بسم الله الرحمن الرحيم

King Fahd University of Petroleum & Minerals

GRADUATE BULLETIN

2003 -2005

Dhahran 31261, Saudi Arabia

GRADUATE BULLETIN
2003-2005

470 p.; 16.5 x 23.5 cm

ISSN No. 1319-9315
Registered at
King Fahd National Library
under No. 20/3898

Printed in the Kingdom of Saudi Arabia by
King Fahd University of Petroleum & Minerals Press

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 2001/2002 academic year and printed in the spring of 2003. The contents were compiled from various inputs received from the academic departments and administrative offices throughout the University.

The Bulletin provides information about graduate academic programs and is intended to provide a helpful summary of university policies and procedures, and selected activities and services. Information concerning admission, academic regulations and requirements, student services, academic offerings, and a listing of the administrative officers and faculty are included. It is hoped that the Bulletin will serve as a useful guide to faculty members, graduate students, and staff whenever questions arise regarding the University's rules, its graduate courses and their prerequisites, its degree requirements, and other academic matters.

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

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Professor,
Electrical Engineering Department,
Editor, Graduate Bulletin,
2003-2005

FOREWORD

The principle objective of the Graduate College 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 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 program is to train the creative type of scientist or engineer so urgently needed in our educational, governmental and industrial development. It is believed that this purpose is attained at King Fahd University of Petroleum & Minerals for both undergraduate and graduate students because of the close contact between the faculty and students.

The purpose of this catalogue is to provide information about the graduate programs of KFUPM to students and prospective students, as well as to the faculty and staff of the University. Included is information concerning requirements for admission to the Graduate Program of KFUPM, services available to students, graduate course offerings and listings of the graduate faculty of the University.

In the Graduate program, KFUPM offers courses leading to the degree of Master of Science, Master of Engineering, Master of Business Administration, Master of City and Regional Planning, and Doctor of Philosophy.

Since its founding in 1972, the College of Graduate Studies (now called the Deanship of Graduate Studies) at King Fahd University of Petroleum & Minerals has witnessed a phenomenal expansion. Currently 22 programs are being offered at the Master and 11 at the Ph.D. level. These programs span the fields of Engineering, Science, and Management.

At the start of the third millennium, the Graduate Studies at King Fahd University of Petroleum & Minerals 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 the new graduate studies, 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 has increased the flexibility and variety of its course offerings, forged stronger links with the international academic community through such innovative programs as Adjunct Professors 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 Chairs and industry-related projects.

Towards this effect and also to spread higher education within the Kingdom, the University recently established two Community Colleges in Hail and in Hafr-Al-Batin, which currently offer Undergraduate Programs to students mainly located in these areas. However, selection of such students takes place on the basis of competitive entrance examination and personal interviews that take place twice a year.

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 (ASCSB).

Currently, KFUPM enrolls more than 8,500 students, 650 of whom are pursuing Graduate Program in 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.

Producing the Graduate Bulletin has been a time-consuming and taxing experience. Our sincere thanks are extended to the Vice Rector for Graduate Studies & Scientific Research for his invaluable support and encouragement. I appreciate the efforts put in by the Editor, Professor Youssef Abdel-Magid in compiling and organizing the materials contained in this Bulletin. The University academic and service departments deserve many thanks for providing updated and expanded material. The secretarial assistance of Mr. Mamerto Altares and Mr. R. Jayaraman is gratefully acknowledged. The production of this Bulletin in its final elegant form is the work of KFUPM Press, in particular, the Director General, Mr. Mohammed Ali Al-Masoud, the Director, Mr. Mohammad A. Al-Shahrani, the designer, Mr. Reynaldo J. Andrada. The excellent photographs that appear in the bulletin are the work of Mr. Khalil Nasr of the KFUPM Public Relations Department

Prof. Osama A. Jannadi
Dean of Graduate Studies

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General INFORMATION

HISTORY AND PHILOSOPHY OF THE UNIVERSITY

King Fahd University of Petroleum & Minerals (KFUPM) was officially established by Royal Decree on 5 Jumada 1, 1383 H. (23 September 1963). The first students were admitted a year later, on 23 September 1964, when 67 young men enrolled in what was then the College of Petroleum and Minerals (CPM). Since that time, the University enrollment has grown to a level that is expected to reach approximately 9000 students by the 2003-2004 academic year.

Two significant events have marked the University's growth. The first of these was when the University conferred its first engineering degrees in 1971/72. In that year, four men received baccalaureate degrees. Since that time, more than 15141 degrees have been awarded including 1600 Master's and 75 Ph.D. degrees. The second event was the official change in both name and status from a college to a university, which occurred in 1975, leading to the name University of Petroleum and Minerals, and later in 1986 to King Fahd University of Petroleum & Minerals.

The rapid growth of KFUPM is related to the rapid economic and technical development of Saudi Arabia. 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 Saudi Arabia as a major source of the world's energy.

The vast petroleum and mineral resources of Saudi Arabia pose a complex and exciting challenge for scientific, technical, and management education. To meet this challenge, the University has as its goals the advanced training of students in the fields of science, engineering, and management, to serve the Kingdom's petroleum and mineral industries and for the promotion of research resulting in contributions to knowledge in these fields. In addition, because it derives a distinctive character from 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 instilling in them an appreciation of the major contributions of their people to the world of mathematics and science. All facets of KFUPM - facilities, faculty, students, and programs- are directed to the attainment of these goals.

ORGANIZATION OF THE UNIVERSITY

KFUPM is one of eight universities in the Kingdom supervised by the Ministry of Higher Education, and regulated by The Council of Higher Education. It is an institution operating under a University Board, headed by the Minister of Higher Education. The Board has the responsibility for policy and control. It assigns to the Chief Executive Officer-the Rector of the University–the principal responsibility for implementation of policy and the administration of the University. The Rector is assisted by three vice rectors, and several advisory standing committees.

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, six 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 six 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; and the College of Computer Sciences & Engineering, offering degrees in Computer Science, Computer Engineering, and Systems Engineering.

The Deanship of Graduate studies awards Master of Science (M.S.) degrees in 19 major fields, namely; Architectural, Chemical, Civil, Computer, 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 Accounting (M.Acc.), Master of Business Administration (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

King Fahd University of Petroleum & Minerals is located in Dhahran, in the Eastern Province of Saudi Arabia. The campus is about five kilometers from the Arabian Gulf, seven kilometers from the city of Al-Khobar, and twenty kilometers from Dammam, the province's administrative capital. The academic campus itself is located on a weathered limestone jebel, 100 meters above the surrounding desert. The University overlooks the Arabian Gulf, and the island of Bahrain – 35 kilometers from Saudi Arabia's eastern cost and linked to it by the King Fahd Causeway – is often clearly visible. The University is situated between the headquarters of the Saudi Arabian Oil Company (SAUDI ARAMCO) to the west, and the

old Dhahran International Airport to the east.

The University is easily accessible by road or air from any point in the Kingdom. The distance to Riyadh is about 400 kilometers and to Jeddah about 1450 kilometers. A Network of paved roads leads to various distant points as Najran, Abha, and Jizan in the far south, to Buraydah 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, providing regular domestic and international airline services.

FACILITIES

The King Fahd University of Petroleum and Minerals occupies a central position within an exceptionally beautiful 640 hectare campus. Located on Jebel Dhahran, the University buildings combine architectural excellence and educational soundness and viability. Their exterior design contrasts the stark color and ruggedness 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 purpose facilities including computer terminals and closed circuit television outlets. All University buildings are centrally air-conditioned.

The Academic Complex consists of 28 major buildings, all of them functional and in use. The facilities available include: faculty & staff offices; shops and laboratory buildings, including 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, the Bookstore and a Stationery shop; the Auditorium, which seats 850 people, 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 Complex, and multi-storey parking garages. The facilities also include a natural exterior amphitheater, playing fields for intercollegiate and intramural sports, and the distinctive KFUPM water tower which is on the University's logo and supplies its circulatory water systems.

The following are located to the north of the Jebel: the Student Housing area, including the Student Reception Center, the Student Cafeteria; mosques; a section of the Faculty and Staff Housing; the Transportation Center, garage for maintenance of University vehicles; and 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, is Faculty and Staff Housing, including the Family Recreation Center and the Co-op Store. The Telephone Exchange, the University Press Building, and the University Schools (Nursery, Kindergarten, Elementary, Intermediate and secondary) 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 Information Technology Center (ITC)** is the primary computing facility at KFUPM. It provides computing support for education, research, and administrative applications to the University community. It also provides services to governmental and industrial agent agencies.

ITC consists of the following departments:

1. Academic Computing Services (ACS)

2. Administrative Application Services (AAS)

3. Computer Applications Development (CAD)
4. Library Automation Services (LAS)
5. Networking and Hardware Services (NHS)
6. Students Information System (SIS)
7. Systems and Operation (S&O)

ACS serves the faculty, students, staff and the Research Institute with extensive consulting services in addition to a comprehensive examination generation and grading services. AAS maintains the University's administrative applications such as payroll, personnel, financial accounting system, material management, etc. CAD is a software development group for developing new applications or reengineering of existing administrative systems. LAS provides technical support to the University Libraries and their automation systems and services. NHS is a service department for all the networking and hardware equipment in the University. SIS is responsible for all applications related to student records. S&O provides systems and operational support to the OS/390 and Unix Operating Systems.

ITC maintains and operates extensive computing facilities supporting a number of computing platforms. A state-of-the-art IBM Enterprise Server IBM 2003-215, running on a 29 MIPS processor with 512 MB memory and 126 GB internal mirrored disk storage, is the main computing platform for administrative applications. The server utilizes the latest IBM operating system OS/390 with full online and batch processing support. The enterprise server is connected to the University backbone. More than 300 concurrent TSO users and five CICS partitions are available. A large number of peripheral devices including high-quality printers, communication controllers for remote dial-up, tape drives, and pen plotters are also connected. DB2 for OS/390 is the relational database running on this server to serve all administrative applications.

IBM RISC System/6000 7026-6H1 is a 2-gigabyte and 36 GB server running AIX operating system. It is mainly used by academic departments for engineering and scientific applications. A total of 150 concurrent interactive users can be supported. The Unix main server is connected to the University enterprise network and is the mail server for the whole University. A backup Unix Server IBM RISC System/6000 7026-H70 is a 1-gigabyte and 117 GB disk storage machine used for running different engineering and scientific applications. The two machines are running under AIX with HACMP (High Availability Cluster Multi-Processing).

ITC operates a full-scale Enterprise Network where all University servers, PC labs, workstation labs and office PCs are interconnected. The network infrastructure consists of a fiber optic Gigabit-Ethernet backbone connecting PC labs in all academic and some administrative buildings. In addition, all offices, classrooms and labs in all University buildings are connected to the Enterprise Network. Advanced switching and routing technology is installed at different locations to enable users to access any computing resource connected to the University Enterprise Network. Currently, more than 4000 nodes are connected to the Enterprise Network.

A number of high performance workstations running X-Windows are available for general use under the control and coordination of the ITC. These include IBM workstations (IBM RISC System/6000, Model 7011 25T) running the latest AIX Operating System.

ITC provides technical support to more than 47 PC Labs with more than 950 PCs located in various academic departments across campus. These labs are used as teaching and general-purpose labs providing students' access to E-mail, Internet and Intranet facilities and services round-the-clock. ITC also operates a number of general-purpose PC Labs with extended timings in academic buildings and student dormitories. PC Software support includes: Windows XP/2000/NT/9x, Unix and standard PC software including language compilers, graphics packages, word processors and presentation software from Microsoft and other major software developers. The University also has licensing agreements with large software developers such as Microsoft, SAS, etc. The software from these companies is installed and updated on computing facilities throughout the University on a regular basis. Internet services are available to students, faculty and staff. In addition, Internet Remote Access Services (RAS) are also available. ITC also maintains KFUPM home page, which can be accessed through the URL http://www.kfupm.edu.sa.

◆ **The Energy Research Laboratory (ERL)** is a unit of the Research institute's Center for Applied Physical Sciences. It occupies specialized facilities on the southern edge of the main campus. The laboratory includes a 350 kV ion accelerator and a 3 MV Tandetron accelerator. Additionally, it includes several lasers used in supersonic jet spectroscopy, atomic spectroscopy, molecular dynamics, and thin films research. The laboratory has conducted numerous basic science investigations and increasingly explores opportunities in such traditional applied research areas as improving building glass, concrete testing, air quality monitoring and minerals characterization, among others. Students with interests in physics, chemistry, electrical engineering, and geology have pursued graduate studies using the laboratory.

◆ **The English Language Center (ELC)** is responsible for developing the English proficiency required in a university where English is the language of instruction. The Center is well equipped with modern educational aids. There are eight twenty-four-booth language laboratories, and facilities exist for both the recording and showing of video material.

English lessons are also available in the computer-assisted learning facility at the ELC. The system consists of 94 microcomputers linked to a file server on a local area network, enough to accommodate three classes simultaneously. Students have access to more than 300 lessons, most of which have been written by faculty members. In addition, they receive training in typing and word processing.

