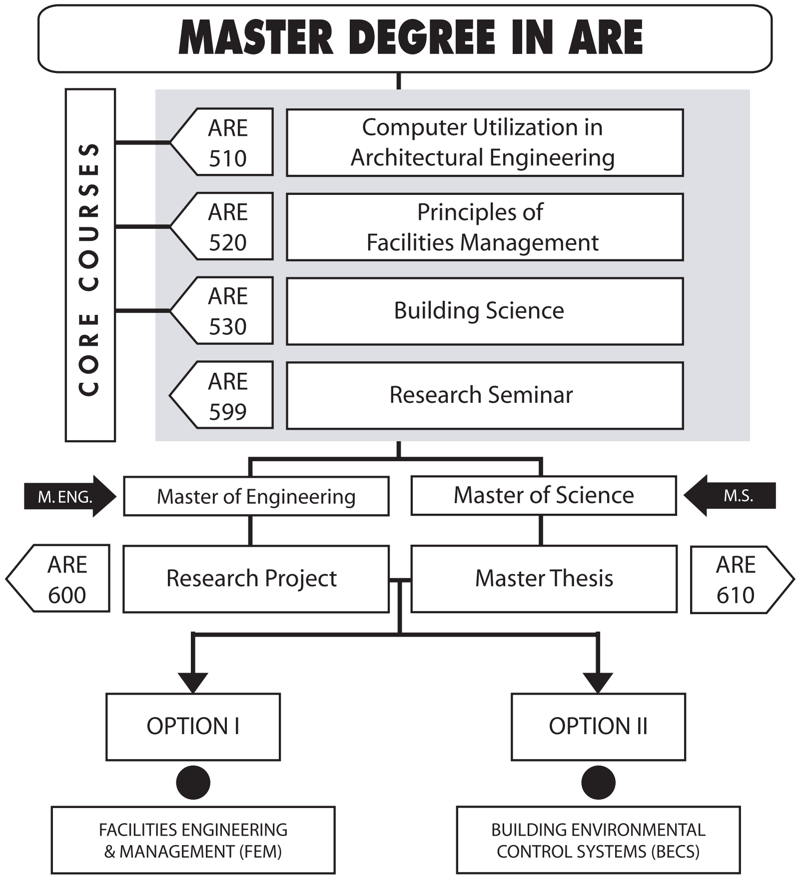


Figure 1. The structure and options of the Master Degree program in ARE

AREAS OF EMPHASIS

Emphasis is given to the areas of study that are related to the post construction phase which currently characterizes the building industry and the construction sector in the Kingdom. The two main areas of emphasis in the Architectural Engineering graduate program are:

- Building Environmental Control Systems **(BECS)**
- Facilities Engineering and Management **(FEM)**

These areas which emphasize building technology and management, not only address the emerging needs of the local building industry, but also give the program a distinct identity and character. The course requirements in the two main areas of emphasis of the Master Degree program are illustrated in *Figure 2*.

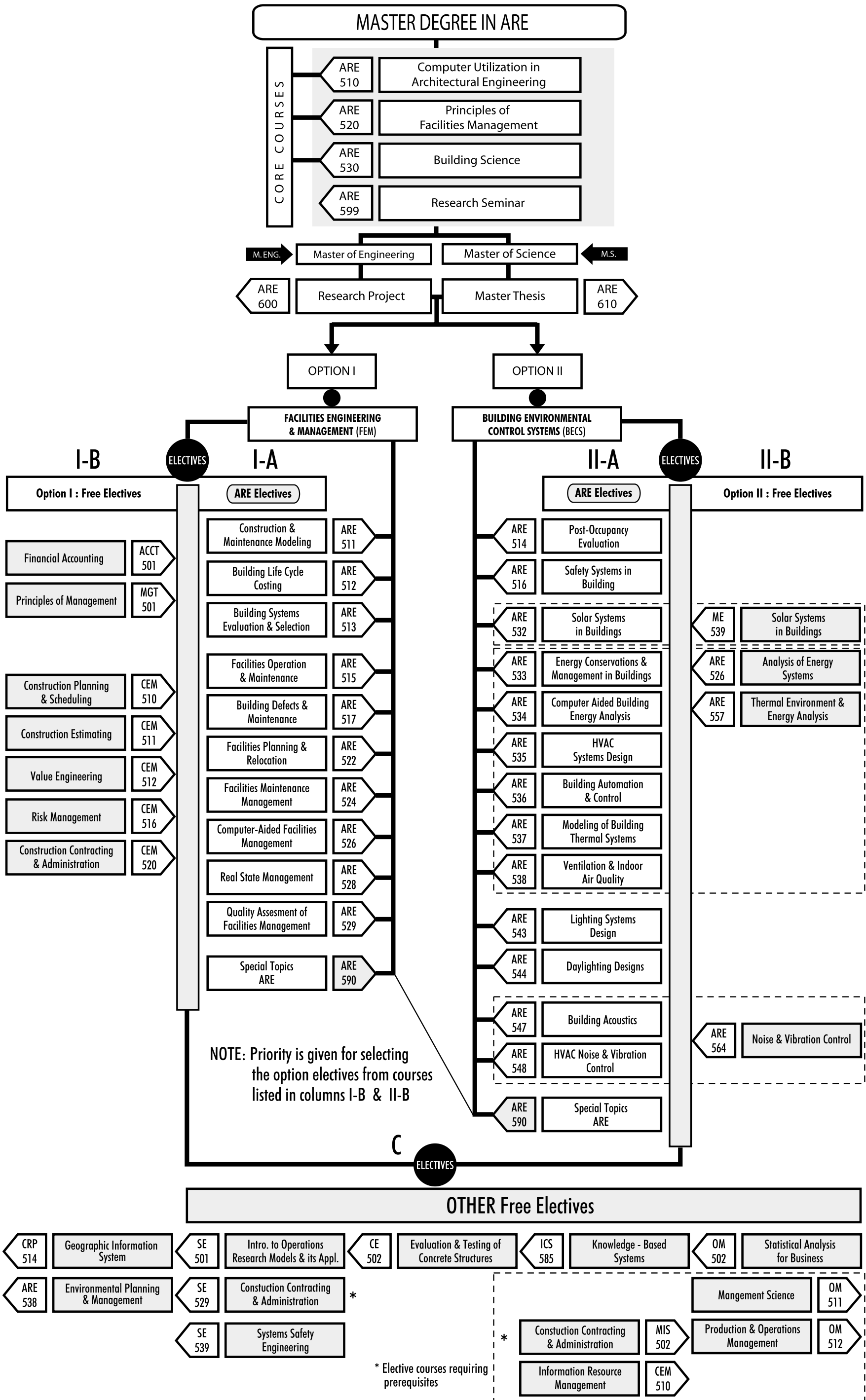


Figure 2. The course requirements in the two options of the Master Degree program

Course Requirements for the M.S. Program in Architectural Engineering

Course #	Title	LT	LB	CR
ARE 510	Computer Utilization in Architectural Engineering	3	0	3
ARE 520	Principles of Facilities Management	3	0	3
ARE 530	Building Science	3	0	3
ARE xxx	ARE Elective	3	0	3
ARE xxx	ARE Elective	3	0	3
ARE xxx	ARE Elective	3	0	3
XXX xxx	Free Elective	3	0	3
XXX xxx	Free Elective	3	0	3
ARE 599	Research Seminar	1	0	0
ARE 610	Master Thesis	0	0	6
		25	**0**	**30**

Elective Courses

1. Nine (9) credit hours: Architectural Engineering Elective courses from the chosen option.
2. Six (6) credit hours: Approved Free Elective courses (one of which may be from Architectural Engineering Elective courses according to the approved degree plan).

ADMISSION REQUIREMENTS

Admission to the program requires fulfilling all KFUPM and Graduate Studies requirements. In addition, the applicant should meet the following ARE requirements:

1. Bachelor degree in Architectural Engineering, Architecture, Civil and Mechanical Engineering or related Engineering fields equivalent to the KFUPM Bachelor Degree.
2. The Master of Engineering (M. Eng.) option is unavailable for graduate and research assistants.

Course Requirements for M.ENGG. Program in Architectural Engineering

Course #	Title	LT	LB	CR
ARE 510	Computer Utilization in Architectural Engineering	3	0	3
ARE 520	Principles of Facilities Management	3	0	3
ARE 530	Building Science	3	0	3
ARE xxx	ARE Elective	3	0	3
ARE xxx	ARE Elective	3	0	3
ARE xxx	ARE Elective	3	0	3
ARE xxx	ARE Elective	3	0	3
ARE xxx	ARE Elective	3	0	3
XXX xxx	Free Elective	3	0	3
XXX xxx	Free Elective	3	0	3
XXX xxx	Free Elective	3	0	3
XXX xxx	Free Elective	3	0	3
XXX xxx	Free Elective	3	0	3
ARE 599	Research Seminar	1	0	0
ARE 600	Research Project	0	0	3
		40	**0**	**42**

Elective Courses

1. Fifteen (15) credit hours: Architectural Engineering Elective courses from the chosen option.
2. Nine (9) credit hours: The Free Elective courses (can be taken from Architectural Engineering Elective courses).
3. Six (6) credit hours: Approved other Free Elective courses (can be taken from relevant KFUPM approved graduate courses outside the department according to the approved degree plan).

Degree Plan for the M.S. Program in Architectural Engineering

Course #	Title	LT	LB	CR
First Semester				
ARE 510	Computer Utilization in Architectural Engineering	3	0	3
ARE 520	Principles of Facilities Management	3	0	3
		6	**0**	**6**
Second Semester				
ARE 530	Building Science	3	0	3
ARE xxx	ARE Elective	3	0	3
ARE xxx	ARE Elective	3	0	3
		9	**0**	**9**
Third Semester				
ARE xxx	ARE Elective	3	0	3
XXX xxx	Free Elective	3	0	3
ARE 599	Research Seminar	1	0	0
		7	**0**	**6**
Fourth Semester				
XXX xxx	Free Elective	3	0	3
ARE 610	Master Thesis	0	0	6
		3	**0**	**9**
Total Credit Hours				**30**

Degree Plan for the M.ENGG. Program in Architectural Engineering

Course #	Title	LT	LB	CR
First Semester				
ARE 510	Computer Utilization in Architectural Engineering	3	0	3
ARE 520	Principles of Facilities Management	3	0	3
ARE xxx	ARE Elective	3	0	3
ARE xxx	ARE Elective	3	0	3
		12	**0**	**12**
Second Semester				
ARE 530	Building Science	3	0	3
ARE xxx	ARE Elective	3	0	3
ARE xxx	ARE Elective	3	0	3
ARE xxx	ARE Elective	3	0	3
		12	**0**	**12**
Third Semester				
ARE 599	Research Seminar	1	0	0
XXX xxx	Free Elective	3	0	3
XXX xxx	Free Elective	3	0	3
XXX xxx	Free Elective	3	0	3
XXX xxx	Free Elective	3	0	3
		13	**0**	**12**
Fourth Semester				
XXX xxx	Free Elective	3	0	3
ARE 600	Research Project	0	0	3
		3	**0**	**6**
Total Credit Hours				**42**

A. Option I: Facilities Engineering and Management (FEM)

ARE Elective Courses

- ARE 511 Construction & Maintenance Modeling
- ARE 512 Building Life Cycle Costing
- ARE 513 Building Systems Evaluation & Selection
- ARE 515 Facilities Operation & Maintenance
- ARE 517 Building Defects and Maintenance
- ARE 522 Facilities Planning and Relocation
- ARE 524 Facilities Maintenance Management
- ARE 526 Computer-Aided Facilities Management
- ARE 528 Real Estate Management
- ARE 529 Quality Assessment of Facilities Management
- ARE 590 Special Topics in ARE

The Option Free Elective Courses

- CEM 510 Construction Planning & Scheduling
  (*Prerequisite:* Grad. Standing)
- CEM 511 Construction Estimating
  (*Prerequisite:* Grad. Standing)
- CEM 512 Value Engineering
  (*Prerequisite:* Grad. Standing)
- CEM 516 Risk Management in Construction
  (*Prerequisite:* Grad. Standing)
- CEM 520 Construction Contracting and Administration
  (*Prerequisite:* Grad. Standing)
- ACCT501 Financial Accounting
  (*Prerequisite:* None)
- MGT 501 Principles of Management
  (*Prerequisite:* None)

B. Option II: Building Environmental Control Systems (BECS)
(Energy & HVAC Systems, Illumination, and Acoustics)

ARE Elective Courses

- ARE 514 Post-Occupancy Evaluation
- ARE 516 Safety Systems in Buildings
- ARE 532 Solar Systems in Buildings
- ARE 533 Energy Conservation & Management in Buildings
- ARE 534 Computer-Aided Building Energy Analysis
- ARE 535 HVAC Systems Design
- ARE 536 Building Automation & Control
- ARE 537 Modeling of Building Thermal Systems
- ARE 538 Ventilation and Indoor Air Quality
- ARE 543 Lighting Systems Design
- ARE 544 Daylighting Design
- ARE 547 Building Acoustics
- ARE 548 HVAC Noise & Vibration Control
- ARE 590 Special Topics in ARE

The Option Free Elective Courses

- EE 526 Analysis of Energy Systems
  (*Prerequisite:* Grad. Standing)
- ME 539 Solar Energy Utilization
  (*Prerequisite:* ME 439)
- ME 557 Thermal Environment & Energy Analysis
  (*Prerequisite:* ME 430)
- ME 564 Noise & Vibration Control
  (*Prerequisite:* Grad. Standing)

C. Other Free Elective Courses

- OM 502 Statistical Analysis for Business
  (*Prerequisite:* None)
- OM 511 Management Science
  (*Prerequisite:* OM 502, or waiver)
- OM 512 Production & Operations Management
  (*Prerequisite:* OM 511)
- ICS 585 Knowledge-Based Systems
  (*Prerequisite:* Grad. Standing & Programming Knowledge)
- SE 501 Intro. to Operations Research Models & its application
  (*Prerequisite:* Grad. Standing)
- SE 529 Advanced Maintenance Planning & Control
  (*Prerequisite:* SE 429 or Consent of Instructor)
- SE 539 Systems Safety Engineering
  (*Prerequisite:* Grad. Stand. & Consent of the Instructor)
- CE 502 Evaluation and Testing of Concrete Structures
  (*Prerequisite:* Grad. Standing)
- CRP 514 Geographic Information Systems
  (*Prerequisite:* CRP 507, or Consent of Instructor)
- CRP 538 Environmental Planning and Management
  (*Prerequisite:* Grad. Standing)
- MIS 502 Management Information Systems
  (*Prerequisite:* None)
- MIS 510 Information Resource Management
  (*Prerequisite:* MIS 502 or Waiver)

COURSE DESCRIPTION

ARE 500 Building Materials and Construction Systems (3-0-3)

Properties, behavior and selection of building materials including, cements, aggregate, concrete, masonry, steel, wood and finishing materials. Pre-cast and pre-stressed concrete. Applications of traditional and modern materials, and construction systems under climatic constraints. Methods of construction, excavation foundation and construction equipment.

Prerequisite: Graduate Standing (not for credit for ARE students)

ARE 510 Computer Utilization in Architectural Engineering (3-0-3)

Introductory exposure of students to the use of computer in the building engineering design process, operation and maintenance. Databases organization. The concepts of Computer-Aided Design and Drafting (CADD), Artificial Intelligence (AI), Knowledge-Based Experts Systems (KBES) and Object-Oriented Programming (OOP). Communication and connectivity, Internet and Web environment, multimedia applications. Computer modeling and simulation. Example applications.

Prerequisite: Graduate Standing

ARE 511 Construction and Maintenance Modeling (3-0-3)

Applications of analytical modeling techniques to problems in construction and maintenance management. Topics include the application of decision theory, queuing, equipment maintenance policies, strategies of maintenance, optimization techniques, and simulation applications in building construction and maintenance.

Prerequisite: Graduate Standing

ARE 512 Building Life Cycle Costing (3-0-3)

Life cycle costing approach. Types, uses, sources and output of data. Life cycle costing techniques. Managing risk and uncertainty. Depreciation, replacement and breakeven analysis. Managing project value through life cycle costing. Problems of applications of life cycle costing. Computer applications.

Prerequisite: Graduate Standing

ARE 513 Building Systems Evaluation & Selection (3-0-3)

The need for a rational approach to building systems and materials evaluation. A structured approach to building systems and materials evaluation and selection.

Performance requirements criteria, system development, creativity approach, evaluating alternatives; building overall performance; case studies.

Prerequisite: ARE 500 or equivalent

ARE 514 Post-Occupancy Evaluation (3-0-3)

Introduction to post-occupancy evaluation (POE); the building performance concept, measuring performance; elements of building performance: spatial, technological, and technical criteria, total indoor environmental quality (TIEQ), the POE process model: planning, conducting and implementing POE; case studies.

Prerequisite: Graduate Standing

ARE 515 Facilities Operation & Maintenance (3-0-3)

Facilities systems functions and components. Operation, maintenance and disposition of building systems such as structural systems, envelope systems, HVAC and mechanical systems, lighting and electrical systems, security and fire safety systems and energy management systems.

Prerequisite: Graduate Standing

ARE 516 Safety Systems in Buildings (3-0-3)

Life safety concepts in building design and operation. Basic theory of fire development and propagation in confined spaces. Fire protection objectives. Fire detection and suppression systems, and methods of fire control. Fire and smoke control. Selection of construction and building materials. Smoke management and ventilation techniques. Design of architectural details' for safety (e.g. stairs, ramps, entrances exits, etc.). Computer applications.

Prerequisite: Graduate Standing

ARE 517 Building Defects and Maintenance (3-0-3)

Design and appearance: including change of appearance of concrete exposure, cracking in buildings, and protection against corrosion of reinforcing steel in concrete. Foundations and walls, including: concrete on sulfate bearing soils and ground waters, sulfate attack on brick work and rising damp in walls. Floors, roofs and joinery, including: damp-proofing solid floors, clay tile flooring, and built-up felt roofs. Painted surfaces, including: painting of iron and steel, nonferrous metals, and woodwork. Services, including: pipes and fittings for domestic water supply and durability of metals in natural waters.

Prerequisite: Graduate Standing

ARE 520 Principles of Facilities Management (3-0-3)

Principles of facilities management (FM), FM skills, FM functions. Facilities planning and administration, space utilization. Human and environmental factors, health, safety and security. Quality management. Value management, outsourcing and contracting administration. Zoning and code requirements. Building performance. Building support services. Building operation and maintenance management. Approaches and strategies for effective management and operation of facilities. Information systems in FM.

Prerequisite: Graduate Standing

ARE 522 Facilities Planning & Relocation (3-0-3)

Tools, techniques and concepts to solve problems in the planning, design, and management of large complex facilities. Analyzing and organizing facility management functions; linking business plans to strategic, tactical and project planning of facilities; developing a project management team and process; planning and programming facility changes; developing and implementing space allocation procedures and policies (including space standards); forecasting space needs; site search and selection; space planning, programming and interior design; furnishing, finishes and materials specifications; management of large scale moves and relocation.

Prerequisite: ARE 520 or Consent of the Instructor

ARE 524 Facilities Maintenance Management (3-0-3)

Maintenance Management techniques, maintenance standards, maintenance contract types, organizing and staffing of maintenance departments, estimating and budgeting, scheduling and controlling work, improving productivity, computer applications.

Prerequisite: Graduate Standing

ARE 526 Computer-Aided Facilities Management (3-0-3)

Information systems in facilities management. Computer-based FMS applications that include; real estate lease and management, space management, furniture and equipment management, telecommunications and cable management, building operations and maintenance management.

Prerequisite: ARE 520

ARE 528 Real Estate Management (3-0-3)

Overview of property management, real estate analysis and development; types of buildings, types of tenants, tenants requirements, site evaluation and selection, market search and analysis, and feasibility studies; environmental and government regulations;

real estate financing, real estate economics; marketing, financial management, management planning; leasing practices and negotiations, and lease terms and management.

Prerequisite: Graduate Standing

ARE 529 Quality Assessment of Facilities Management (3-0-3)

Facilities and services quality assessment and process management of their effectiveness, concepts of Total Quality Management (TQM), ISO standards, benchmarking, process management, audit activities management including assessment of the effectiveness of the facilities maintenance operations by means of complete set of audit forms, key components, conducting the audit, annual review, innovation and improvement; case studies.

Prerequisite: ARE 520

ARE 530 Building Science (3-0-3)

Weather and climate; thermal radiation in the environment; water in the environment and its interaction with buildings; heat transfer in building structures, solar radiation influences on buildings. Effect of wind on buildings; air leakage and ventilation. Introduction to total indoor environmental quality including: thermal, visual, and acoustical comfort requirements and design criteria. Design considerations for buildings in hot and hot-humid climates.

Prerequisite: Graduate Standing

ARE 532 Solar Systems in Buildings (3-0-3)

Available solar radiation, radiation on opaque and transparent materials, solar collection, theory and types of solar collectors, performance of solar collectors, energy storage in solar systems, solar water heating in buildings, passive and active solar heating, design of solar heating systems, solar cooling in buildings; economics of solar systems. Computer applications.

Prerequisite: ARE 530 or Consent of the Instructor

ARE 533 Energy Conservation & Management in Buildings (3-0-3)

Energy conservation as a design determinant. Energy use and buildings in Saudi Arabia. Design techniques to minimize energy consumption of building architectural, mechanical and electrical systems. Energy conservation standards. Energy modeling and simulation, evaluation of alternative energy conservation opportunities. Energy management, energy audit. Computer applications.

Prerequisite: ARE 530 or Consent of the Instructor

ARE 534 Computer-Aided Building Energy Analysis (3-0-3)

Building energy systems analysis and evaluation; energy estimating techniques; computer models for estimating building energy consumption; applications of various building energy analysis computer programs; building energy optimization; computer evaluation of alternative building energy conservation measures (ECMs).

Prerequisite: ARE 533 or Consent of the Instructor

ARE 535 HVAC Systems Design (3-0-3)

HVAC systems characteristics. Thermal comfort, heating and cooling load calculations. Ventilation and air quality requirements. System analysis and equipment selection procedures. Air diffusion design and layout techniques. Duct design and distribution, Energy conservation considerations. Computer applications to the analysis and design of HVAC systems.

Prerequisite: ARE 530 or Consent of the Instructor

ARE 536 Building Automation and Control (3-0-3)

Concepts of automatic control systems. Logic of controls and their interaction with the building and its systems. Control issues related to energy conservation, thermal comfort and indoor air quality in buildings; lighting systems; formulation of control models and their numerical solutions. Selected case studies of control techniques for HVAC systems.

Prerequisite: ARE 535 or Consent of the Instructor

ARE 537 Modeling of Building Thermal Systems (3-0-3)

Thermal comfort systems design performance modeling, equation fitting, and mathematical modeling of thermal equipment, system simulation and optimization. Steady-state simulation of large systems, dynamic behavior of thermal systems; economics.

Prerequisite: ARE 535 or Consent of the Instructor

ARE 538 Ventilation and Indoor Air Quality (3-0-3)

Factors determining indoor air quality; measures of quality, sources of pollutants, standards, testing techniques, effects of sub-standards air quality on occupants. The influence of infiltration and ventilation on air quality. Methods of improving indoor air quality; ventilation, filtration, material selection. Current issues.

Prerequisite: Graduate Standing

ARE 543 Lighting Systems Design **(3-0-3)**

Lighting systems components and characteristics. Visual comfort. Color and lighting. Lighting design calculations methods. System and components selections procedures. Systems analysis, design and layout techniques. Energy conservation considerations. Computer applications.

Prerequisite: Graduate Standing

ARE 544 Daylighting Design **(3-0-3)**

Introduction to daylighting, daylight availability, solar illuminance, overcast sky and clear sky luminous. Design considerations, lumen methods of skylighting and sidelighting. Daylight factor. Computer applications in daylighting analysis and design, energy conservation and daylighting.

Prerequisite: Graduate Standing

ARE 547 Building Acoustics **(3-0-3)**

Basics of sound propagation and quantification; people perception of sound and noise; outdoor and indoor noise sources; noise criteria and rating systems; sound insulation. Techniques for controlling air-borne and structure-borne noise. Behavior of sound in enclosures; acoustical comfort requirements for speech and music; sound quality assessment. Mechanical and electrical equipment noise. Architectural detailing for acoustical performance. Computer applications in acoustical measurements, analysis and modeling.

Prerequisite: Graduate Standing

ARE 548 HVAC Noise & Vibration Control **(3-0-3)**

Noise and vibration, duct-borne transmission; duct-borne flow-generated noise; prediction techniques. Fan noise, calculations of duct-borne noise breakout and controlling techniques. HVAC sound reduction techniques. Noise sources and acoustic characteristics of room units. Plant room noise breakout to adjacent areas. Calculation and analysis techniques for HVAC mechanical equipment noise. Vibration isolation and control strategies. Case studies; Computer applications.

Prerequisite: ARE 535 or Consent of the Instructor

ARE 590 Special Topics in Architectural Engineering **(3-0-3)**

Advanced topics selected from the major areas of Architectural engineering to provide the students with recent applications and developments.

Prerequisite: Consent of the Instructor

ARE 599 Research Seminar in Architectural Engineering (1-0-0)

Identification of a research topic, literature survey, and topic development. Structured presentation on selected topic. Submission of a research paper.

Prerequisite: Graduate Standing (Equivalent to CEM 599)

ARE 600 Research Project (0-0-3)

Research study that deals with the analysis and/or design of a significant problem related to the field of Architectural Engineering and prepared under the supervision of an ARE faculty. The project report should follow formal report format including an introduction, literature review, research methodology, collection and analysis of data, conclusions and recommendations, list of references and appendices of important information. The research project will be presented and evaluated by a faculty committee.

Prerequisite: Graduate Standing

ARE 610 Master Thesis (0-0-6)

An original study on an approved research topic in the field of Architectural Engineering (Building Environmental Control Systems or Facilities Engineering and Management) carried out under the supervision of a faculty member in Architectural Engineering.

Prerequisite: ARE 599

CITY & REGIONAL PLANNING

Chairman

Adel S. Al-Dosary

Professors

Al-Dosary

Alshuwaikhat

Assistant Professors

Al-Naser

Al-Ramadan

Amir

Lecturer

Nahiduzzaman

INTRODUCTION

Planning is concerned with the forces that generate social development, locational change, and economic growth, and with understanding the ways in which resources can best be used. The graduate program in City and Regional Planning at KFUPM is a multi-disciplinary problem-solving curriculum oriented towards the identification and solution of current and future city and regional problems. Nowadays the Master's degree in City and Regional Planning is considered the "standard" professional degree of the field. The program is designed to prepare students to effectively integrated social, economic, legal, political, and scientific theories with planning techniques.

The graduate program at KFUPM is distinctive among planning programs nationally in its emphasis on computer-aided planning and quantitative methods and models useful for rigorous, and systematic analysis of complex problems. The goal of the program is to educate future planners to guide the development of the social, economic, natural and built environments in order to improve the quality of life for people. Graduates in City and Regional Planning enjoy a wide variety of employment options. Their unique multidisciplinary and problem-solving education provides them with the ability to grasp the effects of new technology on all aspects of our society. They find employment with government agencies, consulting firms, as well as in academic institutions.

MASTER DEGREE IN CITY & REGIONAL PLANNING

DEGREE REQUIREMENTS

A Master's Degree of City and Regional Planning (MCRP) is granted after completing 42 semester credit hours with a cumulative GPA of 3.00 or better in all graduate work and satisfactorily completing one seminar (CRP 599) during the degree program.

DEPARTMENTAL ADMISSION REQUIREMENTS

To be eligible for admission, a student must:

1. Hold a B.Sc. in City (or Urban) Planning, Architecture, Architectural Engineering, or Civil Engineering. Applicants from programs such as Systems Engineering, Economics, Geography, and other related fields will be required to take deficiency courses depending on their background.
2. Meet the general KFUPM requirements.

ACADEMIC PROGRAM

The requirements of the program are spread over three semesters with a maximum of 12 credit hours per semester for a full time regular student or a maximum of 9 credit hours for a part-time student. These requirements consist of two parts: 27 credit hours of required courses and 15 credit hours of elective courses.

Of the 27 credit hours of required courses, 21 credit hours are lectures, and 6 credit hours are allocated for the Final Planning Project. In addition, each student will take an extra 15 credit hours of elective courses. Six credit hours of these must be from CRP and three must be from other relevant graduate courses offered outside the department; the remaining 6 credit hours can be taken either from CRP or non-CRP courses.

MCRP PROGRAM

Part I: Required Courses

A - Lectures (21 credit hours)

Course #	Title	LT	LB	CR
CRP 501	Planning Theory	3	0	3
CRP 502	Planning Legislation	3	0	3
CRP 503	Urban & Regional Land Use	3	0	3
CRP 504	Urban Economics	3	0	3
CRP 505	Statistical Analysis in Planning	3	0	3
CRP 506	Urban Planning Methods	3	0	3
CRP 514	Geographic Information System (GIS)	3	0	3
CRP 599	Seminar	1	0	0

B- Final Planning Project (6 credit hours)

Course #	Title	LT	LB	CR
CRP 601	Final Planning Project	1	12	6
Total Required Courses Credit Hours				**27**
Part II: Elective Courses				**15**
Total Credit Hours				**42**

ELECTIVE COURSES

The following list of elective courses is arranged in three groups representing distinct areas of specialty in City and Regional Planning. Students can select from among these courses to satisfy the elective courses requirements regardless of the area of specialty they select from.

1. Quantitative Methods & Computer-Aided Planning

List of CRP elective courses:

CRP	507	Computer Aided Planning
CRP	511	Urban Models
CRP	512	Advanced Quantitative Methods
CRP	513	Cartography and Photogrammetry
CRP	515	Advanced Topics in GIS
CRP	519	Special Topics in Computer-Aided Planning

Relevant elective courses in other departments

SE	501	Survey of Operations Research and Its Applications
SE	523	Forecasting Systems
SE	535	Design of Experiments
ICS	534	Database Design and Implementation
ICS	585	Knowledge-Based Systems
OM	503	Operation Management
MIS	502	Management Information Systems
MIS	512	Data Management
MIS	525	Management Support Systems

2. Socioeconomic Development and Planning

List of CRP elective courses:

CRP	521	History of Urban Development and Planning
CRP	522	Urban and Rural Sociology
CRP	523	Regional Planning
CRP	524	Cultural & Physical Aspects of the Islamic City
CRP	525	Urban Renewal Planning
CRP	526	Planned Cities and Towns
CRP	527	Rural Development Planning

Relevant elective courses in other departments

ECON	501	Principles of Economics
ECON	510	Managerial Economics
ECON	520	The Microeconomics Analysis of Business
MGT	525	Human Resource Management

3. Land Use and Infrastructure Planning

List of CRP elective courses:

CRP	531	Planning Workshop
CRP	532	Theory on Urban Form and Design
CRP	533	Public Works Management
CRP	534	Housing Policies
CRP	535	Urban Infrastructure Planning
CRP	536	Urban Transportation Systems
CRP	537	City and Regional Planning in Arid Zones
CRP	538	Environmental Planning and Management

Relevant elective courses in other departments

CE	571	Transportation Planning and Modeling
CE	593	Transportation System Analysis
CE	635	Water Resources Planning
CE	644	Air Pollution and Control
CE	676	Environmental Impacts of Transportation Facilities
CEM	540	Construction Project Management

TRANSFER FROM OTHER UNIVERSITIES

The number of credit hours to be acknowledged for transfer students of other universities should not exceed 6 and they can only be considered as elective courses. These courses must be those approved by the Department of City & Regional Planning.

Degree Plan for the Master of City & Regional Planning Program

Course #		Title	LT	LB	CR
First Semester					
CRP	501	Planning Theory	3	0	3
CRP	502	Planning Legislation	3	0	3
CRP	503	Urban & Regional Land Use	3	0	3
CRP	505	Statistical Analysis in Planning	3	0	3
					12
Second Semester					
CRP	504	Urban Economics	3	0	3
CRP	506	Urban Planning Methods	3	0	3
CRP	514	Geographic Information Systems (GIS)	3	0	3
CRP	xxx	CRP Elective	3	0	3
					12
Third Semester					
CRP	xxx	CRP Elective	3	0	3
XXX	xxx	Elective*	3	0	3
XXX	xxx	Elective*	3	0	3
CRP	599	Seminar	1	0	0
					9
Fourth Semester					
XXX	xxx	Elective*	3	0	3
CRP	601	Final Planning Project	1	12	6
					9
Total Credit Hours					**42**

* At least one of these three elective courses must be from relevant graduate courses offered outside CRP according to the approved degree plan.

COURSE DESCRIPTION

CRP 501 Planning Theory (3-0-3)

History and definition of planning, determinants, goals and objectives of spatial planning. Role, legitimacy and authority of planning. General and specific theories, such as descriptive, prescriptive and normative theories, and the context of developing countries.

Prerequisite: Graduate Standing

CRP 502 Planning Legislation (3-0-3)

An overview of planning legislation and a short history of planning process in Saudi Arabia. Methods, techniques and instruments for implementing plans through decrees and administrative acts, the basis for urban and regional planning and its relation to Shariah Law as well as the structure and organization of Saudi public planning administration. Discussion of zoning procedures, subdivision, review practices, and budget preparation and execution.

Prerequisite: Graduate Standing

CRP 503 Urban and Regional Land Use (3-0-3)

History and definition of land use planning. The concept of policy, programming and planning. Determinants and systems guiding land use development. Socioeconomic development and Land use. Space requirements, spatial distribution and localization concepts. Land use planning models, and procedures for formal land use plans.

Prerequisite: Graduate Standing

CRP 504 Urban Economics (3-0-3)

Issues of population distribution and economic activities in urban areas. Microeconomic principles, and economic nature of urban systems. Economic aspects and models of urban growth and city size, land use pattern, housing, transportation, environmental problems, unemployment, and public policy.

Prerequisite: Graduate Standing

CRP 505 Statistical Analysis in Planning (3-0-3)

Probability, statistics, decision theory and their applications in city planning. Basic probability concepts, data classification and summarization. Statistical sampling, hypothesis testing, goodness of fit, regression analysis, analysis of variance, contingency tables, and elementary Bayesian decision making. Use of computer statistical packages.

Prerequisite: Graduate Standing

CRP 506 Urban Planning Methods (3-0-3)

Context and role of data and analysis in city and regional planning. Design of survey including questionnaire planning and construction, data collection and data processing. Methods and techniques used in planning such as forecasting, decision models, program evaluation and selection, program scheduling, etc.

Prerequisite: CRP 505

CRP 507 Computer-Aided Planning (3-0-3)

Information and experience with the rapidly growing field of Computer-Aided Planning. Management Information Systems (MIS), Geographic Information Systems (GIS), Decision Support Systems (DSS), Knowledge Based Expert Systems (KBES), and Automated Mapping and Graphing. Basic principles common to the design and use of software in each area.

Prerequisite: Graduate Standing

CRP 511 Urban Models (3-0-3)

Introduction to urban systems modeling in planning. Models of population projection, residential location model, urban transportation/land use models, spatial interaction models, gravitational models, employment analysis and economic base and regional income models.

Prerequisite: Graduate Standing

CRP 512 Advanced Quantitative Methods (3-0-3)

Different analytical techniques that are used by planners and policy makers in the planning process. Topics include Multivariate Analysis, Linear Programming Non-linear Programming, and Queuing Theory. Applications of these techniques in the city and regional planning.

Prerequisite: CRP 506

CRP 513 Cartography and Photogrammetry (3-0-3)

Cartography as instrumental tool for urban and regional planning. Topographic and thematic maps; maps for basic administrative use; systems and scales of maps; legends, keys and symbols; statistics and maps; terminology and automation of maps. Remote sensing and photogrammetry such as geometry of photographs, stereoscopic vision, terrestrial photogrammetry, etc. Interpretation of terrestrial photogrammetry and maps of all kind.

Prerequisite: CE 260 or Consent of the Instructor

CRP 514 Geographic Information Systems (GIS) (3-0-3)

GIS functional elements, attribute and spatial data structures, remote sensing and GIS, global GIS databases, and GIS Applications. Case studies of GIS adoption and application in Saudi Arabia and abroad. GIS planning and implementation, and future of GIS technology.

Prerequisite: Graduate Standing

CRP 515 Advanced Topics in GIS (3-0-3)

Technical aspects of GIS setup, GIS hardware and software, system configurations and data communications. Coordinate systems, map projections, Digital Elevation Models (DEM), data structures, and Global Positioning Systems (GPS).