The Center serves both the KFUPM community and the community at large in a program of continuing education. English language courses to the general public in the evening and other specialized courses are also available for local organizations.

◆ The Research Institute (RI)

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.

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 a prospective client(s) describing the university's applied research capabilities. In other areas, 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 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.

The technical expertise for applied research available in the RI is focused in its seven centers with their sections/labs.

◆ Center for Applied Physical Sciences: Laser Research, Basic & Applied Physics, Metrology & Standards Sections, and Central Analytical Laboratory.

- Center for Communications & Computer Research: Computer Technology, and Communications Technology Sections.
- Center for Economics & Management Systems: Business Incubators, Economic Studies, and Management & Quality Control Sections.
- Center for Engineering Research: Materials, Urban Areas Engineering, Engineering Analysis, Energy Systems Sections, and Material Characterization Laboratory.
- Center for Environment & Water: Water, Environment, and Marine Studies Sections.
- Center for Petroleum & Minerals: Petroleum & Gas Engineering, Petroleum Geology & Geophysics, Mineral Resources, and Remote Sensing Sections.
- Center for Refining & Petrochemicals: Refining, Petrochemicals, and Petrochemical Products Development Sections.

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:

- use of laser and nuclear techniques for applied research, measurement, and elemental analysis services;
- 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, institute 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 is normally around 360 with about 90 each in the categories of PhD, MS, BS, and others. Project teams are typically 35% full time RI researchers, 25% faculty members, 10% students, and 30% support staff.

◆ **Sports and Recreation Facilities** are in three large areas ideally situated on the main campus.

The mid campus area has a 25 meter swimming pool, indoor student showers and changing facilities, two soccer pitches (one with an artificial grass "superturf" surface), a handball/six-a-side court, nine tennis courts, athletic track, basketball, volleyball courts, four squash courts, a weight training room, and two rooms equipped with television and video facilities to aid the teaching and coaching of all sports. There is also an environmental chamber for use in Physical Education research, plus administrative offices for the Physical Education department. The Sports Hall area located on the Jebel contains the latest in modern indoor physical education facilities. Included are areas for basketball, volleyball, gymnastics, handball, squash, table tennis, judo, taekwondo, karate, weight training and many other sports activities. Showers and changing rooms plus seating areas for spectators are also provided. Adjacent to the gymnasium is an Olympic swimming and diving pool with its own showers and changing rooms.

The third main area of sports facilities is the floodlit soccer and athletics Stadium, located near the main entrance to the University. It is designed to seat 10,000 spectators, and has an excellent field house. 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. The playing area is a "superturf" artificial grass field. A weight training room (extended this year) and physical therapy unit are also available in the Stadium.

◆ **Student Housing** The University provides student housing for the total student enrollment in keeping with its policy of being an entirely resi-

dential institution. The undergraduate student dormitories, which constitute the majority of student housing at this time, are in single-storey, air-conditioned houses built of stone, containing between 11 and 22 rooms each, and having two beds per room, a common room, an apartment for a graduate assistant acting as proctor, and showers and other facilities. These units are located in the Student Compound in the North Sector of the campus, and have been modernized. As a part of the program of replacing these dormitories with newer facilities of modern design, consistent with the architecture of the University, some multi-storey buildings have already been completed and are being used. Housing for graduate assistants is also included in this program.

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 Bookstore** is operated for the convenience of the students and faculty. Because of the large number of specialized text-books needed for a university program, the University maintains an extensive text-book acquisition system to ensure that only the most up-to-date books are used. The bookstore is located near the Post Office in the Faculty & Student Center on the Jebel Campus. A new Bookstore is expected to be built in late 2002.

◆ **The University Cafeteria**, a large spacious building accommodating up to 1,500 students, is adjacent to the student housing area. There are also coffee shops in several academic buildings and in the Faculty & Student Center.

◆ **The University Library** is centrally located in Building 8 within a short 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. Three reading rooms are available on the third floor for serious read-

ing, student-teacher meetings and discussions. To encourage and maximize utilization of its resources and services, the University Library operates with minimum regulations and restrictions.

The current collection of monographs and bound periodicals totals 353,115 volumes, of which 75% is in Science and Engineering, and the remaining 25% in Humanities and Social Sciences. In addition, there are 487,300 research reports microfiche, 26,134 educational films and other media, subscriptions to about 1,194 periodical titles (of them many titles are available in both print and e-journal formats) and 37,530 reels of journal back issues on microfilm.

The Library additionally, has a fine collection of electronic resources, including 7 full-text databases on the Internet and 18 bibliographic, 5 full-text (image), 5 multimedia, and 3 specialized databases on CD-ROM. Most CD-ROM databases are available over the Library internet network. Remote access to some databases, such as Applied Science and Technology Plus, ABI/INFORM, and Readers' Guide to Periodical Literature, is through the university-wide network. Access to other databases is in prospect. The Library also provides online access to more than 400 international databases through Dialog search services, numerous Internet resources and several hundred e-journals.

The Library serves all the University community. In addition, it provides borrowing privileges and other services to local government agencies and private institutions.

Library services include:

a. library instruction (orientation of new faculty and preparatory year students in effective use of the Library);

b. interlibrary loan and photocopy services;

c. reference services;

d. research assistance, including manual literature searches and online and CD-ROM searching of bibliographic and full-text databases;

e. circulation of library materials; and

f. AV Services.

There are two separate Internet search labs for faculty and students with over 35 workstations providing access to electronic resources through Intranet and Internet.

Audio-Visual materials and services are provided through a well-equipped AV department. The Department's present collection consists principally of microfilms, motion pictures, filmstrips, recordings, videotapes, maps and other cartographic materials, and audio cassettes. The Library Auditorium is used by faculty and students for projection of AV materials, and also for seminars, lectures, short courses, theses defense, and other presentations.

The Library currently uses DOBIS/LIBIS, an integrated library automation system, which is expected to be replaced by a new system soon. The successor system will have all the features of a modern system, including client/server architecture, GUI, Internet interface, etc. With these features, users will be able to perform multiple tasks from a single workstation, including access to the Internet, KFUPM Intranet, CD-ROM databases, online catalog, etc.

◆ **The Medical Center:** The University operates a health center serving the University community, including all faculty, staff, students, and families. The primary health care fa-

cilities include a well-equipped emergency room with additional facilities for day care patients who need temporary observation.

A well-equipped laboratory is available, which performs most hematological, bacteriological, serological, and biochemistry tests.

Besides the routine x-ray facility, the x-ray department is also equipped to carry out barium studies, I.V.P. films and oral cholecystography, and has an up-to-date facility for ultrasonography scanning.

The ENT Clinic is supplied with a puretone audiometry facility.

In the Obstetric Clinic, ultrasonographic and foetal monitoring facilities help give proper antenatal care, Pap smear screening tests and an infertility screening facility with complete hormonal analysis are also available.

Dental clinics are equipped with the necessary facilities for examinations, dental hygiene, filling and extraction when necessary. Minor operations, which do not need general anesthesia, can be done as well.

The Eye Clinic is equipped with routine eye examination equipment and an up-to-date computerized refractometer and tonometer.

The above facilities are operated by professionals, namely, internists, general practitioners, pediatricians, gynaecologists, an ENT specialist, ophthalmologist, dermatologist/venerologist, pathologist, radiologist, dentist, 1 dental hygienist, 20 nurses, 3 pharmacists, 2 X-ray technicians, and 2 laboratory assistants. Besides this, a psychologist and a psychiatrist are available twice a week.

The doctors and supporting staff, together attempt to give the best possible health care to the community. The Health Center provides other community services as well, such as routine vaccinations, health education programs when needed, an ambulance with emergency personnel services during sports and special events, periodic analysis of the water supply and periodic medical check ups for the laborers in the Food Services Dept.

Health cases which require extended treatment are referred to and/or transferred to the neighborhood hospitals which can provide the necessary medical care such as the King Fahd University Teaching Hospital (KFU), and government hospitals in Al-Khobar, Dammam, and Qatif. In addition several private hospitals are within a 10 minute drive from the University.

Prescribed medicines are available at the Health Center pharmacy at 50% of the actual cost for faculty and staff, and free of charge for students and laborers. All university employees have access without any charge to the neighborhood government hospitals and clinics where specialists may be consulted. When a truly serious health problem arises some university residents may consider seeking private or out of Kingdom medical care. Because of the ease of air travel, a number of patients elect to return to Europe or America for major health problems. The University does not absorb any such expenses of employees that are incurred in private hospitals or out of the Kingdom. A group medical insurance, however is now available and if special arrangements are made, this may cover such treatment.

For emergency services, the Health Center operates on a 24 hour basis, with a nurse on duty, and one of the doctors residing on campus on call. Ambulance service is also available on a 24 hours basis.

SPORTS AND RECREATIONAL ACTIVITIES KFUPM has both intercollegiate athletic teams and intramural teams. University teams have traveled across Saudi Arabia to Riyadh and Jeddah and outside the Kingdom for athletic competitions. The intercollegiate sports in which University teams participate include basketball, football, volleyball, handball, swimming, table tennis, tennis, track and field, judo, karate, squash, badminton, and tae-kwondo.

At the intramural level, the teams from the student housing areas compete against each other in basketball, swimming, football, volleyball, track and field, cross country, and tennis.

RELIGION

Religion is an important part of student life, and both individual and group activities are available. Students are encouraged individually to avail themselves of the mosques on campus for prayers and to utilize the large collection of books on Muslim thought available in the university library. In addition, KFUPM provides special programs involving group activities in the spirit of Islam. The University has, for example, 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.

The University's religious activities program thus complements its academic goals.

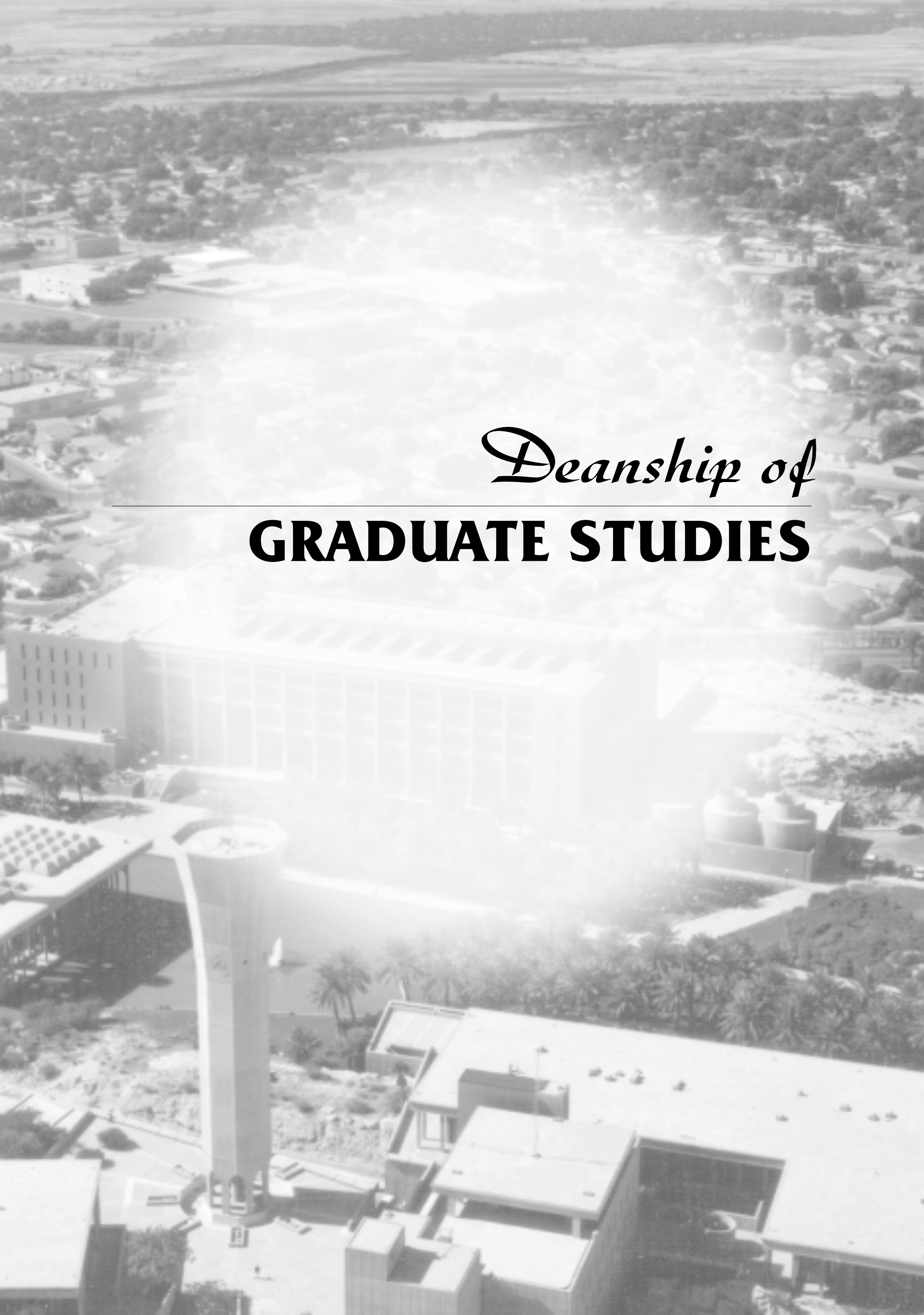
The University also schedules breaks to coincide with the periods of the Id Al-Fitr and Id Al-Adha vacations.

GRADUATION

Upon satisfactory completion of all requirements for a degree from the University, students are invited to participate in the annual commencement exercises. 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 commencement exercises is the academic dress worn by graduates. Designed specifically for KFUPM, the gown is the Arabian mishlah trimmed with gold thread. Instead of the usual mortarboard cap, the KFUPM graduates wear the traditional ghutra and igal. Added to this is the academic hood, featuring the color of the specific college from which a particular student is graduating.

The ceremony and the dress involve an impressive blending of academic and local Arabian traditions.



Deanship of
GRADUATE STUDIES

The Deanship of Graduate Stud ies (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), and the Research Institute for services essential to its instruction and research programs.

◆ **The Major Objectives of the Graduate Studies Program are:**

1. to create, synthesize and disseminate knowledge;
2. to promote research and scholarship;
3. to prepare highly qualified professionals and research personnel in the fields of science, engineering, and management for service and leadership in industry and academia;
4. to improve the quality of undergraduate education through its interaction with graduate programs.

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 Science in Geosciences (M. Sc. in Geo.) Master of Geosciences (M. Geos.) Master of Executive MBA (M. EMBA).

◆ **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 Council of the Deanship of Graduate Studies.

◆ **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 Council of the Deanship of Graduate Studies** is composed of the following:

The Dean of Graduate Studies (Chairman), the Dean of Scientific Research, the Deputy Dean of Graduate Studies, 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.

◆ **Evaluation 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 the 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:

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

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, 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 of Term GPA" 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 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 old 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 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 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. 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. If 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 topics. 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. One member of the committee may be from outside the department. 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 two-thirds 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 thesis and degree.

- A **Department Graduate Committee** is appointed by the chairman of each department to advise the student on matters relating to graduate studies in his department. It is composed of the department graduate coordinators and selected members of the senior faculty.

- A **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 students preparing their degree plan of studies and choosing a thesis advisor. He signs the registration form at the beginning of the semester and makes sure that it 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.

- **Ph.D. Dissertation Committee:**

Following the recommendation of the Chairman and the Dean of Graduate Studies, the student selects a dissertation committee with the help of his dissertation advisor (chairman of the dissertation committee). The membership of the committee is always an odd number (at least 3), 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 candidates field, while one may be from a related area. At least one member of the committee must be a professor. One member of the committee may be from outside the department or another institution. 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 two-thirds majority vote. This is an ad-hoc committee which is dissolved following official approval of the student's dissertation and degree.

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.

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.

Admission to the University's Graduate Studies Program with graduate status is the first 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 candidates is qualified to follow a specific academic program nor that he meets the special qualification requirements of an individual academic department. Securing departmental approval is the second 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.

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 six months before the degree is to be conferred.

◆ General University Requirements

Graduate students are subject 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 Studies Council and approved by the Vice-Rector for Graduate Studies and Science Research, 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 40) 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 indentified 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.

All applicants whose credentials meet 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.

- **G.R.E. Requirements:**

Applicants to the Graduate Studies are normally required to take the general graduate record examination as well as the graduate record examination in their area of specialization.

- **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 Studies Council and are administered by the Dean of Graduate Studies. A score of 520 on the TOEFL examination and of 4.0 in the Test of Written English (TWE) are considered to be a minimum for entry into the Graduate Studies.

A special English course, open to all graduate students with a score of 520 or better in TOEFL (or equivalent), English 510, is highly recommended for all graduate students. (See page 381). This course helps students prepare effective thesis proposals and theses.

Students repeating TOEFL Examination but could not secure the 520 (for Master) or the 550 marks (for Ph.D.) requirements, they can have the following options:

1. If the student secure a minimum of 450 in their TOEFL Examination, they can 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 520 marks for the Master and 550 marks for Doctoral Program.

- **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. Graduate Studies requirements:

   i. 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 and Minerals.

   ii. a Grade-Point Average (GPA) of 3.00 or higher, equivalent to a B average, for all university work taken previously or a GPA of 3.00 in the subject of the major field for all university work taken previously;

   iii. a major in the proposed field, or evidence of suitable background for entering the proposed field;

   iv. acceptable scores (520) in the Test of English as a Foreign language (TOEFL) and the General and Subject Graduate Record Examination (GRE);

2. satisfactorily meeting any additional departmental or university admission requirements.

An applicant whose academic credentials do not meet the minimum regular admission requirements may be admitted on a trial basis as a "provisional student". The minimum requirements for this "provisional" status are an overall GPA of 2.50, or a GPA of 3.0 for the subjects in his major field, and a B.Sc. in engineering or science. Failure to quality for admission as a regular student in the first 12 semester-credit-hours of graduate work undertaken, and within two semesters for full-time, or three semesters for part-time students, will result in permanent dismissal from Graduate Studies (see "Academic Regulations", page 51).

◆ Admission Requirements for the Master of Accountancy Program:

The minimum requirements for admission as a regular graduate student in the M.Acc. program are:

1. a Bachelor's Degree in Accounting or a Bachelor's Degree in Business Administration with a major in Accounting from an approved institution;

2. a major GPA in Accounting of at least 3.00 with an overall GPA of at least 2.5 on a 4.0 scale or equivalent. Official transcripts from each college and university the student has previously attended must be mailed directly from the registrar of that school to the Deanship of Graduate Studies;

3. completion of the Graduate Management Admission Test (GMAT) with a minimum score of 450. The GMAT scores must be sent to the Deanship;

4. satisfactorily meeting the University's language requirements;

5. satisfactorily meeting other general University requirements for admission.

◆ **Admission Requirements for the Master of Business Administration Program:**

An applicant for admission to the MBA program should:

1. Have a four-year baccalaureate (BA or BS) degree from a recognized and reputable institution.

2. 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.

3. Have at least one course in college level calculus which covers both differentiation and integration.

4. Have a working knowledge of computers as evidenced by at least one course in that area (e.g. data processing, programming, information systems, etc.)

5. Have 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.

6. Have a satisfactory score in the Graduate Management Admission Test (GMAT).

7. 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.

A student will 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 test during the first semester of his enrollment at KFUPM.

◆ **Executive MBA Program 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 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 potentials candidates will be invited for a person 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. Graduate Studies Program requirements:

   i. an M.S. degree in engineering or science from an institution whose graduate programs are equivalent to those of King Fahd University of Petroleum and Minerals;

   ii. a minimum GPA of 3.00 (on a 4 point scale) or its equivalent;

   iii. a major in the proposed field or evidence of suitable background for entering the proposed field;

   iv. minimum scores of 550 (247) in the Test of English as a Foreign language (TOEFL);

2. any additional departmental requirements;

3. GRE (General and Subject) scores that meet departmental 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:**

Each student admitted to the Ph.D. program will have to take a preliminary examination which is mainly used to determine areas of deficiency. This examination will be organized and administered by the Department Doctoral Program Committee at a time no later than one semester after enrollment. A clearly unsatisfactory performance in the preliminary examination may also from the basis for dismissal of the student from the program.

A student accepted into the Ph.D. program with deficiencies, will take the preliminary examination no later than the end of the second semester of his enrollment. He should maintain a GPA of 3.0 in his deficiency courses, failing which he will be liable to dismissal from the program.

A graduate student is allowed to take this examination at most twice.

◆ **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, Non-Degree, 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 quality 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. Students on provisional admission status are not eligible for student assistantships.

"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 credit 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 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 Office of the Dean 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 and TWE;

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 summary of one page by the applicant outlining his 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 six 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, text books, an air-ticket, accommodation and a subsidy on meals and basic medical-care, in accordance with the terms of their grant.

In addition to the cost of books, all part-time graduate students pay a tuition fee of SR 150 per credit hour for the courses taken. 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. 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 spend one to two years at the University acquiring a master's degree; then, if considered qualified, he is encouraged to pursue a doctorate degree program.

A second type of student assistantship for graduate students is available in the form of research assistants. 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 Science Research.

REGISTRATION

REGISTRATION PROCESS

Formal registration, or enrollment, of students intending to follow an approved academic program takes place during a one-day period 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 advisor;

3. submitting the approved selection of academic courses, with their schedules, room assignments, and instructors, to the office of the University Registrar;

4. obtaining an official program notice from the registrar office 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 issued by the University Registrar shortly before the date indicated in the academic calendar for registration. Students must first report to their major academic departments for consultation and planning and for completion of the necessary forms. The registration procedure is completed only when the approved program notice is collected from the Registrar.

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", page 40).

- **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.

- **Auditing Courses:**

Registration in a course for the privilege of auditing is permitted in exceptional cases (see "Classification of Admission Status", page 39). 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 Registrar's office and this data may be drawn on in order to print an official record or transcript at any time in the future.

Prerequisite for Ph.D. 710 and 599 as prerequisite for MS 610:

1. all departments offering Ph.D. program include 699 as prerequisite for 710 be taken by Ph.D. students; for MS program, 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 hour for the major area, minor area, electives, and free elective courses.

Masters Program and Ph.D. Program

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.)
- Master of Accounting (M. Acct.)
- Master of Medical Physics (M. Med. Phys.)
- Master of Environmental Sciences (M. 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. Accounting
Architectural Engineering	M.Sc.
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	Ph.D., M.Sc.
Construction Engineering & Management	M.Sc., M. Engg.
Electrical Engineering	Ph.D., M.Sc.
Geology	M.Sc. in Geos., M. Geos., M. Env. Sci.
Information and Computer Science	Ph.D., M.Sc.

Business Administration	M.B.A.
Mathematics	Ph.D., M.Sc.
Mechanical Engineering	Ph.D., M.Sc.
Petroleum Engineering	Ph.D. M.Sc.
Telecommunication Engg	M.Sc.
Physics	M.Sc.
Medical Physics	M.Med. Phys.
Systems Engineering	Ph.D.,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 & 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.

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

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

1. Graduate Studies Requirements:

- i. 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;
- ii. a Grade-Point Average (GPA) of 3.00 or higher, equivalent to a B average for all university work taken previously, or a GPA of 3.00 in the subject of the major field for all university work taken previously;
- iii. a major in the proposed field, or evidence of suitable background for entering the proposed field;
- iv. acceptable scores (520) in the Test of English as a Foreign Language (TOEFL) and the General and Subject Graduate Record Examination (GRE);
- v. at least two letters of recommendation from the faculty who taught the application undergraduate courses.

2. Satisfactorily meeting any additional departmental or university admission requirements:

Admission Requirements for the Master of Accountancy Program:

The minimum requirements for admission as a regular graduate student in the M.Acc. program are:

1. a Bachelor's Degree in Accounting or a Bachelor's Degree in Business Administration with a major in Accounting from an approved institution;
2. a major GPA in Accounting of at least 3.00 with an overall GPA of at least 2.5 on 4.0 scale or equivalent. Official transcripts from each college and university the student has previously attended must be mailed directly from the registrar of that school to the Deanship of Graduate Studies;
3. completion of the Graduate Management Admission Test (GMAT) with a minimum score of 450. The GMAT scores must be sent to the Deanship of Graduate Studies;
4. completion of Test of English as a Foreign Language (TOEFL) with a minimum score of 520. The TOEFL score must be sent to the Deanship of Graduate Studies;
5. satisfactorily meeting other general University requirements for admission.
6. at least two letters of recommendation from the faculty who taught the applicant undergraduate courses.

◆ Admission Requirements for the Master of Business Administration Program:

An applicant for admission to the MBA program should have:

1. A four-year baccalaureate degree (B.A. or B.S.) from a recognized and reputable institution.

2. A Grade-Point Average (GPA) of 2.50 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.

3. At least one course in college level calculus which covers both differentiation and integration.

4. A working knowledge of computers as evidenced by at least one course in that area (e.g. data processing, programming, information systems, etc.)

5. 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.

6. A satisfactory score in the Graduate Management Admission Test (GMAT).

7. 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.

8. At least two letters of recommendation from the faculty who taught the applicant undergraduate courses.

Admission Requirements for the Doctoral Programs

With Full Standing

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

1. Graduate Studies Program Requirements:

i. An M.S. degree in engineering or science from an institution whose graduate programs are equivalent to those of King Fahd University of Petroleum & Minerals.