Prerequisite: CRP 514

CRP 519 Special Topics in Computer-Aided Planning (3-0-3)

Advanced topics are selected from the area of Computer-Aided Planning.

Prerequisite: Graduate Standing

CRP 521 History of Urban Development and Planning (3-0-3)

History and origin of cities, their functions and structures, and theories of urban development and planning. Impact of contemporary urban development on sociocultural and economic systems and urban policies.

Prerequisite: CRP 501

CRP 522 Urban and Rural Sociology (3-0-3)

Identification of similarities and differences in patterns of family life in urban/rural settings and their influence on urban/rural spatial structures. Relationships between technological and social changes and policies, and their impact on urban/rural spatial organization as well as urban planning and design concepts. Discussion and examination of theories of urban/rural sociology in the context of Third World, Middle Eastern and Saudi Cities.

Prerequisite: Graduate Standing

CRP 523 Regional Planning (3-0-3)

Conceptual basis of regional planning; inter-regional analysis including regional input-output analysis, economic base theory, and migration; intraregional analysis including location of industry, spatial structure of regions, and models of spatial interaction.

Prerequisites: CRP 503, CRP 504

CRP 524 Cultural and Physical Aspects of the Islamic City (3-0-3)

Historical development of traditional Muslim towns. Determinants of "Islamic" urban spatial structure. The physical aspects of urban form and the role of the socio-cultural factors and legal system in the structure of Muslim towns. Urban design principles of traditional Arab and Muslim towns. Discussion of the problems of contemporary Islamic cities and the relevance of the traditional design principles to the building of future cities in the Islamic world.

Prerequisite: Graduate Standing

CRP 525 Urban Renewal Planning (3-0-3)

Changes in urban land use and the socio-economic structures of urban settings, historical districts revitalization and regeneration. Goals, plans and operations of adaptive re-use and regeneration of local traditional and modern districts.

Prerequisite: CRP 503

CRP 526 Planned Cities and Towns (3-0-3)

The origin of new town concepts as an approach to urban development in Saudi Arabia in particular and the Middle East in general. Analysis of planning and designing processes. Examination of issues and problems in new town development. Comparative evaluation of Arab, Islamic and the Western new towns. Review industrial towns in Saudi Arabia.

Prerequisite: Graduate Standing

CRP 527 Rural Development Planning (3-0-3)

Ideas, concepts, policies and programs for developing rural areas on national, regional and local level. The links between national policies and rural areas, such as population growth and urbanization and their impact on rural areas. Different models of rural development with specific emphasis on hierarchy in the physical structure ranging from small towns and villages, to hamlets (hijar). Specific topics of planning and design of rural areas in the region will be presented.

Prerequisite: Graduate Standing

CRP 531 Planning Workshop (1-8-3)

Physical planning elements and concepts, analysis and design of the plans of a city district (harah) or a city, in small teams of students to offer experience with group dynamics. Application of the urban planning process, theories and methods are discussed to solve physical urban/rural problems.

Prerequisite: Graduate Standing

CRP 532 Theory on Urban Form and Design (3-0-3)

Review of architecture and urban design history. Theories and concepts of urban spatial design. Elements and analysis of the concept of urban space. Major theoretical and critical responses to the crises of the modern urban environment. Discussion of urban design concepts through analysis of urban settings in the Gulf region.

Prerequisite: Graduate Standing

CRP 533 Public Works Management (3-0-3)

Principles of legislation and regulations of Public Works Management together with its history. Administrative structure of agencies responsible for public works in the Kingdom. Basic budget appropriation for operation, capital projects and budget balancing, borrowing and subsidies.

Prerequisite: Graduate Standing

CRP 534 Housing Policies (3-0-3)

Overview of the housing stocks and its function as a commodity. The private versus the public housing development process. The user and housing design. Housing rehabilitation and conservation as a community development strategy. Adaptive re-use, urban revitalization and manufactured housing. The overall evaluation of housing supply and demand versus housing need based on local demographic developments and general housing strategies at the local, regional, and national levels.

Prerequisite: Graduate Standing

CRP 535 Urban Infrastructure Planning (3-0-3)

Planning for and management of urban infrastructure projects. Identification of physical infrastructure systems such as water and sewage systems, urban transportation networks, etc. Management, finance and budgeting, and operation and maintenance of infrastructure projects. Case studies of local urban infrastructure systems.

Prerequisite: Graduate Standing

CRP 536 Urban Transportation Systems (3-0-3)

Planning and management of urban transportation systems. Functional description, planning, and analysis of transportation systems. Characteristics of major transportation modes in Saudi Arabia. Current research, ethnology, and policy issues are stressed.

Prerequisite: Graduate Standing

CRP 537 City and Regional Planning in Arid Zones (3-0-3)

Discussion of problems and planning aspects specific to arid zones. Different factors influencing the built environment in the arid regions including climate, water, vegetation, and soil. Emphasis on basic considerations of urban site's problems; economically related aspects of urbanized regions. Specific problems of construction and site selection; the design of specific urban physical cityscape and landscape in arid zones. Physical planning for sustainable resources.

Prerequisite: Graduate Standing

CRP 538 Environmental Planning and Management (3-0-3)

Major aspects of environmental analysis, planning and management. Problems and principles of site analysis, land use methods, and geologic hazard planning. Natural resource, pollution and residuals management. Economics of renewable and non-renewable resources, and the economic cost of environmental controls. Environmental impact assessment and local case studies of environmental management.

Prerequisite: Graduate Standing

CRP 590 Special Topics in City and Regional Planning (3-0-3)

Advanced topics are selected from the broad area of city and regional planning.

Prerequisite: Graduate Standing

CRP 599 Seminar (1-0-0)

A graduate student working towards his MCRP degree is required to take this course prior to the end of his degree program and contribute to the general area of his Final Planning Project research. Grades are Pass or Fail.

Prerequisite: Graduate Standing

CRP 601 Final Planning Project (1-12-6)

The student has to utilize his knowledge and skills developed during his graduate studies in dealing with a complete city and regional planning problem under the supervision of a CRP graduate faculty member. The student is expected to deal with the selected topic in his chosen area of focus. The Final Planning Project report will be presented and evaluated by a faculty committee representing the student's area of focus.

Prerequisites: All required courses; at least four elective courses.

CONSTRUCTION ENGINEERING & MANAGEMENT

Chairman

Abdulaziz Bubshait

Professors

Assaf

Jannadi

Bubshait

Shash

Associate Professors

Almohawis

Elazouni

Al-Khalil

Assistant Professors

Siddiqui

INTRODUCTION

The graduate program in Construction Engineering & Management (CEM) has been in existence at KFUPM since 1984. The objective of the program is to provide an in-depth coverage of all the established disciplines of construction engineering and management such as construction organization and contracts, project management and control, construction methods, cost engineering, etc. It is designed to prepare fresh graduates for professional careers and to enhance the knowledge and skills of those already practicing the discipline. In the program the theoretical aspects of the discipline are interwoven with the practical ones so as to provide the synergy necessary for the student to have the option of pursuing an academic and/or professional career in the construction industry.

The CEM Department has a student population of more than forty students the majority of whom are practicing engineers who work for various public and private organizations.

TEACHING AND RESEARCH FACILITIES

Student enrolled in the CEM program have access to all the teaching and research facilities in the University including laboratories, computers, educational aids, and the vast array of references available at the library or through the inter-library service. In addition, CEM students have direct access to the CED facilities which include the college library, the micro-computer lab which is equipped with state-of-the-art personal computers and good collection of software, the materials laboratory, and the audio-video aids necessary for lectures and special events.

Furthermore, the highly practical nature of the construction discipline provides an additional requirement which is satisfied through the CEM Department's interface with the engineering and construction firms that provide an indispensable source of information which invigorates the program.

DEPARTMENTAL ADMISSION REQUIREMENTS

The CEM Department offers a Master of Science (M.S.) degree and a Master of Engineering (M.E.) degree both in Construction Engineering & Management. Admission to the program requires fulfilling all KFUPM and Deanship of Graduate Studies requirements. In addition, the applicant should meet the following CEM requirements:

- Bachelor's degree in Engineering (preferably Civil, or Architectural Engineering) or Architecture equivalent to the KFUPM Bachelor's degree.
- Applicants from other institutions or other related fields may have to take extra courses to cover areas of deficiency without graduate credit.

M.S. AND M.ENGG. PROGRAMS IN CONSTRUCTION ENGINEERING & MANAGEMENT

There are two master's degree options in Construction Engineering & Management, the Master of Science (M.S.) and the Master of Engineering (M.Engg.).

The M.S. in CEM option requires the student to complete 30 credit hours; core courses of 12 credit hours, CEM elective courses of 9 credit hours, one KFUPM approved elective graduate course of 3 credit hours, and a 6 credit hours M.S. thesis. The M.Engg. in CEM option requires the student to complete 42 credit hours which include 24 credit hours of core courses, a 3 credit hours Master of Engineering report, 9 credit hours of CEM electives, 6 credit hours of KFUPM non-CEM graduate courses, and a research seminar. The Master of Engineering in Construction Engineering & Management program is not available to research or graduate assistants. The listing of the M.S. and M.Engg. requirements is shown in the following tables.

Course Requirements for the M.S. in CEM option

Course #	Title	LT	LB	CR
CEM 510	Project Planning and Scheduling	3	0	3
CEM 511	Construction Estimating	3	0	3
CEM 520	Construction Contracting and Administration	3	0	3
CEM 530	Construction Engineering	3	0	3
CEM 599	Seminar on Research Design in Construction Engineering and Management	1	0	0
CEM xxx	Approved Elective	3	0	3
CEM xxx	Approved Elective	3	0	3
CEM xxx	Approved Elective*	3	0	3
XXX xxx	Approved Elective**	3	0	3
CEM 610	Thesis	0	0	6
Total Credit Hours				**30**

* This elective is to be selected from graduate courses from outside the CEM Department according to the approved degree plan.

** This elective can be selected from graduate courses within or outside the CEM Department according to the approved degree plan.

Course Requirements for the M.ENGG. in CEM Option

Course #	Title	LT	LB	CR
CEM 510	Project Planning and Scheduling	3	0	3
CEM 511	Construction Estimating	3	0	3
CEM 520	Construction Contracting and Administration	3	0	3
CEM 530	Construction Engineering	3	0	3
CEM 540	Construction Project Management	3	0	3
CEM 599	Research Seminar	1	0	0
ACCT 501	Financial Accounting	3	0	3
MGT 501	Principles of Management	3	0	3
OM 502	Statistical Analysis for Business (1)	3	0	3
CEM xxx	Approved Elective	3	0	3
CEM xxx	Approved Elective	3	0	3
CEM xxx	Approved Elective	3	0	3
XXX xxx	Non-CEM Elective (2)	3	0	3
XXX xxx	Non-CEM Elective (2)	3	0	3
CEM 600	Master of Engineering Report	0	0	3
Total Credit Hours				**42**

(1) Students can take CRP 505 – Urban Statistics in lieu of OM 502.

(2) This elective is to be selected from graduate courses from outside the CEM Department according to the approved degree plan.

DEGREE PLAN

The CEM Department offers the M.S. and M.Engg. degrees on full-time and part-time bases. A typical full-time M.S. student should be able to finish in three semesters, while, a typical part-time student may finish the degree requirements in six semesters. For M.E. degree, a typical full-time student should be able to finish in four semesters while the part-time student may finish the degree requirements in seven semesters. A typical full-time and part-time degree plans for the M.S., and M.Engg. degrees plan are shown in the following table.

Degree Plan for the M.S. Program in Construction Engineering & Management
(FULL TIME STUDENTS)

Course #	Title	LT	LB	CR
First Semester				
CEM 510	Project Planning and Scheduling	3	0	3
CEM 511	Construction Estimating	3	0	3
CEM 520	Construction Contracting and Administration	3	0	3
CEM xxx	Approved Elective	3	0	3
		12	**0**	**12**
Second Semester				
CEM 530	Construction Engineering	3	0	3
CEM xxx	Approved Elective	3	0	3
CEM xxx	Approved Elective*	3	0	3
XXX xxx	Non-CEM Elective**	3	0	3
CEM 599	Research Seminar in CEM	1	0	0
		13	**0**	**12**
Summer Session and Following Semester				
CEM 610	Thesis	0	0	6
Total Credit Hours				**30**

* This elective is to be selected from graduate courses from outside the CEM Department according to the approved degree plan.

** This elective can be selected from graduate courses within or outside the CEM Department according to the approved degree plan.

Degree Plan for the M.Engg. Program in Construction Engineering & Management
(FULL TIME STUDENTS)

Course #		Title	LT	LB	CR
First Semester					
CEM	510	Project Planning and Scheduling	3	0	3
CEM	520	Construction Contracting and Administration	3	0	3
ACCT	501	Financial Accounting	3	0	3
MGT	501	Principles of Management	3	0	3
			12	**0**	**12**
Second Semester					
CEM	511	Construction Estimating	3	0	3
CEM	530	Construction Engineering	3	0	3
OM	502	Statistical Analysis for Business (1)	3	0	3
CEM	xxx	Approved Elective	3	0	3
			12	**0**	**12**
Third Semester					
CEM	599	Research Seminar	1	0	0
CEM	xxx	Approved Elective	3	0	3
CEM	xxx	Approved Elective	3	0	3
XXX	xxx	Approved Elective (2)	3	0	3
XXX	xxx	Approved Elective (2)	3	0	3
			13	**0**	**12**
Fourth Semester					
CEM	540	Construction Project Management	3	0	3
CEM	600	Master of Engineering Report	0	0	3
Total Credit Hours					**42**

(1) Students can take CRP 505 – Urban Statistics in lieu of OM 502.

(2) This elective is to be selected from graduate courses from outside the CEM Department according to the approved degree plan.

Degree Plan for the M.S. Program in Construction Engineering & Management
(PART TIME STUDENTS)

Course #	Title	LT	LB	CR
First Semester				
CEM 510	Project Planning and Scheduling	3	0	3
CEM 520	Construction Contracting and Administration	3	0	3
		6	**0**	**6**
Second Semester				
CEM 511	Construction Estimating	3	0	3
CEM xxx	Approved Elective	3	0	3
		6	**0**	**6**
Third Semester				
CEM 530	Construction Engineering	3	0	3
CEM xxx	Approved Elective	3	0	3
		6	**0**	**6**
Fourth Semester				
CEM xxx	Approved Elective*	3	0	3
XXX xxx	Non-CEM Elective**	3	0	3
CEM 599	Research Seminar	1	0	0
		7	**0**	**6**
Fifth Semester				
CEM 610	Thesis	0	0	**6**
Total Credit Hours				**30**

* This elective is to be selected from graduate courses from outside the CEM Department according to the approved degree plan.

** This elective can be selected from graduate courses within or outside the CEM Department according to the approved degree plan.

Degree Plan for the M.Engg. Program in Construction Engineering & Management
(PART TIME STUDENTS)

Course #		Title	LT	LB	CR
First Semester					
CEM	510	Project Planning and Scheduling	3	0	3
CEM	520	Construction Contracting and Administration	3	0	3
			6	**0**	**6**
Second Semester					
CEM	511	Construction Estimating	3	0	3
ACCT	501	Financial Accounting	3	0	3
			6	**0**	**6**
Third Semester					
CEM	530	Construction Engineering	3	0	3
MGT	501	Principle of Management	3	0	3
			6	**0**	**6**
Fourth Semester					
CEM	xxx	Approved Elective	3	0	3
OM	502	Statistical Analysis for Business (1)	3	0	3
			6	**0**	**6**
Fifth Semester					
xxx	xxx	Approved Elective (2)	3	0	3
CEM	xxx	Approved Elective	3	0	3
			6	**0**	**6**
Sixth Semester					
CEM	599	Research Seminar	1	0	0
xxx	xxx	Approved Elective (2)	3	0	3
CEM	540	Const. Project Management	3	0	3
			7	**0**	**6**
Seventh Semester					
CEM	xxx	Approved Elective	3	0	3
CEM	600	Master of Engineering Report	0	0	3
Total Credit Hours					**42**

(1) Students can take CRP 505 – Urban Statistics in lieu of OM 502.

(2) This elective is to be selected from graduate courses from outside the CEM Department according to the approved degree plan.

COURSE DESCRIPTION

CEM 510 Project Planning and Scheduling (3-0-3)

Planning, scheduling, and control of construction projects using Critical Path Method (CPM) and Project Evaluation and Review Technique (PERT); Resource leveling; scheduling with limited resources; time-cost tradeoffs, introduction to complex networks, short interval production scheduling, and related computer applications.

Prerequisite: Graduate Standing

CEM 511 Construction Estimating (3-0-3)

Introduction to cost aspects of construction, Quantity take-off methods, labor and equipment production rates, Unit Costs, Overhead, and Profits as they relate to the preparation of construction estimates. Creation and coordination of cost control systems with regard to engineering, estimating constructing, purchasing and subcontracting procedures for construction projects, conceptual, Estimating value Engineering.

Prerequisite: Graduate Standing

CEM 512 Value Engineering (3-0-3)

Value engineering concepts, function analysis system techniques (FAST), diagramming, creativity, matrix evaluation, design-to-cost, life cycle costing, human relations and strategies for organizing, performing and implementing value engineering.

Prerequisite: CEM 511

CEM 513 Construction Productivity (3-0-3)

Components of the construction productivity system; measurements of productivity: Work sampling, Craftsman's Questionnaire, Foreman Delay Survey, and related techniques. Construction methods improvement: Crew Balance Chart, Flow Diagram and Process Chart, Quality Circles; safety; workers' motivation and productivity improvement programs. Application of above techniques on real construction projects and computer applications.

Prerequisite: Graduate Standing

CEM 514 Modeling Construction Operations (3-0-3)

Model development for construction operations at project site level and at the contractor organization level. Probabilistic models, probability functions, Monte Carlo simulation, queuing simulation, cyclic operation network (CYCLONE), continuous simulation, modeling construction firms through system dynamic approach.

Prerequisite: Graduate Standing

CEM 515 Project Quality Assurance **(3-0-3)**

The Objectives of this course is to expose students to Quality knowledge and overall strategic plans, customers satisfaction and focus, tools for Quality Project Management, Statistical process control, tools for continues improvement, recent developments in Quality in Constructed projects, ISO standard, survey of computer application software related to quality management.

Prerequisite: Graduate Standing

CEM 516 Project Risk Management **(3-0-3)**

Putting Risk in perspective, risk and uncertainty, risk management system, decision theory, game theory, utility and risk attitude, multi criteria decision models, simulation, risks and the construction projects - money, time and technical risks, contracts and risks, computer application

Prerequisite: OM 502 or equivalent, CEM 510, CEM 520

CEM 517 Project Safety Management **(3-0-3)**

Introduction to safety management, theories of accident causation, accident investigation, cost of accident, measurement of safety performance, contract provisions that address safety, the role of the different levels of management in safety, the psychological aspects of safety, and computer systems for safety management.

Prerequisite: Graduate Standing

CEM 518 Project Cost Management **(3-0-3)**

The course includes the application of scientific principles and techniques to the problems of cost planning and cost control. The course covers a variety of issues in cost management including evaluating investment alternatives, life cycle costing, cost analysis methods, cost control and computer applications.

Prerequisite: CEM 511

CEM 520 Construction Contracting and Administration **(3-0-3)**

Basic characteristics of the construction industry; interrelationship of the design and construction processes, construction contract documents, bidding and awarding procedures, construction claims and disputes, national labor and procurement regulations, leadership and computer applications.

Prerequisite: Graduate Standing

CEM 522 Globalization and Construction Industry (3-0-3)

The course will expose the students to the differences in Construction systems, technology, management and culture among the advanced industrial countries, newly industrialized countries and local construction industry. Globalization movement and its affect on construction industry and local design and construction firms. Special aspects of international projects including investigation, planning, procurement, logistics, personnel and financing.

Prerequisite: CEM 520

CEM 525 Project Delivery System (3-0-3)

The historical evolution of project delivery, the role of procurement and contracting methods in project success, strengths and weaknesses of contemporary delivery system. Emphasis will be placed on new trends in the Project Delivery Systems such as Construction Management (CM), Design Build (DB), Build Operate And Transfer(BOT), Build Own, Operate and Transfer (BOOT), etc.: when to use, process variation, procurement, contracts and contract language, performance specification, roles of parties, organization and management, conceptual estimating, Lean construction; computer applications.

Prerequisite: CEM 520

CEM 527 Construction Claim and Dispute Resolution (3 - 0 - 3)

Construction Claims, causes and types of construction claims, construction dispute resolution techniques, problem of traditional dispute resolution techniques, alternatives dispute, resolution techniques, alternatives dispute resolution techniques- Arbitration, mediation, conciliation, dispute, review boards, mini trials, professional ethics, computer applications

Prerequisite: CEM 520

CEM 530 Construction Engineering (3-0-3)

Construction Engineering fundamentals, equipment economics, selection and efficient application of equipment, design and simulation of construction operations, analyzing production outputs and cost.

Prerequisite: Graduate Standing

CEM 531 Heavy Industrial Construction (3-0-3)

Design interdependencies, procurement, construction and start-up of heavy industrial facilities, power plants, chemical plants, oil refineries. Design interfaces, specifications, drawings preparation. Procurement contracts, fabrications, quality control. Construction; Site, structural, piping and vessels, electrical, instrumentation. Job planning and organization. Facility start-up, case studies.

Prerequisite: CEM 530

CEM 532 Design & Construction of Temporary Support Structures (3-0-3)

Planning and field engineering for temporary support structures. Design and construction of concrete framework, cofferdams, scaffolding, dewatering systems, and other temporary structures required by construction operations.

Prerequisite: Graduate Standing

CEM 533 Introduction to Construction of Harbor, Coastal, and Ocean Structures (3-0-3)

Construction methods and equipment for construction of cofferdams, caissons, wharves, marine terminals, outfall sewers, power plant intakes and discharge, submarine oil and gas pipelines, dredging, offshore platforms, ocean structures, sub-sea and deep ocean facilities, case studies.

Prerequisite: CEM 530

CEM 540 Project Management (3-0-3)

A comprehensive and integrative approach to managing construction projects throughout their life cycles. Policies and procedures for the development of the project manual: Feasibility studies, contract documents, procurement, controls, and turnover.

Prerequisites: CEM 510, CEM 511, CEM 520

CEM 542 Technological and Innovation in Construction Project Management (3-0-3)

Technology concepts; terminology and classifications. Construction advanced technologies. Emerging technologies and construction applications. Technology management in construction: R&D; technological innovation; technology deploy

ment; support techniques. Construction technology in Saudi Arabia: innovative behavior; strategy; policy; support systems; university/industry interaction. Research projects for industry applications.

Prerequisites: Graduate Standing

CEM 549 Computer Applications in Construction and Maintenance Management (3-0-3)

Design of computerized Management Information System in the construction industry. Computer application in estimating, planning and scheduling, financial and cost analysis, project control. Maintenance management of bridges, pavements, residential housing, equipment, and automobile parking. Selection of software. Future directions in computerized construction and maintenance research. A term paper which covers the Design and Development of an MIS in Construction and Maintenance Management.

Prerequisite: CEM 510, CEM 511

CEM 590 Special Topics in Construction Engineering and Management (3-0-3)

Advanced topics selected from the major areas of Construction Engineering and Management to provide the student with recent developments.

Prerequisite: Graduate Standing

CEM 599 Research Seminar in CEM (1-0-0)

Introduction to the principles of scientific research: The research question, hypotheses, constructs and their operationalization, research design, internal and external validities of research findings, measurements and their reliability, data collection techniques, basic elements of the research proposal. Grades are pass or fail.

Prerequisite: Graduate Standing

CEM 600 Master of Engineering Report (0-0-3)

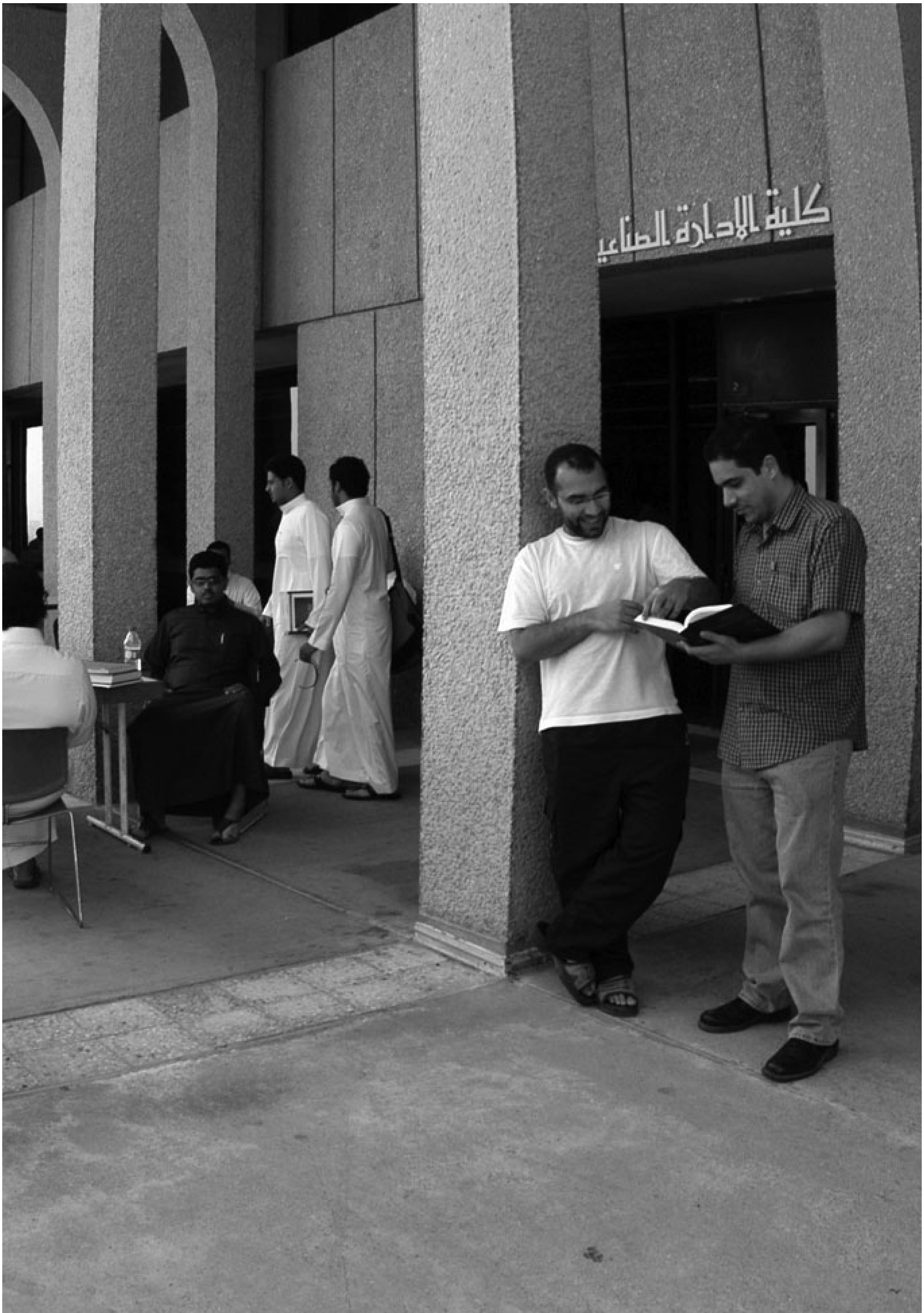
A report on an independent study performed under the supervision of a CEM faculty advisor. This paper should include an introduction to the topic, literature review, research methodology, analysis of data, conclusions and recommendations, appendices and references. The report will be presented and orally examined by a faculty committee.

Co-requisites: CEM 599

CEM 610 Thesis (0-0-6)

The student has to undertake and complete a research topic under the supervision of a graduate faculty member in order to probe in-depth a specific problem in Construction Engineering and Management.

Co requisite: CEM 599


كلية الإدارة

College of INDUSTRIAL MANAGEMENT

GRADAUTE PROGRAMS

Dean
Eid Al-Shammari

Assistant Dean for Graduate Programs
Aymen Kayal

Professors

Achoui, M	Alsahlawi, M	Sadi, M
Al-Buraey, M	Masih, A	Youssef, M
Al-Meer, A		

Visiting Professors

Kazmi, A
Oukil, M

Associate Professors

A. Muhmin, A	Al-Kahtani, A	Hasan, M	Ramady, M
Al-Faraj, T	Al-Zayer, J	Kayal, A	Sohail, M
Al-Ghamdi, S	Calcich, S	Mat-zin, R	Talha, M
Al-Jabri, I	El-Omari, H	Nehari-Talet	Uthman, U

Assistant Professors

Abdel Halim, A	Al-Hajji, M	Alzahrani, M	Jameel, Q	Smaoui, H
Abu-Musa	Al-Harbi, A	Eid, A	Madani, H	Ulussever, T
Aghdam, R	Al-Hazmi, M	Eid, M	Maghrabi, A	Umar, Y
Ahmed, M	Al-Khaldi, M	Elamin, A	Mansour, M	Yamani, Z
Al-Ahmadi, M	Al-Qura'n, M	El-Tayeb, E	Mohammed, M	Yeo, R
Albinali, K	Al-Shammari, E	Falattah, Y	Musa, M	
Al-Elg, A	Al-Shareef, O	Fathollahzadeh, A	Opoku, R	
Algahtani, I	Al-Shebil, S	Ghalleb, N	Qazi, M	
Al-Ghamdi, M	Al-Shuridah, O	Hamdan, B	Sallawi, I	

Lecturers

Ahmad, M	Al-Mulhem, A	Hamdan, S	Murteza, D
Al-Abandi, H	Al-Wahaishi, S	Islam, M	Qahwash, E
Al-Ghamdi, M	Al-Zamel, K	Khan, I (Instructor)	Raza, S

COLLEGE OF INDUSTRIAL MANAGEMENT

Established in 1975, the College of Industrial Management (CIM) offers undergraduate degree programs in Accounting, Finance, Management, Management Information Systems, and Marketing. In addition, the college offers three graduate degrees: Executive Master of Business Administration (EMBA), Master of Business Administration (MBA) and Master of Accountancy. Coordinated by the college Dean, CIM programs are administered by three academic departments: Accounting & MIS, Finance & Economics, and Marketing & Management. All programs are periodically reviewed and bench-marked against leading business programs in the United States and revised to remain topical and current with evolving business trends. An outstanding faculty committed in its efforts toward continuous improvement, through the adoption of new technologies, emphasis on global perspectives and attention to ethical issues, places the CIM business curricula at par with the leading business programs around the world. All aspects of the program are designed to conform to the AACSB standards.

The visions and mission serve as a pivotal focus for the college and provide direction in its pursuit of excellence in teaching, research, and service.

Vision

To be among the best in the world as a center for excellence in management education, research, and community service that actively addresses the needs of stakeholders.

Mission

To be a prominent provider of management education through high quality teaching reinforced by experiential learning for students who will play significant and productive roles in the development of the Saudi economy within the global business environment.

To actively contribute to Saudi business, industry, and community through relevant high quality research, professional services, and dissemination of knowledge responsive to the evolving needs of stakeholders.

Guiding Values

In the pursuit of its mission, the college is guided by the following values.

- Leadership
- Relevance
- Ethics
- Community Involvement
- Professional Growth

CIM will continue to lead the way for business education in the Kingdom, ensure that the curriculum remains relevant and current to the needs of stakeholders, incorporate ethics based on the tenets of Islam, forge links with the business community, and foster intellectual development of its faculty.

CIM Educational Objectives

Learning objectives at CIM are directed toward developing knowledge, competencies, and attributes in areas considered critical for success in today's highly competitive global economy. Specifically these include:

- ability to communicate effectively both orally and in writing;
- ability to apply interpersonal skills effectively as a member or a leader of a team in performing group tasks in business and professional organizations;
- ability to apply logic and exercise sound judgment in making decisions;
- ability to effectively use quantitative and analytically skills in solving business problems;
- ability to incorporate ethical and social dimensions into making business and professional decisions;
- ability to use information technology as a business enabler and to assess the impact of technology on business strategy and operations;
- ability to take initiative, show confidence, and exercise leadership in business and professional organizations.

EXECUTIVE MBA PROGRAM

The Executive MBA (EMBA) program is targeted at executives, senior managers and other seasoned professional and civic leaders in specific functional or technical areas. These leaders have exhibited much success in their chosen field by being visionary and leading their organizations into the future. The objective of the EMBA is to provide these leaders with an advanced management education. Our goal is to empower these leaders to take their companies into the future – locally, nationally, and globally. The participants in our EMBA learn to be forward-thinking individuals with exposure to business processes worldwide.

The curriculum of the Executive MBA is designed to be relevant, global, interactive, and engaging. The curriculum offers an integrative and coordinated perspective on cutting-edge management issues. It is aimed at strengthening participants' leadership and strategic thinking skills.

The Executive MBA program is a 42 credit hours curriculum that provides a complete framework for strategic management of an organization. Structured around a small-class format, this program facilitates the transfer of knowledge and skills needed to achieve the necessary attributes for success in an ever-evolving business environment. To accommodate the busy schedule of its participants, the Executive MBA has been structured as a two-year (four semesters) program. During each semester, the participants meet every two weeks on Wednesdays and Thursdays. Classes are held at the KFUPM campus facilities designed for executive training.

Mission

To provide a high-quality graduate management education to executives of private and public sectors in the region. The Executive MBA enhances the ability to strategically think, plan and act in an increasingly competitive and complex business environment.

Objective

The overall objective of the KFUPM-EMBA is to enhance the managerial skills necessary for experienced managers and executives who wish to improve their effectiveness. Specifically, the program is designed to:

1. Emphasize leadership and innovation
2. Develop strategic perspectives
3. Focus on the management of change
4. Provide a global perspective
5. Improve critical thinking and teamwork skills

Educational Objectives

The overall educational objectives of the Executive MBA program is to enhance the managerial skills necessary for experienced Managers and Executives who wish to improve their effectiveness. The program is designed to meet the following specific educational objectives:

- Enhance the leadership and innovation abilities of the participants
- Develop the strategic perspectives of the participants
- Focus on the management of change
- Provide a global perspective
- Improve the critical thinking and teamwork skills of the participants

Faculty

The Executive MBA participants benefit from a pool of outstanding faculty members who are dedicated scholars. Effective teaching, research, and consulting are the hallmarks of our faculty profiles. The faculty guide and coach EMBA participants in real-life business problems that require real-life solutions.

Teaching Methodology

KFUPM offers a dynamic learning environment. We use teaching methodology that emphasizes the importance of functional interaction and interrelatedness. We deliver a balanced mix of theory and practice through appropriately sequenced individual courses of instruction.

Participants in EMBA learn not just from the expertise of the faculty, but also from the experience of each other. Our EMBA offers a learning environment that is: dynamic, interactive, participative, and application–oriented. Our teaching methodology includes the use of:

- Study Groups
- Simulations and Business Games

- Presentations
- Role Playing
- Discussions
- Case Analysis
- Action Plans
- Lectures by prominent scholars and executives on current subjects and issues

Participant Profile

- The participants in the EMBA program are executives and seasoned professionals. To be successful, the participants should be:
- Highly motivated and dedicated to learning and enhancing their careers
- Highly ambitious and interested in advancing their professional lives
- Highly inspired, inquisitive, and believe in making important contributions

The key to success in our EMBA is commitment. The KFUPM Executive MBA is a demanding endeavor and participants should be committed to the program and its requirements. The participants are expected to devote substantial out-of-class time for preparation of assignments and study group meetings. All EMBA instructional sessions are held in "smart classes". To fully benefit from the facility, the participants are required to have their lap top portable personal computers.

Admission Requirements

Successful candidates should possess the following:

- A baccalaureate degree from a recognized institution of higher education with a minimum GPA of 2.5 out of 4.0
- A minimum TOEFL score of 520 or other evidence of English proficiency
- A minimum of 8 years work experience including 3 years at mid or upper level managerial positions

Application Procedures & Personal Interview

All candidates must submit an admission application to the EMBA Committee. All admission applications must be supported by:

- Three letters of recommendations
- A current resume
- A letter of endorsement from the applicant's employer (if applicable) which should clearly demonstrate the employer understanding of the demands of the program and his willingness to support the applicant's admission to the EMBA

All applications will be evaluated and potential candidates will be invited for a personal interview. The interview is aimed at evaluating the candidate's personal attributes deemed necessary for success in the EMBA. These attributes include, among others, ambition, motivation, commitment, communication and interpersonal skills.

Program Structure

The EMBA program consists of the following parts:

1. The residency period

The residency period starts at the beginning of the program. The duration of this residency period is one week (Saturday-Thursday). Activities during this period include: orientation to the program, an overview of certain business related disciplines (e.g., Management, Information Technology, Economics, Accounting, Marketing, Finance, Statistics, and Research Methodology), and seminars in topical issues (e.g., Communication Skills, Time Management, Stress Management, Negotiation Skills, and Creative Thinking).

2. The curriculum

The program is designed to include sixteen courses of instruction from all business related areas. The first year of the program provides an in-depth examination of the tools and functions of organizations. Emphasis will be placed on the interrelationships among these areas and will provide a strong foundation for deeper analysis in the second year of the program. The second year expands participants' ability to deal with complex management challenges by focusing on the larger contextual environment of business.

Duration and Timing

A 42 credit hours, two-year EMBA is divided into four semesters. Classes will be held bi-weekly on Wednesday and Thursday, every other week. Classes start at 8:00 a.m. and finish at 3:30 p.m. (Wednesday classes during the first year end at 4:45 p.m.) The residency days are from 8:00 a.m. to 4:00 p.m.

Degree Requirements

All candidates for the Executive MBA degree must meet the following graduation requirements:

1. Satisfactory completion of all required course work for the degree including the residential period
2. Maintaining a minimum cumulative GPA of 3.0 on the scale of 4.0
3. Maintaining high standards of professional, ethical, and personal conduct as per university policy

Tuition Fee

The Executive MBA tuition is SR 130,000 for the entire program and includes all course materials, textbooks, university fees, continental breakfast and lunch during the residential period and class days. Tuition is payable in four equal installments of SR 32,500 prior to the start of each of the four semesters.

EMBA CURRICULUM STRUCTURE

YEAR ONE

Residency Period

First Semester

Course #	Course Title	Credit	Classes Meeting Time	
		Hours	Wednesday	Thursday
ECON 551	Managerial Economics	3	8:00-11:45 a.m.	
OM 551	Quantitative Methods	3	13:00–16:45 p.m.	
MIS 551	Information Technology for Managers	3		8:00-11:45 a.m.
ACCT 551	Financial Accounting and Reporting	2		13:00-15:30 p.m.

Second Semester

Course #	Course Title	Credit	Classes Meeting Time	
		Hours	Wednesday	Thursday
ACCT 552	Managerial Accounting	3	8:00-11:45 a.m.	
OM 552	Operations Management	3	13:00-16:45 p.m.	
MGT 552	Organizational Behavior and Leadership	3		8:00-11:45 a.m.
FIN 552	Financial Management	2		13:00-15:30 p.m.

YEAR TWO

First Semester

Course #	Course Title	Credit Hours	Classes Meeting Time Wednesday	Thursday
MKT 561	Strategic Marketing Management	3	8:00-11:45 a.m.	
ECON 561	The Macro Environment of Business	2	13:00–15:30 p.m.	
MGT 561	International Business and Globalization	3		8:00-11:45 a.m.
FIN 561	Investment Analysis and Portfolio Management	2		13:00–15:30 p.m.

Second Semester

Course #	Course Title	Credit Hours	Classes Meeting Time Wednesday	Thursday
FIN 562	Strategic Corporate Finance	3	8:00-11:45 a.m.	
MIS 562	Electronic Business Strategy	2	13:00-15:30 p.m.	
MGT 562	Strategic Management	3		8:00-11:45 a.m.
OM 562	Supply Chain Management	2		13:00–15:30 p.m.

COURSE DESCRIPTION

ACCT 551 Financial Accounting and Reporting (2-0-2)

An introduction to the perspectives, principles, concepts, and assumptions underlying the process of financial reporting. Critical analysis of the role of regulation in the measurement and reporting of the results of economic activities to enable a more effective and efficient use of financial information for decision-making purposes. This course will also explain the "management assertions" embodied in the financial statements and its relationship with an independent audit of financial information.

ACCT 552 Managerial Accounting (3-0-3)

An introduction to the relevant fundamental concepts and principles underlying the production and reporting of financial information to plan and control the activities of an organization. The discussion of strategic cost concepts; methodology of short and long-term decision analysis; planning and control of organizational activities, transfer pricing methods, performance evaluation and their related behavioral implications; and critical analysis of long term decisions are among the topics covered in this course.

ECON 551 Managerial Economics (3-0-3)

Deals with the strategic application of microeconomic theory to management in markets where the firm has market/monopoly power. Covers sophisticated pricing policies, transfer pricing, dealing with competitors, corporation strategies, managing under uncertainty, asymmetric information and externalities. Examines how microeconomics may be used to enhance decision-making within the manager's organization.

ECON 561 The Macro Environment of Business (2-0-2)

Prepares to think systematically about the state of the economy, macroeconomic policy, and the economic environment. Includes the use of economic theory in understanding financial markets, the operation and impact of government policies that determine national income, employment, investment, interest rates, and money supply inflation.

FIN 552 Financial Management (2-0-2)

Develops skills and abilities in financial analysis and provides a framework for analyzing financial decisions to acquire assets as well as their financing. Central to the decision making process is the notion that corporations are intended to create value. Topics include discounted cash flow analysis, financial performance evaluation, valuation techniques, capital budgeting, risk-return concepts, evaluation of financing options, and dividend policy.

FIN 561 Investment Analysis and Portfolio Management (2-0-2)

Combines theoretical and practical aspects of investment analysis and portfolio management. It covers the portfolio management process from the institutional and individual perspectives. Examines setting of investment objectives, formulation of portfolio management strategies, asset allocation, security selection, pricing and trading of options and futures, use of derivatives to alter portfolio risk-return profile, and evaluation of portfolio performance. This is a hands-on course in which students manage simulated security portfolios and use the Internet sources of financial information extensively.

FIN 562 Strategic Corporate Finance (3-0-3)

Integrative course that builds on materials covered earlier and addresses strategic corporate finance issues and decisions with emphasis on global perspectives. The course highlights analysis and the interaction of investment, financing, and dividend decisions as they affect firm value and develops student valuation skills. Other areas include mergers and acquisitions, lease analysis, options and futures, managing foreign exchange risk, and financial analysis and planning. It blends theory with practice through extensive use of case studies. The cases require student teams to draw on their personal experiences and integrate functional knowledge and diverse perspectives to address variety of issues raise.

MGT 552 Organizational Behavior and Leadership (3-0-3)

Addresses the problem of managing and leading people in organizations. Issues include the bases of individual and group behaviors, contextual factors, organizational attitudes, motivation, communication, decision-making, influence processes, and the role of leadership in organizational success.

MGT 561 International Business and Globalization (3-0-3)

Addresses economic, political, legal, cultural, and managerial challenges and opportunities facing the firm in the international and global arenas.

MGT 562 Strategic Management (3-0-3)

The focus of this course is the strategic management process which involves the overall mission and objectives of the organization, internal analysis to determine strengths and weaknesses, external analysis to determine opportunities and threats, formulating corporate, business, and functional strategies, implementation of chosen strategies and courses of action, and evaluation and control of strategies to take corrective actions. Global strategies and environments will be covered as well. Emphasis will be placed on the building blocks of competitive advantage (efficiency, quality, innovation, and customer responsiveness) that underlie most strategies. Students will learn relevant concepts and techniques and will develop skills in strategic analysis and strategy formulation through variety of methods including business cases and simulation. Students will also learn to function as an effective member of a strategic team by working with others to analyze cases and solve business problems.

MKT 561 Strategic Marketing Management (3-0-3)

Addresses the importance of organizations being market-driven and customer focused and presents current theories and practices of marketing management. The course examines the topics of new product development, marketing resource allocation and competitive strategy. Deals with the formulation of strategic marketing as a key element of overall organization plans and policies. Focuses on balancing market opportunities and threats with resources available and alternative responses, including analysis of markets, product, promotion, distribution and pricing strategies.

MIS 551 Information Technology for Managers (3-0-3)

Presents a managerial perspective on the effective design and use of information systems for strategic advantage and maximum organizational performance. It links technology, the organizational implications of the technology, and ways to successfully incorporate information technology into organizations.

MIS 562 Electronic Business Strategy (2-0-2)

Focuses on the development of e-business strategies and management of related technology. The course examines the linkage of organizational strategy and electronic methods of delivering products, services and exchanges in inter-organizational, national and global environments.

OM 551 Quantitative Methods (3-0-3)

Basic quantitative techniques used in the analysis of business decision problems are introduced. Techniques covered include descriptive and inferential statistics, linear programming, decision trees, queuing theory and simulations.

OM 552 Operations Management (3-0-3)

Emphasizes quality management in the planning and control of an operating system. Includes matching operating decisions to the firm’s strategy; design of operations control systems; unique operations considerations in the services; the design, selection and improvement of processes; capacity planning; productivity competitiveness; quality management and assurance; forecasting, plant layout; project management; management of inventories; and flexible manufacturing system.

OM 562 Supply Chain Management (2-0-2)

Provides managerial concepts in supply chain management. The major issues and strategies in supply chain will be identified for better understanding of performance. The major content of the course is divided into three modules: supply chain integration, supply chain decisions, and supply chain management and control. A variety of instructional tools including lectures, case discussions, and group projects and presentations are employed.

MASTER OF ACCOUNTANCY PROGRAM

Program Objectives

The Master of Accountancy Program (M. Acct.) is designed to provide students with accounting education for careers in the accounting profession, with emphasis on both the theoretical and practical aspects of the discipline. This program will provide effective support for the accounting profession and businesses at the national, regional, and international levels.

The focus of the program is to ensure that graduates gain the accounting knowledge necessary to meet the educational standards of the accounting profession. This program prepares students to cope with the rapid changes in the theory and practice of the accounting profession which is a requisite to a successful career as a professional accountant and as an executive in industry, commerce, non-profit organizations, and the government sector.

Academic Requirements of the Program

The following are the program's academic requirements:

A. Academic Background Requirements

Each student is required to have successfully completed eleven (11) courses in Accounting (33 credit hours) in the Undergraduate Accounting Program or their equivalent. These courses include Principles of Accounting I, Principles of Accounting II, Accounting Information Systems, Intermediate Accounting I, Intermediate Accounting II, Cost Accounting, Managerial Accounting, Advanced Accounting, Auditing, Accounting for Governmental and Non-Profit Entities, and Accounting Theory and Research. Any deficiency must be met before admission to candidacy for the Master of Accountancy Degree.

B. Program Requirements

The program requirements are presented in the following four (4) sections:

Section I – Accounting Core (18 credit hours)

The following eighteen (18) credit hours are required in each student's

Graduate Program for a Master of Accountancy Degree:

ACCT	512	Cost Management Systems	3
ACCT	515	Computerized Accounting Information Systems	3
ACCT	516	Seminar in Accounting Theory	3
ACCT	517	Seminar in Professional Accounting and Auditing	3
ACCT	518	Accounting Policy and Practice Workshop	3
ACCT	528	Independent research in Accounting	3

Section II – Business Core (9 credit hours)

Each student must take three (3) of the following courses:

FIN	510	Managerial Finance	3
MGT	520	Organizational Theory & Design	3
MGT	590	Business Policy	3
MIS	510	Information Resources Management	3
OM	510	Quantitative Business Analysis	3

Section III – Electives (6 credit hours)

A student can choose six (6) credit hours from the following courses:

ACCT	504	Advanced International Accounting	3
ACCT	514	Advanced Accounting for Governmental & Non-Profits Entities	3
ACCT	519	Professional Accounting Ethics and Legal Responsibility	3
ACCT	520	Internal and EDP Accounting	3
ACCT	523	Advanced Accounting Systems Analysis Design	3

ACCT	524	Research Methodology in Accounting	3
ACCT	526	Foundations of Internal Auditing	3
ACCT	527	Operational Auditing	3
FIN	520	Financial Policies	3
FIN	521	International Finance	3
MGT	521	International Business	3

Section IV

ACCT	600	Written Comprehensive Examination	(0-0-0) (P/F)

Each student who successfully completes all required class work must take a written comprehensive examination in Accounting. This exam is administered by the Department of Accounting and Management Information Systems. If a student fails to pass the exam, he will be given another chance to retake it one semester later. Failure to pass this exam for the second time will lead to discontinuation of the student from the program.

Degree Plan for the Master of Accountancy Program

COURSE #	TITLE	LT	LB	CR
FIRST SEMESTER				
ACCT 512	Cost Management Systems	3	0	3
ACCT 515	Computerized Accounting Information Systems	2	2	3
XXX xxx	Business Core Course	3	0	3
		8	**2**	**9**
SECOND SEMESTER				
ACCT 516	Seminar in Accounting Theory	3	0	3
ACCT 517	Seminar in Professional Accounting and Auditing	3	0	3
XXX xxx	Business Core Course	3	0	3
		9	**0**	**9**
THIRD SEMESTER				
ACCT 518	Accounting Policy and Practice Workshop	3	0	3
ACCT 528	Independent Research in Accounting	3	0	3
XXX xxx	Business Core Course	3	0	3
XXX xxx	Elective	3	0	3
		12	**0**	**12**
FOURTH SEMESTER				
XXX xxx	Elective	3	0	3
ACCT 600	Written Comprehensive Exam	0	0	0
		3	**0**	**3**
Total Credit Hours				**33**

GRADUATION REQUIREMENTS

A. The maximum residency for completion of the master of Accountancy Program is three years.

B. Completion of 33 credit hours of approved graduate courses.

C. Each student must pass a written comprehensive exam in accounting upon completion of the required course work.

D. Compliance with all graduation requirements of the Deanship of Graduate Studies.

FEATURES OF THE PROGRAM

1. The program has an international dimension to implement AACSB Standards (American Assembly of Collegiate Schools of Business). For any organization working in an international environment, global emphasis of the accounting curriculum is needed. This program offers three courses of an international dimension. Advanced International Accounting (ACCT 504), International Finance (FIN 521), and International Business (MGT 521).

2. The program is flexible and adaptive to the Saudi environment. The course entitled “Research Methodology in Accounting” (ACCT 524), which is offered, emphasizes the application of research techniques on local accounting issues and cases. Moreover, other courses of the program are geared toward applying accounting concepts and procedures in the Saudi environment.

3. The program copes with the development of new technologies. The Cost Management Systems course (AACT 512) deals with cost accounting and cost management in high technology companies and with Just-in-Time production systems. In addition, the accounting practice workshop course (ACCT 518) covers topics such as measuring quality costs, product costing, flexible manufacturing systems, capital budgeting under automation, and performance measurement in high technology companies.

4. The program’s objectives focus on building the student’s research skills in accounting. Two courses are designed to achieve this objective: “Research Methodology in Accounting” (ACCT 524) and “Independent Research in Accounting” (ACCT 528). Additionally, the other required courses of the program will enhance the research skills of the students.

5. The program is concerned with goals of accounting ethics education (a new area) for the development of professionalism and enhancing the student’s ability to deal with ethical issues in accounting, and maintain public trust and confidence in the accounting profession. The course entitled “Professional Accounting Ethics and Legal Responsibility” (ACCT 519) covers this area.

6. The program focuses on achieving goal congruence between student’s desires and program offerings. This is achieved by providing the students with practical accounting skills to work as accountants, controllers, budget directors, and auditors, and by providing students with excellent conceptual and analytical training in accounting.

7. One main objective of this program is the integration of computers into the accounting curriculum. This program will train students to use computers in accounting effectively. Three courses are offered to achieve this objective:

Computerized Accounting Information Systems (ACCT 515), Internal and EDP Auditing (ACCT 520), and Information Resources Management (MIS 510). Other accounting courses in the program also emphasize computer applications.

8. The program deals with changes in the practice of accounting in service organizations. Since the importance of the service sector is rising in the economy, the courses of the program are designed to provide students with the accounting skills needed for service organizations.

COURSE DESCRIPTION

ACCT 504 Advanced International Accounting (3-0-3)

This course focuses on the following issues: Similarities and differences in principles and procedures relating to the functional accounting areas of financial, cost, managerial, and auditing among different regions and countries of the world, consolidation of foreign subsidiaries, performance evaluation of foreign operations, analysis of foreign exchange transactions of financial statements of foreign operations, inflationary accounting in an international setting, Accounting and Taxation for multinational corporations, Ethics and Reporting Standards of the auditor in an international setting, and globalization of accounting standards and principles.

Prerequisites: ACCT 302, ACCT 304, ACCT 403 or equivalent at the Undergraduate level

ACCT 512 Cost Management Systems (3-0-3)

This course involves review and evaluation of recent developments in the area of Management Accounting. Emphasis on the following issues: Conceptual framework for cost systems design, new approaches and design principles for modern cost management systems. Functions of cost management systems, problems in cost allocations, assigning the expenses of capacity resources to production departments and products, design of operational control and performance measurement systems with emphasis on non-financial measures of quality performance, design principles for activity-based cost systems used for strategic profitability measurement, activity-based cost systems in manufacturing and service organizations. Cost accounting and cost management in high technology companies and in a just-in-time environment.

Prerequisites: ACCT 401, ACCT 402

ACCT 514 Advanced Accounting for Governmental & Non-Profit Entities (3-0-3)

This course focuses on fund theory, governmental accounting standards, budgeting and program evaluation. It also includes, advanced study in efficiency and effectiveness measures as prescribed by auditing standards and techniques in governmental organizations. It includes also, comprehensive accounting control techniques for non-profit entities.

Prerequisite: ACCT 305 or equivalent

ACCT 515 Computerized Accounting Information Systems (2-2-3)

An in-depth study of general ledger (G/L) software packages with emphasis on interfaces with related subsidiary ledgers; evaluation of built-in control features and audit trail of G/L software packages; in-depth study of software packages for planning and control. Special emphasis in internal control systems of computerized accounting systems.

Prerequisite: ACCT 300 or equivalent

ACCT 516 Seminar in Accounting Theory (3-0-3)

This course focuses on contemporary issues of accounting theory and practice as reflected in the accounting literature and professional accounting pronouncements. Also, it investigates thoroughly alternative models of income determination and balance sheet valuation and measurement. The course will be conducted through discussion of issues, presentations of research papers, research forum, and guest lecturers.

Prerequisites: ACCT 403, ACCT 405 or equivalent

ACCT 517 Seminar in Professional Accounting and Auditing (3-0-3)

This course is concerned with the theory and philosophy of auditing, and professional practice. Study of advanced topics in the discipline of auditing such as the development of auditing theory, generally accepted auditing standards, professional responsibility and legal ability of the auditor, cases in audit decision making, EDP auditing, internal control, and analysis of emerging issues and contemporary problems in auditing. Consideration is given to non-audit services provided by the auditor and their impact of the quality of the audit service. The course will be conducted through discussion of issues, presentations of research papers, research forum, and guest lecturers.

Prerequisites: ACCT 403, ACCT 404 or equivalent

ACCT 518 Accounting Policy and Practice Workshop (3-0-3)

This course is concerned with rigorous case studies in different areas of accounting in manufacturing and service organizations. Heavy emphasis on cases covering new areas in accounting such as measuring quality costs product casting, flexible manufacturing systems, capital budgeting under automation, product profitability analysis, and performance measurement in high technology companies. Cases in accounting policies, financial disclosure and reporting.

Prerequisites: ACCT 512, ACCT 515, ACCT 517

ACCT 519 Professional Accounting Ethics and Legal Responsibility (3-0-3)

This course is concerned with goals of Accounting Ethics Education for the development of a sense of professionalism and enhancing students' abilities to deal with ethical issues in accounting in order to maintain the public trust and confidence in the Accounting profession.

Emphasis on the following topics: Legal Environment of Business, Ethical Issues in Business, Ethical Theories, Ethical Standards and Codes adopted by professional organizations, financial fraud and illegal acts, Ethics on tax practice, computer ethics, competition in public accounting profession, moral and ethical issues related to accounting fields, and ethical problems in the multinational sector. Cases in Accounting Ethics and professionalism are used in teaching this course.

Prerequisite: ACCT 517

ACCT 520 Internal and Electronic Data Processing (EDP) Auditing (3-0-3)

This course focuses attention on the role and importance of modern internal auditing techniques used in the changing manufacturing and service environments such as statistical and computer sampling techniques, analytical reviews, flow-charting, standardization. Furthermore, it provides an in-depth exposure in developing, conducting, and reporting EDP procedures and reports. Such programs include financial and operational areas, pre-contract reviews, post-con-tract audits, special investigations, EDP audits. It also deals with the theory and techniques for measuring operational efficiency and effectiveness; informing management of operating problems and possible courses of action.

Prerequisite: ACCT 517

ACCT 523 Advanced Accounting Systems Analysis & Design (3-0-3)

An advanced study of accounting systems analysis and design methodologies, techniques, and processes with specific reference to accounting systems development life cycle; emphasis on identification of user information needs and logical system design. Special emphasis on vendors selection, system implementation, and post implementation audits.

Prerequisite: ACCT 515

ACCT 524 Research Methodology in Accounting (3-0-3)

Research technique methodologies and their application in the field of accounting for manufacturing and service organizations. Emphasis on application of research techniques on local accounting issues and problems.

Prerequisites: ACCT 516, departmental approval

ACCT 526 Foundations of Internal Auditing (3-0-3)

Concepts and principles of internal auditing, Professional Standards, internal control, operational approach and behavioral dimensions of internal auditing, administering internal auditing activities, statistical sampling and computer applications in internal auditing, relationship between the internal and the external auditor, responsibilities of board of directors' audit committee and internal auditor services. A practice-oriented research paper is required.

Prerequisite: ACCT 517 or ACCT 522

ACCT 527 Operational Auditing (3-0-3)

Operational Audit methodology, tools and techniques, functional audits, EDP audit, employees and management fraud investigation, control and assessment of management controls, government and not-for-profit audits. A practice-oriented research paper is required.

Prerequisite: ACCT 526

ACCT 528 Independent Research in Accounting (3-0-3)

Independent readings and study of selected topics in contemporary Accounting issues in manufacturing and service organizations. Emphasis on the accounting issues which deal with the changes in technology and organization of production processes, globalization of accounting standards and practice. Subject matter to be arranged.

Prerequisites: ACCT 512; ACCT 516, departmental approval

ACCT 600 Written Comprehensive Examination (0-0-0)

Each student who successfully complete all required accounting course work must take a written comprehensive examination in Accounting. Intended to assess a student's ability to demonstrate his accounting knowledge in an integrative fashion. This exam is administered by the Department of Accounting and Management Information Systems. If a student fails to pass the exam, he will be given another chance to retake it one semester later. Failure to pass this exam for the second time will lead to discontinuation of the student from the program.

Prerequisites: ACCT 512, ACCT 515, ACCT 516, ACCT 517, ACCT 518, ACCT 528

FIN 510 Managerial Finance (3-0-3)

Managerial finance consists of the two interrelated decisions of investment and financing. The former deals with capital theory and its application to capital budgeting under uncertainty. The latter deals with financial leverage, the cost of capital, dividend policy, and valuation. Leasing and other instruments of long-term financing growth through mergers and the holding company, as well as reorganization and bankruptcy are also included.

Prerequisites: FIN 501, ACCT 510

FIN 520 Financial Policies (3-0-3)

A case method analysis of corporate assets, liability management and related financial problems stressing financial decisions and formulation of financial policy. The subject coverage includes: working capital management; operating and financial leverage; capital budgeting; cost of capital, dividend policy, and valuation.

Prerequisite: FIN 510

FIN 521 International Finance (3-0-3)

Analysis of balance of payments problems; the functions of international and foreign investments; international monetary structure and lending agencies; current issues of international financial relations such as exchange rate fluctuations; arbitrage dealings; and fixed versus floating exchange rates.

Prerequisite: FIN 510

MIS 510 Information Resources Management (3-0-3)

Development of framework for planning the introduction, evolution, and assimilation of information technology (computer, telecommunication, office automation) into the organization. The specific role of top management in designing a long-range information architecture is stressed.

Prerequisite: MIS 502 or equivalent

MGT 520 Organizational Theory and Design (3-0-3)

Analysis of organizations as open systems, with emphasis on maximizing congruency among organizational structure, strategy, and environment. Impact of alternative design configurations on individual, group and inter-group behavior. Role of structure in determining organizational performance and effectiveness. Strategies of change for integrating the total organizational system.

Prerequisite: MGT 501 or equivalent

MGT 521 International Business (3-0-3)

A comprehensive introduction to multinational business with particular emphasis upon the Middle East and Saudi Arabia. Managerial problems that relate to the balance of trade and payments, markets for foreign exchange, international inflation, currency devaluation, governmental restrictions and controls, and strategic planning.

Prerequisite: MGT 501 or equivalent

MGT 590 Business Policy (3-0-3)

General management strategy, policy determination and decision making, case analysis drawing from Saudi Arabia and international business environments. A comprehensive course integrating the various functional areas of business including computerized management game.

Prerequisite: Advanced M. Acc. standing

OM 510 Quantitative Business Analysis (3-0-3)

Linear Programming and its extensions: the Simplex algorithm, duality theory, post-optimality analysis, transportation and assignment models; network models: PERT/CPM; dynamic programming inventory control with deterministic and probabilistic models; queuing theory. The use of the Operations Research and Operations Management Computer Business Programs Library will be emphasized.

Prerequisites: OM 501, OM 502

MASTER OF BUSINESS ADMINISTRATION (MBA)

The Department of Management and Marketing in the College of Industrial Management offers a Master of Business Administration (MBA) degree which provides the necessary education and skills to prepare students to work and perform successfully at all levels of management. The program covers all the functional areas of business and allows the students to take additional elective courses that match their career aims and their personal goals and development which allows them to further integrate all functional areas and gain the essential overall view of organizational performance. The program accepts both full and part-time students and provides a list of deficiency courses for those whose educational background is not in business fields. Various teaching technologies are utilized including cases, team projects, field research, and simulations.

While the overall orientation of the program is general business management, it also puts sufficient emphasis on the international dimensions of organizational management and on the application of the theory and skills to the Saudi business environment.

MBA Program Learning Goals

The overall objective of the MBA program is to equip the students with knowledge and skills that enable them to be effective managers in business organizations. Specific goals and objectives are as follows:

1. Students should have the analytical skills and know the analytical tools to solve complex business problems.
2. Students should have the skills and perspectives to develop and implement business policy and strategy.
3. Student should have the knowledge and perspective to function in diverse and global business environments.
4. Students should develop teamwork and leadership/supervision skills.
5. Students should have the ability to communicate effectively.
6. Students should develop an understanding and ability to use information technology as a tool of management.

ADMISSION REQUIREMENTS

An applicant for admission to the MBA program should:

1. Meet the admission requirements of the Deanship of Graduate Studies at KFUPM.
2. Have a four-year baccalaureate (BA or BS) degree from a recognized and reputable institution.
3. Have a Grade-Point Average (GPA) of 2.5 or higher on a 4.0 scale in previous university work. An official transcript must be mailed directly from the Registrar of the school from which the applicant earned his baccalaureate degree to the Deanship of Graduate Studies at KFUPM.

4. Have at least one course in college level calculus, which covers both differentiation and integration.
5. Have a working knowledge of computers as evidenced by at least one course in that area (e.g. data processing, programming, information systems, etc.).
6. Have at least one-year full-time work experience. This requirement may be waived for graduate assistants, research assistants, and applicants with exceptional academic records.
7. Have a satisfactory score in the Graduate Management Admission Test (GMAT).
8. Have a score of not less than 520 in the Test of English as a Foreign Language (TOEFL), or acceptable evidence of proficiency in the English Language.

ADMISSION OF STUDENTS WITH DEFICIENCIES

Students who are admitted to the MBA program are expected to have all the basics and fundamentals in the functional areas of business administration. Those who have a deficiency in all or some of these areas will be provided with the opportunity to enroll in the deficiency courses offered by the College of Industrial Management. The following conditions will apply to these students:

1. They are admitted as Pre-MBA students and are not allowed to enroll in the MBA core and elective courses until they complete all of their deficiency courses. A student who is left with only 3 or 6 credit hours in the Pre-MBA courses may be allowed to enroll in some core courses with the approval of the Department Chairman and Dean of Graduate Studies.
2. All Pre-MBA courses must be completed with a cumulative GPA of 3.00 or more for the student to be admitted to the MBA program.
3. Pre-MBA courses will not count in the MBA program GPA calculation for purposes of graduation. The MBA cumulative GPA will include grades in the core, elective and research requirement courses only.

Pre-MBA Deficiency Courses:

Each applicant's academic record will be reviewed. The applicants who are deficient in the basics and fundamentals of business functional areas will be provided with the opportunity to enroll in all or some of the following deficiency courses:

ACCT	501	Financial Accounting	3
ECON	501	Principles of Economics	3
FIN	501	Corporate Finance	3
MGT	501	Principles of Management	3
MKT	501	Principles of Marketing	3
MIS	502	Management Information Systems	3
OM	502	Statistical Analysis for Business	3

Deficiency Courses Waiver Guidelines:

The deficiency courses will be waived according to the following guidelines:

1. ACCT 501 - Financial Accounting may be waived for those whose BS or BA was in Accounting and for others through the successful completion of two courses in the principles of financial accounting (at KFUPM ACCT 201 and ACCT 202) or equivalents with a grade of ‘C’ or better in each of the two courses.

2. ECON 501 - Principles of Economics may be waived for those whose BS or BA degree was in Economics and for others through the successful completion of two principles of economics (macro and micro) courses (at KFUPM ECON 101 and ECON 202) or equivalents with a grade of ‘C’ or better in both courses.

3. FIN 501 - Corporate Finance may be waived for those whose BS or BA degree was in Finance and for others through the successful completion of FIN 301 at KFUPM or equivalent with a grade of ‘C’ or better .

4. OM 502 -Statistical Analysis for Business may be waived through the successful completion of OM 201 and OM 202 at KFUPM or equivalents with a grade of ‘C’ or better in both courses.

5. MGT 501- Principles of Management may be waived for those whose BS or BA degree was in Management and for others through the successful completion of MGT 301 at KFUPM with a grade of ‘C’ or better.

6. MKT 501 - Principles of Marketing may be waived for those whose BS or BA degree was in Marketing and for others through the successful completion of MKT 301 KFUPM or equivalent with a grade of ‘C’ or better.

7. MIS 502 - Management Information Systems may be waived for those whose BS degree was in MIS and for others through the successful completion of MIS 215 at KFUPM or equivalent with a grade of ‘C’ or better.

MBA DEGREE REQUIREMENTS

The candidates for the MBA degree are those students who have been admitted to the program and are not required to take deficiency courses or have completed their required deficiency courses with a cumulative GPA of at least 3.00 on a 4.0 scale, and fulfilled all admission provisions. The MBA degree requirements consist of 45 credit hours of which 30 credit hours are in core courses, 12 credit hours in electives and 3 credit hours in the research requirement.

The MBA degree course requirement:

1. Core Courses			**(30 Credit Hours)**
ACT	510	Managerial Accounting	3
ECON	510	Managerial Economics	3
FIN	510	Managerial Finance	3
MIS	510	Information Resource Management	3
MGT	511	Organizational Theory and Design	3
MGT	580	Strategic Management	3
MKT	513	Strategic Marketing	3
MKT	512	Applied Marketing Research	3
OM	511	Management Science	3
OM	512	Production and Operation Management	3

2. Electives (12 Credit Hours)

Each student is required to take 12 credit hours from the list of elective courses. The student is given the freedom and flexibility to tailor his electives to meet his personal and career goals and interests. A student may elect to broaden his knowledge and skills by taking his electives from different functional areas or he may elect to concentrate all of his electives in one functional area to gain depth and specialization in that area.

In addition to the MBA elective courses available to the MBA students in the College of Industrial Management, a student may take one of his electives from other graduate courses offered in the University with the approval of the Department Chairman and the Dean of Graduate Studies.

The Elective courses are:

ACCT	512	Cost Management Systems
ACCT	515	Computerized Accounting Information Systems
ACCT	526	Fundamentals of Internal Auditing
ACCT	527	Operational Auditing
ACCT	592	Independent Research in Accounting
ECON	511	The Macroeconomic Environment of Business
ECON	512	Econometrics
ECON	520	Microeconomic Analysis
ECON	522	International Trade
ECON	525	Energy Economics
ECON	592	Independent Research in Economics
FIN	520	Financial Policy
FIN	521	International Finance
FIN	522	Financial Institution
FIN	523	Investment Analysis
FIN	525	Options, Futures, and Other Derivative Securities
FIN	529	Bank Management
FIN	531	Real Estate Management
FIN	592	Independent Research in Finance
MIS	512	Data Management
MIS	515	Systems Analysis Methodologies
MIS	525	Management Support Systems
MIS	530	Seminar in MIS
MIS	592	Independent Research in MIS
MGT	513	Managerial Communications
MGT	521	International Business
MGT	522	Organizational Behavior
MGT	523	Leadership, Motivation, and Power

MGT	524	International and Comparative Management
MGT	525	Human Resources Management
MGT	526	Management of Organizational Change and Development
MGT	527	Entrepreneurship and Small Business Management
MGT	592	Independent Research in Management
MKT	520	International Marketing
MKT	521	Buyer Behavior
MKT	523	Marketing Communications
MKT	525	Marketing Channels Management
MKT	526	Services Marketing
MKT	592	Independent Research in Marketing
OM	515	Business Forecasting
OM	516	Decision Analysis
OM	518	Project Management
OM	519	Business Simulation
OM	521	Management of Inventory Systems
OM	592	Independent Research in OM

3. Research Requirement **(3 Credit Hours)**

Each student is required to complete 3 credit hours in an independent research course (XXX 592) in any of the functional fields of business administration. Under the direction of an MBA faculty member, the student is expected to conduct a study that involves identification of business problems, literature review, data collection, systematic data analysis, and presentation (oral and written) of the problems, the methods, the results, and the conclusions

Total MBA Course Requirements **(45 Credit Hours)**

Master of Business Administration

Pre-MBA Requirements

Course #		Title	LT	LB	CR
FIRST YEAR					
First Semester					
ACCT	501	Financial Accounting	3	0	3
ECON	501	Principles of Economics	3	0	3
MGT	501	Principles of Management	3	0	3
			9	**0**	**9**
Second Semester					
MIS	502	Management Information Systems	3	0	3
FIN	501	Corporate Finance	3	0	3
OM	502	Statistical Analysis for Business	3	0	3
MKT	501	Principles of Marketing	3	0	3
			12	**0**	**12**

Degree Plan for the Master of Business Administration (MBA)

Course #	Title	LT	LB	CR	
FIRST YEAR					
First Semester					
ACCT 510	Managerial Accounting	3	0	3	
ECON 510	Managerial Economics	3	0	3	
OM 511	Management Science	3	0	3	
MGT 511	Organizational Theory & Design	3	0	3	
		12	**0**	**12**	**12**
Second Semester					
OM 512	Production and Operations Management	3	0	3	
MKT 513	Strategic Marketing	3	0	3	
FIN 510	Management Finance	3	0	3	
MIS 510	Information Resources Management	3	0	3	
		12	**0**	**12**	**12**
SECOND YEAR					
First Semester					
MKT 512	Applied Marketing Research	3	0	3	
	ELECTIVE 1	3	0	3	
	ELECTIVE 2	3	0	3	
	ELECTIVE 3	3	0	3	
		12	**0**	**12**	**12**
Second Semester					
MGT 580	Strategic Management	3	0	3	
XXX 592	Independent Research	0	0	3	
	ELECTIVE 4	3	0	3	
		6	**0**	**9**	**9**
Total Credit Hours					**45**

MBA COURSE DESCRIPTION

ACCOUNTING

ACCT 501 Financial Accounting (3-0-3)

Financial accounting principles underlying accounting statements as they apply to financial statements of business firms, accounting system and records, income measurement and asset valuation. Emphasis on interpretation and uses of financial statements.

ACCT 510 Managerial Accounting (3-0-3)

Development and uses of accounting data for management decision-making; cost concepts, behavior, and systems; activity-based costing; pricing, process, and activity decisions; budgeting, planning and control; contemporary management accounting issues. Emphasis on real-world situations.

Prerequisite: ACCT 501 or waiver of this prerequisite according to the waiver guidelines.

ACCT 512 Cost Management Systems (3-0-3)

Problems with traditional cost allocation methods, design of operational control and performance evaluation, non-financial measurement of performance, activity-based costing systems, application of activity-based cost systems in manufacturing and service industries, cost accounting and most management system in high technology business. Readings and cases.

Prerequisite: ACCT 510 or equivalent

ACCT 515 Computerized Accounting Information Systems (2-2-3)

Role of accounting information systems within companies' operating environments, their capabilities and limitations, accounting information system data for gathering and processing, internal controls in computerized accounting systems analysis and designs, accounting decision support and expert systems, computerized accounting systems in small businesses, service industries, and not-for-profit organizations. A comprehensive project is required.