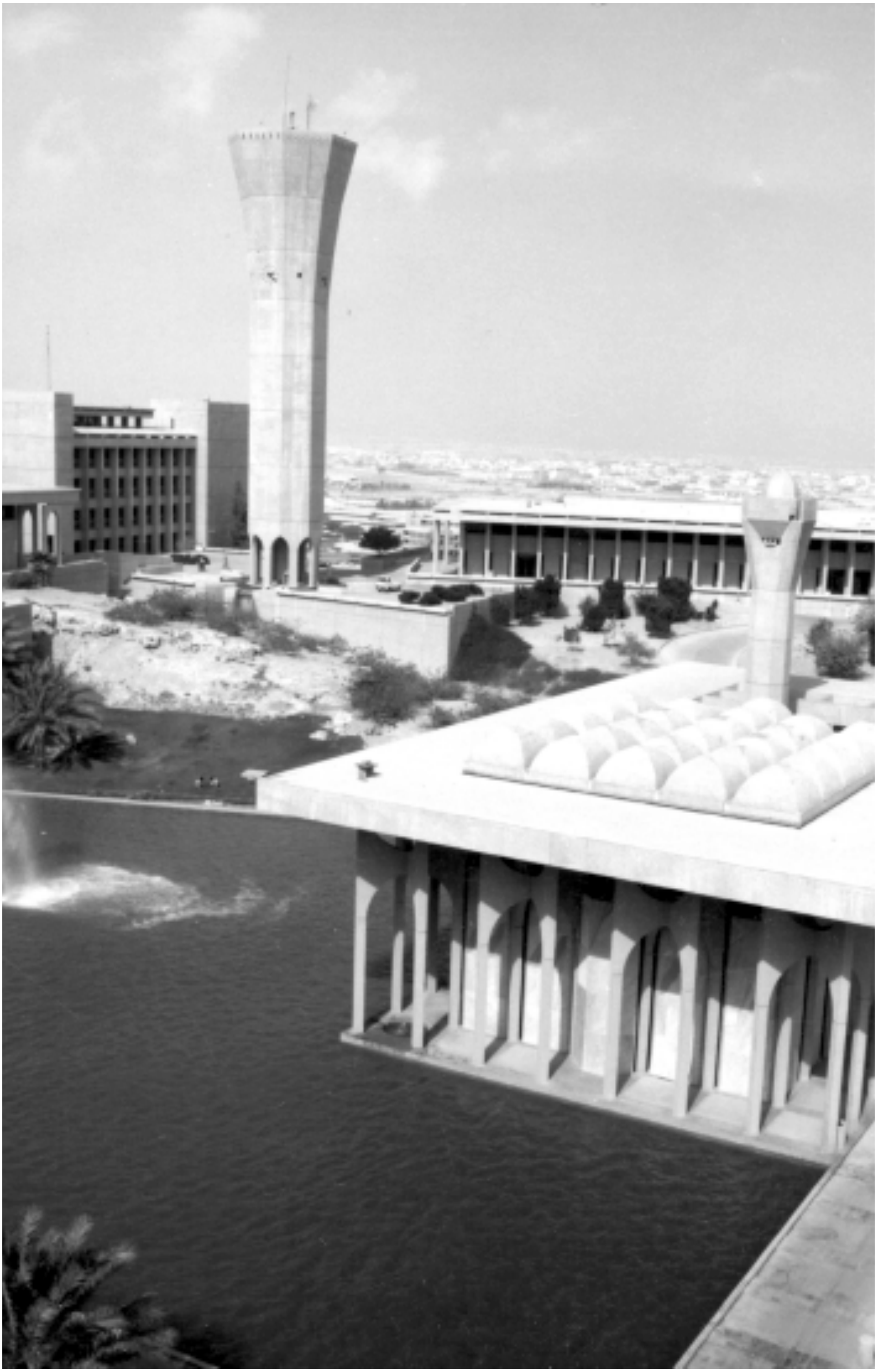
ii. A minimum GPA of 3.00 (on a 4 point scale) or its equivalent.

iii. A major in the proposed field or evidence of suitable background for entering the proposed field.

iv. Minimum scores of 550 (247) in the Test of English as a Foreign Language (TOEFL).

2. Any additional departmental requirements:

3. GRE (General and Subject) scores that meet departmental requirements:



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 Studies 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 quality 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 twelve (12) credit hours of graduate work attempted at the University. This requirement must be met within the first two

(2) semesters following admission. Failure to do so will result in his being suspended/dismissed from the University. If the first twelve credit hours occur in term in which the cumulative total exceeds twelve (12), the evaluation is made on the basis of the GPA for all graduate work completed.

◆ **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. These two courses must be approved by the student's graduate committee, 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 44). Non-Saudi students who withdraw from all courses, or who do not maintain satisfactory progress toward 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 the grade of the course subject of the recalculation is C+ or below maximum number of credit hour for recalculation is 6 credit hours 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.

DEGREE REQUIREMENTS

◆ **General Requirements:**

Advanced degree are awarded primarily in recognition of the professional development of a graduate student, rather than for completing prescribed list of courses as 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 check-points. 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.

◆ **Sequence**

The following checklist indicates the normal sequence in meeting degree requirements:

Master's Degree

1. Admission process completed, including: evaluation of transcripts, tests, if required, completed (TOEFL, TWE, GMAT, GRE, etc.), transfer credit, if any, evaluated and approved, major selected
2. Degree plan prepared and approved
3. *Thesis topic and advisor selected
4. *Student's graduate 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 (six months before degree conferred)
7. Completion of formal course work, and grades reported to Registrar
8. *Completion of thesis (four weeks before degree conferred)
9. *Thesis oral defense (two weeks before degree conferred)
10. Proof of completion of degree requirements
11. Graduation and award of advanced degree

***Not applicable for students pursuing Master of Engineering, Master of City and Regional Planning, Master of Accountancy, or Master of Business Administration Programs.**

Ph.D. Degree

1. Admission process completed, including: evaluation of transcripts, tests, if required completed (TOEFL or other English exam, GRE, etc.)
2. Preliminary examination passed
3. Transfer credit, if any, evaluated and approved
4. Fulfillment of remedial courses, if any
5. Degree plan prepared and selected
6. Dissertation topic and advisor approved
7. Fulfillment of course requirements
8. Results of comprehensive examination reported
9. Student's dissertation committee appointed
10. Application for admission to candidacy filed
11. Admission to candidacy approved (at least one year before degree conferred)
12. Completion of dissertation (four weeks before degree conferred)
13. Dissertation defense (two weeks before degree conferred)
14. Proof of completion of degree requirements
15. 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 the Master of Science (M.S.), Master of Engineering (M. Engg), Master of Accountancy (M. Acc.), Master of Business Administration (M.B.A.), Master of City & Regional Planning (M. CRP) and Doctor of Philosophy (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 candidates 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 the 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. It also makes essential the careful review and approval of each individual program by Graduate Studies. The student's departmental graduate coordinator and the student's graduate committee must be formally approved by the chairman of the department or program and the Dean of Graduate Studies. This should be completed as soon as possible after admission. 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 in the first year of the M. Acc. or M.B.A. degree programs may not be included and have no bearing upon the decision to grant admission to candidacy. Approval for this candidacy must be secured one year before the degree is conferred. Candidacy for the Ph.D. degree will only be granted after successful completion of the comprehensive examination, both written and oral and preparation of an approved dissertation proposal. 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", page 52);
2. the removal of any special conditions of the academic department related to admission; and,
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 Office of the Dean of Graduate Studies.

◆ **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.

COMPREHENSIVE EXAMINATION

1. Upon completion of all course work, every Ph.D. student is required to take a comprehensive examination.

2. The purpose of the comprehensive examination is to ensure that students advancing to candidacy for the Ph.D. degree have sufficient breadth and depth of knowledge in their field of specialization and are prepared to undertake the program of research required for completing the Ph.D. degree.

3. The comprehensive examination consists of written and oral components.

4. The comprehensive examination will be administered by the Doctoral Program Committee. This includes preparing time schedules for this examination, nominating faculty members for examination preparation, etc.

5. The comprehensive examination will normally be given during the semester following the completion of the student's course work.

6. The written and oral examinations are graded as a unit – pass or fail. If a student fails the comprehensive examination, he may be allowed to take it again at the next scheduled date of this examination.

7. In the case of failure in the second attempt, the student will be dismissed from the program.

8. If a student passes the comprehensive examination, he will be admitted to Ph.D. candidacy and a research topic will be identified. If the department feels it necessary, the Doctoral Program Committee may assign a dissertation advisor before the student is formally admitted to candidacy for the Ph.D. degree.

◆ **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.

◆ **Graduate 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.) degree regardless of the area of specialization. It is not normally required of candidates for the Master of City & Regional Planning (M.CRP), 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 thesis or dissertation is considered 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, graduate thesis or 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. Six (6) copies of thesis or dissertation, incorporating 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 Office of the Deanship of Graduate Studies not less than ten (10) days before the graduation convocation.

- **Oral Thesis 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 of Accountancy (M.Acc.), Master of Business Administration (M.B.A.), Master of City and Regional Planning, (M.CRP) and Master of Engineering degrees (ME).

The student is required, following consultation with his thesis or dissertation committee and upon securing the approval of Graduate Studies, to arrange a time and 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. At the discretion of the chairman of the graduate thesis or dissertation committee, the faculty who are present but are not members of that committee, may be invited to participate, but they shall not vote. The graduate students enrolled in the College are normally invited to observe but not 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 at least 2/3 majority vote of the committee. 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.

A student may take this oral thesis defense only twice. If a student fails the examination twice, he shall be dropped from the University.

- **Submission of Thesis & Dissertations:**

After the student has successfully defended his thesis, he is given at least 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 four (4) of original signature page for the signature of the concerned.

Five volumes (hardbound), one unbound clean copy and a floppy or CD copy of the thesis will be submitted to the Graduate Studies.

- **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 four (4) calendar years. 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 will be considered by the Deanship of Graduate Studies for not more than one additional year.

- The Ph.D. programs are designed for full time study. The student must thus engage himself in scholarly work on a full-time basis. A student must complete at least one year in full-time research at KFUPM for his Ph.D. dissertation.

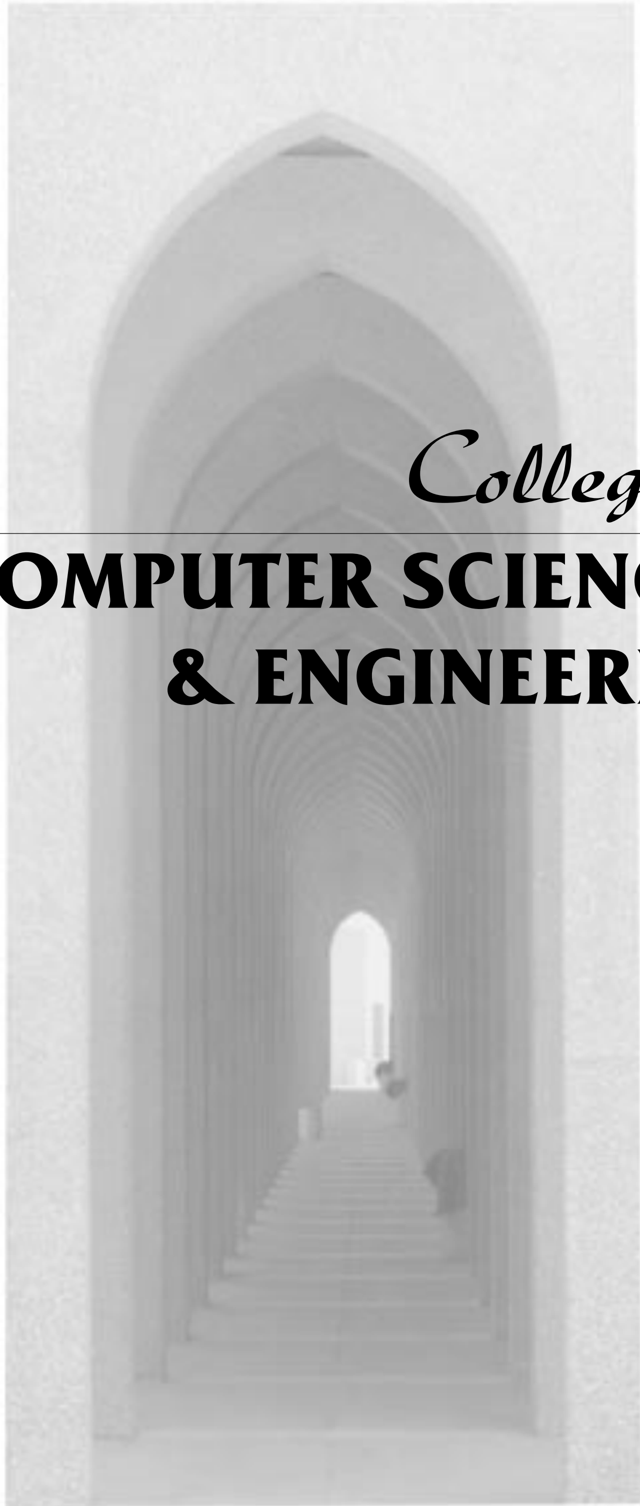
All requirements for any Ph.D. degree must be completed within period of five (5) calendar years. The limit for pursuit of the award of this degree is six (6) years.

- Credit for graduate courses taken at KFUPM or transferred from another university (see "Transfer with Advanced Standing", page 40) may be applied to meet the requirements of a master's degree within three (3) years from the completion of such courses provided the other credits for the advanced degree at KFUPM have already been completed.

- **Credit loads**

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

ENGINEERING & SCIENCE	**Credit Hours semester Min**	**Max**	**Minimum Credit Hours per year**	**Time limit for completion**
Graduate/Research Assistant	6	9	12	4 years
Lecturer B	6	9	12	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
M.Acc., M.CRP & M.B.A. PROGRAMS				
Full-time Graduate Student	9	15	18	4 years
Graduate/Research Assistant	6	9	12	4 years
Part-time Graduate Student	3	9	6	6 years



College of

COMPUTER SCIENCES & ENGINEERING

COMPUTER ENGINEERING

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Graduate 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 super computers.

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 System 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.

M.S. PROGRAM IN COMPUTER ENGINEERING

DEPARTMENT ADMISSION REQUIREMENTS

Students admitted to the Computer Engineering MS program must satisfy the following requirements:

1. A 4-year BS in COE or closely related discipline with a GPA of at least 3 out of 4,
2. A TOEFL score of at least 520,
3. An acceptable GRE score,
4. A minimum of two recommendation letters from faculty acquainted with the student's academic performance,
5. A statement of purpose written by the applicant.

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

COE 551: Computer and Network Security

COE 552: Network Management

COE 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

<u>COE 589:</u> Special Topics in Computer Systems and Applications

<u>COE 591:</u> Neural Networks

<u>COE 592:</u> Human Computer Interface Engineering

<u>COE 593:</u> Multimedia

<u>COE 594:</u> DPS Systems and Architectures

<u>COE 595:</u> Hardware/Software Co-design of Embedded Systems

<u>COE 596:</u> Intelligent Computing

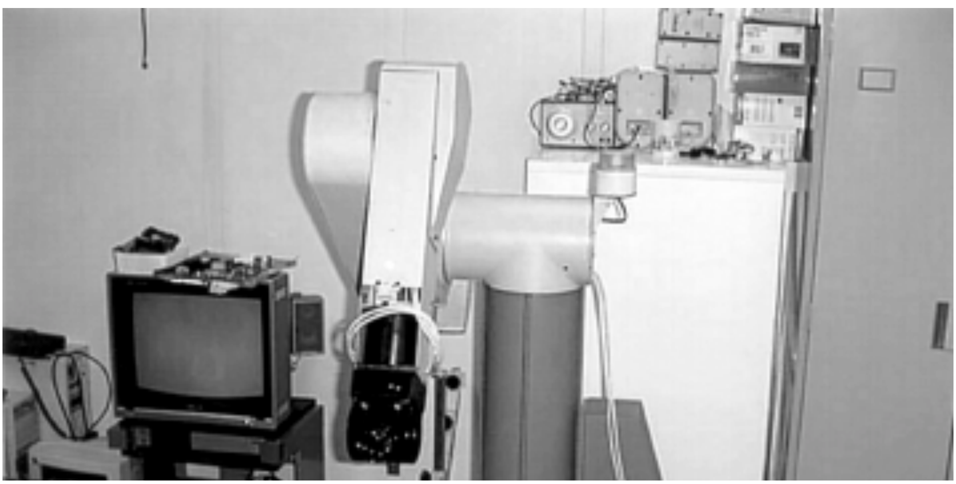
<u>COE 597:</u> Real Time Systems

4. Two electives are to be selected from a list of approved graduate courses from within or outside the COE Department. They must, however, be taken from departments of a *related discipline*, e.g. ICS, Math, EE, and SE. The student advisor must approve the two courses. 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)

7. Students admitted on a provisional basis, should satisfy any conditions, e.g. remedial courses, required to attain regular status.



DEGREE PLAN

COURSE	#	TITLE	LT	LB	CR
First Semester					
COE	5xx	Core I	3	0	3
COE	5xx	Core II	3	0	3
COE	5xx	Elective I	3	0	3
Second Semester					
COE	5xx	COE Core III	3	0	3
COE	5xx	COE Elective II	3	0	3
XXX	xxx	Elective Course I	3	0	3
Third Semester					
COE	5xx	COE Elective III	3	0	3
XXX	xxx	Elective Course II	3	0	3
COE	599	Seminar	1	0	0
Fourth Semester					
COE	610	MS Thesis Work	0	0	6

The two XXX xxx electives maybe taken from the graduate courses from within or outside the Computer Engineering Department. 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 442 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 practices 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 442, ICS 432, or Consent of the Instructor.

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

Protocols and Network Architectures. Various Technologies for Local and Metropolitan Area Networks (LAN 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 the 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 the 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 adhoc 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 the 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 the 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 proverbs. Verification using Specific Calculus. Formal verification versus formal synthesis. Future trends in hardware verification.

Prerequisite: Consent of the 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 Combination 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.

Prerequisites: COE 308, 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.

Prerequisites: COE 360, ICS 353; or equivalent.

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

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

Prerequisite: Consent of the Instructor.

COE 584 Robotics (3-0-3)

Morphological Structures of robotics system. 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 EE 603

Prerequisite: COE 305 or equivalent.

COE 585 Switching Theory (3-0-3)

Review of Switching Algebra, Complex Gates, Boolean Algebra, Multi-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 and SE 518

Prerequisites: ICS 202; STAT 319, SE 205, or Consent of the Instructor.

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

Advanced selected topics in computer systems and applications.

Prerequisites: Graduate standing, Consent of the 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 EE 560

Prerequisites: Graduate standing, Consent of the 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

Prerequisites: Graduate standing, Consent of the 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.

Prerequisites: Graduate standing, Consent of the 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-dependent 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.

Prerequisites: Graduate standing, Consent of the 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 Cases Studies.

Prerequisites: Graduate standing, Consent of the 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 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 Computer Science

M.S. PROGRAM IN COMPUTER NETWORKS

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.

Students admitted to the Computer Networks MS program must also satisfy the following requirements:

1. A 4-year BS in COE or ICS or closely related discipline with a GPA of at least 3 out of 4,
2. A TOEFL score of at least 520,
3. An acceptable GRE score,
4. A minimum of two recommendation letters from people acquainted with the student's academic performance,
5. A statement of purpose written by the applicant.

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: Ptotocol 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. (For a list of possible courses see Appendix A.)

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

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**	**9**
Second Semester						
CSE/COE/ICS	5xx	Network Core III	3	0	3	
CSE/COE/ICS	5xx	Networks Elective II	3	0	3	
XXX	xxx	Elective Course I	3	0	3	
XXX	xxx	Elective Course II	3	0	3	
			12	**0**	**12**	**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**	**3**
Fourth Semester						
COE 610/ICS	610	MS Thesis Work	0	0	6	
			0	**0**	**6**	**6**
						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. 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-tolerance. 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)

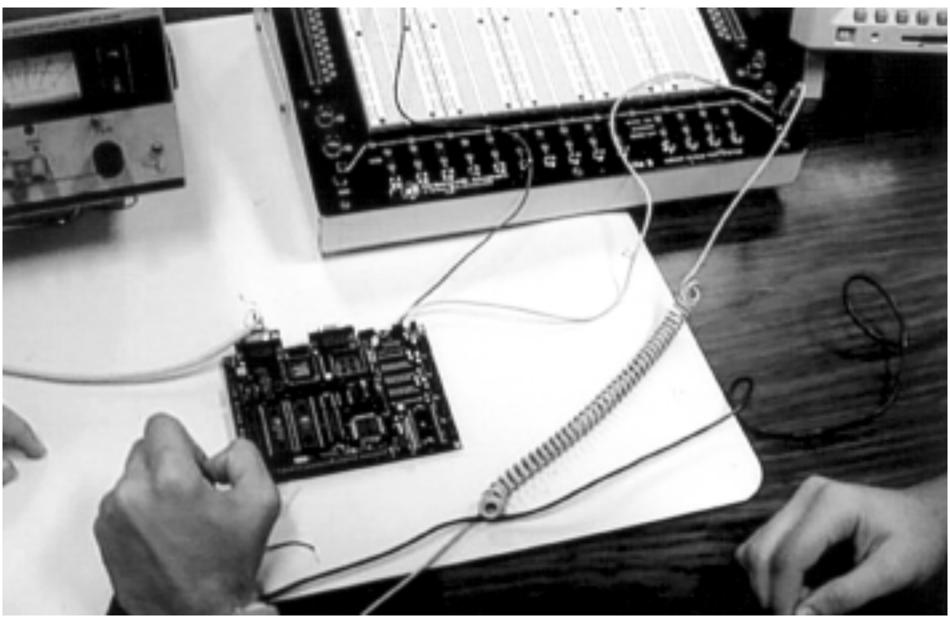
Protocols and languages. Protocol structure. Structured protocol design. Fundamentals of Protocol Engineering. Specification and modeling. State Machines and Reachability Analysis. Formulation of desirable properties of protocols. Formal Logic and Deduction. Verification techniques. Formal description 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.



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Ghandi	Raharja	

Graduate Program in COMPUTER SCIENCE

Information and Computer Science today is a major branch of knowledge. The principles of computing are widely used not only in science and industry but also in office and home. This has generated a long term demand for experts in the field of Information & Computer Science throughout the world. The undergraduate and graduate programs in Computer Science at KFUPM are established to help meet this demand in Saudi Arabia.

The Computer Science Program at KFUPM came into existence in 1982. In 1986, the department became one of the three departments of the newly established College of Computer Science & Engineering. The other two departments are Computer Engineering and Systems Engineering.

The ICS Graduate Program was established to provide the advanced knowledge in all fields related to computer and information sciences such as programming languages, software engineering, information systems, distributed processing, 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 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 transferred to the country.

COMPUTING FACILITIES

The main departmental hardware resources are utilized in various laboratories.

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. They are not for general use.

ARTIFICIAL INTELLIGENCE LAB

The Artificial Intelligence Lab is a multi-faceted research facility being used for research on natural language processing, knowledge representation, Expert system tools and applications, and other aspects of Artificial Intelligence. The equipment in the lab include several SUN SPARC LX stations, several state-of-the-art PCs and laser printer.

PARALLEL AND DISTRIBUTED SYSTEMS (TRANSPUTER) LAB

This laboratory has a number of TRAMs (Transputer modules) which can be interconnected in the form of one or more networks. The lab supports Helios operating system as well as a TDS2 (Transputer Development System) with Occam, C, Pascal, and FORTRAN languages. It also has a number of Transputer based educational kits. The lab is used by ICS and COE faculty and students. Currently it is managed jointly by ICS and COE departments.

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.

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 lab provides:

- Over 60 DOS and Windows applications and utilities on the network.
- Terminal sessions to the UNIX platform and DPC mainframe.
- Electronic mail service linking to the rest of the world.

OPTICAL COMPUTING LAB

The lab includes two pentium-based machines running Next-Step, a sparc based machine running Next-Step, two Sun LX machines running Solaries, a Power Mac, a 486-machine running Windows NT3.5, and a 486-machine running windows.

The lab also has a number of optical components that can be used to prototype small scale architecture.

CURRENT RESEARCH TOPICS

- A client-server database system
- A study of fiber optic switching systems and Optical interconnection networks
- Asymmetric Error Correcting Codes
- Developing a management information system using data from the automated operations.
- Development of visual OCCAM
- English to Arabic machine translation
- Fault tolerance in neural networks
- KHABEER: an Arabic expert system shell
- Load balancing for distributed and parallel applications
- Load migration for distributed and parallel applications
- Scheduling for distributed and parallel applications

- Partitioning for distributed and parallel applications
- Machine translation
- Online recognition for Arabic handwriting
- PROVER: a production system for hardware verification
- Pruning decision trees
- Revision of expert decision trees by learning from examples
- Software metrics for object-oriented systems
- Using semantics of data in the interoperatibility of heterogeneous database systems
- Visualization of scientific data
- Computer Aided Geometric Design
- Designing Efficient Algorithms for Computer Graphics Techniques
- Font Designing Techniques using splines
- Object-Oriented Knowledge Representation

ACADEMIC PROGRAM

In addition to meeting the overall requirements of KFUPM, M.S. students must satisfy the following:

1. A student in the graduate program should satisfactorily complete a minimum of 24 credit hours of course work (8 courses) for graduate credit, not including thesis. Four courses, out of 8 courses, are required core courses as mentioned in items 2 and 3 below, the other four courses are elective courses.
2. All students are required to take:

   ICS511 Designand Implementationof Programming Languages,

   ICS 531 Advanced Operating System, and

   ICS 553 Design and Analysis of Algorithms.
3. All students are required to take at least one course from the following list of courses in the areas of **Parallel and Distributed Computing and Artificial Intelligence:**

   ICS 571 Distributed Systems

   ICS 572 Computer Communication Networks

   ICS 573 Concurrent and Parallel Processing

   ICS 574 Parallel Algorithms

   ICS 575 Distributed Databases

   ICS 581 Advanced Artificial Intelligence

   ICS 582 Natural Language Processing

   ICS 583 Pattern Recognition

   ICS 584 Automated Theorem Proving

   ICS 585 Knowledge-Based Systems
4. All students are required to complete four electives (12 credit hours) to be chosen from 500 level courses. A maximum of six credit hours from the other departments is allowed, if approved by the department.