Prerequisite: ACCT 510 or equivalent

ACCT 526 Foundation of Internal Auditing (3-0-3)

Concepts and principles of internal auditing, professional standards, internal auditing process; internal control, audit evidence, EDP auditing, fraud; internal audit skills; problem solving, audit communication and behavioral skills, statistical sampling; information technology; administration of internal auditing department. Cases and a project are required.

ACCT 527 Operational Auditing (3-0-3)

Operational auditing concepts and techniques, functional audits, control and assessments of management controls, ISO and TQM, operational audits in governmental and not-for-profit organizations. Cases and project are required.

Prerequisite: ACCT510 or equivalent

ACCT 592 Independent Research in Accounting (0-0-3)

A research proposal must be submitted in writing by the student and approved by the supervising faculty member and the MBA Chairman prior to registration. The student is required to conduct a research study in the area of accounting that is business related and adheres to all elements of sound business research. The study methods and findings must be presented orally and in writing in a manner that is consistent with acceptable standards of research communication.

Prerequisites: ACCT 510, MKT 512

ECONOMICS

ECON 501 Principles of Economics (3-0-3)

Introduction to economic systems and economic analysts. The course is an overview microeconomics covering topics such as supply and demand in individual markets, elasticities of supply and demand, theory of consumer behavior, theory of the firm, theory of production, analysis of cost elements, factors and product markets, and analysis of competitive and monopolistic markets and oligopoly. The course also includes an analysis of macroeconomics covering topics such as aggregate and aggregate supply, national output and income determination, consumption, savings, investment, government expenditures, international trade and restrictions, general price level, theory of money, monetary and fiscal policies, business cycles, unemployment, and inflation.

ECON 510 Managerial Economics (3-0-3)

This course analyzes the role of business in society as well as the role of profits in the allocation of scare resources. It develops the relevant demand and production theories, the theory of the firm, economic optimization techniques, cost/benefits analysis, and pricing policies. Economic forecasting techniques, public policy issues, public regulations, and the role of government in a market economy are introduced.

Prerequisite: ECON 501 or waiver of this prerequisite according to the waiver guidelines.

ECON 511 The Macroeconomic Environment of Business (3-0-3)

This is an advanced course in aggregate economic theory. The course analyzes the components of aggregate demand and aggregate supply, and factor shares in production functions. It also encompasses the basic structure of the classical. Keynesian, monetarist, and new classical approaches to macroeconomics and their implications for the determination of output (GDP), interest rates, general price level, unemployment, and inflation. Applications of the theory of the business cycle and the use of monetary and fiscal policy for economic stabilization are also analyzed.

Prerequisite: ECON 510

ECON 512 Econometrics (3-0-3)

This course stresses the mathematical formulation, estimation, and empirical testing of basic econometric models which can be used for forecasting economic and financial data for future planning purposes. The theory of normal linear (and nonlinear) models, generalized least squares methods, hypothesis testing, specification error, regression diagnostics, and distributed lags are analyzed in the context of economic and financial theories. Applications include simultaneous equation model, seemingly unrelated regression, pooled data estimation, and single-equation models.

Prerequisites: OM 502 or waiver of this prerequisite according to the waiver guidelines, ECON 510.

ECON 520 Microeconomic Analysis (3-0-3)

This is an advanced course covering selected topics in utility theory, analysis of demand and supply, production theory, labor market, and capital theory. It also covers price and output determination in different market structures, resource allocation, income distribution, welfare economics, the economics of uncertainty and information, as well as the analysis of partial and general equilibrium systems.

Prerequisite: ECON 510

ECON 522 International Trade (3-0-3)

This course covers advanced analysis of topics such as the gains from trade, sources of the gains from trade, sources of comparative advantage, economic integration, trade policy, the theory of commercial policy, foreign exchange rates, the balance of payments, protectionism and barriers to trade, and the gains from specialization.

Prerequisite: ECON 510

ECON 525 Energy Economics (3-0-3)

This course deals with the analysis of energy sources (such as petroleum coal, gas and electricity), and the rates of extraction. The course also covers the analysis of demand for and supply of oil, in particular, under the assumptions of the theory of Cartels. It also includes analysis of short-and long-run costs of investments in such resources under uncertainty, the pricing of exhaustible resources such as oil, and modeling of long-run theory demand. The course includes a case study on the energy sector of the Saudi Economy.

Prerequisite: ECON 511

ECON 592 Independent Research in Economics (0-0-3)

A research proposal must be submitted in writing by the student and be approved by the supervising faculty member and the MBA Chairman prior to registration. The student is required to conduct a research study in the area of economics that is business related and adheres to all elements of sound business research. The study method and findings must be presented orally and in writing in a manner that is consistent with acceptable standards of research communication.

Prerequisites: ECON 510, MKT 512

FINANCE

FIN 501 Corporate Finance (3-0-3)

An introduction to the basic concepts and tools of corporate finance. The course covers financial planning and control techniques such as forecasting financial needs, cash budgeting, operating leverage, ratio analysis, return-on-investment, and fund statement. Other topics include working capital policies, capital budgeting, and the treatment of risk in investment decisions.

Prerequisite: ACCT 501 or waiver of this prerequisite according to the waiver guidelines.

FIN 510 Managerial Finance (3-0-3)

Managerial finance consists of two inter-related decisions of investment and financing. The former deals with capital theory and its application to capital budgeting under uncertainty. The latter deals with financial leverage, the cost of capital, dividend policy and valuation. Leasing and other instruments of long-term financing, growth through mergers and the holding company, as well as reorganization and bankruptcy are also included.

Prerequisites: FIN 501 or waiver of this prerequisite according to the waiver guidelines, ACCT 510.

FIN 520 Financial Policy (3-0-3)

A case method analysis of corporate assets/liabilities management and related financial problems stressing financial decisions and formulation of financial policy. The subject coverage includes: working capital management, operating and financial leverage, capital budgeting, cost of capital, dividend policy, and mergers, acquisitions, and corporate restructuring. This course attempts to familiarize the students with practical aspects of financial concepts and theories. It provides the students with the tools and financial models to make decisions in real-life situations. A case-based approach is emphasized to give the students 'hands-on' managerial financial skills. It is also intended to develop communication and presentation skills and strengthen the students' confidence in their own judgment.

Prerequisite: FIN 510

FIN 521 International Finance (3-0-3)

The focus is understanding how multinational corporations make financial decisions in an international environment. Students learn about international money and capital market operations, the determination of exchange rates, and how to analyze the balance payments accounts. Specific skills to measure and manage exposure to foreign exchange risk are developed. The course also covers corporate functions including international capital budgeting, working capital management, direct foreign investment, political risk analysis, and international banking and taxation.

Prerequisite: FIN 510

FIN 522 Financial Institutions (3-0-3)

This course has a dual objective. One focus is to understand the flow of funds across financial markets, the nature and characteristics of these markets, and the determination of interest rates and security prices. Students are exposed to the process of financial product evolution and financial engineering techniques. The second focus is to familiarize students with the strategic and operational issues involved in the management of financial institutions including commercial banks, Islamic financial institutions, savings banks, finance companies, pension funds and insurance companies. The course also includes a description and comparative analysis of the Islamic financial system, the Saudi financial infrastructure, and Western financial system.

Prerequisite: FIN 510

FIN 523 Investment Analysis (3-0-3)

Analysis of investments in financial securities such as bonds, common stock, preferred stock, options, commodities and Islamic financial instruments. Nature, regulation, and operations of securities markets in a western economy and an Islamic economy. Portfolio management theory and implications for capital market theory. Stock price behavior in relation to technical analysis and to capital market efficiency hypothesis.

Prerequisite: FIN 510

FIN 525 Options, Futures and Other Derivative Securities (3-0-3)

This course provides a detailed coverage of the organization, structure, and role of the derivative securities market. The course explores the properties of derivative securities (such as futures, options, options on futures, and swap markets) that are commonly encountered in practice and provides a theoretical framework within which these securities can be valued. Students learn skills required to use derivative securities in hedging and risk-altering investment strategies.

Prerequisite: FIN 510

FIN 529 Bank Management (3-0-3)

Examines the nature and operating strategies of banking institutions including Islamic banking institutions. Bank management issues such as liquidity management, investment strategies, capital management and asset/liability management are emphasized. Banking practices in an international environment are also examined. Students work through cases that simulate real world decision-making.

Prerequisite: FIN 510

FIN 531 Real State Management (3-0-3)

This course deals with the analysis of residential and commercial real estate development, appraisal techniques, real estate financing, real estate market analysis, real estate management and legal environment. It also covers the theory of risk, and management of personal and business risk.

FIN 592 Independent Research in Finance (0-0-3)

A research proposal must be submitted I writing by the student and be approved by the supervising faculty member and the MBA Chairman prior to registration. The student is required to conduct a research study in the area of finance that is business related and adheres to all elements of sound business research. The

study methods and findings must be presented orally and in writing in a manner that is consistent with acceptable standards of research communication.

Prerequisites: FIN 510, MKT 512

MANAGEMENT INFORMATION SYSTEMS

MIS 502 Management Information Systems (3-0-3)

Introduction to the concepts of Management Information Systems. Topics include information systems support to organizational activities and functions. Fundamentals of database management and data communication concepts. Strategic applications of information systems. An overview of system development processes and the fundamentals of system analysis and design.

MIS 510 Information Resource Management (3-0-3)

Development of a framework for planning the introduction, evolution, and assimilation of information technology (computer, telecommunication, office automation) into the organization. The specific role of middle and top management in designing a long-range information architecture with emphasis on strategic and global issues. Use of case studies is emphasized.

Prerequisite: MIS 502 or waiver of this prerequisite according to the waiver guidelines.

MIS 512 Data Management (3-0-3)

Introduction of Data Base Management Systems (DBMS). Relational model and Structured Query Language. Logical database design and semantic data integrity. Physical design issues of relational databases. Transaction integrity. Database and data administration functions. Introduction to non-relational data models. Fundamentals of distributed DBMS.

Prerequisite: MIS 510

MIS 515 Systems Analysis Methodologies (3-0-3)

Business information system development covering used requirements identification, feasibility study, system analysis, design, and implementation. Systems analysis and design methodologies including SDLC, JAD, RAD, and prototyping. System analysis and project management tools.

Prerequisite: MIS 510

MIS 525 Management Support Systems (3-0-3)

Study of the decision-making processes. Comparison between Management Support Systems (MSS) and conventional information systems. Decision Support Systems (DSS), Group DSS, Executive Support Systems, Expert Systems, and Neutral

Network Systems. Applications of MSS. Integration of Management Support Systems. Behavioral and technical issues in the implementation and operation of MSS.

Prerequisite: MIS 512

MIS 530 Seminar in MIS (3-0-3)

Study of contemporary issues and concepts in Management Information Systems and management of information technology. Use of presentations based on periodicals, book reviews, cases, and student term papers. Students will participate in class presentations.

Prerequisite: MIS 510

MIS 592 Independent Research in MIS (0-0-3)

A research proposal must be submitted in writing by the student and be approved by the supervising faculty member and the MBA Chairman prior to registration. The student is required to conduct a research study in the area of Management Information Systems that is business related and adheres to all elements of sound business research. The study methods and findings must be presented orally and in writing in a manner that is consistent with acceptable standards of research communication.

Prerequisites: MIS 510, MKT 512

MANAGEMENT

MGT 501 Principles of Management (3-0-3)

Fundamentals of managing work and organization, managing people and managing production and operations. Topics include basic management functions of planning, organizing, leading, and controlling and related organizational processes of communication, decision-making and socialization. Other related issues such as globalization, social responsibility, ethics and application to the Saudi business environment are also covered.

MGT 511 Organizational Theory and Design (3-0-3)

Analysis of organizations as open systems, with emphasis on maximizing congruency among organizational structure, strategies, and environments; and the understanding of the impact of alternative design configurations and strategies on the individual, group, and inter-group behavior and performance. A primary focus is the influences on organizational performance and effectiveness.

Prerequisite: MGT 501 or waiver of this prerequisite according to the waiver guidelines.

MGT 513 Managerial Communications (3-0-3)

This course covers various behavioral and technical aspects of the communication processes at different levels and in various contexts in business organizations. Topics include interpersonal communication, cross-cultural communication, linguistic skills; communication aspects of interviewing, business meetings, negotiation, conflict, work relationships, and group work; and the planning, organizing, and delivery of different types of business presentations and reports.

Prerequisite: MGT 511

MGT 521 International Business (3-0-3)

The course develops the analytical capability and perspectives to manage a firm's interaction with its international and global environment. Topics include international economics and political developments, the economics and politics of trade, comparative international strategy, international strategic alliances, foreign exchange and international capital markets, risk analysis, and country culture analysis.

Prerequisites: MGT 511, ECON 510

MGT 522 Organizational Behavior (3-0-3)

Enhancing and developing students' diagnostic skills by examining individual behaviors (motives, perception, attitudes, and learning), group dynamics (communication, power conflict, productivity and morale), and organizational theory and development (culture, socialization, structure and design). The course also provides the foundation to develop the skills required to work effectively in teams. Globalization and the international dimensions of organizational behavior are also covered.

Prerequisite: MGT 511

MGT 523 Leadership, Motivation, and Power (3-0-3)

Theoretical and practical approaches to influencing and motivating people. Effectiveness of various leadership styles, different motivation theories and techniques, and power tactics from a managerial point of view. Cases, experiential exercises, and group discussions are used to enhance the learning of these concepts and managerial actions.

Prerequisite: MGT 511

MGT 524 International and Comparative Management (3-0-3)

Focus is on exploring knowledge and research findings about influences of culture and cultural diversity on management functions and processes. Topics include influences of national cultures on organizational cultures, influences of inter-organizational interactions in cross-cultural contexts, management practices in different social environments, and management perspectives in different countries.

Prerequisite: MGT 511

MGT 525 Human Resources Management (3-0-3)

Application of current behavioral science theory, research and techniques to cover how organizations plan, recruit, select, train, evaluate, compensate and develop their human resources. The coverage of these issues includes the international and global aspects of human resources management and dimensions that are specific to Saudi business environment such as the relevant laws and regulations and the Saudization efforts.

Prerequisite: MGT 511

MGT 526 Management of Organizational Change and Development (3-0-3)

Building a set of conceptual and pragmatic skills useful in understanding and managing change within organizations. Topics include theory and management of OD, planned change, business consultation, and interventions such as team interventions, third-party peacemaking interventions, training-based intervention, structural interventions, and comprehensive interventions.

Prerequisite: MGT 511

MGT 527 Entrepreneurship an Small Business Management (3-0-3)

Study and development of analytical and conceptual skills in the management of new ventures and small businesses. Coverage includes nature and importance of entrepreneurial activities and alternatives, launching and start-up issues and challenges, market and financial planning, and the processes involved in the management, marketing, finance, and control of the enterprise.

Prerequisites: MGT 511, ECON 510, FIN 510

MGT 580 Strategic Management (3-0-3)

The objectives of this course are (1) to acquaint students with the viewpoint of top managers in complex organizations; (2) to provide exposure to major strategic issues involved in planning, organizing, leading, and controlling complex organizations; and (3) to integrate the specific analytical techniques and viewpoints of functional fields into the larger view of the overall organizational strategies and goals. Included is the coverage and application of certain activities such as long-range planning, environmental analysis, internal analysis, corporate creativeness and development, strategies and strategic choices and so on. Cases from the Saudi and international business environments are used.

Prerequisite: Advanced MBA Standing

MGT 592 Independent Research in Management (0-0-3)

A research proposal must be submitted in writing by the student and be approved by the supervising faculty member and the MBA Chairman prior to registration. The student is required to conduct a research study in the area of management that is business related and adheres to all elements of sound business research. The study methods and findings must be presented orally and in writing in a manner that is consistent with acceptable standards of research communication.

Prerequisites: MGT 511, MKT 512

MARKETING

MKT 501 Principles of Marketing (3-0-3)

The principles of marketing to include marketing's role in society and the firm, the marketing concept, market segmentation, and target marketing. Emphasis on buyer behavior, market measurement, and elements of the marketing mix.

MKT 512 Applied Marketing Research (3-0-3)

Application of research methods for enhancing managerial decision-making in marketing. Includes use of multivariate research methodology and computer software specific to marketing problems in customer analysis, market segmentation, market forecasting, product positioning and attribute preference research.

Prerequisites: MKT 501, OM 502; or waiver of these prerequisites according to the waiver guidelines.

MKT 513 Strategic Marketing (3-0-3)

Applications of concepts, tools, and processes in marketing decision-making. Analysis of strategic marketing opportunities and problems. Planning, developing and implementation of customer-driven strategies.

Prerequisite: MKT 501 or waiver of this prerequisite according to the waiver guidelines.

MKT 520 International Marketing (3-0-3)

Developing skills, knowledge, and cultural sensitivity necessary to market successfully in an international environment. Critical discussion of contemporary international marketing issues, analyzing marketing opportunities within a global context, evaluating market entry strategies, and developing and assessing international product, pricing, promotional, distribution and purchasing strategies.

Prerequisite: MKT 513 or equivalent

MKT 521 Buyer Behavior (3-0-3)

Study of decision processes and behavior of individuals and organizations as they relate to the purchase and consumption of goods and services. Consideration of concepts and theories of the behavioral sciences, research methods, and applications in marketing management.

Prerequisite: MKT 513 or equivalent

MKT 523 Marketing Communication (3-0-3)

Analysis of the marketing communications process as it relates to the design and implementation of persuasive communications with current and potential customers. Consideration of the full range of contacts between organizations and markets, message and media factors, and program performance evaluation.

Prerequisite: MKT 513

MKT 525 Marketing Channels Management (3-0-3)

Analysis of the dynamics of marketing channel relationships among firms working together to deliver goods and services to markets. Consideration of problems, opportunities, and managerial requirements of building and maintaining supply chain relationships with other firms consistent with marketing strategy.

Prerequisite: MKT 513 or equivalent

MKT 526 Services Marketing (3-0-3)

Analysis of the distinctive aspects of services as they relate to planning, organizing and implementing marketing strategies. Consideration of demand management, customer portfolios, and frameworks to understand and position services in competitive markets.

Prerequisite: MKT 513 or equivalent

MKT 592 Independent Research in Marketing (0-0-3)

A research proposal must be submitted in writing by the student and be approved by the supervising faculty member and the MBA Chairman prior to registration. The student is required to conduct a research study in the area of marketing that is business related and adheres to all elements of sound business research. The study methods and findings must be presented orally and in writing in a manner that is consistent with acceptable standards of research communication.

Prerequisites: MKT 513, MKT 512

OPERATIONS MANAGEMENT

OM 502 Statistical Analysis for Business (3-0-3)

The course will employ the application of basic statistical techniques for Management. Basic concepts of probability and probability distributions, estimation theory and test of hypothesis, regression analysis, and analysis of variance.

OM 511 Management Science (3-0-3)

Linear Programming: Concepts and Solutions Techniques, Duality and Sensitivity Analysis. Transportation and Assignment Models, Goal Programming Model, Network Optimization Models including PERT/CPM project management models, Integer Programming. Additional topics may be selected from Inventory Model, Decision Analysis, Queuing Theory, Simulation, Quadratic Programming, Dynamic Programming, or Non-Linear Programming, Applications of LP and other models in Business and Industrial Management will be emphasized. Computer optimization packages will be used extensively.

Prerequisite: OM 502 or waiver of this prerequisite according to the waiver guide lines.

OM 512 Production and Operations Management (3-0-3)

Process Management; Business Process Re-Engineering; Total Quality Management; International Quality Standards such as ISO 9000, Statistical Process Control; Work Force Management and Scheduling: Capacity Planning; Aggregate Planning; Location Decisions; Layout Planning; Purchasing and Materials Management; Inventory Management Systems: Probabilistic and Deterministic Inventory Models; JIT, MRP and MRP II.

Prerequisite: OM 511

OM 515 Business Forecasting (3-0-3)

Principles and methods of forecasting. Short and long-term industry forecasting. Evaluation of reliability of existing forecasting techniques. National and international business trends. The role of business forecasting in managerial planning. The use of time series models including exponential smoothing and Box-Jenkins (ARIMA) techniques for business and economics forecasting.

Prerequisite: OM 511 or equivalent

OM 516 Decision Analysis (3-0-3)

Topics may include: Decision-making under uncertainty. Decision Trees. Multi-criteria decision-making. Data Envelopment Analysis (DEA). Analytical Hierarchy Process (AHP).

Prerequisite: OM 511

OM 518 Project Management (3-0-3)

Management of development projects. Decision-making environment, economic analysis, network analysis, scheduling and control of development projects, sequential and aggregate development decisions.

Prerequisite: OM 512

OM 519 Business Simulation (3-0-3)

Application of computer simulation to the analysis and design of management decision systems. Design of simulation experiments in business research.

Prerequisite: OM 511

OM 521 Management of Inventory Systems (3-0-3)

Analysis of business organizations as integrated inventory systems. Inventory theory and model building as tools for management decision-making. General discussion of inventory models, with emphasis on characterizing the terms of optional policies and efficient computational methods.

Prerequisite: OM 512

OM 592 Independent Research in Operations Management (0-0-3)

A research proposal must be submitted in writing by the student and be approved by the supervising faculty member and the MBA Chairman prior to registration. The student is required to conduct a research study in the area of operations management that is business related and adheres to all elements of sound business research. The study methods and findings must be presented orally and in writing in a manner that is consistent with acceptable standards of research communication.


IBM

College of SCIENCES

CHEMISTRY

Chairman

Abdullah Al-Hamdan

Professors

Abulkibash	El Ali	Oweimreen
Ali Asrof	Förner	Sultan
Al-Arfaj	Isab	Al-Suwaiyan
Badawi	Jaber	Wazeer

Associate Professors

Fettouhi	Morsy
Khaled	Perzanowski
Maung	Al-Thukair

Assistant Professors

Alameddine	Al-Saadi	Kawde
Al-Daous	Antonijevic	Siddiqui
Al-Hooshani	Ibdah	Ullah
Al-Muallem		

INTRODUCTION

The Department of Chemistry is one of the first departments established at the university to meet the demand for chemists and industrial chemists in government, academic, and industrial organizations in the Kingdom. The wide ranging interdisciplinary environment at KFUPM is ideal for the pursuit of modern chemistry and as a result, chemists graduating from KFUPM have an impressive record of teaching and research accomplishments.

TEACHING AND RESEARCH FACILITIES

The research activities of the Department of Chemistry are exceptionally diverse and broad. Graduate courses and research projects are available in the major branches of chemistry: analytical, industrial, inorganic, organic and physical chemistry. The ongoing research programs cover most areas of study in modern chemistry and also involve collaborative programs with other departments. Current areas of research include: organic synthesis, physical organic chemistry, coordination chemistry, X-ray structure determination, chromatography, thermodynamics of solutions, molecular dynamics by ESR, NMR, and laser techniques, polymer synthesis and characterization, electroanalytical methods, fuels chemistry research, energy production research and solid state reactions.

The Chemistry Department is well equipped for advanced research leading to higher degrees in chemistry. Research supporting facilities such as mechanical and electronic workshops are available in the Chemistry Department. The Department maintains a glass blowing shop for the repair or design of glass equipment. In addition to the University central chemical store, the departmental chemical store stocks almost all commonly used chemicals, glassware, etc. for teaching and research. General instruments aiding students and faculty in their teaching and research include various spectrophotometers, atomic absorption spectrometers, gas chromatographs and a high performance liquid chromatography unit.

GRADUATE PROGRAMS IN CHEMISTRY

Objectives and Outcomes

The overall objective of the graduate program at the Chemistry Department is to develop scientists with technical depth and leadership breadth for academic and industrial positions. It is aimed also to meet the requirements of the rapidly expanding petroleum and petrochemical industries, geological survey laboratories, research and development needs of Saudi Arabian industries and other institutions.

Our graduate students will be able to use the knowledge and skills they have acquired during their graduate years to pursue a wide variety of career and life goals. The MS and PhD graduates in Chemistry possess strong fundamental and practical knowledge in all chemistry disciplines including analytical, inorganic, organic, physical, theoretical and industrial chemistry. The program prepares students for careers in research and development. Also, the program is designed to strengthen the students' background in all areas through course offerings, research projects and seminars.

The chemistry graduates are given the means as well as the confidence to:

- become effective leaders in fundamental, applied and industrial chemistry ;
- apply critical thinking skills to the solution of chemistry related problems;
- interact effectively as team members and in leadership roles;
- contribute to the chemical society including academia and industry where individuals are empowered to permeate all professional structures and personal interactions;
- expand their knowledge and contribution to the chemistry fields through the tools of research and academic development.

DEPARTMENTAL ADMISSION REQUIREMENTS

All applicants must fulfill the Deanship of Graduate Studies admission requirements.

Departmental Academic MS Requirements

The Master of Science program in Chemistry is available to students who meet the requirements for admission to the university with a B.S. in Chemistry or equivalent.

1. Towards the end of their first year in residence, students must select their research topic and advisor.
2. A total of 24 credit hours of course work (500 or 600 level) is required. This includes 18 credit hours of chemistry courses (500 or 600 level) and 6 credit hours of free electives (500 or 600 level).
3. The free electives can be taken from chemistry graduate courses or, upon the approval of the graduate advisor, from graduate courses in other departments.
4. M.S. students are required to attend all departmental seminars.
5. M.S. students are required to present a seminar once during the program.
6. Six credit hours of research work towards the preparation of an M.S. thesis are required.

Departmental Academic Ph.D. Requirements

The Ph.D program in Chemistry is available to students who meet the requirements for admission to the university with a MS in Chemistry or equivalent.

1. Entering students may be required by the Departmental Graduate Committee to sit for a Preliminary Examination in each of the four main areas of chemistry: analytical, inorganic, organic, and physical. Such students should take the examination during the first semester of study.
2. Students graduated with MS degree from the Chemistry Department at KFUPM and meet the admission requirements can be exempted from Preliminary Examination.
3. Towards the end of their first year in residence, students may select their research Supervisor and their research topic.
4. Students should submit their degree plan during the first year of study.
5. The student must maintain a cumulative GPA of 3.0 or above at all times. Departmental requirements for the 30 credit hours are:
   (*a*) 15 credit hours must be in the major area,
   (*b*) 6 credit hours must be in the minor area,
   (*c*) Ph.D students can take a maximum of nine (9) credit hours from chemistry graduate courses in areas other than the major and minor areas or, upon the approval of the degree plan.
6. The minor must be in a field within the department.
7. Ph.D students are required to attend all departmental seminars.
8. Ph.D students are required to present a seminar once during the program.
9. A written comprehensive examination in the major area of specialization must be passed on completion of the second year of enrolment.
10. Twelve credit hours of research work towards the preparation of a PhD thesis are required.
11. The candidate shall prepare a dissertation on an approved topic under the guidance of his supervisor and his dissertation supervising committee.
12. The Dissertation Committee examines the candidate on the dissertation. The candidate, in consultation with his Dissertation Committee, and after approval from the Dean of Graduate Studies, shall arrange a time and place for a public defense of the dissertation.

Guidelines for MS Thesis and PhD Dissertation Defense

1. The student should be on a regular status;
2. He has completed formal course work;
3. He has maintained a cum GPA of ≥3.0;
4. He has passed the Comprehensive Exam and defended his Dissertation Proposal (Ph.D. students).
5. All the applications for admission to candidacy; thesis proposal and selection of thesis committee have been approved by the Deanship of Graduate Studies. This approval should be attained 3 months before the defense date;
6. The student must have passed the Seminar Course;
7. He must be registered for the thesis on the terms in which he is submitting his proposal and applying for his defense;
8. The request for the defense must be approved by the Deanship of Graduate Studies at least two (2) weeks before the date of defense.
9. The defense will not be allowed during the period of final examinations.

M.S. PROGRAM IN CHEMISTRY

The master's program consists of a total of 30 credit hours: 12 credit hours of core courses, 12 credit hours of elective courses plus 6 credit hours for a thesis.

Degree Plan for the M.S. Program in Chemistry

Course #		Title	Lec	Lab	Cr
First Semester					
CHEM	510	Advanced Physical Chemistry	3	0	3
CHEM	540	Advanced Analytical Chemistry	3	0	3
			6	**0**	**6**
Second Semester					
CHEM	520	Physical Methods in Inorganic Chemistry	3	0	3
CHEM	530	Advanced Organic Chemistry	3	0	3
CHEM	5XX / CHEM 6XX	Elective	3	0	3
			9	**0**	**9**
Third Semester					
CHEM	5XX / CHEM 6XX	Elective	3	0	3
Free	5XX / Free 6XX	Elective	3	0	3
Free	5XX / Free 6XX	Elective	3	0	3
			9	**0**	**9**
Fourth Semester					
CHEM	599	Graduate Seminar	1	0	0
CHEM	610	MS Thesis	0	0	IP
			1	**0**	**0**
Fifth Semester					
CHEM	610	MS Thesis	0	0	6
			0	**0**	**6**
Total Credit Hours					**30**

PH.D. PROGRAM IN CHEMISTRY

Thirty (30) credit hours of course work (500 and 600 level) beyond the master degree as given under the Ph.D. requirements plus 12 credit hours for a dissertation.

Degree Plan for the Ph.D. Program in Chemistry

Course #		Title	Lec	Lab	Cr
First Semester					
CHEM	5XX / CHEM 6XX	Elective 1 (CHEM)	3	0	3
CHEM	5XX / CHEM 6XX	Elective 2 (CHEM)	3	0	3
CHEM	5XX / CHEM 6XX	Elective 3 (CHEM)	3	0	3
			9	**0**	**9**
Second Semester					
CHEM	5XX / CHEM 6XX	Elective 4 (CHEM)	3	0	3
CHEM	5XX / CHEM 6XX	Elective 5 (CHEM)	3	0	3
CHEM	5XX / CHEM 6XX	Elective 6 (CHEM)	3	0	3
			9	**0**	**9**
Third Semester					
CHEM	5XX / CHEM 6XX	Elective 7 (CHEM)	3	0	3
Free	5XX / Free 6XX	Elective 8	3	0	3
			6	**0**	**6**
Fourth Semester					
Free	5XX / Free 6XX	Elective 9	3	0	3
Free	5XX / Free 6XX	Elective 10	3	0	3
CHEM	699	Graduate Seminar	1	0	0
			7	**0**	**6**
Fifth Semester					
CHEM	710	Ph.D. Dissertation	0	0	IP
			0	0	12
			0	**0**	**12**
Sixth Semester					
CHEM	710	Ph.D. Dissertation			
Total Credit Hours					**42**

IP: Dissertation in progress

LIST OF GRADUATE COURSES

General Graduate Courses and Requirements

CHEM 500	Introduction to Research in Chemistry
CHEM 599	Graduate (M.S) Seminar
CHEM 610	M.S Thesis
CHEM 699	Graduate (PhD) Seminar
CHEM 710	Ph.D Dissertation

Physical Chemistry Courses

CHEM 510	Advanced Physical Chemistry
CHEM 511	Chemical Kinetics
CHEM 512	Chemical Thermodynamics
CHEM 514	Electrochemical Corrosion
CHEM 515	Spectroscopy
CHEM 516	Quantum Chemistry I
CHEM 517	Computational Chemistry
CHEM 518	Colloid and Surface Chemistry
CHEM 519	Special Topics in Physical Chemistry
CHEM 614	Characterization of Materials
CHEM 615	Statistical Thermodynamics
CHEM 616	Quantum Chemistry II
CHEM 617	Chemistry and Physics of Nanomaterials
CHEM 618	Advanced Magnetic Resonance Techniques

Inorganic Chemistry Courses

CHEM 520	Physical Methods in Inorganic Chemistry
CHEM 521	Advanced Chemistry of Coordination Compounds
CHEM 522	Organometallic Chemistry
CHEM 523	Chemical Crystallography
CHEM 524	Catalysis in Industry
CHEM 525	Metal-Metal Bonds and Cluster Compounds
CHEM 528	Mechanisms of Inorganic Reactions
CHEM 529	Special Topics in Inorganic Chemistry
CHEM 620	Homogeneous Catalysis by Coordination Compounds
CHEM 621	Heterogeneous Catalysis
CHEM 622	Surface Chemistry and Catalysis

CHEM 623	Photochemistry of Coordination Compounds
CHEM 624	Solid State Chemistry
CHEM 626	Bio-Inorganic Chemistry
CHEM 627	X-ray Diffraction Analysis

Organic Chemistry Courses

CHEM 530	Advanced Organic Chemistry
CHEM 531	Physical Organic Chemistry
CHEM 532	Synthetic Organic Chemistry
CHEM 533	Nuclear Magnetic Resonance Spectroscopy
CHEM 534	Chemistry of Heterocyclic Compounds
CHEM 535	Petrochemicals
CHEM 536	Spectroscopic Identification of Organic Compounds
CHEM 537	Polymer Synthesis
CHEM 538	Natural Products Chemistry
CHEM 539	Special Topics in Organic Chemistry
CHEM 630	Physical Chemistry and Characterization of Polymers
CHEM 631	Molecular Biochemistry
CHEM 632	Bioseparations, Recombinant Techniques and Protein Sciences
CHEM 633	Polymeric Drug Delivery Systems

Analytical Chemistry Courses

CHEM 540	Advanced Analytical Chemistry
CHEM 542	Electroanalytical Chemistry
CHEM 543	Separation Methods
CHEM 549	Special Topics in Analytical Chemistry
CHEM 640	Analytical Spectroscopy
CHEM 642	Chemometrics
CHEM 643	Environmental Analytical Chemistry

Environmental Chemistry Courses

CHEM 550	Advanced Environmental Chemistry
CHEM 551	Analytical Geochemistry
CHEM 552	Organic Geochemistry
CHEM 553	Environmental Pollution
CHEM 554	Environmental Geochemistry
CHEM 555	Environmental Ecology

COURSE DESCRIPTION

CHEM 500 Introduction to Research in Chemistry (3-0-3)

Overview of current research trends in an emerging field of chemistry. Students are expected to document new instrumentations and techniques used in different areas of research in chemistry. Based on this overview, the student will write an original research proposal and defend it in an open seminar in the department.

Prerequisite: approval of the Graduate Advisor

CHEM 510 Advanced Physical Chemistry (3-0-3)

Classical and statistical thermodynamic concepts with emphasis on application to chemical species in solution. A consideration of theories of chemical reaction rates, kinetic studies of simple and complex systems. Basic principles and procedures of quantum chemistry with applications to atomic and molecular systems.

Prerequisite: CHEM 312 or equivalent

CHEM 511 Chemical Kinetics (3-0-3)

Empirical rate law. Order of reactions. Elementary reactions. Complex reactions. Reaction mechanisms. Steady-state approximation theory. Transition state theory. Thermodynamic formulation of the rate constant. Homogeneous reactions. heterogeneous reactions. Catalysis. Enzyme kinetics. Flash photolysis. Relaxation methods.

Prerequisite: CHEM 510

CHEM 512 Chemical Thermodynamics (3-0-3)

Principles of thermodynamics. Exact differentials and line integrals. Homogeneous functions. Equations of state of real gases; fugacity. Thermochemistry. Mixtures and solutions. Chemical and phase equilibria. Electrolytic solutions and electrochemical cells. Systematic methods of deriving thermodynamic equations. Statistical thermodynamics. Lagrange’s method of undetermined multipliers. The Boltzmann H-theorem. The Einstein crystal model and the Debye crystal model.

Prerequisite: CHEM 510

CHEM 514 Electrochemical Corrosion (3-0-3)

Fundamentals of electron transfer at the metal-solution interface, advances in electrochemical corrosion techniques, types of corrosion: galvanic, pitting, crevice, bacterial, etc. Corrosion inhibitors and coating, materials properties and selection in different corrosive environments. Advances in monitoring techniques.

Prerequisite: CHEM 510

CHEM 515 Spectroscopy (3-0-3)

An introduction to modern molecular spectroscopy with emphasis on the concepts and methods needed to understand the interaction of radiation with matter. Topics include atomic, rotational, vibrational and electronic spectra of molecules, and radio frequency spectroscopy.

Prerequisite: CHEM 510

CHEM 516 Quantum Chemistry I (3-0-3)

Postulates of quantum mechanics. Schroedinger equation, simple quantum mechanical systems, atomic wave functions, angular momentum, orbital, molecular orbital theory, variation, perturbation theory.

Prerequisite: CHEM 510

CHEM 517 Computational Chemistry (3-0-3)

Implementation of the different theoretical models: Force field, semi-empirical, abolition, calculations to chemically related problems using latest PC-software packages. Emphasis will be placed on molecular modeling, simulations, and spectral properties of matter in its isolated or solvated form.

Prerequisite: CHEM 510

CHEM 518 Colloid and Surface Chemistry (3-0-3)

Introduction to colloid and surface chemistry, sedimentation and diffusion, rheology of dispersions, adsorption from solution, colloidal structures and surfactant solutions, electrical double layer, electrophoresis, electrostatic and polymer-induced colloid stability.

Prerequisite: CHEM 510

CHEM 519 Special Topics in Physical Chemistry (3-0-3)

Recent topics in Physical Chemistry.

Prerequisite: CHEM 510

CHEM 520 Physical Methods in Inorganic Chemistry (3-0-3)

Theory and applications of physical methods used for characterization of inorganic and organometallic compounds. Group theoretical consideration for understanding of molecular spectra and chemical bonding in coordination compounds. General concepts of molecular spectroscopy. Basic concepts of X-ray diffraction. Ionization methods (mass spectrometry and photoelectron spectroscopy).

Prerequisite: CHEM 332

CHEM 521 Advanced Chemistry of Coordination Compounds (3-0-3)

Review of the chemistry of transition and inner transition elements. Theories of bonding in coordination compounds. Applications of the ligand field theory to the interpretation of spectra and magnetochemistry. Structure and reactivity. Coordination compounds in biological systems and industry.

Prerequisite: CHEM 520

CHEM 522 Organometallic Chemistry (3-0-3)

General properties of organometallic compounds, metal-carbon and metal-hydrogen bonds. Ligand substitution reactions, complexes of π-bond ligands, oxidative addition and reductive elimination, insertion and elimination, nucleophilic and electrophilic addition and abstraction. Homogeneous catalysis. Characterization of organometellic compounds, carbenes, metathesis and polymerization, activation of small molecules, application to organic synthesis, oxidation and high-oxidation-state complexes. Bio-organometallic chemistry.

Prerequisite: CHEM 520

CHEM 523 Chemical Crystallography (3-0-3)

X-ray diffraction, symmetry operations and space group determination, crystals and their properties, geometric and intensity data collection, data reduction, theory of structure factors and Fourier syntheses, calculation of structure factors and Fourier syntheses; solution of structure by heavy-atom methods, refinement of structure and results. Electron microscopy and neutron diffraction.

Prerequisite: CHEM 520

CHEM 524 Catalysis in Industry (3-0-3)

Theory of homogeneous versus heterogeneous catalysis. Hydrogenation-dehydrogenation, oxidation, alkylation, addition reactions, acid reactions, and catalytic polymerization. Preparation and characterization of catalysts.

Prerequisite: CHEM 520

CHEM 525 Metal-Metal Bonds and Cluster Compounds (3-0-3)

A study of metal-metal bonds in transition metal compounds with reference to the formation of cluster compounds, the interpretation of vibrational spectra for such complexes, closed metal carbonyl cluster, general methods of preparation, structure and reactivity, application to catalysis.

Prerequisite: CHEM 520

CHEM 528 Mechanisms of Inorganic Reactions (3-0-3)

Review of fundamental concepts of chemical kinetics. Physical methods for the determination of reaction rates in inorganic systems. Application of valence bond and ligand field theories to reactions in octahedral and square planar complexes. Associative and dissociative mechanisms, the trans effect, racemization, isomerization, oxidation-reduction, and photochemical reactions.

Prereq*uisite:* CHEM 520

CHEM 529 Special Topics in Inorganic Chemistry (3-0-3)

Recent topics in Inorganic Chemistry.

Prerequisite: CHEM 520

CHEM 530 Advanced Organic Chemistry (3-0-3)

Reaction mechanisms, conformations and structure reactivity relationships, aromaticity, carbanions, carbocations, organic reaction types including substituent effects and stereochemistry: substitution, addition, elimination, hydrolysis, electrophilic and nucleophilic aromatic substitution, and pericyclic reactions.

Prerequisite: CHEM 202

CHEM 531 Physical Organic Chemistry (3-0-3)

Structure and reactivity of organic molecules through the study of linear free-energy relationships, thermochemistry, kinetics, thermodynamics, rate of complex chemical reactions, isotope effects, potential energy surfaces, transition states, and general and specific acid-base theory as applied to various types of organic reactions.

Prerequisite: CHEM 530

CHEM 532 Synthetic Organic Chemistry (3-0-3)

Introduction to the concept of strategy in multi-step organic syntheses, retrosynthetic analysis, new reagents and concepts, stereospecificity, stereoselectivity, regioselectivity, chiral reagents, protecting groups, selected examples of total synthesis of natural products.

Prerequisite: CHEM 530

CHEM 533 Nuclear Magnetic Resonance Spectroscopy (3-0-3)

The study of the physical basis of the nuclear magnetic resonance spectroscopy (NMR), NMR spectra of organic molecules, experimental aspects of NMR spectroscopy, chemical shift and spin-spin coupling as a function of structure, the analysis of high-resolution NMR spectra, two-dimensional NMR spectroscopy, dynamic effects on NMR, selected experimental techniques of NMR, carbon-13 NMR spectroscopy and solid state NMR.

Prerequisite: CHEM 530

CHEM 534 Chemistry of Heterocyclic Compounds (3-0-3)

Nomenclature, structure and properties of heterocyclic compounds, heterocyclic analogs of cyclopropane and cyclobutane, compounds with one and two heteroatoms in a five-membered ring, heterocyclic analogs of benzene and naphthalene, compounds with two or more heteroatoms in a six –membered ring, fused ring systems, heterocyclic compounds in nature and medicine.

Prerequisite: CHEM 530

CHEM 535 Petrochemicals (3-0-3)

Raw Materials – natural and associated gas and crude oil, – their composition and processing. Thermal, catalytic cracking, catalytic reforming, Hydroprocessing, catalysts, operation variables and reaction mechanisms. Catalysis by transition metal complexes.

Prerequisite: Graduate Standing

CHEM 536 Spectroscopic Identification of Organic Compounds (3-0-3)

Identification and structural analysis of organic compounds by nuclear magnetic resonance, infrared, ultraviolet and mass spectroscopy. Discussion of instrumentation, sample handling and basic theory of each technique with emphasis on their practical applications for structure determination.

Prerequisite: CHEM 530 or equivalent

CHEM 537 Polymer Synthesis (3-0-3)

Types of polymerization reactions. Kinetic and mechanistic studies of addition and condensation polymerization by ionic, free radical and coordination initiators and catalysts. Ring opening polymerization, stereochemistry of polymerization.

Prerequisite: CHEM 530

CHEM 538 Natural Products Chemistry (3-0-3)

Classification of natural products, physico-chemical data, structural determination, syntheses, biosynthesis and physiological activity of several classes of natural products including terpenoids, steroids, carbohydrates, aromatic, aliphatic, alkaloids and non alkaloid nitrogen compounds.

Prerequisite: CHEM 530

CHEM 539 Special Topics in Organic Chemistry (3-0-3)

Recent topics in Organic Chemistry.

Prerequisite: CHEM 530

CHEM 540 Advanced Analytical Chemistry (3-0-3)

Advanced instrumental analysis: electroanalytical methods including potentiometry, voltammetry and coulometry. Spectroscopic techniques: AA, FE, ICP, molecular spectroscopy: fluroscence and phosophrescence. Chromatography: principles GC, HPLC, mass spectrometry. Flow injection analysis technique (FIA).

Prerequisite: CHEM 324

CHEM 542 Electroanalytical Chemistry (3-0-3)

Advanced treatment of the analytical techniques and methodology with emphasis on the modern methods. Basic principles, kinetics, and mechanisms of electrode reactions and surface phenomena; potentiometry, ion-selective electrodes, electrochemical sensors, voltammetry.

Prerequisite: CHEM 540

CHEM 543 Separation Methods (3-0-3)

Theory and applications of equilibrium and non-equilibrium separation techniques. Extraction, counter current distribution, gas chromatography, liquid chromatography, column and plane chromatographic techniques, electrophoresis and other separation methods.

Prerequisite: CHEM 540

CHEM 549 Special Topics in Analytical Chemistry (3-0-3)

Recent topics in Analytical Chemistry.

Prerequisite: CHEM 540

CHEM 550 Advanced Environmental Chemistry (3-0-3)

The course focuses on the study of the sources, reactions, transport, effects, and fates of chemical species in water, soil, and air environment. Specifically, the course deals with aquatic chemistry, atmospheric chemistry, soil chemistry, geospheres and hazardous substances. The nature and source of hazardous wastes, their environmental chemistry, and their treatment, minimization, and the effect of pollutants and hazardous substances on living organisms are discussed.

Equivalent to EnvS 520.

Prerequisite: Graduate standing

CHEM 551 Analytical Geochemistry (3-0-3)

Analytical techniques presently available for geochemical correlation purposes have increased dramatically both in number and level of sophistication. This course focuses on the recent advancements in correlation techniques such as gas chromatography and mass-spectrometry (GC, GC/MS, GC/MS/MS, and MS/MS), principles and analytical applications of modern molecular and atomic spectroscopy. Ultraviolet, visible, infrared, luminescence and scattering techniques. Flame, plasma, arc and spark emission, atomic absorption and atomic fluorescence techniques. X-ray diffraction, nuclear magnetic resonance and isotopic ratio techniques.

Equivalent to EnvS 521.

Prerequisite: Graduate standing

CHEM 552 Organic Geochemistry (3-0-3)

The objective of this course is to provide an up-to-date overview on the composition of the biosphere, both chemically and isotopically, thus affording a perspective on the nature and fate of organic compounds that may be preserved in the geosphere. The course focuses on the early diagenesis of organic matter and its consequences for application of molecular biomarkers; kerogen and related materials; and application of organic geochemical methods for hydrocarbon exploration. Application of organic geochemistry in quaternary research and an assessment of present-day problems and future perspectives in organic geochemistry are discussed.

Equivalent to EnvS 522.

Prerequisite: Graduate standing

CHEM 553 Environmental Pollution (3-0-3)

The course will mainly deal with problems related to marine pollution. Some of the topics are: different marine habitats, sources of marine pollution, types of pollution, effects of pollution on marine life, prevention and remedies for problems of pollution.

Equivalent to EnvS 523.

Prerequisite: Graduate standing

CHEM 554 Environmental Geochemistry (3-0-3)

Interaction of water with minerals and organic compounds at the low temperature of many environmental settings. Emphasis on understanding groundwater compositions and capacity for transporting metals and organic solutes in the groundwater. Species classification, mass transport, surface reactions, contaminant sources, and remediation methods.

Equivalent to EnvS 524.

Prerequisite: Graduate standing

CHEM 555 Environmental Ecology (3-0-3)

The goal of this course is better understanding of resources sharing among communities, and basic and fundamental concepts of terrestrial and aquatic environments. Global changes and nutrient cycling, nutrient availability and how resource competition among individuals within a community affects the distribution and abundance of organisms and human interactions. It also focuses on primary production, decomposition, and microbial ecology.

Equivalent to EnvS 525.

Prerequisite: Graduate standing

CHEM 599 Graduate (M.S) Seminar (1-0-0)

Attendance of departmental seminars given by faculty, graduate students and visiting scholars. An M.S. student is expected to give a seminar on a literature topic of current interest in Chemistry

Prerequisite: Graduate standing

CHEM 610 M.S Thesis (0-0-6)

CHEM 614 Characterization of Materials (3-0-3)

Introduction to techniques of imaging, and compositional analysis of advanced materials including nanomaterials. Principles and applications of various microscopy methods. Topics include AFM, SEM, TEM, EELS etc and imaging processes.

Prerequisite: CHEM 510

CHEM 615 Statistical Thermodynamics (3-0-3)

The concept of ensemble and kinds of ensembles, quantum statistical mechanics, the partition function, Fermi and Bose statistics, imperfect fluids, cluster expansion, phase transitions.

Prerequisite: CHEM 512

CHEM 616 Quantum Chemistry II (3-0-3)

Application of quantum theory to molecular systems. Group theory: point groups and continuous groups. Application of group theory to atomic and molecular spectroscopy.

Prerequisite: CHEM 516

CHEM 617 Chemistry and Physics of Nanomaterials (3-0-3)

Fundamental chemical concepts and basic ideas needed to calculate the difference between the bulk properties of matter and the properties of aggregates. Tools needed to probe matter at the nanoscale level. Examples of nanoscale materials such as monolayers, fulleries, clusters, biomolecules etc., and their applications

Prerequisite: CHEM 510

CHEM 618 Advanced Magnetic Resonance Techniques (3-0-3)

Magnetic resonance theory, spin-lattice relaxation and motional narrowing of resonance lines. The density matrix of two level systems. Angular momentum and molecular rotation. Time dependent phenomena, time correlation function and memory function formalisms. Advanced concepts in pulsed magnetic resonance.

Prerequisite: CHEM 510

CHEM 620 Homogeneous Catalysis by Coordination Compounds (3-0-3)

Criteria for an effective homogeneous catalyst, survey of developed homogeneous catalytic processes, experimental methods of investigation of reaction mechanisms, supported homogeneous catalysis, metallocene catalysts, catalytic chain transfer catalysis and recent developments in coordination compounds as homogeneous catalysts.

Prerequisites: Graduate Standing

CHEM 621 Heterogeneous Catalysis (3-0-3)

Survey of developed heterogeneous catalytic processes, structures of surface, physical methods of investigation of surface phenomena, kinetics, catalysis by metal clusters, experimental considerations.

Prerequisite: Graduate Standing

CHEM 622 Surface Chemistry and Catalysis (3-0-3)

Physical and chemical properties of the surface in a reacting system, crystallite morphology, interface equilibria, adsorption and desorption kinetics, binding states and adsorbate structures, electronic properties of nonmetal catalysts, and metal-electrolyte interfaces.

Prerequisite: CHEM 520

CHEM 623 Photochemistry of Coordination Compounds (3-0-3)

Photophysical properties of excited states, photochemical reactions of excited states in coordination compounds, techniques for the study of the excited states and their reactions, photochemistry of polypyridyl complexes, photochemistry of porphyrin complexes, applications, recent developments.

Prerequisite: CHEM 520

CHEM 624 Solid State Chemistry (3-0-3)

Status solidi, shape of particles, lattice energy and Haber cycle, concepts of symmetry, crystal chemistry, structures of elements and parent structures of compounds, covalent solids, lattice defects and their thermodynamics, non stoichiometry, alloy and intermetallic compounds, doping and semiconductors, order-disorder, phenomena, phase diagrams magnetic and electric properties, fast ionic conductivity, industrial chemicals, overview on experimental methods.

Prerequisite: CHEM 520

CHEM 626 Bio-Inorganic Chemistry (3-0-3)

Study of metalloproteins and other metal-containing biological molecules, photosynthesis, metallo- and metal-activated enzymes in hydrolysis and group-transfer reactions, the transition metals in biological redox reactions, nitrogen fixation, the biochemistry of iron, essential and trace elements in biological systems, metal ions and chelating agents in medicine, inorganic problems in biological systems.

Prerequisite: CHEM 520

CHEM 627 X-ray Diffraction Analysis (3-0-3)

Single crystal X-ray diffraction: data collection, structure solution and refinement. Polycrystalline X-ray diffraction: data collection and analysis including Rietveld refinement. Applications to molecular compounds, minerals and polymers.

Prerequisite: CHEM 520

CHEM 630 Physical Chemistry and Characterization of Polymers (3-0-3)

Application of physical methods to the determination of the structure of polymers, physical chemistry of macromolecules, principles of experimental techniques and application, correlation between structure and physical macro-properties.

Prerequisite: CHEM 537

CHEM 631 Molecular Biochemistry (3-0-3)

The course focuses on the chemistry, structure, and function of biological molecules, macromolecules and systems. Topics covered include protein and nucleic acid structure, enzymology, mechanisms of catalysis, regulation, lipids and membranes, carbohydrates, bioenergetics and carbohydrate metabolism.

Prerequisite: CHEM 530

CHEM 632 Bioseparations, Recombinant Techniques and Protein Sciences (3-0-3)

General characteristics of separation processes used in the biotechnology industry - including the removal of insolubles, isolation and purification of thermally sensitive products and the preparation of products for final use by the customer. Application of principles for biological separations, recombinant DNA techniques, protein engineering.

Prerequisite: CHEM 530

CHEM 633 Polymeric Drug Delivery Systems (3-0-3)

Biocompatible polymers and their application in drug delivery systems. Polymers of natural and synthetic origin, Special emphasis on the synthesis of biocompatible polymers. The formation of polymeric micelles, hydrogels and liposomes. The process of extravasations as uptake mechanism for polymeric delivery systems. Reading material will be based on the latest publications in the field.

Prerequisite: CHEM 530

CHEM 640 Analytical Spectroscopy (3-0-3)

Principles and analytical applications of modern molecular and atomic spectroscopy. Ultraviolet, visible, infrared, luminescence and scattering techniques. Flame, plasma, emission techniques, atomic absorption and atomic fluorescence techniques.

Prerequisite: CHEM 540

CHEM 642 Chemometrics (3-0-3)

Basic Statistics, Analysis of Variance (*ANOVA*), Computer Software (Mat Lab for Windows), Principles of Experimental Design, Factorial Designs and Analysis, Fractional Factorials, Response Surface Methodology, Second-order Designs, Application of the chemical Optimization by simplex.

Prerequisite: CHEM 540

CHEM 643 Environmental Analytical Chemistry (3-0-3)

Analytical aspects of several types of pollutants and the most common and recent analytical techniques used in environmental chemical analysis. This includes: atmosphere, water, oceans, land and environmental monitoring; instrumental techniques (chromatography, spectrometry, mass spectrometry, X-ray, radiochemical and electrochemical methods) used as tools for environmental analysis; sampling techniques; environmental data analysis and presentation.

Prerequisite: CHEM 540

CHEM 699 Graduate (Ph.D) Seminar (1-0-0)

Attendance of departmental seminars given by faculty and graduate students and visiting scholars. A Ph.D student is expected to give a seminar on a literature topic of current interest in Chemistry

Prerequisite: Graduate standing

CHEM 710 Ph.D Dissertation (0-0-12)

EARTH SCIENCES

Chairman

Abdulaziz M. Al-Shaibani

Professors

Korvin

Associate Professors

Abokhodair

Al-Hinai

Hariri

Qahwash

Makkawi

Al-Shuhail

Assistant Professors

Al-Shaibani

Al-Ramadan

Abdulghani

Abdullatif

Kaka

Safeen

Tawabini

GRADUATE PROGRAMS IN EARTH SCIENCES

The economic prosperity and industrial growth potentials of a nation are largely based on the availability of natural resources. Traditionally, by locating and exploiting natural resources, earth scientists (geologists and geophysicists) play a vital role in the development of a country. This is particularly true for a country like Saudi Arabia who owes its economic prosperity and rapid developments to the discovery of enormous reserves of petroleum by earth scientists only a few decades ago.

The successful management of the vast petroleum and mineral resources poses a complex and exciting challenge for scientific, technical, and management education in the Kingdom. Keeping this broad perspective in mind, King Fahd University of Petroleum and Minerals (KFUPM) adopted advanced academic programs in these fields as one of its goals. Obviously, the Earth Sciences department is one of the first departments to be organized and established in the university. The University established the Department of Geology in 1963. By the addition of Geophysics option in 1976, the name was changed to the Department of Earth Sciences.

The Earth Sciences Department offers both undergraduate and graduate studies in geology and geophysics and MS degree in Environmental Sciences. The primary goal of the department's graduate programs is to educate geologists and geophysicists who can go directly into productive positions in the industry or government establishments. The level of instruction is also at a high standard such that it prepares the students towards the pursuance of higher studies leading to Ph.D. degree.

There are two master's degree options in Earth Sciences, namely Master of Science in Geology or Master of Science in Geophysics, and Master of Geology or Master of Geophysics.

The Master of Science in Geology or Geophysics is designed for students who wish to focus on excellence in research. It requires 24 credit hours of approved core work and 6 hours of an acceptable thesis. Students are allowed to pursue their request in any area of their interest. However, the department encourages students to concentrate in any of the following research area: Sedimentology and Petroleum Geology, Economic Geology and Geochemistry, Hydrogeology, Environmental Geology, and Exploration Geophysics.

The master of Geology or Geophysics is designed for students who wish to focus on excellence in training in Earth Sciences rather than research. It requires (39) credit hours of approved course work and (3) hours of an acceptable Master Report.

The Master of Science in Environmental Sciences requires 24 credit hours and 6 hours of acceptable thesis.

TEACHING AND RESEARCH FACILITIES

Facilities currently available in the department include several well equipped lecture, seminar, audio-visual and resources rooms. The resource room contains a wide selection of professional journals, memories, reference textbooks and other publications. In addition, the department has a good collection of audio-visual and other instruction materials. The Earth Sciences' museum located in building 26, has a huge inventory of geological specimens (rocks, minerals, fossils, fossil fuels) collected from different areas in the Kingdom and worldwide. The department owns several 4-wheel drives and dune buggies for field trips. These vehicles are used both for local course-related field trips as well as geological itineraries during the Summer Field camp.

Laboratory facilities and equipment available in the department include thin section, reflection petroscopy, scanning electron microscopy (SEM), Xray defactometry (XRD), ground penetrating radar (GPR), paleomagnetism, remote sensing, aerial photography, resistivity, gravimeter, seismograph, and instruments for field as well as laboratory hydrologic and radiometric measurement. A modern seismic monitoring station is also located in the department. In addition, the department enjoys unrestricted access to the highly developed and equipped research facilities in the Central Analytical Laboratories, the Energy Research Laboratory and Remote Sensing units of the university Research Institute (RI). Facilities available at RI include XRF, SEM, TEM, ICP, AA, and GC-MS, X-ray emission (PIXE).

The PC laboratory of the department is equipped with the state-of-the art computing facilities. The department has several SUN workstations for training students in different geological and geophysical application software packages including IESX 2D/3D, Geo Viz, Stratlog II, GeoFrame, and GPS-3. In addition, the department is connected to the UNIX server of the university Information Technology Center (ITC), a major data processing center in the region.

DEPARTMENT ADMISSION REQUIREMENTS

Graduates in Earth Sciences or related disciplines from the KFUPM or any other recognized institutions with a cumulative GPA of 3.00 or above (on scale of 4.00) or equivalent are eligible to apply for admission to the graduate programs. However, candidates with a GPA between 2.5 and 3.00 are also considered for provisional admission. In addition, the applicants need to satisfy the general admission requirements of the Deanship of Graduate Studies. Students with inadequate background are expected to take the deficiency courses determined by the department.

ACADEMIC PROGRAMS

(A) M.S. IN GEOLOGY

The Master of Science in Geology is designed for students who wish to focus on excellence in research.

(1) Degree Requirements

Total credit hours required for the Master of Science in Geology program is 30 credit hours. The distribution of credit hours is as follows:

Geology Core Courses	9
Geology Elective Courses	9
Free Elective Courses	6
Thesis	6
Total Credit Hours	**30**

The Free Elective courses can be taken from any academic department (including Earth Sciences Department) provided the courses are 500-level or higher and approved in the student's degree plan. Up to two graduate-level Geology elective courses can be substituted with 400-level undergraduate Geology courses only after advisor and department approvals. No credit will be given for any 400-level courses taken outside the department.

Students are allowed to pursue thesis research in any area of their interest. However, considering the current industry and academia needs, the department encourages students, in the Geology option, to specialize/concentrate in any of the following research areas: Sedimentology and Petroleum Geology, Economic Geology and Geochemistry, Hydrogeology, Environmental and Engineering Geology.

(2) Core Courses

The following courses are required for all graduate students in the Geology option:

Course #	Title	Credit Hours
GEOL 501	Geology of the Middle East	3
GEOL 502	Advanced Structural Geology	3
GEOL 581	Geophysical Exploration	3
GEOL 599	Seminar	0
GEOL 610	Thesis	6

(3) Geology Elective Courses

Geology elective courses, their titles, and credit hours are listed below:

GEOL 521	Advanced Petroleum Geology	3
GEOL 522	Micropaleontology	3
GEOL 531	Advanced Stratigraphy	3
GEOL 532	Advanced Sedimentology	3
GEOL 533	Carbonates and Evaporites	3
GEOL 534	Seismic and Sequence Stratigraphy	3
GEOL 535	Quaternary Geology of Saudi Arabia	3
GEOL 541	Advanced Mineralogy	3
GEOL 542	Advanced Petrology	3
GEOL 543	Ore Mineralogy	3
GEOL 544	Ore deposits	3
GEOL 545	Advanced Economic Geology	3
GEOL 551	Advanced Geochemistry	3
GEOL 552	Geochemical Prospecting	3
GEOL 561	Advanced Hydrogeology	3
GEOL 562	Groundwater Modeling	3
GEOL 563	Development of Ground Water Resources	3
GEOL 571	Advanced Engineering Geology	3
GEOL 572	Geo-Environment	3

GEOL 573	Terrain Analysis	3
GEOL 582	GIS Applications in Geology	3
GEOL 583	Photogeology and Remote Sensing	3
GEOL 584	Applied Geostatistics	3
GEOL 585	Geological Laboratory Techniques	3
GEOL 590	Independent Studies	3
GEOL 592	Special Topics	3

(4) Free Elective Courses

All students are required to complete two electives (6 credit hours) to be chosen from any academic department, including Earth Sciences Department, provided the courses are 500 level courses or above and approved in the student's degree plan.

(5) Students are required to attend and pass the Geol 599 seminar, which carries no credit.

(6) The student must satisfy the Geol 610 thesis requirement (6 credit hours). He must complete the thesis on an approved topic under the supervision of his graduate thesis committee.

(7) The student must maintain a cumulative and major GPA of 3.00 or above in all graduate work.

DEGREE PLAN

Students admitted in the Master of Science in Geology program are required to prepare and submit a degree plan in consultation with their academic advisors at the first semester in the program. Students will be barred from registering for any additional courses in the following semester unless the degree plan is approved. Students admitted conditionally into the program must satisfy the imposed conditions at the earliest available opportunity. The plan outlined below applies to the Master of Science in Geology program.

Degree Plan for the M.S. in Geology

Course #	Title	LT	LB	CR
First Semester				
GEOL 501	Geology of the Middle East	3	0	3
GEOL xxx	Geology Elective I	3	0	3
GEOL xxx	Geology Elective II	3	0	3
		9	**0**	**9**
Second Semester				
GEOL 502	Advanced Structural Geology	3	0	3
GEOL xxx	Geology Elective III	3	0	3
XXX xxx	Free Elective I	3	0	3
GEOL 599	Seminar	1	0	0
		10	**0**	**9**
Third Semester				
GEOL 581	Geophyiscal Exploration	3	0	3
XXX xxx	Free Elective II	3	0	3
		6	**0**	**6**
Fourth Semester				
GEOL 610	Thesis	0	0	6
		0	**0**	**6**
Total Credit Hours				**30**

(B) MASTER OF GEOLOGY

The Master of Geology program is designed for the professional geoscientists who wish to focus on excellence in training in geosciences rather than research.

(1) Degree Requirements

Total credit hours required for the Master in Geology program is 42. The distribution of credit hours is as follows:

Geology Core Courses	12
Geology Elective Courses	15
Free Elective Courses	12
Geology Master Report	3
Total Credit Hours	**42**

The Free Elective courses can be taken from any academic department (including Earth Sciences Department) provided the courses are 500-level or higher and approved by the student's academic advisor. Up to two graduate-level Geology elective courses can be substituted with 400-level undergraduate Geology courses only after advisor and department approvals. No credit will be given for any 400-level courses taken outside the department.

Students are allowed to pursue thesis research in any area of their interest. However, considering the current industry and academia needs, the department encourages students, in the Geology option, to specialize/concentrate in any of the following research areas: Sedimentology and Petroleum Geology, Economic Geology and Geochemistry, Hydrogeology, Environmental and Engineering Geology.

(2) Core Courses

The following courses are required for all graduate students in the Geology option:

Course #	Title	Credit Hours
GEOL 501	Geology of the Middle East	3
GEOL 502	Advanced Structural Geology	3
GEOL 581	Geophysical Exploration	3
GEOL 585	Geological Laboratory Techniques	3
GEOL 599	Seminar	0
GEOL 600	Geology Master Report	3

(3) Geology Elective Courses

Geology elective courses, their titles, and credit hours are listed in the following table:

GEOL 521	Advanced Petroleum Geology	3
GEOL 522	Micropaleontology	3
GEOL 531	Advanced Stratigraphy	3
GEOL 532	Advanced Sedimentology	3
GEOL 533	Carbonates and Evaporites	3
GEOL 534	Seismic and Sequence Stratigraphy	3
GEOL 535	Quaternary Geology of Saudi Arabia	3
GEOL 541	Advanced Mineralogy	3
GEOL 542	Advanced Petrology	3
GEOL 543	Ore Mineralogy	3
GEOL 544	Ore deposits	3
GEOL 545	Advanced Economic Geology	3
GEOL 551	Advanced Geochemistry	3
GEOL 552	Geochemical Prospecting	3
GEOL 561	Advanced Hydrogeology	3
GEOL 562	Groundwater Modeling	3
GEOL 563	Development of Ground Water Resources	3
GEOL 571	Advanced Engineering Geology	3
GEOL 572	Geo-Environment	3
GEOL 573	Terrain Analysis	3
GEOL 582	GIS Applications in Geology	3
GEOL 583	Photogeology and Remote Sensing	3
GEOL 584	Applied Geostatistics	3
GEOL 590	Independent Studies	3
GEOL 592	Special Topics	3

(4) Free Elective Courses

All students are required to complete four electives (12 credit hours) to be chosen from any academic department, including Earth Sciences Department, provided the courses are 500 level courses or above and approved in the student's degree plan.

(5) Students are required to attend and pass the Geol 599 seminar, which carries no credit.

(6) The student must satisfy the Geol 610 Geology Master Report requirement (3 credit hours). He must complete the report on an approved topic under the supervision of his academic advisor.

(7) The student must maintain a cumulative and major GPA of 3.00 or above in all graduate work.

DEGREE PLAN

Students admitted in the Master of Geology are required to prepare and submit a degree plan in consultation with their academic advisors at the first semester. Students will be barred from registering for any additional courses in the following semester if the degree plan is not approved. Students admitted conditionally into a program are expected to satisfy all university and departmental requirements at the earliest available opportunity. The plan outlined below applies for the Master of Geology Program.

Degree Plan for the Master in Geology

Course #	Title	LT	LB	CR
First Semester				
GEOL 501	Geology of the Middle East	3	0	3
GEOL xxx	Geology Elective I	3	0	3
GEOL xxx	Geology Elective II	3	0	3
XXX xxx	Free Elective I	3	0	3
		12	**0**	**12**
Second Semester				
GEOL 502	Advanced Structural Geology	3	0	3
GEOL xxx	Geology Elective III	3	0	3
GEOL 599	Seminar	1	0	0
XXX xxx	Free Elective II	3	0	3
		10	**0**	**9**
Third Semester				
GEOL 581	Geophysical Exploration	3	0	3
GEOL xxx	Geology Elective IV	3	0	3
XXX xxx	Free Elective III	3	0	3
XXX xxx	Free Elective IV	3	0	3
		12	**0**	**12**
Fourth Semester				
GEOL 585	Geological Laboratory Techniques	2	3	3
GEOL xxx	Geology Elective V	3	0	3
GEOL 600	Geology Master Report	0	0	3
		5	**3**	**9**
Total Credit Hours				**42**

(C) M.S. IN GEOPHYSICS

The Master of Science in Geophysics is designed for students who wish to focus on excellence in research.

(1) Degree Requirements

Total credit hours required for the Master of Science in Geophysics program is 30 credit hours. The distribution of credit hours is as follows:

Geophysics Core Courses	9
Geophysics Elective Courses	6
Graduate Mathematics Course	3
Free Elective Courses	6
Thesis	6
Total Credit Hours	**30**

The Free Elective courses can be taken from any academic department (including Earth Sciences Department) provided the courses are 500-level or higher and approved by the student's academic advisor. Up to two graduate-level Geophysics elective courses can be substituted with 400-level undergraduate Geophysics courses only after advisor and department approvals. No credit will be given for any 400-level courses taken outside the department.

(2) Core Courses

The following courses are required for all graduate students in the Geophysics option:

Course #	Title	Credit Hours
GEOP 501	Reflection Seismology	3
GEOP 502	Potential Theory Methods	3
GEOP 503	Solid-Earth Geophysics	3
MATH 5xx	Graduate Mathematics Course	3
GEOP 599	Seminar	0
GEOP 610	Thesis	6

(3) Geophysics Elective Courses

Geophysics elective courses, their titles, and credit hours are listed in the following table:

GEOP 504	Applied Environmental Geophysics	3
GEOP 505	Advanced Computational Geophysics	3
GEOP 510	Seismic Data Analysis	3
GEOP 515	Geophysical Inversion	3
GEOP 520	Geomagnetism & Paleomagnetism	3
GEOP 525	Electrical Methods	3
GEOP 530	Basin Analysis	3
GEOP 535	Seismic & Sequence Stratigraphy	3
GEOP 540	Three-Dimensional Seismic Interpretation	3
GEOP 545	Petroleum Data Integration & Management	3
GEOP 550	Reservoir Characterization	3
GEOP 590	Independent Studies	3
GEOP 592	Special Topics	3

(4) Mathematics and Free Elective courses

All students are required to complete one graduate Mathematics course and two electives (6 credit hours) to be taken from any academic department, including Earth Sciences Department, provided the courses are 500 level courses or above and approved in the student's degree plan.

(5) Students are required to attend and pass the Geop 599 seminar, which carries no credit.

(6) The student must satisfy the GEOP 610 thesis requirement (6 credit hours). He must complete the thesis on an approved topic under the supervision of his graduate thesis committee.

(7) The student must maintain a cumulative and major GPA of 3.00 or above in all graduate work.

DEGREE PLAN

Students admitted in the Master of Science in Geophysics program are required to prepare and submit a degree plan in consultation with their academic advisors at the first semester in the program. Students will be barred from registering for any additional courses in the following semester unless the degree plan is approved. Students admitted conditionally into the program must satisfy the imposed conditions at the earliest available opportunity. The plan outlined below applies to the Master of Science in Geophysics program.

Degree Plan for the M.S. in Geophysics

Course	Title	LT	LB	CR
First Semester				
GEOP 501	Reflection Seismology	3	0	3
GEOP 502	Potential Theory Methods	3	0	3
GEOP xxx	Geophysics Elective I	3	0	3
GEOP 599	Seminar	1	0	0
		10	**0**	**9**
Second Semester				
GEOP 503	Solid-Earth Geophysics	3	0	3
GEOP xxx	Geophysics Elective II	3	0	3
XXX xxx	Free Elective I	3	0	3
		9	**0**	**9**
Third Semester				
MATH 5xx	Graduate Mathematics Course	3	0	3
XXX xxx	Free Elective II	3	0	3
		6	**0**	**6**
Fourth Semester				
GEOP 610	Thesis	0	0	6
		0	**0**	**6**
Total Credit Hours				**30**

(D) MASTER OF GEOPHYSICS

The Master of Geophysics program is designed for the professional geoscientists who wish to focus on excellence in training in geosciences rather than research.

(1) Degree Requirements

Total credit hours required for the Master of Geophysics is 42. The distribution of credit hours is as follows:

Geophysics Core Courses	9
Geophysics Elective Courses	15
Graduate Mathematics Course	3
Free Elective Courses	12
Geophysics Master Report	3
Total Credit Hours	**42**

(2) Core Courses

The following courses are the core courses for graduate students in the Geophysics option.

Course #	Title	Credit Hours
GEOP 501	Reflection Seismology	3
GEOP 502	Potential Theory Methods	3
GEOP 503	Solid-Earth Geophysics	3
MATH 5xx	Graduate Mathematics Course	3
GEOP 600	Geophysics Master Report	3
GEOP 599	Seminar	0

(3) Geophysics Elective Courses

Geophysics elective courses, their titles, and credit hours are listed in the following table:

GEOP 504	Applied Environmental Geophysics	3
GEOP 505	Advanced Computational Geophysics	3
GEOP 510	Seismic Data Analysis	3
GEOP 515	Geophysical Inversion	3
GEOP 520	Geomagnetism & Paleomagnetism	3
GEOP 525	Electrical Methods	3
GEOP 530	Basin Analysis	3
GEOP 535	Seismic & Sequence Stratigraphy	3
GEOP 540	Three-Dimensional Seismic Interpretation	3
GEOP 545	Petroleum Data Integration & Management	3
GEOP 550	Reservoir Characterization	3
GEOP 590	Independent Studies	3
GEOP 592	Special Topics	3

(4) Mathematics and Free Elective courses

All students are required to complete one graduate Mathematics course and four electives (12 credit hours) to be taken from any academic department, including Earth Sciences Department, provided the courses are 500 level courses or above and approved in the student's degree plan.