5. Students are required to attend and pass the ICS 599 Seminar, which carries no credit.
6. The student should satisfy the ICS 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 satisfy any special conditions (such as passing remedial courses satisfactorily) connected with his admission.
8. The student must maintain a cumulative and major GPA of 3.00 or better in all graduate work.
9. Full-time students must complete all requirements for the master's degree in three (3) calendar years.

DEGREE PLAN

COURSE	#	TITLE	LT	LB	CR	
First Semester						
ICS	511	Design and Implementation of Programming Languages	3	0	3	
ICS	531	Advanced Operating Systems	3	0	3	
ICS	xxx	ICS Elective	3	0	3	
XXX	xxx	Elective	3	0	3	
			12	**0**	**12**	**12**
Second Semester						
ICS	553	Design and Analysis of Algorithms	3	0	3	
ICS	yyy	Core Elective Course	3	0	3	
ICS	xxx	ICS Elective	3	0	3	
XXX	xxx	Elective	3	0	3	
ICS	599	Seminar	1	0	0	
			13	**0**	**12**	**12**
Summer Session & Following Semester						
ICS	610	Thesis	**0**	**0**	**6**	**6**
						30

yyy is one of 571, 572, 573, 574, 575, 581, 582, 583, and 584.
The XXX xxx electives can be selected from the courses within or outside the ICS department.

COURSE DESCRIPTION

AREA 1. PROGRAMMING LANGUAGES AND SOFTWARE ENGINEERING

ICS 511 Design and Implementation of Programming Languages (3-0-3)

Rules for specifying syntax and semantics of programming languages, design methodology for designing various programming languages such as software requirement specification languages with examples drawn from some of the newly-designed languages such as ADA and MODULA.

Prerequisite: ICS 313

ICS 512 Advanced Compiler Design (3-0-3)

Organization of Compilers. Lexical, Syntactic, and Semantic Analysis. Advanced Parsing Techniques. Run-time Environments. Code Generation and Register Allocation Methods. Advanced Optimization Techniques. Compiler Generator Techniques and Compiler Compilers. Language Based Editors and Program Synthesizers. Advances in the Theory of Compilation. Project(s).

Prerequisite: ICS 412 or Consent of the Instructor

ICS 513 Principles of Software Engineering I (3-0-3)

Formal specification techniques. Design of reliable software. Programming languages and reliability. Reliability models. Reusability. Software engineering metrics. Software testing, verification, and validation.

Prerequisite: ICS 413 or Consent of the Instructor

ICS 514 Principles of Software Engineering II (3-0-3)

Software development tools and environments. Case tools. Software configuration management. State-of-the-art software engineering environments for the automated support of requirements analysis, specification, modeling, and simulation. Support for design specification, code generation, testing and debugging, maintenance, and project management. The role of knowledge-based environments for the production and evolution of software. Student will design and implement a software project.

Prerequisite: ICS 413 or Consent of the Instructor

ICS 515 Human-Computer Interaction (3-0-3)

Understanding of the theoretical and methodological issues in human-computer interaction (HCI) as applied to the design and evaluation of interactive computer system. Definition of user interfaces from user's and designers' views; user information processing capabilities and limitations; user models, dialogue management, user interface management systems (UIMS), task analysis, formal models of human-computer interface.

Prerequisite: Graduate Standing, Consent of the Instructor

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

Advanced topics selected from current journals of Programming Languages and Software Engineering that deal with theoretical development or applications of computer systems.

Prerequisite: Consent of the Instructor

AREA 2. SYSTEMS

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

Structural design aspects of an operating system. The process model. Interprocess communication. Synchronization mechanisms. Resource management and use. Scheduling. Capabilities. Deadlock detection, recovery, and avoidance. Memory management. File systems. Protection issues. Introduction to distributed operating systems. Case studies. Students are to conduct projects on the design and implementation aspects of an operating system.

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 multiserver systems. Model validation methods. Case studies. Projects.

Equivalent to COE 532

Prerequisite: ICS 431 or Consent of the Instructor

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

Basic probability and statistics: random variables, probability distributions. Generation of random numbers and random variables. Review of discrete-event simulation tools and methodologies. Mathematical modeling computing systems. Simulation languages. Applications to computer systems: time shared systems, multiprocessor systems, LANs, computer networks, DBMS, and distributed systems. Distributed and concurrent discrete-event simulation. Projects.

Equivalent to COE 554

Prerequisite: STAT 319 or equivalent

ICS 534 Database Design and Implementation (3-0-3)

Review of database concepts. Database design: requirements analysis, conceptual design; logical design, physical design; user application development, testing, maintenance, and performance monitoring. Various types of database systems such as logic, object-oriented and federated. Issues in database systems. Current research trends. The student is expected to carry out a project on the design and implementation of a real life database or the development of a database tool.

Prerequisite: ICS 334 or Consent of the Instructor

ICS 535 Advanced Computer Graphics (3-0-3)

An overview of two dimensional concepts and methods. Detailed treatment of three-dimensional topics: concepts, representations, and transformations. Hidden-surface methods. Shading and coloring models. Modeling methods. The course will include a number of programming projects.

Prerequisite: ICS 435 or equivalent

ICS 536 Architecture and Design of Computer Systems (3-0-3)

Computer system description at the system level and register transfer level, use of Petrinets to model computer system. Design of CPU: the functions of control unit, the design of ALU, integer and floating point processors. Design of memory: memory hierarchy, associate memory, virtual memory, problem of memory contention. The architecture of I/O processors. Examples drawn from some well-known architectures.

Prerequisite: COE 308 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 the Instructor

AREA 3. THEORETICAL COMPUTER SCIENCE

ICS 551 Theory of Automata and Formal languages (3-0-3)

Chomsky hierarchy of Phrase-structure grammars. Classes of languages (regular, context-free, context-sensitive, free) and their representations (grammars and automata). Closure and decidability properties of classes of languages. Universal Turing machines. Undecidable problems.

Prerequisite: Consent of the Instructor

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

Machines and Languages. Universal machines. Recursive functions. The s-m-n Theorem, Church thesis. Godel's incompleteness theorem. Decidability and Undecidability. Complexity classes and the polynomial time hierarchy.

Prerequisite: Consent of the Instructor

ICS 553 Design and Analysis of Algorithms (Core) (3-0-3)

Analysis of algorithms and problem complexity. Algorithm design techniques. Matroids. Planar separator theorem. Matching: cardinality matching in bipartite and general graphs, weighted matching. Network flow algorithms: Edmond's Dinic's, Enumeration: permutation generation, ranking and unranking. NP-completeness and approximation algorithms.

Prerequisite: ICS 353 or Consent of the Instructor

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: Consent of the Instructor

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

A survey of the mathematical principles of cryptography and data security. A detailed study of conventional and modern cryptosystems. Information theory, Number theory, Complexity theory concepts and their applications to cryptography.

Prerequisite: Graduate Standing

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 the Instructor

AREA 4. PARALLEL AND DISTRIBUTED COMPUTING

ICS 571 Distributed Systems (3-0-3)

Taxonomy of distributed systems: architecture, topology, communication medium and methods. Computer networks. Local area networks. Multiprocessor systems. Resource sharing. Reliability. Programming distributed systems: communication and synchronization. Distributed application issues. Performance evaluation. Case studies. Projects on main aspects of distributed systems.

Prerequisite: Consent of the Instructor

ICS 572 Computer Communication Networks (3-0-3)

Architecture of a computer network with some examples. Techniques of data communication: data communication through circuit switching, message and packet switching via ground, radio, or satellite. Minimization of overheads in data communication, routing and flow control capacity assignment, buffering and concentrating, etc. Communication interfaces: protocols, line control procedures.

Equivalent to COE 560

Prerequisite: Consent of the Instructor

ICS 573 Concurrent and Parallel Processing (3-0-3)

Concepts and foundation of parallel processing. Parallel processing applications. Computational models. Parallel algorithms. Parallel software characteristics and requirements: languages, compilers, and operating systems. Parallel computer architectures. Highly parallel computers: architecture, operating systems, and programming languages. Case studies. Project(s).

Equivalent to COE 553

Prerequisite: ICS 431 or equivalent

ICS 574 Parallel Algorithms (3-0-3)

Parallel algorithms: Linear recurrences, sorting, pattern matching. Graph algorithms for connected components, matching, transitive closure. Scheduling problems. Knapsack problems. Systolic algorithms. Approximation algorithms. Random algorithms. Projects.

Prerequisite: ICS 353 or equivalent

ICS 575 Distributed Databases (3-0-3)

Architecture of a distributed database system, query decomposition and processing in a distributed database, concurrency control, fault tolerance and reliability. General issues of designing and implementing a distributed database.

Prerequisites: ICS 534; ICS 471 or equivalent

ICS 579 Special Topics in Parallel and Distributed Computing (3-0-3)

Advanced topics selected from current journals of Parallel and Distributed Computing that deal with theoretical development or applications of computer systems.

Prerequisite: Consent of the Instructor

AREA 5. ARTIFICIAL INTELLIGENCE

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

An in-depth study of Artificial Intelligence topics. State of the art approaches to Artificial Intelligence. Knowledge Engineering. Planning Natural Language Understanding. Speech Understanding. Computer Vision.

Prerequisite: ICS 381 or equivalent

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

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. Recent trends.

Prerequisite: ICS 381 or equivalent

ICS 583 Pattern Recognition (3-0-3)

Various methods of pattern recognition, extraction methods, statistical classification, minmax procedures, maximum likelihood decisions, data structures for pattern recognition, 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: Programming knowledge and Graduate Standing (Cannot be taken for credit with ICS 485)

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 the Instructor

OTHER COURSES

ICS 591 Independent Study (3-0-3)

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

Prerequisite: Consent of the Instructor

ICS 599 Seminar (1-0-0)

Graduate students working towards either M.S. or Ph.D. degrees, are required to attend the seminars and contribute to the general area of their thesis research. Grade on a Pass or Fail basis.

Prerequisite: Consent of the Instructor

ICS 610 Thesis (0-0-6)

Prerequisite: Consent of the 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, mechanizable 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. There are over 60 workstations including SUN, NeXT, DEC machines running UNIX. The UNIX servers include alpha and MIPS based machines. The PC Labs (comprised of pentium, 486, and Macs) are connected to the network. Besides the College PC Labs, 16 other specialized labs are available to support teaching and research.

The university information technology center has an IBM 3090, AMDAHL 5850 and UNIX based server and workstations. These are linked to the College facilities via a campus wide fiber optic token ring.

All the College computing facilities are networked together through an ETHERNET Local Area Network. Regional research centers and universities are linked through GULFNET. The College network is also linked to INTERNET.

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. passing of a preliminary examination,
2. completion of 30 credit hours of course work with a GPA of at least 3.0 (on a scale of 4.0),
3. satisfactory performance in the written and oral comprehensive examinations,
4. successful completion and defense of original work documented as a dissertation, and
5. 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 student to complete the Ph.D. is 6 years. A student must spend a minimum of one year in residence doing his Ph.D. dissertation work.

FACULTY RESEARCH INTERESTS

Computer Science and Engineering faculty are actively involved in several research areas. Below is a list summarizing the current research interests of the faculty:

- Design and Analysis of Algorithms
- CAD of Digital Systems
- VLSI System Design
- Digital System Testing and Design for Testability
- Fault Tolerant Computing
- Computer Networks
- Performance Analysis and Evaluation
- Parallel Computing and Distributed Processing
- Neural Networks
- Software Engineering
- Machine Learning
- Natural Language Processing and Machine Translation
- Computer Vision and Robotics
- Computer Graphics

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

A Typical Program
Preliminary Examination
Completing Deficiency Courses*

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**	**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**	**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**	**6**
						30
Comprehensive Examination						
Fourth Semester						
CSE	699	Seminar	1	0	0	
CSE	710	Ph.D. Dissertation Work	12	0	IP	
Fifth Semester						
CSE	710	Ph.D. Dissertation Work	12	0	IP	
Six Semester						
CSE	710	Ph.D. Dissertation Work	12	0	12	

Dissertation Defense
IP should read dissertation in progress.

***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.**

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 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.

Prerequisites: 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. Nondeterminacy. 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 511 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: ICS 512 or 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 552 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.

Prerequisites: 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 not 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

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Andijani
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Duffuaa
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Murty
Raouf

LECTURERS

Akhtar	Khan	Seliaman
Al-Amer	Nazeer	Siddiqui
Arifusalam	Riyaz	Vaqar

Graduate Programs in SYSTEMS ENGINEERING

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.

The Master's Program has been in existence since 1979 and the Ph.D. was approved in 1992.

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.

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.

ACADEMIC PROGRAM

MASTER OF SCIENCE

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. THE FOLLOWING ARE THE LISTS OF CORE COURSES FOR EACH OPTION:

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 M.S. 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 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 offering 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.

DEGREE PLANS

M.S. DEGREE PLAN (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**	**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**	**9**
Third Semester						
SE	xxx	SE Elective II	3	0	3	
XX	xxx	Free Elective II	3	0	3	
			6	**0**	**6**	**6**
Fourth Semester						
SE	610	Thesis	0	0	6	
			0	**0**	**6**	**6**

M.S. DEGREE PLAN (IE/OR 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**	**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**	**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**	**6**
Fourth Semester						
SE	610	Thesis	0	0	6	
			0	**0**	**6**	**6**
						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	Non-linear 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

However, two free technical electives may be taken from other disciplines. The student continues the research activities during the Summer Semester, completes the research, prepares, and defends his thesis.

PH.D. PROGRAM

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.

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 Non-linear 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.

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 brief description 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

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, 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, 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 the 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 416 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: Graduate 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 the 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 416 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, equivalent, or Consent of Instructor. (Crosslisted 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.

Prerequisite: SE 205, 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 the 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, 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, 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 416, 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, 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, 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, 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.

Prerequisites: Graduate Standing, 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 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.

Prerequisites: SE 507, 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 the 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; 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; 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 System (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 416 or equivalent

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 416 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; Hoo optimization problem; model reduction; l1-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.

Prerequisite: SE 624 or Consent of the Instructor. (Crosslisted with EE 613).

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 416, 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. Electrochemical machining, electrical discharge machining, high energy forming, and laser and electron beam machining.

Prerequisite: SE 322. (Crosslisted 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 416 or equivalent

SE 668 Guided Systems Control (3-0-3)

Dynamic equations of rigid bodies; missile dynamic equations; introduction to missile 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. (Crosslisted 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.

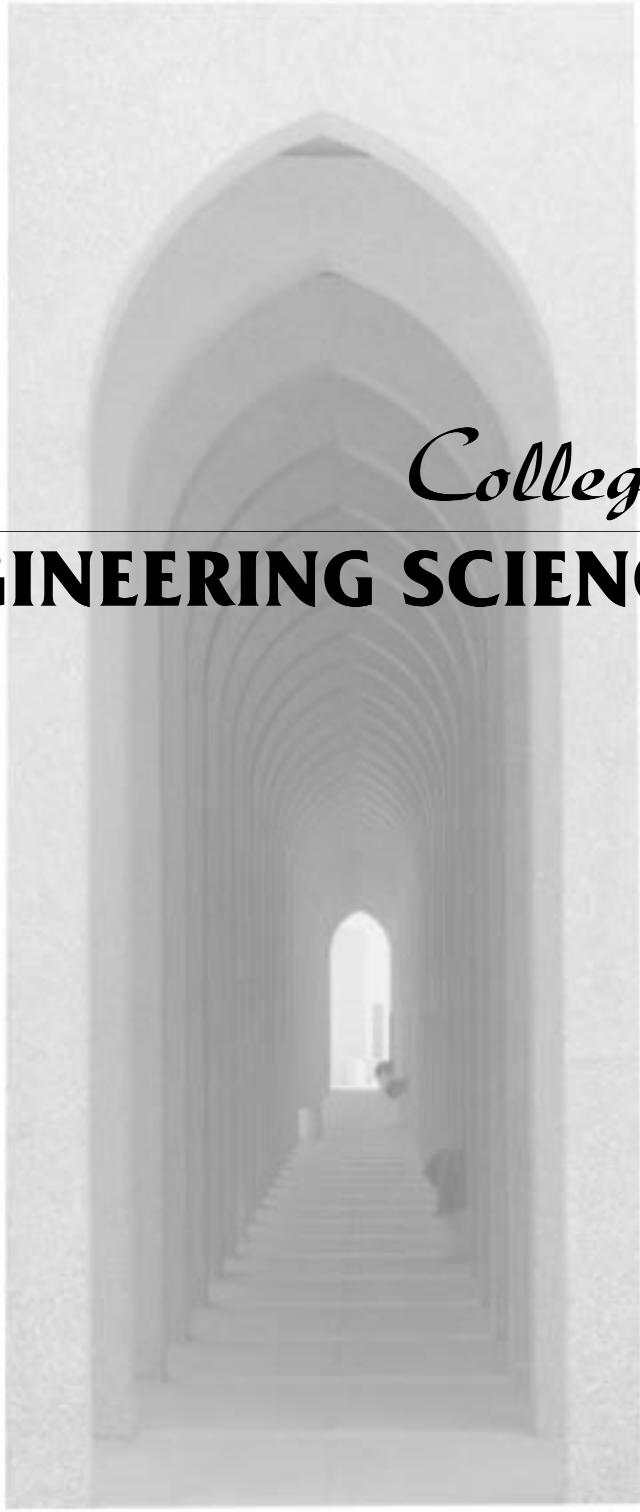
SE 699 Seminar (1-0-0)

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

CHEMICAL ENGINEERING

CHAIRMAN
Dr. Mohamed B. Amin

PROFESSORS

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Al-Saleh	Ma'adhah	Sharma
Al-Shalabi	Redhwi	

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Al-Mutairi*	El-Nafaty	

***On study leave**

Graduate Programs in CHEMICAL ENGINEERING

MISSION STATEMENT

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.

INTRODUCTION

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.

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.

MASTER OF SCIENCE PROGRAM

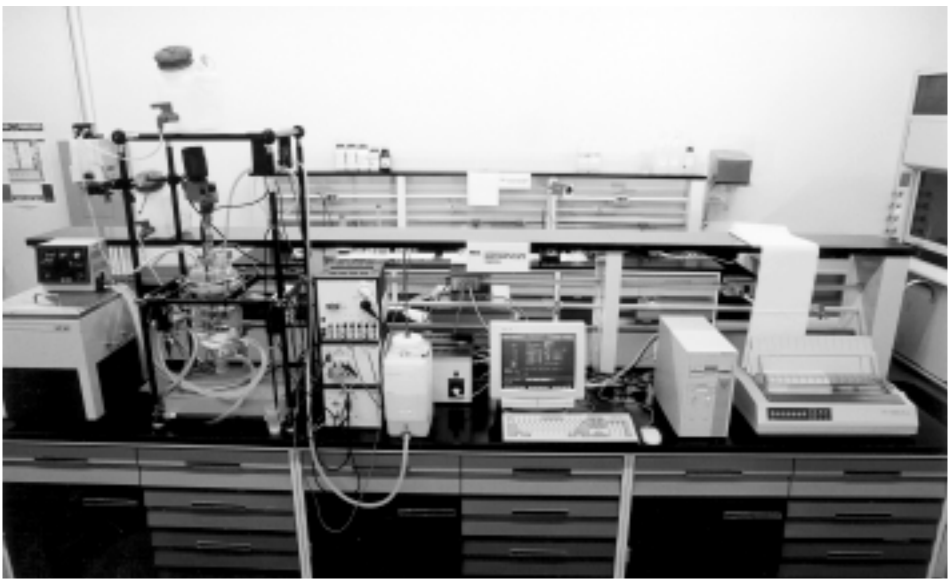
The Master of Science program is designed to provide a strong background in fundamental subjects, including scientific and mathematical principles, as well as the opportunity to define and investigate novel and challenging research problems through experimental and computational techniques.

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.



M.S. DEGREE PLAN

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**	**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**	**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**	**6**
						30

PH.D. PROGRAM

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 and pass a written entrance examination.

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

Entering students have to sit for an Entrance Examination consisting of two papers of three hours length each. The philosophy of the examination is to identify the analytical ability and breadth of background of the students to satisfy the department of their capability to pursue the Ph.D. program. Paper I includes the areas of Fluid Mechanics, Heat Transfer, Mass Transfer, and Separation Processes. Paper II includes the areas of Thermodynamics, Reaction Engineering, and Process Control. Applicants should take the examination during their first semester of study.

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.

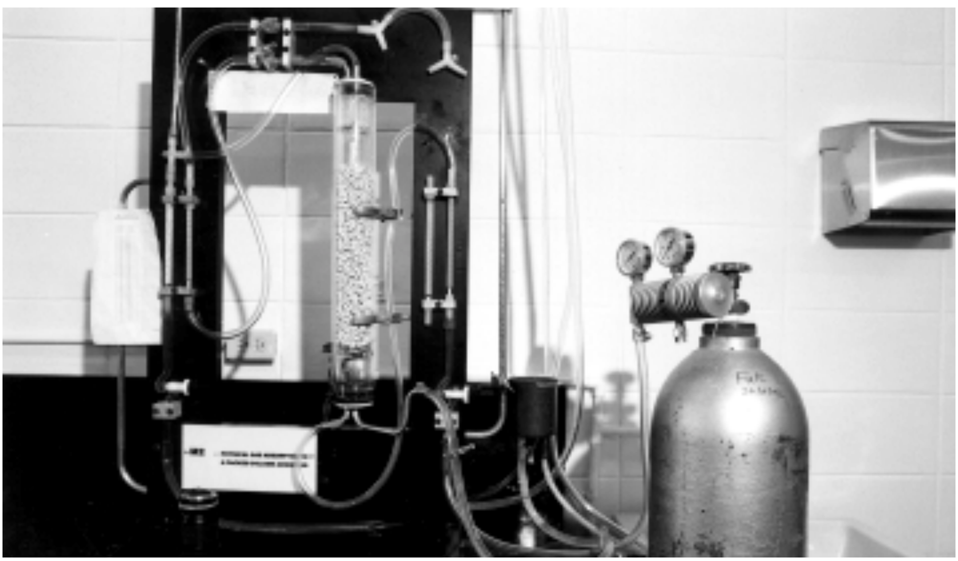
Ph.D. students are required to present a seminar every year starting from the second year of the program.

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.



PH.D. DEGREE PLAN

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**	**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**	**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**	**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**	**12**
						42

GRADUATE COURSES IN CHEMICAL ENGINEERING

FLUID AND THERMAL SCIENCES GROUP

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 GROUP

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 GROUP

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 GROUP

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 GROUP

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 boundary-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 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

Al-Abdul Wahhab, H.I.

PROFESSORS

Al-Abdul Wahhab	Baluch
Abduljauwad	Dakhil
Allayla	Ishaq
Almusallam	Sharif
Azad	

ASSOCIATE PROFESSORS

Aiban	Al-Malack
Al-Amoudi	Al-Mandil
Al-Gadhib	Al-Saadon
Al-Gahtani, A.	Al-Senan
Al-Gahtani, H.	Al-Shayea
Al-Ghamedy	Al-Suwaiyan
Al-Juruf	Bakhrebah

ASSISTANT PROFESSORS

Al-Ahmadi	Alghamdi
Al-Dulaijan	Bader, M.
Al-Ofi	Bader, T.
Al-Sughaiyer	Bukhari
Al-Zahrani, M. A.	Khatlan
Al-Zahrani, M. M.	Ratrout

LECTURERS

Al-Mana	Bouchama
Al-Yousif	Shamshad

Graduate Programs in CIVIL ENGINEERING

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 to suit a student's particular interest beyond undergraduate study. In addition to the mandatory courses in each option, students can elect 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.

Current research in the environmental engineering area emphasizes petrochemical and hazardous waste treatment, evaluation of wastewater treatment plants, disinfection and biological treatment, removal of viruses through slow sand filtration, and reuse of wastewater effluents for desert greening.

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, durability modeling, shrinkage, creep, repair and fatigue. Other areas of research include concrete durability; finite element modeling of intact or damaged structures for assessment, strengthening and/or repair, nonlinear finite element analysis of mitred bends, laminated shell elements, steel connections, reinforced concrete and slabs on grade; structural optimization, boundary elements, 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 and sanitary laboratory

5. Traffic Engineering Laboratory
6. Photogrammetry Laboratory
7. Surveying Laboratory
8. Geotechnical Engineering Laboratory

The department has an array of over forty microcomputers for data processing, data acquisition, plotting, and research functions. The department also maintains a computer laboratory and has terminals to the University's IBM 390-150E mainframe computer within the civil engineering building.

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 application 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.

ACADEMIC PROGRAM

The M.S. option requires 24 hours of approved course work and an acceptable thesis. 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:

MASTER OF SCIENCE

The objective of Master of Science program is to enable the bright and talented graduate engineers to further intensify their training by specializing in the field of their 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.

DOCTOR OF PHILOSOPHY

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.