(5) Students are required to attend and pass the Geop 599 seminar, which carries no credit.

(6) The student must satisfy the Geop 600 Master Report requirement (3 credit hours). He must complete the report on an approved topic under the supervision of his academic advisor.

(7) The student must maintain a cumulative and major GPA of 3.00 or above in all graduate work.

DEGREE PLAN

Students admitted in the Master of Geophysics are required to prepare and submit a degree plan in consultation with their academic advisors at the first semester. Students will be barred from registering for any additional courses in the following semester if the degree plan is not approved. Students admitted conditionally into a program are expected to satisfy all university and departmental requirements at the earliest available opportunity. The plan outlined below applies for the Master of Geophysics Program.

Degree Plan for the Master of Geophysics

Course	Title	LT	LB	CR
First Semester				
GEOP 501	Reflection Seismology	3	0	3
GEOP 502	Potential Theory Methods	3	0	3
GEOP 5xx	Geophysics Elective I	3	0	3
XXX xxx	Free Elective I	3	0	3
		12	**0**	**12**
Second Semester				
GEOP 503	Solid-Earth Geophysics	3	0	3
GEOP xxx	Geophysics Elective II	3	0	3
XXX xxx	Free Elective II	3	0	3
GEOP 599	Seminar	1	0	0
		10	**0**	**9**
Third Semester				
MATH 5xx	Graduate Mathematics Course	3	0	3
GEOP xxx	Geophysics Elective III	3	0	3
XXX xxx	Free Elective III	3	0	3
XXX xxx	Free Elective IV	3	0	3
		12	**0**	**12**
Fourth Semester				
GEOP xxx	Geophysics Elective IV	3	0	3
XXX xxx	Geophysics Elective V	3	0	3
GEOP 600	Geophysics Master Report	0	0	3
		6	**0**	**9**
Total Credit Hours				**42**

COURSE DESCRIPTION

GEOLOGY COURSES

GEOL 501 Geology of the Middle East (3-0-3)

Topography, geomorphology and geologic setting of the Middle East, major tectonic elements in the region, Pre-Cambrian rocks (the Arabian-Nubian Shield); Non-Folded Phanerozoic rocks, Mesozoic Cenozoic fold belts (e.g. the Oman Mountains, the Zagros Belt, the Northern Iraq Chain, the Toros Chain); origin of the minerals in the Middle East. At least one field trip is required.

Prerequisite: GEOL 318 or consent of the instructor

GEOL 502 Advanced Structural Geology (3-0-3)

Principles and concepts of rock mechanics applied to structural features, brittle and ductile deformations, large-scale tectonics and regional tectonic provinces and associated structures; geometrical analysis of megascopic structures in terranes with multiple or complex deformations; analysis of strain from deformed primary features. At least one field trip is required.

Prerequisite: GEOL 305 or consent of the instructor.

GEOL 521 Advanced Petroleum Geology (3-0-3)

Origin, migration and accumulation of petroleum; Properties of reservoir rocks; Biomarkers and geochemical correlations; Techniques of subsurface geology – formation evaluation using well logs, different mapping techniques; geological problems. of production and secondary recovery are emphasized; case histories of major oil fields are reviewed. At least one field trip is required.

Prerequisite: GEOL 415 or consent of the instructor

GEOL 522 Micropaleontology (3-0-3)

Definition and historical development of micropaleontology, techniques in micropaleontological and microstratigraphical analysis; survey of the major microfossil groups, their morphology, taxonomy, ecology, geologic distribution, evolutionary trends and stratigraphic use, with selected problems. from Arabia and nearby regions.

Prerequisite: GEOL 214 or consent of the instructor.

GEOL 531 Advanced Stratigraphy (3-0-3)

Review of basic stratigraphic concepts; Sedimentary facies and facies relations-Walther's law; International codes and procedures on classification and nomenclatures of stratigraphic units – lithostratigraphy, biostratigraphy and chronostratigraphy, methods of correlations; Seismic stratigraphy; Sequence stratigraphy- sequences, system tracts, parasequrences; other stratigraphic methods including magneto-stratigraphy, isotope stratigraphy and event stratigraphy; Basin analysis and tectonics. At least one field trip is required.

Prerequisite: GEOL 307 or consent of the instructor.

GEOL 532 Advanced Sedimentology (3-0-3)

Review of properties of sedimentary materials- clastic and carbonates; Concept of flow regime and bed forms; Sedimentary processes and depositional environments – continental, marginal marine and marine; Facies and facies analysis-criteria for recognition of ancient sedimentary environment; Interpretation and recognition of major depositional environments: fluvial, eolian, delta, beach and barrier bar, marine shelf-clastics and carbonates, deep marine turbidite, pelagic; Burial diagenesis – clastics and carbonates.

Prerequisite: GEOL 307 or consent of the instructor.

GEOL 533 Carbonates and Evaporites (3-0-3)

Principles of carbonate and evaporite sedimentology; depositional sequences defined in modern environments and utilized to interpret ancient rock records; depositional and diagenetic microfacies; recognition and description of hydrocarbon reservoirs in carbonate rocks.

Prerequisite: GEOL 307 or consent of the instructor.

GEOL 534 Seismic and Sequence Stratigraphy (3-0-3)

Seismic velocities, Wavelets, Acoustic impedance, Reflection coefficient, Data acquisition & data processing, 2-D and 3-D seismic methodology, Seismic response to geological structures, convergent margins, Divergent margins, Salt tectonics, Sedimentary processes, Depositional environments, Well log correlation, Seismic facies analysis, Global changes in sea level, System tracts, Chrono- and litho-stratigraphy, Clastics and carbonate sequence stratigraphy, Case histories.

Prerequisite: (GEOL 307 and GEOP 202) or consent of the instructor

GEOL 535 Quaternary Geology of Saudi Arabia (3-0-3)

Evaluation of sedimentological, hydrogeological, geomorphological and climatic processes during the Quaternary period in Saudi Arabia; characteristics, distribution, and origin of Quaternary deposits, stratigraphy and chronology; formation of associated landforms, landscapes, sea level fluctuations; comparison of the Quaternary hydrogeology, geochronology and climate of the Arabian peninsula with that of North Africa and Europe.

Prerequisite: GEOL 307 or consent of the instructor.

GEOL 541 Advanced Mineralogy (2-3-3)

Chemical and physical basis of mineralogy such as crystal chemistry, crystal structure, geochemistry, etc. Studies of some of the less common minerals. Laboratory work will cover instrumental techniques using X-ray diffraction, differential thermal analysis, heavy liquids, isodynamic separator, etc.

Prerequisite: GEOL 216 or consent of the instructor.

GEOL 542 Advanced Petrology (2-3-3)

Selected topics in igneous and metamorphic petrology such as magmatic differentiation, generation, metamorphic facies, in conformity with concepts of global tectonics. Emphasis may be varied to suit the needs of students. Laboratory studies will examine suits of rocks from igneous and metamorphic terranes. At least one field trip is required.

Prerequisite: GEOL 320 or consent of the instructor.

GEOL 543 Ore Mineralogy (2-3-3)

Ore microscopic techniques. Textures and optical properties of ore minerals. Systematic mineralogy of ore minerals. Study of fluid inclusions in ore minerals. Stable isotopes. Mineral stabilities and paragenesis. Introduction to mineral processing.

Prerequisite: GEOL 216 or consent of the instructor.

GEOL 544 Ore Deposits (3-0-3)

Study of the different metallic and non-metallic ore deposits, their characteristics, ore geneses, and geological settings. Ore formation processes, ore bearing fluids, wall rock alteration, paragenesis, isotopic and fluid inclusion studies and ore deposits distribution according to their geological environment. The metalogenic provinces in Saudi Arabia and examples of ore deposits within the Arabian Shield and cover rocks. At least one field trip to an operational mine or mineral prospect is required.

Prerequisite: GEOL 456 or consent of the instructor.

GEOL 545 Advanced Economic Geology (3-0-3)

Study of the different exploration methods of the ore deposits, and the control of structural, sedimentological, chemical and physical factors on ore deposits formation. Methods of ore deposits evaluation and the geostatistical assessments of the ore deposits. Preparation of an exploration project and steps of its implementation. At least one field trip to an operational mine is required.

Prerequisite: GEOL 456 or consent of the instructor.

GEOL 551 Advanced Geochemistry (3-0-3)

Principles, Geochemistry applied to mineral exploration, pollution characterization and low-temperature diagenesis; clay mineral and cation exchange; adsorption; redox equillibria; heavy metals and metalloids; stability relationships; overview of isotope geochemistry; transport and reaction modeling; interpretation of data, case histories and research problem.

Prerequisite: GEOL 355 or consent of the instructor.

GEOL 552 Geochemical Prospecting (3-0-3)

Geochemical behavior of common ore elements, development of primary and secondary holes around ore deposits, distribution of detrital material and solutions by streams. and glaciers, etc. Strategy of geochemical exploration programs. in different terrains and different climates. Field and semifield methods of analysis for trace amount of metals.

Prerequisite: Consent of the instructor.

GEOL 561 Advanced Hydrogeology (3-0-3)

A general review of the principles of physical hydrogeology: Geology of porous media; Darcy’s law; Groundwater flow equations; Pumping test analysis and aquifer evaluation. Concepts of mass transport in porous medium; Contaminant hydrogeology; Capture zone analysis; Methods of remediation.

Prerequisite: GEOL 423 or equivalent

GEOL 562 Groundwater Modeling (3-0-3)

Review of groundwater flow and transport equations; Development of numerical models describing groundwater flow and transport; Application of numerical modeling related to groundwater depletion and contaminant transport; Case studies.

Prerequisite: GEOL 423 or equivalent. Experience in a programming language is recommended.

GEOL 563 Development of Ground-Water Resources (3-0-3)

An introduction to geophysical and geochemical methods of exploration for planning, and design of regional water resources investigations. Case histories in the management of ground-water resources. Literature review and special field problems. in resource developments.

Prerequisite: GEOL 562 or consent of the instructor.

GEOL 571 Advanced Engineering Geology (3-0-3)

Use of different site investigation techniques for identification and evaluation environmental problems. before and after construction phases, engineering geological mapping, and assessment of engineering geological hazards in the arid region, geohazards, risk assessment, sampling and monitoring methods utilized in the engineering applications. Special emphasis is also given to study the engineering geological aspects of existing engineering/environmental problem(s) at selected site(s).

Prerequisite: GEOL 341 or consent of the instructor

GEOL 572 Geo-Environment (3-0-3)

Study of interaction between human activity and geologic environment; role of geosciences in planning and management of the environmental applications, prediction and forecasting of hazards and changes of the environment caused by natural processes, man-made and technological activities; selected case studies.

Prerequisite: GEOL 446 or consent of the instructor

GEOL 573 Terrain Analysis (3-0-3)

Study of geomorphic processes, landform development, surficial earth materials, terrain mapping and hazard evaluation, urban climate, urban hydrology, engineering geological aspects, soil types, terrain classification, ecology and vegetation, role of Geographic Information Systems. (GIS) on terrain analysis. Special emphasis will be given to evaluate of the engineering geological properties of terrain factors for site selection and design of engineering and environmental projects. Selected case studies

Prerequisite: GEOL 312 or consent of the instructor

GEOL 581 Geophysical Exploration (3-0-3)

General survey of the most widely used Geophysical methods for natural resources exploration and environmental studies (e.g. seismic, gravity, magnetic, resistivity, telluric, magnetelluric, self-potential and GPR methods). Discussions include theoretical basis, field instruments, acquisition and reduction of raw data, various interpretation techniques and field examples. This course cannot be taken for credit by students in the Geophysics option.

Prerequisite: GEOP 202 or equivalent

GEOL 582 GIS Applications in Geology (3-0-3)

Introduction to the GIS. Type of geological and remote sensing data used in GIS and data preparation for GIS studies. Uses of GIS in mineral and hydrocarbon exploration, and in geological, and structural studies. Spatial relationship and geological associations.

Prerequisite: Consent of the instructor.

GEOL 583 Photogeology and Remote Sensing (3-0-3)

Advanced application of multi spectral imagery, radar and other remote sensing data to geological environments. Emphasis will be given to different digital image processing techniques and how they can be utilized for specific geological problem.

Prerequisite: Graduate standing.

GEOL 584 Applied Geostatistics (3-0-3)

Importance of modeling and simulation in characterizing geologic parameters; Conventional estimation techniques; Principles of the regionalized variables theory; Analysis of spatial structures and there relation to geologic features; Kriging methods and their applications; Types of conditional simulation techniques; Utilization of geostatistical packages for modeling purposes.

Prerequisite: Graduate standing.

GEOL 585 Geological Laboratory Techniques (2-3-3)

The use of equipment such as the XRD, XRF, AA, SEM, M.S.-GC, HPLC, ultrasonic wave generators in geological investigations; preparation of both thin and polished sections in rocks, minerals and ores; preparation of oriented thin sections in microfossils staining techniques in mineralogical, petrological and paleontological investigations.

Prerequisite: Consent of the instructor.

GEOL 590 Independent Studies (3-0-3)

Advanced work in certain phases of geology, adapted to the student's own field of interest. A well-written report and presentation are required. The course should not duplicate thesis work and cannot be repeated for credit. Approval of the Chairman of the Department should be secured each time the course is offered.

Prerequisite: Consent of the instructor.

GEOL 592 Special Topics **(3-0-3)**

Advanced course that may be offered on a geological topic of interest to a faculty member apart from the topics covered in the elective courses. The Department should secure the approval of the Graduate Council each time the course is offered.

Prerequisite: Consent of the instructor.

GEOL 599 Seminar **(1-0-0)**

Graduate students are required to attend all the technical seminars organized by the department. Additionally, each student must present at least one seminar on a timely research topic. This course is designed to provide students an overview of research in the Department, and a familiarity with the latest research methodologies, journals and professional societies in his discipline. This course is graded on a Pass or Fail basis.

Prerequisite: Graduate standing.

GEOL 600 Geology Master Report **(0-0-3)**

The student carries out a research project on an approved topic in Geology. A written report and an oral presentation are required. The project, report, and presentation should be finished in one semester. Pass-fail basis only. This course is available only for the students enrolled in the Master of Geology program.

Prerequisite: Graduate standing.

GEOL 610 Thesis **(0-0-6)**

Preparation of a thesis, oral presentation and defense.

GEOPHYSICS COURSES

GEOP 501 Reflection Seismology **(3-0-3)**

Elasticity of anisotropic media, general wave equations and their solutions, Zoeppritz equations, direct hydrocarbon indicators, vertical seismic profiling, crosshole tomography, 3-D seismic exploration, correlation of well-log and seismic data, S-wave exploration.

Prerequisite: GEOP 315 or equivalent

GEOP 502 Potential Theory Methods **(3-0-3)**

In-depth study of potential field theory as applied to the gravity and magnetic methods of exploration, field equations and their solutions, representation of fields in spherical harmonics, instruments and field procedure in the collection and processing of gravity and magnetic data, interpretation techniques, and separation, continuation, and filtering of field anomalies, the direct and inverse problems of potential fields, computer modeling of 2-D and 3-D dimensional sources.

Prerequisite: GEOP 404 or equivalent

GEOP 503 Solid-Earth Geophysics (3-0-3)

Movement of the Earth, standard Earth models, heat flow in the Earth, the Earth's magnetic field, plate tectonics, physics of faulting and principles of earthquake seismology.

Prerequisite: GEOP 202 or equivalent

GEOP 504 Applied Environmental Geophysics (3-0-3)

Geophysical methods in environmental site assessment, emphasis on sites relevant to toxic waste disposals, contamination, detection and mapping of cavities, near-surface pipes, and hidden harmful objects, geophysical precursors for monitoring earthquakes and volcanic eruptions, case histories.

Prerequisite: GEOL 201 and GEOP 202 or equivalent

GEOP 505 Advanced Computational Geophysics (2-3-3)

Overview of linear algebra and potential field theory, the MATLAB, linear transforms of potential fields, 1-D and 2-D filtering, multi-channel optimal filtering, optimization, the maximum entropy and its applications, discriminant analysis and neural networks.

Prerequisite: GEOP 205 or equivalent

GEOP 510 Seismic Data Analysis (2-3-3)

Amplitude variation with offset, anisotropy, dip moveout processing, seismic migration algorithms, time-lapse studies, multicomponent recording, converted modes, deterministic and statistical deconvolution, wavelet shaping, wavelet extraction, multiple suppression, and automated static correction. Processing packages such as Seismic Unix, Hampson-Russell, Focus, and ProMax will be used during this course.

Prerequisite: GEOP 320 or equivalent

GEOP 515 Geophysical Inversion (3-0-3)

Overview of information theory & linear algebra, discrete and continuous inverse problems, Backus-Gilbert inversion, Monte Carlo inversion, case histories from exploration seismics, potential fields, geoelectric prospecting and rock physics.

Prerequisite: GEOP 205 or equivalent

GEOP 520 Geomagnetism & Paleomagnetism (3-0-3)

In-depth study of the nature, description, and analysis of the present magnetic field, spherical harmonics in applied geophysics, observatory weak remnants of the field, computation of its coefficients, the IGRF, measurement and analysis of the ancient geomagnetic field, theory of rock magnetism, acquisition of remnants by rocks, theories of TRM and DRM, instruments and techniques of paleointensity and paleodirection measurement from rocks, analysis and interpretation of paleomagnetic measurements, applications of paleomagnetic methods in geology and geophysics, brief discussion of the origin of the geomagnetic field.

Prerequisite: GEOP 202 or equivalent

GEOP 525 Electrical Methods (3-0-3)

Physical principles of electrical and electromagnetic methods, numerical solutions for 2-D and 3-D problems, instrumentation and layout planning for land and airborne surveys, computer modeling and processing of field data, methods of interpretation, including curve matching, forward modeling, inversion, and recent advances in resistivity logging for oil and gas reservoirs.

Prerequisite: GEOP 450 or equivalent

GEOP 530 Basin Analysis (3-0-3)

Isostacy and subsidence, salt tectonics, basin classification, basin geometry, thermal burial history, oil generation and migration, heat flow and gradients, paleotemperature, basin modeling, and case histories.

Prerequisite: GEOL 201, and GEOP 202 or equivalent

GEOP 535 Seismic & Sequence Stratigraphy (2-3-3)

Review of seismic reflection principles, geodynamics, causes of changes in sea level, eustatic change of sea level, cycle chart, sedimentary supply and processes, sequence boundaries, seismic facies analysis, chronostratigraphy verus lithostratigraphy, system tracts, clastics sequence stratigraphy, carbonate sequence stratigraphy, seismic response of different structures, case histories.

Prerequisite: Consent of the instructor

GEOP 540 Three-Dimensional Seismic Interpretation (2-3-3)

Review of 3-D seismic data acquisition and processing, structural interpretation from 3-D slices and sections, stratigraphic interpretation, seismic attributes and wavelet analysis, seismic resolution, reservoir imaging and classification, high resolution data and integration with well-log data, 3-D visualization, and geophysical computer application in seismic interpretation.

Prerequisite: GEOP 415 or equivalent

GEOP 545 Petroleum Data Integration & Management (2-3-3)

Data structure and fundamental considerations, data quality, error, natural variation, data input, verification, storage and output format, geographic information system and different types of software, spatial data and attributes, data management and integration.

Prerequisite: Consent of the instructor

GEOP 550 Reservoir Characterization (3-0-3)

Reservoir description, scaling, core and rock description, log interpretation and calibration to 3-D seismic, geostatistics, kriging, distributions, simulation, structural and sequence stratigraphy and their use in reservoir characterization, reservoir heterogeneities, data integration and quality control.

Prerequisite: GEOP 415 or equivalent

GEOP 590 Independent Study (3–0-3)

Advanced work in certain areas of geophysics, adapted to the student’s own field of interest. A well-written report and presentation are required. The course should not duplicate thesis work and cannot be repeated for credit. Approval of the Chairman of the Department should be secured each time the course is offered.

Prerequisite: Graduate Standing

GEOP 592 Special Topics (3-0-3)

Advanced course that may be offered on a geophysical topic of interest to a faculty member apart from the topics covered in the elective courses. The Department should secure the approval of the Graduate Council each time the course is offered.

Prerequisite: Graduate Standing

GEOP 599 Seminar (1-0-0)

Graduate students are required to attend the seminars given by faculty members, visiting scholars, and fellow graduate students. Additionally, each student must present at least one seminar on a timely research topic. This course is designed to give the student an overview of research in the Department, and a familiarity with the research methodology, journals, and professional societies in his discipline. Graded on a Pass or Fail basis.

Prerequisite: Graduate Standing

GEOP 600 Geophysics Master Report (0-0-3)

The student carries out a research project on an approved topic in Geophysics. A written report and an oral presentation are required. The project, report, and presentation should be finished in one semester. Pass-fail basis only. This course is available only for students enrolled in the Master of Geophysics program.

Prerequisite: Graduate Standing

GEOP 610 Thesis (0-0-6)

Preparation of a thesis, oral presentation and defense.

M.S. PROGRAM IN ENVIRONMENTAL SCIENCES

INTRODUCTION

Environmental Science is an interdisciplinary field dealing with the scientific study of natural systems and human impacts on these systems. Most environmental problems are complex, demanding the problem-solving insights of multiple disciplines. A student seeking to specialize in Environmental Science is required to focus on at least three areas. First, it is important for him to understand the natural processes (both physical and biological) that operate in the world. Second, it is important to appreciate the role that technology plays in our society and its capacity to alter natural processes as well as solve problems caused by human impact. Third, the complex social processes that are characteristics of human populations must be understood and integrated with knowledge of technology and natural processes to fully appreciate the role of humans in the natural world.

OBJECTIVES

The Environmental Sciences program aims at providing students with a broad-based foundation in the scientific principles that govern natural and engineered environmental systems. In addition, the program focuses on the critical environmental problems which transcend national borders, but which also have local relevance. The program will help students prepare for careers that require the policy-and decision-making skills necessary to integrate technical knowledge into a broader, applied framework.

The program integrates the natural, chemical, and physical sciences taught in the College of Sciences with a strong emphasis on concept-based learning and empiricism. In this program the students are trained for careers in Environmental Science research and management in a wholly problem-solving setting.

EMPLOYMENT OPPORTUNITIES

Graduate students with a Mater's degree in Environmental Sciences have a wide choice of employment opportunities in the following sectors:

- Government or private sectors dealing with environmental effects of oil, water resources, and mineral resources on the earth's systems.
- Government planning agencies dealing with the environmental assessments of urbanization programs.
- Consultation, construction and maintenance firms dealing with environmental applications.
- Research centers and national organizations dealing with detection, monitoring and mitigation programs of environmental hazards.

ADMISSION REQUIREMENTS

Science or engineering graduates from recognized institutions who have a GPA of 3.00 or above (on a 4.00 scale), or equivalent, are eligible to apply for admission as a regular student in the Master of Environmental Sciences Program. Applicants should also have satisfied the Graduate School admission requirements. Students with any deficiencies in their undergraduate courses will be required to take the relevant deficiency courses.

PARTICIPATING DEPARTMENTS

The program is administered by the Department of Earth Sciences in the College of Sciences with the active involvement of the Department of Chemistry.

DEGREE AWARDED

The degree awarded in this program is Master of Science in Environmental Sciences.

RESEARCH AND TEACHING FACILITIES

The Earth Sciences Department houses a variety of teaching and research laboratories. Facilities and instruments include a thin-section preparation laboratory, polarizing, reflection, and binocular microscopy, sieving, x-ray diffractometry, a wet geochemistry laboratory, portable hydrogeochemistry laboratory, geophysical instruments and lab, remote sensing and aerial photography, SEM and two Sun Workstations in addition to a well-developed PC lab and computing facilities.

The Department and RI/KFUPM centers are furnished with the required field and lab equipment, tools and other facilities (i.e. geophysical, soil mechanics, rock mechanics, soil/water sampling) that are needed for environmental and geological activities. Additional facilities including XRF, SEM, ICP, TEM, AA, CL, and GC-MS are available in the KFUPM Research Institute (RI). The Department owns three 4-wheel drive vehicles, a dune buggy, and field augers for field trips.

The laboratory facilities in the Chemistry Department include a wide array of general equipment, in addition to major instruments such as the AC-80 FT Nuclear Magnetic Resonance Spectrometer, the Electron Paramagnetic Resonance (EPR) Spectrometer with a 15 inch magnet, 4-microwave bridges at the L, S, X and Q bands and an electron-nuclear double resonance accessory, an X-ray diffractometer equipped with low temperature accessories, an inductively coupled plasma emission spectrometer, a flame atomic absorption spectrometer, a C, H, N, S-Elemental analyzer, infrared spectrometers including dispersive and Fourier transform Infrared (FTIR) spectrophotometers, and conventional and capillary gas chromatographs.

PROGRAM REQUIREMENTS

Core Courses

ENVS 510	Advanced Environmental Geology	(3-0-3)
ENVS 520	Advanced Environmental Chemistry	(3-0-3)
ENVS 530	Advanced Biological Studies	(3-0-3)
ENVS 540	Environmental Policy and Management	(3-0-3)

General Required Courses:

ENVS 599	Seminar	(0-0-1)

Degree Requirements:

ENVS 610: MS Thesis (0-0-6)

ENVIRONMENTAL SCIENCES ELECTIVE COURSES

Students are also required to take two courses from the following elective course list for a total of 6 credit hours as Environmental Sciences electives.

ENVS 511	Advanced Engineering Geology	(3-0-3)
ENVS 514	Desertification	(3-0-3)
ENVS 517	Exploration Geophysics for Environmental Applications	(3-0-3)
ENVS 521	Applied Hydrogeology	(3-0-3)
ENVS 524	Ground-Water Planning & Management	(3-0-3)
ENVS 527	Environmental Risk Assessment	(2-3-3)
ENVS 531	GIS Applications in Geology	(2-3-3)
ENVS 534	Geomorphology	(3-0-3)
ENVS 537	Photogeology and Remote Sensing	(2-3-3)
ENVS 541	Analytical Geochemistry	(3-0-3)
ENVS 544	Organic Geochemistry	(3-0-3)
ENVS 547	Environmental Pollution	(3-0-3)
ENVS 551	Environmental Geochemistry	(3-0-3)
ENVS 554	Environmental Ecology	(3-0-3)
ENVS 557	Environmental Physics	(3-0-3)
ENVS 561	Health Physics	(3-0-3)
ENVS 564	Statistical Methods in Environmental Research	(3-0-3)

LIST OF TECHNICAL ELECTIVES

Students are required to take two courses from the following list as technical elective courses for a total of 6 credit hours.

Course #		Title
ARE	534	Life Safety System
ARE	538	Ventilation and Indoor Air-Quality
CHE	565	Advanced Process Air Pollution Control
CHE	566	Saline Water Conservation
CHE	571	Advanced Process Wastewater Pollution Control
CE	531	Advanced Hydrology
CE	536	Irrigation and Drainage Engineering
CE	540	Chemistry and Biology in Water Resources
CE	544	Sanitary Engineering Process Laboratory
CE	545	Water Reclamation and Reuse
CE	546	Industrial Water and Wastewater Treatment
CE	550	Natural and Behavior of Soils
CE	591	Advanced Topics in Water Resources and Env. Engineering
CE	634	Groundwater Resources Evaluation
CE	635	Water Resources Planning
CE	642	Advanced Microbiology in Environmental Engineering
CE	643	Solid and Hazardous Waste Management
CE	644	Air Pollution and Control
CE	656	Seepage through Soils and Rock
CE	676	Environmental Impacts of Transportation Facilities
CRP	502	Planning Theory
CRP	509	Ecological Analysis in Urbanized Areas
CRP	561	Urban Geography
CRP	567	City and Regional Planning in Arid Zones
CRP	569	Norms, Rules and Regulations for the Protection of Environment
CRP	570	Geographic Information Systems
ME	564	Noise and Vibration Control
SE	527	Decision making
SE	567	Work physiology

Degree Plan for the M.S. Program in Environmental Sciences

Course #		Title	LT	LB	CR
First Semester					
ENVS	510	Advanced Environmental Geology	3	0	3
ENVS	520	Advanced Environmental Chemistry	3	0	3
XXX	5xx	Technical Elective I	3	0	3
			9	**0**	**9**
Second Semester					
ENVS	530	Advanced Biological Studies	3	0	3
ENVS	540	Environmental Policy & Management	3	0	3
ENVS	5xx	Environmental Sciences Elective I	3	0	3
			9	**0**	**9**
Third Semester					
ENVS	599	Seminar	0	0	0
ENVS	5xx	Environmental Sciences Elective II	3	0	3
XXX	5xx	Technical Elective II	3	0	3
			6	**0**	**6**
Fourth Semester					
ENVS	610	MS Thesis	0	0	6
					6
Total Credit Hours					**30**

COURSES DESCRIPTION

Core Courses

ENVS 510 Advanced Environmental Geology (3-0-3)

Study of interaction between man and geologic environment; role of geology in environmental applications, natural, man-made, and technological hazards, generation and dispersion of contaminants in earth systems; waste management, environmental impact studies, selected case studies.

Prerequisite: GEOL 201 or equivalent

ENVS 520 Advanced Environmental Chemistry (3-0-3)

Study of the sources, reactions, transport, effects, and fates of chemical species in water, soil, and air environment; nature and source of hazardous wastes, their environmental chemistry, and their treatment, minimization, and the effect of pollutants and hazardous substances on living organisms.

Prerequisite: CHEM 102 or equivalent

ENVS 530 Advanced Biological Studies (3-0-3)

Examines major issues in biology, human uses of environments, and study of biological diversity in different types of environments. Offers an opportunity for students to conduct in-depth individual research projects in biology. Critical examination of published evidence, extensive library research, data analysis, writing of reviews, and oral presentations. Students present their scientific results in a symposium. Field trips to affected sites and interaction with conservationist, and biologists.

Prerequisite: BIOL 101 or equivalent

ENVS 540 Environmental Sciences and Policy (3-0-3)

Introduction to the emerging interdisciplinary field of environment science. Explore connections between traditional relationship of disciplinary of the physical and natural sciences. Evaluate the impact of human activities, consider the environmental, economic and social consequences of changing those activities, and consider how scientific information gets converted into policy.

Prerequisite: Graduate standing

General Required Courses

ENVS 599 Seminar (0-0-1)

Graduate students are required to attend all the technical seminars organized by the department. Additionally, each student must present at least one seminar on a current research topic. This course is designed to provide students with an overview of research in the Department, and a familiarity with the latest research methodologies, journals and professional societies in their discipline. This course is graded on a Pass or Fail basis.

Prerequisite: Graduate standing.

Degree Requirements

ENVS 610 Thesis (0-0-6)

Preparation of a thesis, oral presentation and defense.

Elective Courses

ENVS 511 Advanced Engineering Geology (3-0-3)

Use of different site investigation techniques for identification and evaluation of environmental problems before and after construction phases, engineering geological mapping, and assessment of engineering geological hazards in the arid region, geohazards risk assessment, sampling and monitoring methods utilized in the environmental applications. Special emphasis is also given to study the engineering geological aspects of existing environmental problem(s) at selected site(s).

Prerequisite: GEOL 341 or equivalent

ENVS 514 Desertification (3-0-3)

Course covers the concept and evolution of desertification, land degradation, dimension and distribution of desertification in each continent, process of desertification, prevention and remedial measures. Special emphasis is given to desertification in the Middle East.

Prerequisite: GEOL 201 or equivalent

ENVS 517 Exploration Geophysics for Environmental Applications (3-0-3)

Basic geophysical techniques used in exploration and detection of environmental problems, emphasizing seismic, electric, and electromagnetic methods.

Prerequisite: GEOP 202 or equivalent

ENVS 521 Applied Hydrogeology (3-0-3)

The course will emphasize the quantitative evaluation of groundwater systems, including aquifer testing, steady and unsteady state flow equations, well field designs, and integration of ground-water and surface water systems. An introduction to geophysical and geochemical methods of exploration for planning and design of regional water resource investigations.

Prerequisite: GEOL 423 or equivalent

ENVS 524 Ground-Water Planning & Management (3-0-3)

Darcy's law, theory and quantitative measurements of flow through porous and fractured media, application of digital models for aquifer simulation, waste disposal, salt water intrusion and control. Case histories in the management and protection of ground-water resources. Literature review and special field problems in resource developments.

Prerequisite: GEOL 423 or equivalent

ENVS 527 Environmental Risk Assessment (2-3-3)

Introduction to the theories of probability and sampling, application of statistical methods for environmental pollution monitoring; design of spatial and temporal stochastic models; concepts of uncertainty analysis and risk assessment and their applications in environmental analysis.

Prerequisite: CHEM 102 and GEOL 201 or equivalent

ENVS 531 GIS Applications in Geology (2-3-3)

Introduction to the GIS. Type of geological and remote sensing data used in GIS and data preparation for GIS studies. Uses of GIS in mineral and hydrocarbon exploration, and in solving environmental problems and environmental studies. Spatial relationship and geological associations.

Prerequisite: GEOL 305 or equivalent

ENVS 534 Geomorphology (3-0-3)

Study of landforms along with the agents and processes that produce them. Geomorphology of selected regions, etc., geomorphic provinces.

Prerequisite: GEOL 201 or equivalent

ENVS 537 Photogeology and Remote Sensing (2-3-3)

Stereoscopic interpretation of topographic and geologic features; methods of delineating formational contacts, faults, and other geologic features. Estimation of dip and strike on air photos. Application of multispectral imagery including infra-red multispectral photography, radar, and other techniques to geological environments. A visit to the department of photogrammetry in the Ministry of Petroleum and Minerals will be made is necessary.

Prerequisite: GEOL 305 or equivalent

ENVS 541 Analytical Geochemistry (3-0-3)

Analytical techniques presently available for geochemical correlation purposes have increased dramatically both in number and level of sophistication. This course focuses on the recent advancements in correlation techniques such as gas chromatography and mass-spectrometry (GC, GC/MS, GC/MS/MS, and MS/MS), principles and analytical applications of modern molecular and atomic spectroscopy. Ultraviolet, visible, infrared, luminescence and scattering techniques. Flame, plasma, arc and spark emission, atomic absorption and atomic fluorescence techniques. X-ray diffraction, nuclear magnetic resonance and isotopic ratio techniques.

Prerequisite: ENVS 520 or consent of the Instructor

ENVS 544 Organic Geochemistry (3-0-3)

The objective of this course is to provide an up-to-date overview on the composition of the biosphere, both chemically and isotopically, thus affording a perspective on the nature and fate of organic compounds that may be preserved in the geosphere. The course focuses on the early diagenesis of organic matter and its consequences for the application of molecular biomarkers; kerogen and related materials; and application of organic geochemical methods for hydrocarbon exploration. The application of organic geochemistry in quaternary research and an assessment of present-day problems and future perspectives in organic geochemistry are discussed.

Prerequisite: ENVS 520 or consent of the Instructor

ENVS 547 Environmental Pollution (3-0-3)

The course will mainly deal with problems related to marine pollution. Some of the topics are: different marine habitats, sources of marine pollution, types of pollution, effects of pollution on marine life, prevention and remedies for problems of pollution.

Prerequisite: ENVS 520 or consent of the Instructor

ENVS 551 Environmental Geochemistry (3-0-3)

Interaction of water with minerals and organic compounds at the low temperature of many environmental settings. Emphasis on understanding groundwater compositions and capacity for transporting metals and organic solutes in the groundwater. Species classification, mass transport, surface reactions, contaminant sources, and remediation methods.

Prerequisite: ENVS 520 or consent of the Instructor

ENVS 554 Environmental Ecology (3-0-3)

The goal of this course is a better understanding of resource- sharing among communities, and basic and fundamental concepts of terrestrial and aquatic environments. Global changes and nutrient cycling, nutrient availability and how resource competition among individuals within a community affects the distribution and abundance of organisms and human interactions. It also focuses on primary production, decomposition, and microbial ecology.

Prerequisite: ENVS 530 or consent of the Instructor

ENVS 557 Environmental Physics (3-0-3)

Physical principles used in the assessment, prevention or reduction of environmental problems. Main themes include energy sources, energy and mass transport, and pollution in soil, water and air.

Prerequisite: PHYS 201 or 212 or equivalent

ENVS 561 Health Physics (3-3- 4)

Physical and biological aspects of the use of ionizing radiation in industrial and academic institutions; physical principles underlying shielding instrumentation, waste disposal; biological effects of low levels of ionizing radiation, lecture and lab.

Prerequisite: PHYS 102 or equivalent

ENVS 564 Statistical Methods in Environmental Researches (3-0-3)

Role of statistics in scientific research, particularly environmental. Different statistical methods and their application in environmental studies, experimental design; inference and modeling. Solutions to environmental problems based on statistical methods and modeling.

Prerequisite: STAT 201 or equivalent

MATHEMATICS AND STATISTICS

Chairman

Suliman S. Al-Homidan

Professors

Al-Bar	Chanane	Messaoudi
Ansari	Chaudhry	Muttlak
Azad	El-Gebeily	Rahimov
Bokhari A.	Joarder	Zaman
Bokhari M.	Kabbaj	
Boucherif	Laradji	

Adjunct Professors

Ahmad	Al-Daffa’	Mordukhovich
Ahsan	Hogendijk	Qadir

Associate Professors

Abuihlail	Furati	Mustafa
Abu-Sbeih	Ibrahim	Samman
Alassar	Khan	Sarhan
Al-Homidan	Kharab	Tatar
Al-Shuaibi	Mimouni	

Assistant Professors

Al-Assaf	Beg	Lo
Al-Attas	Binns	Mustapha K.
Al-Furaidan	Ee	Omar
Al-Mutawa	Fairag	Saleh
Al-Rasasi	Halic	Tawfiq
Al-Sabah	Jibril	Yousuf
Al-Shammari	Latif	

Lecturers

Al-Humaidi	Anabosi	Malik
Al-Momani	Khan	Saleh
Al-Sawi		

M.S. PROGRAM IN MATHEMATICS

The Department offers graduate programs leading to the degrees of Master of Science and Doctor of Philosophy. The diversity of graduate courses offered in the Department gives the student an opportunity to specialize in one of the several fields of pure mathematics, applied mathematics, numerical analysis, and mathematical statistics.

M. S. ADMISSION REQUIREMENTS

The applicant should have the equivalent degree of an undergraduate mathematics major of KFUPM. However, an applicant lacking an adequate undergraduate training may be admitted if recommended by the Graduate Committee, with the understanding that the courses work taken to remove the deficiency in the undergraduate training may not be credited towards the degree.

M. S. DEGREE REQUIREMENTS

To complete the M.S. program, a candidate must:

1. Complete 24 credit hours, of which:
   a. at least 18 credits must be in the Department of Mathematical Sciences, and
   b. a maximum of 6 credits at the 400 level can be counted.
2. Take the seminar course Math 599 under the guidelines provided by the MS committee.
3. Prepare a thesis.

The following three are required courses for MS program;

- Math 531 Real Analysis
- Math 533 Complex Variables I
- Math 550 Linear Algebra

The remaining courses are chosen by the student under the guidance of the academic advisor.

Degree Plan for the M.S. Program in Mathematics

Course #	TITLE	LT	LB	CR
First Semester				
Math 531	Real Analysis	3	0	3
Math 550	Linear Algebra	3	0	3
Math xxx	Math Elective	3	0	3
Math xxx	Math Elective	3	0	3
Second Semester				
Math 533	Complex Variables I	3	0	3
Math xxx	Math Elective	3	0	3
XXX xxx	Free Elective	3	0	3
XXX xxx	Free Elective	3	0	3
Math 599	Seminar	1	0	0
Third Semester				
Math 610	Thesis	0	0	6
Fourth Semester				
Math 610	Thesis continued	0	0	0
Total Credit Hours				**30**

Ph.D. PROGRAM IN MATHEMATICS

The Department offers Ph. D. program in the following two major areas.

Area 1: Applied Mathematics & Numerical Analysis

Area 2: Pure Mathematics

Each of these two areas consists of a number of fields of specialization.

Ph. D. ADMISSION REQUIREMENTS

Applicants should have a Masters' degree in Mathematics or a related field with a minimum GPA of 3.5 from an institution of acceptable standing.

They should also meet the standards of performance in the GRE advanced test in mathematics and in the TOEFL as laid down by the College of Graduate Studies. Any deficiency in the mathematical background of a student must be removed within two semesters of admission into the graduate program.

Ph. D. DEGREE REQUIREMENTS

1. Each entering student will take an Preliminary Examination.
2. Each Ph.D. student will complete a minimum of 30 credit hours of graduate level courses, in addition to his M.S. degree and deficiency courses. These courses are to be chosen such that
   a. A minimum of 15 credit hours must be in one of the two major areas cited above. Of these, 12 must be in the student's field of specialization.
   b. A minimum of 6 credit hours must be taken in a minor field from outside the student's chosen area.
   c. A minimum of 4 600-level courses in mathematics must be taken for credit.
3. After completion of most of his course work, a Ph. D. student will take a written Comprehensive Examination, covering certain basic areas of mathematics as well as areas related to his specialization.
4. Following this, the Ph. D. student will take an Oral Comprehensive Examination designed to test the depth of his knowledge in his chosen field of concentration, particularly as related to his proposed dissertation research.
5. The student must submit and successfully defend a dissertation based on original and scholarly research done by him and judged to be a significant contribution to his area of specialization.

Degree Plan for the Ph.D. Program in Mathematics

Course #	TITLE	LT	LB	CR
First Semester				
Math xxx	Course from Major Area	3	0	3
Math xxx	Course from Major Area	3	0	3
XXX xxx	Free Elective	3	0	3
Second Semester				
Math xxx	Course from Major Area	3	0	3
XXX xxx	Free Elective	3	0	3
XXX xxx	Free Elective	3	0	3
At the end of the first year, the student selects a field of specialization				
Third Semester				
Math xxx	Course from Major Area	3	0	3
Math xxx	Course from Major Area	3	0	3
Fourth Semester				
Math 695	Reading & Research I	3	0	3
Written Comprehensive Examination				
Fifth Semester				
Math 696	Reading & Research II	3	0	3
Oral Comprehensive Examination (Dissertation Proposal)				
Math 699	Math Seminar	1	0	0
Sixth Semester				
Math 710	PhD Dissertation	0	0	IP
Seventh Semester				
Math 710	PhD Dissertation… cont'd.	0	0	IP
Eighth Semester				
Math 710	PhD Dissertation… cont'd.	0	0	12
Total Credit Hours				**42**

IP: Dissertation in progress

COURSE DESCRIPTION

MATH 502 General Relativity (3-0-3)

Minkowski space. Tensor analysis on differentiable manifolds. The Einstein field equations. Exact solutions; the Schwarzschild and Reissner-Nordstrom solutions. The three classical tests of general relativity. Energy momentum tensor for perfect fluids and the electromagnetic field. The interior Schwarzschild solution. Black holes and analytic extensions. Robertson-Walker and other cosmological models of the universe. Distance measurements in cosmology.

Prerequisite: MATH 301. (Credit may not be obtained for both MATH 502 and PHYS 575)

MATH 505 Mathematical Theory of Elastodynamics (3-0-3)

An introduction to Cartesian tensors. Stress and strain tensors. Conservation of mass, energy and momentum. Hooke's law and constitutive equations. Isotropic solids and some exact solutions of elasticity. Elastodynamic equations. Elastic waves in an unbounded medium. Plane waves in a half space. Reflection and refraction at an interface. Surface waves.

Prerequisite: MATH 301 or equivalent

MATH 513 Mathematical Methods for Engineers (3-0-3)

Laplace transforms including the convolution theorem, error and gamma functions. The method of Frobenius for series solutions to differential equations. Fourier series, Fourier-Bessel series and boundary value problems, Sturm-Liouville theory. Partial differential equations: separation of variables and Laplace transforms and Fourier integrals methods. The heat equation. Laplace equation, and wave equation. Eigenvalue problems for matrices, diagonalization.

Prerequisite: Math 202. (Not open to mathematics majors. Students cannot receive credit for both MATH 301 and MATH 513)

MATH 514 Advanced Mathematical Methods (3-0-3)

Integral transforms: Fourier, Laplace, Hankel and Mellin transforms and their applications. Singular integral equations. Wiener-Hopf techniques. Applications of conformal mapping. Introduction to asymptotic expansion

Prerequisite: MATH 301or MATH 430 or MATH 513

MATH 521 General Topology I (3-0-3)

Basic set theory (countable and uncountable sets, Cartesian products). Topological spaces (basis for a topology, product topology, functions, homeomorphisms, standard examples). Connected spaces, path connectedness. Compact spaces, compactness in metrizable paces. Countability axioms, first countable and second countable spaces. Separation axioms, Urysohn's Lemma, Urysohn's metrization theory. Complete metric spaces.

Prerequisite: MATH 421

MATH 523 Algebraic Topology (3-0-3)

Concept of categories and functors. Simplicial complexes, subdivision and simplicial approximations. Homotopy, fundamental group and covering spaces. Fundamental group of polyhedron. Chain complexes, homology groups and their topological invariance.

Prerequisite: MATH 421. (MATH 521 is recommended)

MATH 525 Graph Theory (3-0-3)

Review of basic concepts of graph theory. Connectivity, matching, factorization and covering of graphs, embeddings, edge and vertex coloring. Line graphs. Reconstruction of graphs. Networks and algorithms.

Prerequisite: MATH 425

MATH 527 Differential Geometry (3-0-3)

Curves in Euclidean spaces: arclength, tangent, normal and binormal vectors, curvature and torsion. Frenet formulas. Isoperimetric inequality. Differential geometry and local theory of surfaces, the first and second fundamental forms. Local isometries. Geodesics. Gaussian and mean curvature of surfaces. The Gauss–Bonnet theorem. Manifolds and differential forms. Introduction to Riemannian geometry.

Prerequisite: MATH 421

MATH 531 Real Analysis (3-0-3)

Lebesgue measure and outer measure. Measurable functions. The Lebesgue integral. Lebesgue convergence theorem. Differentiation and integration. Lp spaces. Riesz representation theorem. Introduction to Banach and Hilbert spaces.

Prerequisite: MATH 411

MATH 533 Complex Variables I (3-0-3)

Analytic functions. Cauchy's theorem and consequences. Singularities and expansion theorems. Maximum modulus principle. Residue theorem and its application. Compactness and convergence in space of analytic and meromorphic functions. Elementary conformal mappings.

Prerequisites: MATH 411; MATH 430 or consent of the instructor

MATH 535 Functional Analysis I (3-0-3)

Normed linear spaces, Banach spaces, Hilbert spaces, Banach Algebras (definitions, examples, geometric properties), bounded linear operators, convex sets, linear functionals, duality, reflexive spaces, weak topology and weak convergence, Banach fixed point theorem, Hahn-Banach theorem, uniform boundedness principle, open mapping theorem, closed graph theorem, representation of functionals on Hilbert spaces (Riesz Representation Theorem).

Prerequisite: MATH 411

MATH 536 Functional Analysis II (3-0-3)

Algebra of bounded operators, self-adjoint operators in Hilbert Spaces, Normal operators, compact operators, projections, spectral theory of linear operators in normed spaces and Hilbert spaces, spectral mapping theorem, Banach-Alaoglu theorem.

Prerequisite: MATH 535

MATH 537 Topological Vector Spaces (3-0-3)

Topological vector spaces, locally convex spaces, Krein-Milman theorem, duality in locally convex spaces, separation theorem for compact convex sets, topological tensor products, nuclear mappings and spaces.

Prerequisite: MATH 535

MATH 538 Applied Functional Analysis (3-0-3)

A quick review of basic properties of topological, metric, Banach and Hilbert spaces. Introduction of Hausdorff metric and iterated function system. Fixed point theorems and their applications. Introduction to infinite dimension calculus – Frechet and Gateaux derivatives, Bochner integral. Introduction to weak and w*-topologies. Algorithmic optimization including complementarity problems and variational inequalities.

Prerequisite: MATH 411

MATH 540 Harmonic Analysis (3-0-3)

Fourier series on the circle group (Fourier coefficients, Fourier series of square summable functions, absolutely convergent Fourier series, Fourier coefficients of linear functionals), The convergence of Fourier series, Fourier transforms on L1(R), Fourier transforms on Lp(R), The Payley-Wienner theorems. Fourier analysis on locally compact groups (locally compact groups, the Haar measure, characteristic and the dual group, Fourier transforms, almost periodic functions and the Bohr compactification).

Prerequisite: MATH 411

MATH 545 Algorithms and Complexity (3-0-3)

Polynomial time algorithms and intractable problems; relationship between the classes P, NP, and NP-complete; Cook's theorem and the basic NP-complete problems. Techniques for proving NP-completeness; NP-hardness. Hierarchy of complexity classes.

Prerequisite: Consent of the Instructor

MATH 550 Linear Algebra (3-0-3)

Basic properties of vector spaces and linear transformations, algebra of polynomials, characteristic values and diagonalizable operators, invariant subspaces and triangulable operators. The primary decomposition theorem, cyclic decompositions and the generalized Cayley-Hamilton theorem. Rational and Jordan forms, inner product spaces, The spectral theorem, bilinear forms, symmetric and skew symmetric bilinear forms.

Prerequisite: MATH 280

MATH 551 Abstract Algebra (3-0-3)

Basic definitions of rings and modules, homomorphisms, sums and products, exactness, Hom and tensor, adjoint isomorphism, free, projective and injective modules. Chain conditions, primary decomposition, Noetherian rings and modules, Artinian rings, structure theorem.

Prerequisite: MATH 345. (MATH 450 is recommended)

MATH 552 Fields and Galois Theory (3-0-3)

Field extensions, the fundamental theorem. Splitting fields and algebraic closure, finite fields, separability, cyclic, cyclotomic, and radical extensions. Structure of fields: transcendence bases.

Prerequisite: MATH 345. (MATH 450 is recommended)

MATH 553 Homological Algebra (3-0-3)

Review of free, projective, and injective modules, direct limits. Watt's theorems. Flat modules. Localization. Noetherian, semisimple, Von Neumann regular, hereditary, and semi-hereditary rings. Homology, homology functors, derived functors. Ext. and Tor. homological dimensions, Hilbert Syzygy theorem.

Prerequisite: MATH 551

MATH 554 Rings and Categories of Modules (3-0-3)

Classical ring structure theorems, functors between module categories, equivalence and duality for module categories. Decomposition properties of injective and projective modules. Specific Artinian rings.

Prerequisite: MATH 551

MATH 555 Commutative Algebra (3-0-3)

Basics of rings and ideals. Rings of fractions, integral dependence, valuation rings, discrete valuation rings, Dedekind domains, fractional ideals. Topologies and completions, filtrations, graded rings and modules. Dimension theory.

Prerequisite: MATH 551

MATH 560 Applied Regression and Experimental Design (3-0-3)

Simple linear regression. Testing of intercept and slope. Multiple linear regression. Estimation parameters and testing of regression coefficients. Prediction and correlation analysis. Analysis of variance technique. Completely randomized and randomized block designs. Latin square design. Incomplete block design. Factorial design, 2k factorial design and blocking and confounding in 2k factorial design.

Prerequisite: STAT 201, STAT 319, or Instructor's Consent. (Students cannot receive credit for both MATH 560 and STAT 430 or SE 535)

MATH 561 Mathematical Statistics (3-0-3)

Axioms and foundations of probability. Conditional probability and Bayes' theorem. Independence. Random variables and distribution functions and moments. Characteristic functions, Laplace transforms and moment generating functions. Function of random variables. Random vectors and their distributions. Convergence of sequences of random variables. Laws of large numbers and the central limit theorem. Random samples, sample moments and their distributions. Order statistics and their distributions.

Prerequisite: STAT 302 or Consent of the Instructor

MATH 563 Probability Theory (3-0-3)

Foundations of probability theory. Measure-theoretic approach to definitions of probability space, random variables and distribution functions. Modes of convergence and relations between the various modes. Independence, Kolmogorov type inequalities. Tail events and the Kolomogorov 0-1 law. Borel-Cantelli lemma. Convergence of random series and laws of large numbers. Convergence in distribution. Characteristic functions. The central limit theorem. Weak convergence of probability measures. Conditional expectations and martingales.

Prerequisite: STAT 301

MATH 565 Advanced Ordinary Differential Equations I (3-0-3)

Existence, uniqueness and continuity of solutions. Linear systems, solution space, linear systems with constant and periodic coefficients. Phase space, classification of critical points, Poincare'-Bendixson theory. Stability theory of linear and almost linear systems. Stability of periodic solutions. Laypunov's direct method and applications.

Prerequisite: MATH 465

MATH 568 Advanced Partial Differential Equations I (3-0-3)

First order linear and nonlinear equations. Classification of Second order equations. The wave equation, heat equation and Laplace's equation. Green's functions, conformal mapping. Separation of variables, Sturm-Liouville theory. Maximum principles and regularity theorems.

Prerequisite: MATH 470

MATH 571 Numerical Analysis of Ordinary Differential Equations (3-0-3)

Theory and implementation of numerical methods for initial and boundary value problems in ordinary differential equations. One-step, linear multi-step, Runge-Kutta, and extrapolation methods; convergence, stability, error estimates, and practical implementation, Study and analysis of shooting, finite difference and projection methods for boundary value problems for ordinary differential equations.

Prerequisite: MATH 471 or Consent of the Instructor

MATH 572 Numerical Analysis of Partial Differential Equations (3-0-3)

Theory and implementation of numerical methods for boundary value problems

in partial differential equations (elliptic, parabolic, and hyperbolic). Finite difference and finite element methods: convergence, stability, and error estimates. Projection methods and fundamentals of variational methods. Ritz-Galerkin and weighted residual methods.

Prerequisite: MATH 471 or Consent of the Instructor

MATH 573 Matrix Computations and Optimization Algorithms (3-0-3)

Survey of practical techniques of numerical analysis for engineering and graduate students. Topics include computational and theoretical aspects of direct and iterative methods for linear systems, iterative solutions of nonlinear systems (successive approximations, relaxation, conjugate gradient, and quasi-Newton methods), sparse materials, least-squares problems (both linear and nonlinear), eigenvalue problems, and optimization problems. Problems include case studies in various disciplines.

Prerequisites: MATH 280; MATH 321 or SE 301. (Not Open to Mathematics Majors)

MATH 574 Numerical Methods of Partial Differential Equations (3-0-3)

Concepts of consistency, stability, and convergence of numerical schemes. Initial and boundary value problems for ordinary differential equations. Various finite difference and finite element methods and their applications to fundamental partial differential equations in engineering and applied sciences. Case studies selected from computational fluid mechanics, solid mechanics, structural analysis, and plasma dynamics.

Prerequisite: MATH 321, SE 301, or Consent of the Instructor.
(Not Open to Mathematics Majors)

MATH 575 Introduction to Approximation Theory (3-0-3)

Best approximation in normed linear spaces: basic concepts. Lagrange and Hermite interpolation. Approximate solution of over-determined system of linear equations. Linear approximation of continuous functions in Chebyshev and least squares norms. Rational approximation. Piecewise polynomial approximation. Cubic and B-splines.

Prerequisite: Consent of the Instructor.

MATH 577 Introduction to Industrial Mathematics (3-0-3)

Why and how industrial mathematics? The description of air bag sensor. How to judge the quality of a non-woven fabric? Damage estimation in a machine (fatigue life time). Mathematics to solve the above mentioned problems.

Prerequisite: MATH 202, MATH 280, or Consent of the Instructor

MATH 579 Wavelets and Fractals (3-0-3)

The continuous wavelet transform, the discrete wavelet transform, advantages of using wavelet transforms over the classical Fourier transform. Applications of wavelets in solution of differential and partial differential equations. Iterated function system and deterministic fractals.

Prerequisite: MATH 202

MATH 580 Convex Analysis (3-0-3)

Convex sets and convex functions; epigraphs, level sets. Inf-convolution; continuity and semi-continuity. Separation theorems and the Hahn-Banach theorem. Representation theorems, Caratheodory theorem. Polyhedra. Farkas lemma. Fenchel's theorem. Applications to linear systems. The weak duality theorem. Convex systems. Differentiability. Subdifferentials and subgradients, generalized gradients. Inf-compactness. Applications to Math programming and control theory. Cones of tangent. Constraint qualifications and optimality conditions for non-smooth minimization problems.

Prerequisite: MATH 411, or Consent of the Instructor

MATH 581 Advanced Linear Programming (3-0-3)

A rigorous and self-contained development of the theory and main algorithms of linear programming. Formulation of linear programs. Theory of linear programming (linear inequalities, convex polyhedral duality). Main LP algorithms (simplex, revised simplex, dual, and ellipsoidal algorithms). Geometry and theory of the simplex, dual, and ellipsoidal algorithms. Geometry and theory of the simplex method. Sensitivity analysis. Related topics (games, integer programming, parametric programming, stochastic programming). Representative applications in Economics, Engineering, Operations Research, and Mathematics. Familiarity with computer implementation of LP methods will be acquired by working on individual (or small group) projects of applying LP to student's chosen areas.

Prerequisite: MATH 321, MATH 573, or Consent of the Instructor.
(Credit cannot be given to both MATH 581 and SE 503)

MATH 582 Nonlinear Programming (3-0-3)

An advanced introduction to theory of nonlinear programming, with emphasis on convex programs. First and second order optimality conditions, constraint qualifications, Lagrangian convexity and duality. Penalty function methods. Theory and algorithms of main computational methods of nonlinear programming. Representative applications of nonlinear programming in Economics, Operations Research and Mathematics.

Prerequisite: MATH 412

MATH 586 Design and Analysis of Experiments (3-0-3)

Concepts of statistical designs and linear models. Basic designs: Completely randomized design. Randomized block design. Latin square designs (computer aided selection) models: Fixed, random and mixed models, estimation of parameter using Gauss-Markov theorem. Expectation of mean squares with and without use of matrix theory. Incomplete block designs. Factorial experiment, 2^p confounding, fractional replicate and orthogonal designs. 3^p confounding, fractional replicate and orthogonal designs. P q N confounding; fractional replicate and orthogonal designs. Tagouchi method as applied to design of experiments for engineering, industrial and agricultural data analysis. Extensive use of computer packages and computer aided designs.

Prerequisites: Graduate Standing, Consent of the Instructor

MATH 587 Advanced Applied Regression (3-0-3)

Least square method and properties. Simple and multiple linear regression with matrix approach. Development of liner models. Residual analysis. Polynomial models. Use of dummy variables in multiple linear regression. Analysis of variance approach. Selection of 'best' regression equation. Concepts of mathematical model building. Non-linear regression and estimation. Extensive use of computer packages.

Prerequisites: Graduate Standing, Consent of the Instructor

MATH 590 Special Topics in Mathematics (Variable Credit 1-3) Variable Contents

Prerequisite: Graduate Standing

MATH 591 Introduction to the Mathematical Literature (0-1-0)

Research and expository survey journals in mathematical sciences, review journals, citation journals, journal abbreviations and literature citations. Classification of mathematical subjects. Library search: books, bound journals, current periodicals, microfilms. Searching for publications on a specific subject or by a certain author.

Structure and organization of a research paper in mathematics. Methods of dissemination of mathematical results: abstracts, conferences, research papers, books and monographs. Major mathematical societies and publishers and their publication programs. The course will consist of one lecture a week and «workshop» sessions at the KFUPM Library supervised by the instructor.

MATH 595 Reading and Research I (Variable Credit 1-3) Variable Contents

Prerequisite: Graduate Standing

MATH 596 Reading and Research II (Variable Credit 1-3) Variable Contents

Prerequisite: Graduate Standing

MATH 599 Seminar (1-0-0)

Prerequisite: Graduate Standing

MATH 602 Topics in Fluid Dynamics (3-0-3)

Kinematics and dynamics. Potential flow. Navier-Stokes equations. Some exact solutions. Laminar boundary layers. Stokes and Oseen flows. Sound waves. Topics in gas dynamics. Surface waves. Flow in porous media. Darcy's law and equation of diffusivity.

Prerequisite: MATH 505 or equivalent

MATH 605 Asymptotic Expansions and Perturbation Methods (3-0-3)

Asymptotic sequences and series. Asymptotic expansions of integrals. Solutions of differential equations at regular and irregular singular points. Nonlinear differential equations. Perturbation methods. Regular and singular perturbations. Matched asymptotic expansions and boundary layer theory. Multiple scales. WKB theory.

Prerequisites: MATH 430; MATH 301 or MATH 513

MATH 607 Inverse and Ill-Posed Problems (3-0-3)

Mathematical and numerical analysis of linear inverse and/or ill-posed problems for partial differential, integral and operator equations. Tikhonov regularization. Constraints and a priori bounds. Methodologies for achieving «optimal» compromise between accuracy and stability. Applications to practical problems in remote sensing, profile inversion, geophysics, inverse scattering and tomography.

Prerequisite: MATH 513, MATH 573, or Consent of the Instructor.

MATH 610 MSC Thesis (0-0-6)

MATH 611 Hilbert Space Methods in Applied Mathematics I (3-0-3)

Review of normed and product spaces. Theory of distributions, weak solution.

Complete orthonormal sets and generalized Fourier expansions. Green's functions and boundary-value problems, modified Green's functions. Operator theory, invertibility, adjoint operators, solvability conditions. Fredholm alternative. Spectrum of an operator. Extremal principles for eigenvalues and perturbation of eigenvalue problems. Applications.

Prerequisite: MATH 535

MATH 612 Hilbert Space Methods in Applied Mathematics II (3-0-3)

Integral equations; Fredholm integral equation, spectrum of a self-adjoint compact operator, inhomogeneous equation. Variational principles and related approximation methods. Spectral theory of second-order differential operator, Weyl's classification of singular problems. Continuous spectrum. Applications. Introduction to nonlinear problems. Perturbation theory. Techniques for nonlinear problems.

Prerequisite: MATH 611

MATH 621 General Topology II (3-0-3)

The Tychonoff theorem, one-point compactification, the Stone-Cech compactification. Paracompactness, Lindelof spaces, Stone's theorem. Metrizability, the Nagata-Smirnov metrization theorem. Homotopy paths, fundamental group, simply-connected spaces, retracts and deformation retracts; the fundamental groups of the circle, the punctured plane and the n-sphere; Van Kampen's theorem.

Prerequisite: MATH 521

MATH 627 Differentiable Manifolds and Global Analysis (3-0-3)

Calculus on manifolds. Differentiable manifolds, mappings, and embeddings.

Implicit functions theorem, exterior differential forms, and affine connections. Tangent bundles. Stoke's theorem. Critical points. Sard's theorem. Whitney's embedding theorem. Introduction to Lie groups and Lie algebras. Applications.

Prerequisite: MATH 527

MATH 631 Advanced Topics in Real and Abstract Analysis (3-0-3)

Topics to be chosen from Measure and Integration, Measurable Selections, Locally Convex Spaces, Topological Groups, Harmonic Analysis, Banach Algebras.

Prerequisite: MATH 531

MATH 633 Complex Variables II (3-0-3)

Harmonic functions. The Riemann mapping theorem. Conformal mappings for multi-connected domains. Elliptic functions and Picard's theorem. Analytic continuation. Entire functions. Range of an analytic function. Topics in univalent functions and geometric function theory.

Prerequisite: MATH 533

MATH 637 Non-linear Functional Analysis and Applications (3-0-3)

Fixed points methods. Nonexpansive mappings. Differential and integral calculus in Banach spaces. Implicit and inverse function theorems. Potential operators and variational methods for linear and nonlinear operator equations. Extrema of functionals. Monotone operators and monotonicity methods for nonlinear operator equations. Applications to differential and integral equations and physical problems.

Prerequisite: MATH 535

MATH 640 Calculus of Variations (3-0-3)

Gateaux and Fréchet differentials. Classical calculus of variations. Necessary conditions. Sufficient conditions for extrema. Jacobi and Legendre conditions. Natural boundary conditions. Broken extrema, Erdmann-Weierstrass condition. Multiple integral problems. Constrained extrema. Hamilton principle with applications to mechanics and theory of small oscillations. Problems of optimal control. Direct methods including the Galerkin and the Ritz-Kantorovich methods. Variational methods for eigenvalue problems.

Prerequisite: MATH 411, or Consent of the Instructor

MATH 641 Topics in Calculus of Variations (3-0-3)

Selected topics from the following: Variational inequalities, weak lower semicontinuity and extremal problems in abstract spaces, theory of optimal control, stochastic control, distributed parameter systems, optimization problems over infinite horizons, algorithmic and penalty methods in optimization.

Prerequisite: MATH 640

MATH 642 Control and Stability of Linear Systems (3-0-3)

Review of systems of linear differential equations to include existence and uniqueness, contraction mappings, fixed points, transition matrix, matrix exponentials, the Laplace transform and stability. Linear control systems. Controllability, observability and duality. Weighting patterns and minimal realizations. Feedback. Linear regulator problem and matrix Riccati equations. Fixed-end point problems. Minimum cost and final-value problems in control theory. Stability of linear systems. Uniform stability. Exponential stability.

Prerequisites: MATH 465; MATH 460 or MATH 550

MATH 645 Combinatorics and Graph Theory (3-0-3)

Enumerative analysis, generating functions. Sorting and searching. Theory of codes. Block design. Computational combinatorics. Methods of transforming combinatorial ideas into efficient algorithms. Algorithms on graphs, network flow.

Prerequisite: MATH 425

MATH 651 Universal Algebra (3-0-3)

Lattices: basic properties, distributive and modular lattices, complete lattices, equivalence relations and algebraic lattices; Algebras: definition and examples, isomorphisms, subalgebras congruences and quotient algebras, homomorphism theorems, direct products, subdirect products, simple algebras, class operators and varieties, terms and term algebras, free algebras, Birkhoff's theorem, equational logic, Boolean algebras: Boolean algebras and Boolean rings, filters and ideals, Stone duality, connections with model theory: First-order languages and structures, reduced products and ultraproducts.

Prerequisite: MATH 551

MATH 652 Advanced Topics in Group Theory (3-0-3)

Advanced theory of solvable and nilpotent groups. General free groups. Krull- Schmidt theorem. Extensions. The general linear group. Group rings and group algebras. Representation theory of groups.

Prerequisite: MATH 450. (MATH 551 is recommended)

MATH 653 Advanced Topics in Commutative Algebra (3-0-3)

Selected topics from: prime spectra and dimension theory; class groups; ideal systems and star operations; multiplicative ideal theory; generator Property; homological aspects of commutative rings; pullbacks of commutative rings.

Prerequisite: MATH 555. (MATH 552 and MATH 553 are recommended)

MATH 654 Advanced Topics in Algebra (3-0-3)

Selected topics from: groups, rings, modules, and general algebraic systems.

Prerequisites: Graduate Standing, Consent of the Instructor

MATH 655 Applied & Computational Algebra (3-0-3)

Contents vary. Concepts and methods in algebra which have wide applications in mathematics as well as in computer science, systems theory, information theory, physical sciences, and other areas. Topics may be chosen from fields of advanced matrix theory; algebraic coding theory; group theory; Gŕbner bases; or other topics of computational and applied algebra.

Prerequisites: Graduate Standing, Consent of the Instructor

MATH 661 Mathematical Statistics (3-0-3)

Theory of point estimation, Properties of estimators. Unbiased estimation and lower bounds for the variance of an estimator. Methods of moments and maximum likelihood. Bayes' and minimax estimation. Minimal sufficient statistics. Neymann-Pearson theory of testing of hypotheses. Unbiased and invariant tests. Confidence estimation. Confidence intervals (shortest length, unbiased and Bayes'). The general linear hypothesis and regression. Analysis of variance. Nonparametric statistical inference.

Prerequisite: MATH 561

MATH 663 Advanced Probability (3-0-3)

Measurable functions and integration. Radon-Nikodym theorem. Probability space. Random vectors and their distributions. Independent and conditional probabilities. Expectation. Strong laws of large numbers. The weak compactness theorem. Basic concepts of martingales. Invariance principles. The Law of the Iterated Logarithm. Stable distributions and infinitely divisible distributions.

Prerequisites: MATH 531, MATH 563

MATH 665 Advanced Ordinary Differential Equations II (3-0-3)

Self-adjoint boundary-value problems, Sturm-Liouville theory. Oscillation and comparison theorems. Asymptotic behavior of solutions. Singular Sturm-Liouville problems and non self-adjoint problems. Hypergeometric functions and related special functions. Bifurcation phenomena.

Prerequisite: MATH 565

MATH 667 Advanced Partial Differential Equations II (3-0-3)

Classification of first order systems. Hyperbolic systems, method of characteristics. Applications to gas dynamics. Dispersive waves; application to water waves. Potential theory, single and double layers, existence theory for Dirichlet and Neumann problems.

Prerequisite: MATH 568

MATH 669 Integral Equations (3-0-3)

Review of the Fredholm and Hilbert-Schmidt theories for Fredholm integral equations of the second kind. Kernels with weak and logarithmic singularities. Singular integral equations of the first and second kind (Abel, Carleman, and Wiener-Hopf equations). Nonlinear integral equations (Volterra and Hammerstein equations). Application of the Schauder fixed point theorem. Nonlinear eigenvalue problems and integral equation methods for nonlinear boundary-value problems. Nonlinear singular integral equations. Applications to engineering and physics (the nonlinear oscillator, the airfoil equation, nonlinear integral equations arising the radiation transfer, hydrodynamics, water waves, heat conduction, elasticity, and communication theory).

Prerequisite: MATH 535

MATH 673 Numerical Solution of Integral Equations (3-0-3)

Numerical methods and approximate solutions of Fredholm integral equations of the second kind (both linear and nonlinear). Approximation of integral operators and quadrature methods. Nystrom method. Method of degenerate kernels. Collectively compact operator approximations. Numerical methods for Volterra integral equations. Methods of collocation, Galerkin, moments, and spline approximations for integral equations. Iterative methods for linear and nonlinear integral equations. Eigenvalue problems.

Prerequisite: MATH 471 or Consent of the Instructor

MATH 674 Numerical Functional Analysis (3-0-3)

Theoretical topics in numerical analysis based on functional analysis methods. Operator approximation theory. Iterative and projection methods for linear and nonlinear operator equations. Methods of steepest descent, conjugate gradient, averaged successive approximations, and splittings. Stability and convergence. Abstract variational methods and theoretical aspects of spline and finite element analysis. Minimization of functionals. Vector space methods of optimization. Newton and quasi-Newton methods for operator equations and minimization.

Prerequisite: MATH 535 or MATH 611

MATH 680 Dynamic Programming (3-0-3)

Development of the dynamic programming algorithm. Optimality principle and characterizations of optimal policies based on dynamic programming. Shortest route problems and maximum flow problems. Adaptive process. One-dimensional allocation processes. Reduction of dimensionality. Additional topics include imperfect state information models, the relation of dynamic programming to the calculus of variations, and network programming. Computational experience will be acquired by working on individual projects of applying dynamic programming to case study problems.

Prerequisite: MATH 640

MATH 681 Topics in Mathematical Programming (3-0-3)

Contents vary. Topics selected from: Nonconvex optimization, geometric programming, Lagrangian algorithms, sensitivity analysis, large-scale programming, nonsmooth optimization problems and optimality conditions in infinite-dimensional spaces, combinatorial optimization, computation of fixed points, complementarity problems, multiple-criteria optimization, and semi-infinite programming.

Prerequisite: MATH 582, or Consent of the Instructor

MATH 690 Special Topics in Mathematics (Variable Credit 1-3) Variable Contents

Prerequisite: Admission to Ph.D. Program

MATH 695 Reading and Research I (Variable Credit 1-3) Variable Contents

Prerequisite: Admission to Ph.D. Program

MATH 696 Reading and Research II (Variable Credit 1-3) Variable Contents

Prerequisite: Admission to Ph.D. Program

MATH 699 Seminar **(1-0-0)**

Prerequisite: Admission to Ph.D. Program

MATH 710 Ph.D. Dissertation **(0-0-12)**

PHYSICS

Chairman

Abdul-Aziz Mohammad Al-Jalal

Professors

Al-Adel	Al-Jarallah	Nasser
Ayub	Khattak	Tabet
Bahlouli	Naqvi	Ziq
Gondal		

Associate Professors

Abdelmonem	Faiz	Mekki, A
Aksoy	Garwan	Nagadi
Al-Kuhaili	Khiari	Yamani
Al-Ohali	Maalej	

Assistant Professors

Al-Aithan	Al-Quraishi	Al-Sulami
Al-Amoudi	Al-Ramadhan	Al-Sumaidi
Al-Jalal	Al-Sadah	Musazay
Al-Karmi	Al-Shukri	

Lecturers

Al-Zahrani	Ghannam	Mekki, M
Azad-U-Islam	Kariapper	Salem
Enaya	Khateeb-Ur-Rahman	

M.S. PROGRAM IN PHYSICS

The Graduate Program in Physics is designed to prepare the students for professional careers and further research in physics. Candidates are expected to pursue a course of study and research that will give them a greater comprehension of basic theoretical and experimental physics. Students of this program will be either theoretically or experimentally oriented, depending on the type of research they are interested in.

The program encompasses the following major branches of physics:

1. Atomic, Molecular, and Laser Physics
2. Condensed Matter Physics
3. Medical Physics (see page 407 for details)
4. Nuclear Physics
5. Theoretical Physics
6. Radiation Physics.

TEACHING AND RESEARCH FACILITIES

Radiation Protection

The Radiation Protection laboratory houses a variety of radiation detection instruments and radiation sources that include:

> Liquid scintillation counter; Ion chamber survey meters; Gamma scintillation/Geiger Müller survey meters; Neutron survey meter; Nuclear track detection system (chemical etching and optical microscope with image analyzing system); Am-Be neutron sources; Co-60 gamma sources; Cs-137 gamma sources; Ra-226 alpha/gamma sources.

Superconductivity

The superconductivity Laboratory houses a 9-Tesla vibrating sample magnetometer (VSM). Transport measurements and AC-susceptibilities set-up. Magnetic properties of superconductors, nanoparticles, alloys and glasses are routinely studied in this lab.

Surface Science

The Surface Science laboratory houses a VG ESCA-LAB MKII electron spectrometer. This is a multi-technique instrument allowing complete surface analysis of samples using X-ray photoelectron spectroscopy (XPS), Auger electron spectroscopy (AES) and scanning AES, Ultraviolet photoelectron spectroscopy (UPS) and Low-energy electron diffraction (LEED). An ion gun (type EXO5) enables measuring depth profiles of elements over surface areas of various dimensions. In-situ heat treatment under controlled atmosphere is possible up to 600 degrees Celsius in a heating cell attached to the instrument.

The laboratory also possesses a home-made magnetron dc-sputtering system that is used to synthesize thin films. The Hall effect measurements can be carried out on thin films at room temperature and liquid nitrogen using the Van Der Pauw method.

The laboratory houses also a Shimadzu X-ray Diffraction (XRD) instruments and a Veeco INOVA Atomic Force Microscope (AFM) instrument.

Thin Films and Materials

Energy Research Centers (ERC)

The department has access to the following research facilities at the Energy Research Center (ERC), a separate department of the College of Sciences at KFUPM.

Nuclear Physics Facility: This consists mainly of a 350 KV, high current accelerator.

The main area of research at the 350 KV ion accelerator are fast neutron activation studies and nuclear reaction studies suing polarized and non-polarized beams of neutrons, protons and deuterons.

Laser Research Laboratory (LRL): The laser research laboratory houses a variety of molecular and atomic activities supported by advanced equipment that include several dye lasers pumped by excimer/yag/Argon ion lasers suitable for frequency-resolved (500kHz) or time-resolved studies (femtosecs).

Other Facilities

A major asset of the department that deserves separate mention is the cryogenic facility for liquefying helium and nitrogen.

In addition to the research facilities mentioned, the department also has a well-equipped workshop, and an electronic shop. The department also has a computer room containing several personal computers with major scientific software, scanners, CD Rom and CD writer, as well as all other peripherals connected with the Information Technology Center (ITC) network.

DEPARTMENTAL ADMISSION REQUIREMENTS

The Master of Science program in Physics is available to students who meet the requirements for admission to the University with a B.S. in Physics or equivalent.

The subject GRE is usually required, unless the applicant comes from a University whose grading system and standards are well known, and his undergraduate Physics record is superior.

Normally a minimum of 24 (500 level) credit hours of course work and a maximum of 6 (400 level) credit hours can be counted (approval of the advisor and the chairman) provided it is not a complete repetition of graduate courses and not core courses for undergraduate and graduate, plus six credit hours of research towards the preparation of an M.S. thesis will be required.

ACADEMIC PROGRAM

The M.S. program in Physics consists of two main groups of courses (“core courses”, and “specialty courses”), seminar, and thesis. The five core courses (15 credits) must be taken by all candidates. The candidates must take three* specialty courses (9 credits). Details of the program are given below in the following degree plan.

Degree Plan for the M.S. Program in Physics

Course #	Title	LT	LB	CR
FIRST SEMESTER				
PHYS 501	Quantum Mechanics I	3	0	3
PHYS 507	Classical Mechanics	3	0	3
PHYS 571	Advanced Methods of Theoretical Physics**	3	0	3
PHYS 5xx/4xx		3	0	3
		12	**0**	**12**
SECOND SEMESTER				
PHYS 503	Graduate Laboratory	0	6	3
PHYS 505	Classical Electrodynamics I	3	0	3
PHYS 5xx/4xx		3	0	3
PHYS 5xx/4xx		3	0	3
PHYS 599		1	0	0
		10	**6**	**12**
SUMMER SESSION AND FOLLOWING SEMESTER				
PHYS 610	Thesis	0	0	6
		0	**0**	**6**
Total Credit hours				**30**

* Normally the Department recommends that PHYS 530 (Statistical Mechanics) be taken as one of the elective courses.

** MATH 515 (Methods of Linear Operators in Science and Engineering) may be used to satisfy the PHYS 571 requirement.

The courses PHYS 5xx are to be selected from the physics specialized course offerings.

COURSE DESCRIPTION

PHYS 501 Quantum Mechanics I **(3-0-3)**

Brief review of quantum mechanics including operators, linear vector spaces and Dirac notation; General theory of angular momentum and rotation group, addition of angular momentum, Clebsh-Gordan technique, scattering of spin ½ particles with spinless particles, tensor operators; a brief review of time dependent perturbation theory, interaction of radiation with matter, absorption of light, induced and spontaneous emission, electric and magnetic dipole transitions, selections rules and scattering of light.

Prerequisite: PHYS 402

PHYS 502 Quantum Mechanics II **(3-0-3)**

Quantization of radiation field; Emission and absorption of photons by atoms, Lamb shift; Relativistic spin zero particles, Klein–Gordon equation, Quantization of spin 0 field; Relativistic spin 1/2 particles; details of Dirac equation and its applications; Quantization of Dirac field; 2-component neutrino theory; Covariant perturbation theory; S-matrix; electron and photon propagators; Application to 2-photon annihilation, Compton scattering and Moller scattering; Introduction to mass and charge renormalization.

Prerequisite: PHYS 501

PHYS 503 Graduate Laboratory **(0-6-3)**

Four experiments from the different areas of current research interest in the Physics Department, each is supervised by a faculty member from the respective research specialty. Emphasis on some of the techniques and instrumentation currently used in research; computer-assisted and advanced techniques of analysis of data.

Prerequisite: PHYS 403 or Consent of the Instructor

PHYS 505 Classical Electrodynamics I **(3-0-3)**

Boundary value problems in electrostatics and magnetostatics; dielectrics and magnetic media; Maxwell's equations and conservation laws; wave guides and resonators; simple radiating systems.

Prerequisite: PHYS 306

PHYS 506 Classical Electrodynamics II (3-0-3)

The electromagnetic potentials and the Hertz vectors; cylindrical waves, spherical waves, the Debye potentials; multipole radiation; classical relativistic electrodynamics; radiation from moving charges.

Prerequisite: PHYS 505

PHYS 507 Classical Mechanics (3-0-3)

Topics discussed include variational principles; Lagrange's equations; the rigid body equations of motion; Hamilton's equations; canonical transformations; Hamilton–Jacobi theory; small oscillations and normal coordinates; continuous systems and fields.

Prerequisite: PHYS 301

PHYS 511 Quantum Optics (3-0-3)

Partial coherence; photon statistics; stochastic processes; Markoffian processes; statistical states in quantum theory; equation of motion of the electromagnetic field; coherent state representation of the electromagnetic field; quantum theory of optical correlation; theoretical laser models; nonlinear optical phenomena.

Prerequisites: PHYS 411, PHYS 501

PHYS 515 Astrophysics (3-0-3)

Radiative transfer and internal structure of normal stars; red giants; white dwarfs; neutron stars; pulsars; nova and super-nova explosions; nuclear theories of stellar evolution; binary systems and galactic x-ray sources; galaxies; quasars and cosmology.

PHYS 520 Introduction to Strong Interactions (3-0-3)

Topics of borderline between Nuclear and Particle Physics will be emphasized e.g., Isospin and charge dependent effects in nuclear forces; Meson exchange effects in nuclear physics; Structure of nucleon and nuclei by electron scattering; Quarks in nuclei.

Corequisites: PHYS 501

PHYS 521 Advanced Nuclear Physics I (Nuclear Structure) (3-0-3)

Generalities; Nuclear sizes, forces, binding energies, moments; Nuclear models: Fermi-gas model, liquid drop model (fission), collective models (rotational/vibrational spectra), Electromagnetic transitions: multipole expansion, decay rates, selection rules; Simple theory of Beta decay.

Prerequisites: PHYS 422, PHYS 501

PHYS 522 Advanced Nuclear Physics II (Nuclear Reactions) (3-0-3)

Two body system and nuclear forces; nuclear reactions; scattering matrix, resonance optical model; compound nucleus; direct reactions; fission, heavy ion nuclear reactions; photo-nuclear reactions.

Prerequisites: PHYS 422, PHYS 501

PHYS 523 Nuclear Instrumentation (3-0-3)

Nuclear radiation detectors; basic pulse circuits, pulse shaping methods for nuclear spectroscopy, resolution in nuclear spectroscopy systems, amplifiers; pulse height and shape discriminators; timing circuits; multi-channel pulse height analyzers; multi-parameter and computer analysis.

Prerequisites: PHYS 403, PHYS 422

PHYS 524 Neutron Physics (3-0-3)

Production and detection of neutrons; introduction to polarization; production of polarized neutrons; polarized targets; neutron-induced reactions; applications in other fields.

Prerequisites: PHYS 422, PHYS 501

PHYS 530 Statistical Mechanics (3-0-3)

The statistical basis of thermodynamics; elements of ensemble theory, the canonical and grand canonical ensembles; quantum statistics; application to simple gases; Bose and Fermi systems; Imperfect gas; Phase transitions and Ising model.

PHYS 532 Solid State Physics I (3-0-3)

Review of free electron gas. Bravais lattice and crystal structure, reciprocal lattice and Brillouin zones, crystal binding, electron states in periodic potential, energy band structure and application to metals, semiconductors and insulators, Fermi surface, surface effects, lattice dynamics and lattice specific heat, electron-photon and effective electron-electron interactions, and dielectric properties and applications.

Prerequisites: PHYS 306, PHYS 432

PHYS 533 Solid State Physics II (3-0-3)

Transport phenomena, impurity effects and impurity structure, various spectroscopies using photons and charged particles as excitation source and application to bulk and surface properties, many-body effects, magnetism and related topics, superconductivity and related theories, and resonance phenomena and applications.

Prerequisite: PHYS 532

PHYS 536 Low Temperature Physics (3-0-3)

Production of low temperatures; the cryogenic fluids; superfluidity; helium I and II; He 3; type I and II super-conductivity; BCS theory; applications of superconductivity.

Prerequisite: PHYS 401

PHYS 541 Elementary Particle Physics I (3-0-3)

Characterization of particle: Mass, spin and magnetic moment; classification of particles; internal quantum numbers; baryon and lepton charges and hypercharge; Isospin and SU(2) group; Discrete space-time transformations; Determination of parity and spin of particles; K^0-K^0 complex; CP violation; CPT theorem; Quark model of hadrons; 3 quark flavors and SU(3) classification of particles; Mass spectrum of hadrons and their magnetic moments in quark model; Discovery of additional quark flavors; Color charge and gluon; Non-relativistic treatment of one gluon exchange potential and its application to mass spectrum of hadrons.

Prerequisite: PHYS 501

PHYS 542 Elementary Particle Physics II (3-0-3)

Introduction to weak interactions, V-A theory; Vector and axial vector currents; Intermediate vector bosons, Non-abelian gauge transformations; Spontaneous symmetry breaking; Unification of weak and electromagnetic interactions; Introduction to quantum chromodynamics; Introduction to grand unification.

Prerequisites: PHYS 502, PHYS 541

PHYS 551 Atomic and Molecular Physics (3-0-3)

Energy levels and wave functions of atoms and molecules; microwave, infrared, visible and UV spectroscopies; lasers and masers; LS and j j coupling; Thomas-Fermi and Hartree-Fock approximations; relativistic effects; group theoretical considerations; collisions.

Prerequisite: PHYS 501

PHYS 561 Plasma Physics I **(3-0-3)**

Review introduction to the basics of plasma physics; thermodynamics and statistical mechanics of equilibrium plasma; macroscopic properties and waves in the fluid plasma; stability of the fluid plasma; transport phenomena.

Prerequisites: PHYS 461, PHYS 530

PHYS 562 Plasma Physics II **(3-0-3)**

Kinetic equations; Vlasov theory of plasma waves; Vlasov theory of plasma stability; the nonlinear Vlasov theory of plasma waves and instabilities; fluctuation correlation and radiation; particle motion; selected advanced topics.

Prerequisite: PHYS 561

PHYS 571 Advanced Methods of Theoretical Physics **(3-0-3)**

Partial differential equations, Separation of variables; Eigenfunctions and Eigenvalues; Linear vector spaces and linear operators; Green functions; Integral equations; Integral transforms.

Prerequisite: PHYS 371 or Consent of the Instructor

PHYS 573 Group Theory and Quantum Mechanics **(3-0-3)**

An introductory course into the physical application of group theory. Topics discussed are abstract group theory; group representations; symmetries; the rotation group; application of group theory to atoms, molecules, and solids.

Prerequisite: PHYS 501

PHYS 575 General Relativity **(3-0-3)**

The Equivalence principle; Field equations and the gravitational potential; solutions of Einstein’s equations; the classical tests for general relativity; cosmology; star phenomenology including stellar equilibrium; Neutron star and gravitational collapse.

Prerequisite: Consent of the Instructor

PHYS 590 Special Topics in Physics **(3-0-3)**

Advanced topics selected for their current interest.

Prerequisite: Consent of the Instructor

PHYS 599 Seminar **(1-0-0)**

Graduate students are required to attend the seminars given by faculty, visiting scholars, and fellow graduate students. Additionally, each student must present at least one seminar on a timely research topic. Among other things, this course is designed to give the student an overview of research in the Department, and a familiarity with the research methodology, journals, and professional societies in his discipline. Graded on a Pass or Fail basis.

Prerequisite: Graduate Standing

PHYS 610 Thesis **(0-0-6)**

MASTER'S PROGRAM IN MEDICAL PHYSICS

MEDICAL PHYSICS

Medical physics is an applied branch of physics concerned with the application of the concepts and methods of physics to the diagnosis and treatment of human disease. The main areas of medical physics are the treatment of cancer by ionizing radiation (radiation oncology), diagnostic imaging with X-rays, ultrasound and nuclear magnetic resonance (diagnostic radiology), diagnostic imaging with radioisotopes (nuclear medicine) and the study of radiation hazards and radiation protection (health physics).

ADMISSION REQUIREMENTS

Motivated applicants who have a B.S. degree in science or engineering from a university of recognized standing are invited to apply for admission to the Master's degree in medical physics, provided they satisfy the general admission requirements of the Graduate School. Applicants must have a suitable scientific background to enter the medical physics program demonstrated by the completion of the following KFUPM courses or their equivalent: Methods of Applied Mathematics (MATH 301), Modern Physics (PHYS 212), Experimental Physics I (PHYS 303). Applicants must make up any deficiencies in their prior program within two semesters of enrollment. Once accepted in the program, graduate students are required to take a full time course load.

ACADEMIC PROGRAM

The following are the requirements for the Master's degree in Medical Physics.

Course	Credit hours
1. Completion of core courses	18
2. Completion of elective courses	15
3. Completion of clinical training	6
4. Completion of Med Phys Project	3
5. Passing the comprehensive examination	-
Total Credit Hours	**42**

Core Courses

The following core courses are required for the Master's degree in Medical Physics.

COURSE #	TITLE	CR
MEPH 500	Human Anatomy Physiology	3
MEPH 510	Radiobiology	2
MEPH 561	Radiological Physics and Dosimetry	3
MEPH 563	Radioisotopes in Medicine and Biology	3
MEPH 566	Radiotherapy Physics	3
MEPH 567	Diagnostic Radiology Physics	4
MEPH 569	Health Physics	4
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Elective Courses

A candidate for the Master's degree in medical physics will also be required to take 15 credit hours to be chosen as follows:

1. A minimum of 3 credit hours to be selected from the following list of courses.

COURSE #	TITLE	CR
MEPH 581	Laboratory in Radiological Physics – Radiotherapy	1
MEPH 582	Laboratory in Radiological Physics – Diagnostic Radiology	1
MEPH 583	Laboratory in Radiological Physics – Nuclear Medicine	1
MEPH 584	Laboratory in Radiological Physics – Health Physics	1
MEPH 585	Laboratory in Radiological Physics – CT, MRI, and DSA	1
MEPH 586	Laboratory in Radiological Physics – Medical Ultrasound	1

2. The remaining credit hours are to be selected from the following list of courses.

A minimum of 12 credit hours to be selected from the following list of courses.

COURSE #	TITLE	CR
MEPH 501	Physics for Medicine and Biology	3
MEPH 511	Instrumentation for Medical Physics	3
MEPH 568	Magnetic Resonance Imaging (MRI)	2
MEPH 570	Advanced Brachytherapy Physics	2
MEPH 571	Advanced External Radiation Oncology	3
MEPH 573	Imaging in Medicine	3
MEPH 574	Applications of Digital Imaging: DSA, CT, MRI	2
MEPH 575	Diagnostic Ultrasound Physics	3
MEPH 591	Selected Topics in Medical Physics	3
MEPH 592	Independent Reading	3
EE 614	Digital Signal Processing	3
EE 617	Image Processing and Holography	3
MATH 513	Mathematical Methods for Engineers	3

CLINICAL TRAINING

Clinical medical physics training is obtained in the Laboratory in Radiological Physics courses (MEPH 581-586). Each laboratory involves performing particular experiments and procedures in hospitals. Additional clinical medical physics training is obtained in the clinical training course (MEPH 590). The course consists of a 16-week hospital-based clinical rotation in: diagnostic imaging (x-rays, CT, DSA, fluoroscopy, diagnostic ultrasound), MRI, nuclear medicine, radiation therapy, mammography, radiation protection, and health physics. A student in this course observes and practices clinical procedures under the direct supervision of a senior clinical medical physicist. The student will write a monthly progress report about the clinical procedures he learned and performed. The evaluation and the follow-up of each student will be done in cooperation between the supervising medical physicist from the hospital and a medical physics faculty member from KFUPM.

COMPREHENSIVE EXAMINATION

All candidates for the Master's Degree in Medical Physics are required to take a written comprehensive examination prior to receiving the degree. The examination is offered near the end of each semester and consists of questions on the core courses. Candidates are advised to take this exam at the end of the semester in which they complete the courses. A candidate who fails the examination may repeat it at a later regularly scheduled time. Only one such repeat is permitted.

Degree Plan for the Master's Program in Medical Physics

COURSE #	TITLE	LT	LB	CR
First Semester				
MEPH 500	Human Anatomy	3	0	3
MEPH 510	Physiology Radiobiology	2	0	2
MEPH 561	Radiological Physics and Dosimetry	3	0	3
MEPH 567	Diagnostic Radiology Physics	3	3	4
		11	**3**	**12**
Second Semester				
MEPH 563	Radioisotopes in Medicine and Biology	2	3	3
MEPH 566	Radiotherapy Physics	2	3	3
MEPH 58x	Elective Lab in Radiological Physics	0	3	1
XXX xxx	Elective	3	0	3
		7	**9**	**10**
Third Semester				
MEPH 569	Health Physics	3	3	4
MEPH 58x	Elective Lab in Radiological Physics	0	3	1
MEPH 58x	Elective Lab in Radiological Physics	0	3	1
XXX xxx	Elective	3	0	3
MEPH 599	Seminar	1	0	0
		7	**9**	**9**
Fourth Semester				
MEPH 590	Clinical Training	0	0	6
MEPH 600	Medical Physics Project	0	0	3
		0	**0**	**9**
Total Credit Hours				**42**

COURSE DESCRIPTION

MEPH 500 Human Anatomy and Physiology (3-0-3)

The course will cover subjects including cell physiology, organs and systems physiology ans anatomy. The student will learn to identify gross anatomical structures, define the major organ systems, and describe the physiological mechanisms for repair, maintenance, and growth. Anatomical structures and physiological function should be correlated with imaging modalities to view them.

Prerequisite: Instructor Consent

MEPH 501 Physics for Medicine and Biology (3-0-3)

Forces on bones and muscles; body fluid flow; electrodynamics of nerve impulses; electrocardiograms; magnetocardiograms and magnetoencephalograms; diffusion processes, membrane transport, kidney function; biological effects in magnetic resonance and ultra-low frequency electromagnetic radiation; laser applications.

Prerequisite: PHYS 212 or equivalent

MEPH 510 Radiobiology (2-0-2)

Effects of ionizing radiations on living cells and organisms, including physical, chemical, and physiological bases of radiation cytotoxicity, mutagenicity, and carcinogenesis.

*Corequisites:*MEPH 561

MEPH 511 Instrumentation for Medical Physics (2-3-3)

Concepts of medical instrumentation, transducers, and medical electronics design. Various types of sensors and measurement apparatus used for the calibration of medical imaging and therapy systems will receive particular attention.

Prerequisite: PHYS 303 or equivalent

MEPH 561 Radiological Physics and Dosimetry (3-0-3)

Interactions and energy deposition by ionizing radiation in matter; concepts, quantities and units in radiological physics; principles and methods of radiation dosimetry.

Prerequisites: PHYS 212; MATH 202 or equivalent

MEPH 563 Radioisotopes in Medicine and Biology **(2-3-3)**

Physical principles of radioisotopes used in medicine and biology and operation of related equipment; lecture and lab.

Prerequisite: PHYS 212 or equivalent

MEPH 566 Radiotherapy Physics **(2-3-3)**

Ionizing radiation use in radiation therapy to cause controlled biological effects in cancer patients. Physics of the interaction of the various radiation modalities with body-equivalent materials, and physical aspects of clinical applications; lecture and lab.

Prerequisite: MEPH 561

MEPH 567 Diagnostic Radiology Physics **(3-3-4)**

Physics of x-ray diagnostic procedures and equipment, radiation safety, general imaging considerations; lecture and lab.

Prerequisites: PHYS 212; MATH 202 or equivalent

MEPH 568 Magnetic Resonance Imaging (MRI) **(2-0-2)**

Physics and technology of magnetic resonance imaging (MRI), emphasizing techniques employed in medical diagnostic imaging. Major topics: physics of MR, pulse sequences, hardware, imaging techniques, artifacts, and spectroscopic localization.

Prerequisite: MEPH 567

MEPH 569 Health Physics **(3-3-4)**

Physical and biological aspects of the use of ionizing radiation in industrial and academic institutions; physical principles underlying shielding instrumentation, waste disposal; biological effects of low levels of ionizing radiation; lecture and lab.

*Prerequisite:*MEPH 561

MEPH 570 Advanced Brachytherapy Physics **(2-0-2)**

The use of radioactive sources for radiotherapy including: materials used, source construction dosimetry theory and practical application, dosimetric systems, localization and reconstruction. The course covers low dose rate, high dose rate and permanently placed applications.

Prerequisite: MEPH 566

MEPH 571 Advanced External Radiation Oncology (3-0-3)

Physics of ionizing radiation therapy with emphasis on external beam dosimetry and treatment planning.

Prerequisite: MEPH 566

MEPH 573 Imaging in Medicine (3-0-3)

The conceptual, mathematical and statistical aspects of imaging science, and a survey from this formal viewpoint of various medical imaging modalities, including film-screen radiography, positron and x-ray computed tomography, and magnetic resonance imaging.

Prerequisites: PHYS 212; MATH 301 or equivalent

MEPH 574 Applications of Digital Imaging: DSA, CT, MRI (2-0-2)

This course will focus on practical aspects of digital diagnostic imaging. The course will cover digital subtraction angiography (DSA), x-ray transmission computed tomography (CT), and nuclear magnetic resonance imaging (MRI).

Prerequisites: MEPH 561, MEPH 567

MEPH 575 Diagnostic Ultrasound Physics (2-3-3)

Propagation of ultrasonic waves in biological tissues; principles of ultrasonic measuring and imaging instrumentation; design and use of currently available tools for performance evaluation of diagnostic instrumentation; biological effects of ultrasound; lecture and lab.

Prerequisites: PHYS 212; MATH 202 or equivalent

MEPH 581 Laboratory in Radiological Physics – Radiotherapy (0-3-1)

Practicing the protocol for the determination of absorbed dose from high-en-ergy photon and electron beams. Performing dosimetry and quality assurance for radiation therapy machines. Participating in treatment plans of cancer patients.

Prerequisite: MEPH 566

MEPH 582 Laboratory in Radiological Physics – Diagnostic Radiology (0-3-1)

Measuring the performance of clinical x-ray, mammography, fluoroscopy and angiography machines. Performing dosimetry tests and quality assurance.

Prerequisite: MEPH 567

MEPH 583 Laboratory in Radiological Physics – Nuclear Medicine (0-3-1)

Practicing the acceptance and quality assurance procedures for Nuclear Medicine imaging and non-imaging hardware. Practicing regulations and record keeping associated with the acquisition and dispensing of radio-pharmaceuticals. Radiation safety of patients, personnel, and area monitoring.

Prerequisite: MEPH 563

MEPH 584 Laboratory in Radiological Physics – Health Physics (0-3-1)

Performing dosimetry procedure to monitor ionizing radiation in hospital and radiation areas. Performing shielding tests and shielding design. Practicing regulations and record keeping associated with radiation monitoring and radiation safety.

Prerequisite: MEPH 569

MEPH 585 Laboratory in Radiological Physics – CT, MRI, and DSA (0-3-1)

Performing acceptance and quality assurance tests on CT, DSA and MR scanners and machines. Performing dosimetry measurements to insure radiation safety.

Prerequisite: MEPH 567

MEPH 586 Laboratory in Radiological Physics – Medical Ultrasound (0-3-1)

Performing acceptance and quality assurance tests for clinical diagnostic ultrasound scanners. Operating clinical ultrasound equipment independently.

Prerequisites: PHYS 212; MATH 201 or equivalent

MEPH 590 Clinical Training (0-0-6)

The course consists of a 16-week hospital-based clinical rotation in: diagnostic imaging (x-rays, CT, DSA, fluoroscopy, diagnostic ultrasound), MRI, nuclear medicine, radiation therapy, mammography, radiation protection, and health physics. The student will write a monthly progress report about the clinical procedures he learned and performed.

Prerequisite: Department Approval

MEPH 591 Selected Topics in Medical Physics (3-0-3)

Various subjects of interest to medical physics faculty and students.

Prerequisite: Consent of the Instructor

MEPH 592 Independent Reading (3-0-3)

The course can be taken under the supervision of a faculty member to conduct an in-depth study of a subject.

Prerequisite: Consent of the Instructor

MEPH 599 Seminar (1-0-0)

Graduate students are required to attend the regular departmental seminars. This course carries no credit and is graded on a Pass or Fail basis.

Prerequisite: Graduate Standing

MEPH 600 Medical Physics Project (0-0-3)

The project is an independent study performed under the supervision of a medical physics faculty advisor. The report should include an introduction to the topic, literature review, research methodology, analysis of data, conclusions and recommendations, appendices and references. The report will be presented and evaluated by a faculty committee.

Prerequisite: Graduate Standing

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M.S. (1999)
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Lecturer
Electrical Engineering (1997)

Dr. Shafique, Muhammad
Ph.D. (1989)
Wayne State University
Assistant Professor
Information and Computer Science (1989)

Dr. Shaikh, Abdullah Abed A
Ph.D. (1984)
University of Notre Dame
Professor
Chemical Engineering (1977)

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Ph.D. (1982)
University of Washington
Professor
Civil Engineering (1975)

Mr. Sharqawi, Husam Khaled Khalil
M.S. (1997)
University of Malta
Lecturer
Mathematics and Statistics (2001)

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Ph.D. (1988)
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Professor
Construction Engineering and Management (1982)

Mr. Shaw, Stephen
Bachelor (1995)
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Lecturer
Mechanical Engineering (2000)

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Chemical Engineering (2007)

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Ph.D. (1978)
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Professor
Mechanical Engineering (1979)

Dr. Sheikh, Asrar Ul Haq
Ph.D. (1969)
University of Birmingham
Chair Professor
Electrical Engineering (2000)

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Ph.D. (1996)
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Assistant Professor
Electrical Engineering (1998)

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Ph.D. (2003)
Queen's University
Assistant Professor
Computer Engineering (2004)

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Ph.D. (1998)
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Mechanical Engineering (1980)

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Khattab G. Al-Hinai
Secretary of International Advisory Board, and Manager of Research & Innovation Support at KFUPM

International Advisory Board (IAB)
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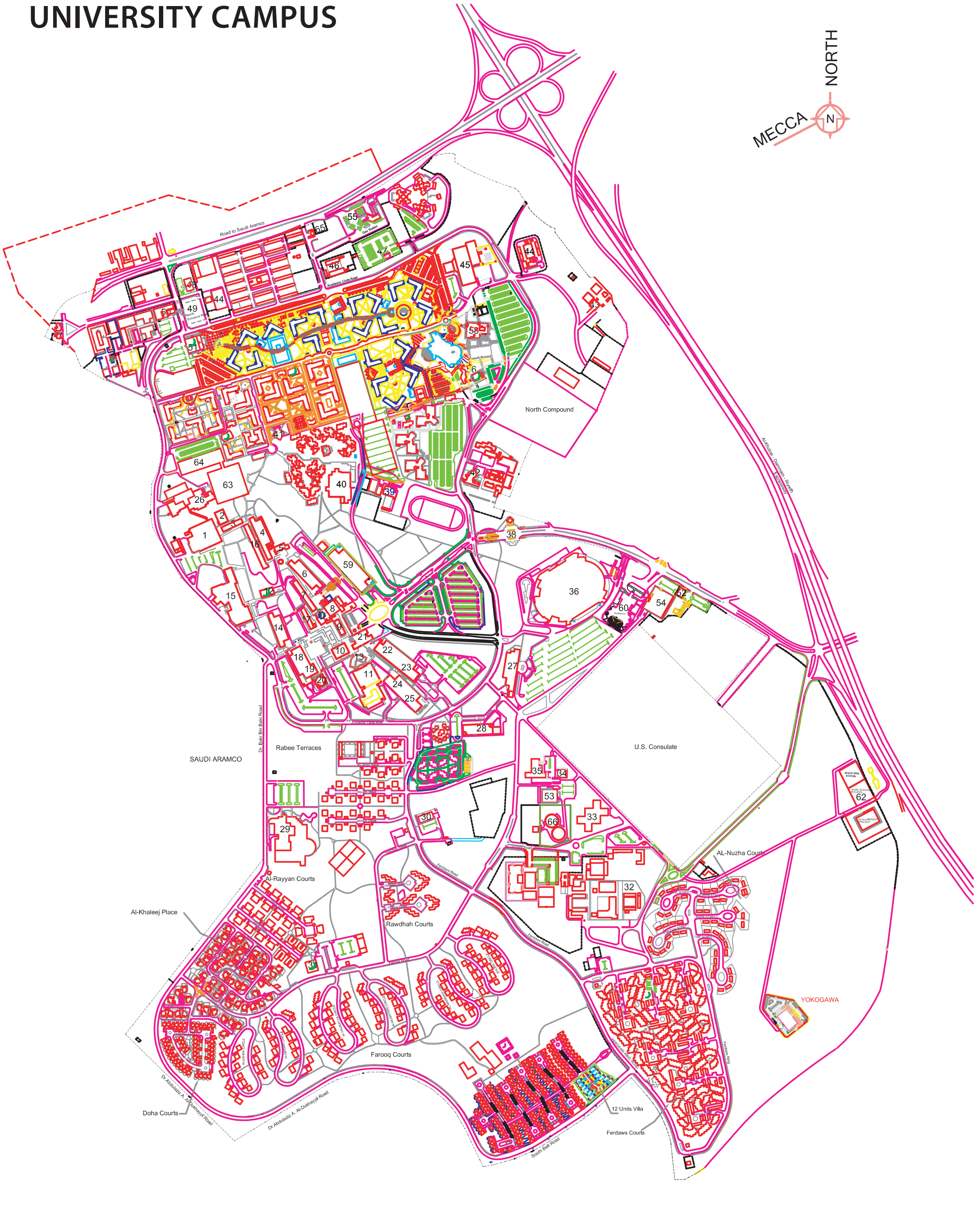
CAMPUS MAP

UNIVERSITY CAMPUS



LEGEND

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7. Building 7
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11. Building 11, Gymnasium
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14. Building 14, Information Technology Center
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24. Building 24, College of Industrial Management
25. Building 25, Parking Garage
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27. Building 27, Medical Center
28. Building 28, Energy Research Laboratory
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30. Co-op Store
31. Al-Farouq Mosque
32. KFUPM Schools
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34. Telephone Exchange
35. KFUPM Press
36. The Stadium
37. King Abdul Aziz Monument
38. The Main Gate
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41. Student Reception Center
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43. North Water Plant
44. Store Houses & Administration
45. Central Kitchen / Food Services Dept.
46. Car Maintenance Workshop
47. Transportation Dept.
48. Safety & Security Dept.
49. Northern Gate
50. Projects Dept. & Maint. Dept.
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52. Riyad Bank
53. Book Store
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55 Gas Station
56. Othman Bin Affan Mosque
57. Class Room Bldg., Prep. Year
58. Class Room Bldg., Prep. Year
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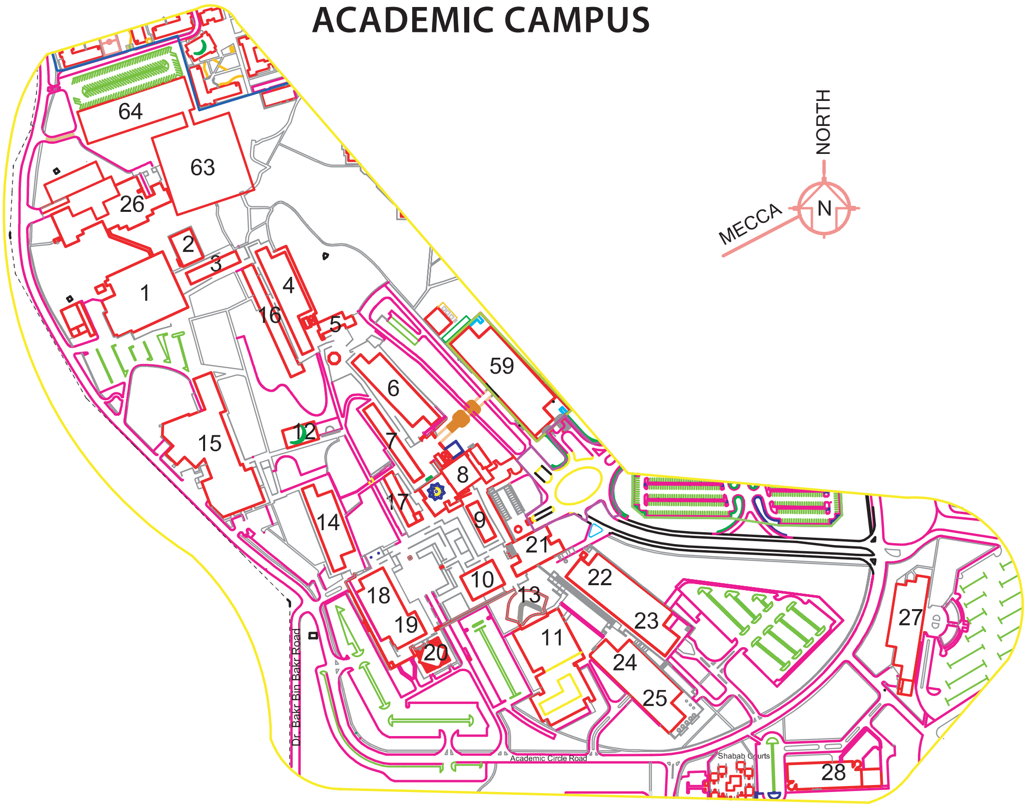
60. King Fahd Auditorium
61. SCECO Grid Station
62. New Telephone Building
63. College of Computer Sciences
64. Multistory Parking Building
65. Fire Truck Shed
66. Sweet Water Tanks

ACADEMIC CAMPUS



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27. Building 27, Medical Center
28. Building 28, Energy Research Laboratory Bldg.
59. Class Room Building
63. Faculty of Computer Science Building
64. Multistory Parking Building


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