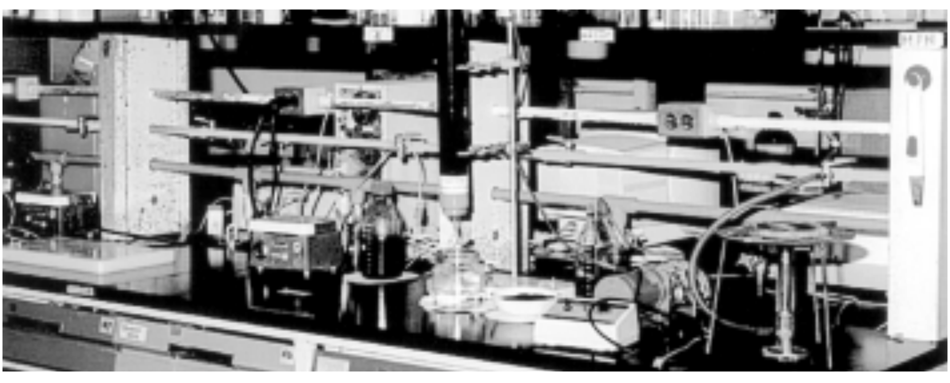
The program leading to the degree of Doctor of Philosophy involves advanced studies in Civil Engineering and related areas. Formal study in terms of advanced courses coupled with independent research prepares the student for leadership in the option of Structures, Water Resources and Environmental Engineering, 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.

All students who have been admitted to the Ph.D. program with full standing will have to take an Entrance Examination in their major area to demonstrate their competence and identify areas of deficiencies. The results of the Entrance 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 graduate course offerings in the various options areas.



GEOTECHNICAL ENGINEERING OPTION
(Master Of Science)

COURSE	#	TITLE	LT	LB	CR	CU
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	**9**
Second Semester						
CR	552	Foundation Engineering	3	0	3	
CE	5xx/6xx	Geotechnical Elective	x	x	3	
CE	5xx/6xx	Geotechnical Elective	x	x	3	
					9	**18**
Third Semester						
CE	5xx/xx	CE Elective**	x	x	3	
CE	610	Thesis	0	0	6	
					9	**27**
Fourth Semester						
XX	5xx/x	Technical Elective***	x	x	3	
					3	**30**

* Math 513 or Math 560.

** From Civil Engineering courses (including Geotechnical option).

*** From relevant graduate courses offered university wide with consent of graduate advisor.

STRUCTURAL OPTION
(Master Of Science)

COURSE #		TITLE	LT	LB	CR	CU
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	**9**
Second Semester						
MATH	5xx	Advanced Mathematics	3	0	3	
CE	521	Advanced Reinforced Concrete Design	3	0	3	
CE	5xx/6xx	Structures Elective	x	x	3	
					9	**18**
Third Semester						
CE	5xx/6xx	CE Elective*	x	x	3	
CE	610	Thesis	0	0	6	
					9	**27**
Fourth Semester						
XX	5xx/6xx	Technical Elective**	x	x	3	
					3	**30**

* From Civil Engineering courses (including structures option).

** From relevant graduate courses offered university wide with consent of graduate advisor.

TRANSPORTATION ENGINEERING OPTION
(Master Of Science)

COURSE #		TITLE	LT	LB	CR	CU
First Semester						
MATH	560	Applied Regression and Exptl. 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	**9**
Second Semester						
CE	5xx/6xx	Transportation Elective	x	x	3	
CE	5xx/6xx	Transportation Elective	x	x	3	
CE	5xx/6xx	Transportation Elective	x	x	3	
					9	**18**
Third Semester						
CE	5xx/6xx	CE Elective*	x	x	3	
CE	610	Thesis	0	0	6	
					9	**27**
Fourth Semester						
XX	5xx/6xxt	Technical Elective**	x	x	3	
					3	**30**

* From Civil Engineering (including Transportation Engineering option).

** From relevant graduate courses offered university wide with consent of graduate advisor.

WATER RESOURCES AND ENVIRONMENTAL OPTION
(Master Of Science)

COURSE #		TITLE	LT	LB	CR	CU
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	3	3	
CE	599	Seminar	1	0	0	
					9	**9**
Second Semester						
CE	5xx/6xx	Water Resources/Env. Elective[1,2]	3	0	3	
CE	5xx/6xx	Water Resources/Env. Elective	x	x	3	
CE	5xx/6xx	CE Elective**	x	x	3	
					9	**18**
Third Semester						
CE	5xx/6xx	Water Resources/Env. Elective	x	x	3	
CE	610	Thesis	0	0	6	
					9	**27**
Fourth Semester						
XX	5xx/6xx	Technical Elective***	x	x	3	
					3	**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 advisor.**

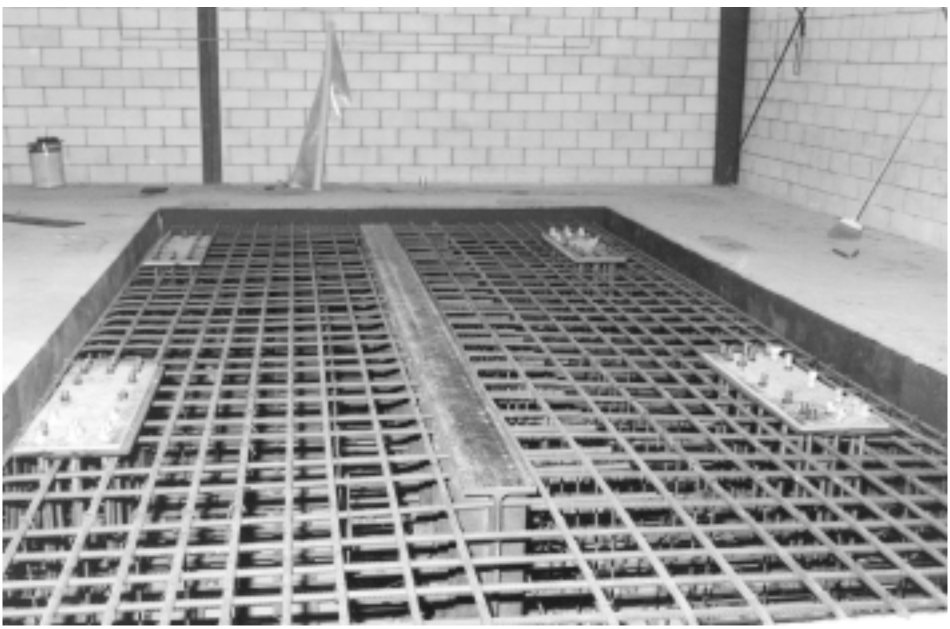
1. CE 531 is mandatory for candidates pursuing research in Water Resources.
2. CE 547 is mandatory for candidates pursuing research in Environmental Engineering.

PH.D. PROGRAM
All Options

A typical breakdown of credit hours is given for each of the available four options of study, namely: Structures, Water Resources and Environmental Engineering, Geotechnical, and 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.



COURSE DESCRIPTION

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; bending of curved beams; torsion of prismatic bars; beams on elastic foundations; introduction to Cartesian tensors; tensorial transformation of stress; Mohr's circle for 3-D stress transformation; 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.

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 STRUDL 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, design and behavior of continuous flexural members, two-way floor systems, design of slender columns, beam-column joints; deflection of RC members; design for shear and torsion; foundation design; computer modeling for analysis and design of RC structures.

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 prestressing, 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 members with large width-thickness ratio and 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 of 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 and 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 and 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 or 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 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 value 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 or 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 nonharzardous wastes; fate and transport of contaminants; compacted clay and synthetic linears; leachatecollection 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.

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 traffic signals 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, inter-changes, 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 advances in the analysis and design of structures including optimization of engineering designs, dynamics of structures and design of special structures.

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 the 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 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 and 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 fibre 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 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 damaged; 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 Genuchtenmodels; 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 projection; 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; examination of control technologies, regulatory policies and management strategies.

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; back calculation 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/faculty 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 and 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; 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; legislation; measurement and prediction of air, noise, and water pollution; 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

ELECTRICAL ENGINEERING

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Dr. Jamil Bakhashwain

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Sheikh, A — *Bugshan / Bell Labs*

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Al-Shaikhi	Kandlawala	Tassaduq
Bashar	Khan, A	
Hussain	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 communication, electromagnetics, modern electronics, control systems, digital signal processing, digital systems, and power systems.

For all three programs, the students are required to successfully complete 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 Ph.D. dissertation, which must be defended by the student.

TEACHING AND RESEARCH FACILITIES

The Department has a variety of excellent laboratories to support teaching and research in the areas of communication, electromagnetics, power, control, electronics and digital systems, image processing, and digital signal processing. The Department has special facilities for research which include an indoor computer-controlled antenna test range, an underwater digital communication laboratory, signal and image processing facilities, a high voltage testing facility, analog and digital control laboratory, programmable logic controller laboratory, and several computer laboratories.

Graduate students have opportunities to participate in existing research efforts in areas that include 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; telephony; digital filtering; robot simulation and control.

ADMISSION REQUIREMENTS

COLLEGE OF GRADUATE STUDIES REQUIREMENTS

Graduates in engineering and science from recognized institutions are eligible to apply for admission to the master's program as regular students. Applicants holding a master's degree with a GPA of 3.00 or above from a reputable university equivalent to KFUPM are eligible for admission to the Ph.D. program. All Applicants must satisfy the general Graduate School admission requirements.

DEPARTMENTAL REQUIREMENTS

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.

ACADEMIC PROGRAM

MASTER OF SCIENCE PROGRAM

The program leading to the degree of Master of Science 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 Digital Communication I, Analog Integrated Circuits Design, Design of Digital Systems, Radiation and Propagation of Electromagnetic Waves, Power System Analysis, Linear Control systems, and Digital signal Processing 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 elective course from other departments.

DEGREE PLAN

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 Communication I	3	0	3	
XX	xxx	Free Elective	3	0	3	
			12	**0**	**12**	**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	
			12	**0**	**12**	**12**
Summer Session And Following Semesters						
EE	610	Thesis	0	0	6	
			0	**0**	**6**	**6**
						30

Master of Science 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 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	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	663	Image Processing	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	541	Local and Metropolitan Area Networks	3	0	3
CSE	551	Computer and Network Security	3	0	3
CSE	555	Protocol Engineering	3	0	3
ICS	555	Data Security and Encryption	3	0	3
ICS	583	Pattern Recognition	3	0	3

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 include:

COURSE	#	TITLE	LT	LB	CR
MIS	502	Management Information Systems	3	0	3
MIS	510	Information Resource Management	3	0	3
MIS	511	International Telecommunications Management	3	0	3
MIS	513	Information Systems and Telecommunications Strategies	3	0	3

PH.D. PROGRAM

The program leading to the degree of Doctor of Philosophy is intended for those exceptional individuals who plan to pursue a career in fundamental applied research. The program requires coursework 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 coursework beyond the M.S. Degree in addition to the dissertation. In addition to successfully passing an entrance examination (ENEX), a Ph.D. student is also required to pass a comprehensive examination (COEX) covering his area of study, a preliminary dissertation proposal defense (PDPD), and presentation and defense of the dissertation. The student must declare a major area and a minor area by the end of the first semester of enrollment in the Ph.D. program.

The ENEX is required of all Ph.D. Candidates. It is a two part written examination. Part I of the Entrance Examination is based on undergraduate courses. Part II of the Entrance Examination is based on graduate courses. The Entrance Examination is administered every semester unless the Graduate Program Committee decides to postpone it. It is intended to evaluate a student's qualifications and aptitude for Electrical Engineering, and to determine areas of weakness. The department encourages taking this exam during the first year of study.

The COEX consists of two parts (a) written and (b) oral. The purpose of this exam is to ensure that the student has a sufficient breadth and depth of knowledge and to evaluate student's ability to research a specific topic and critique its state of the art. The written part will include the candidate's major as well as minor fields and NOT on courses taken in these areas. The oral part will cover the candidate's major as well as his dissertation area. This exam will be conducted upon successful completion of all coursework. The COEX will be managed by an ad hoc departmental committee having a minimum of five members of whom at least one must be from outside the Electrical Engineering Department, and preferably from the department of the minor field. The Candidate's advisor normally chairs the committee. Decisions of the committee are based on a majority of at least two thirds of the total number of the members.

In case of failure, the COEX may be attempted once more after a period of time determined by the committee with specified remedial work. 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 COEX 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 preliminary proposal. The student must make a public defense of the preliminary proposal and must incorporate the comments raised during this defense in his preliminary 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	623	HVDC Transmission Systems	3	0	3
EE	651	Adaptive Control	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 Phd.D degrees are required to register for EE 599 (Seminars) once before finishing the degree requirements.

COURSE DESCRIPTION

The description of all EE graduate courses in the six areas of research is presented next. All Courses' number start with either a 5 or 6. The second digit in a course number indicates the area.

Courses in the area of Power Systems are coded as	EE 52x or EE 62x.
Courses in the area of Electromagnetics are coded as	EE 53x or EE 63x.
Courses in the area of Electronics and Digital Systems are coded as	EE 54x or EE 64x.
Courses in the area of Control Systems are coded as	EE 55x or EE 65x.
Courses in the area of Signal Processing are coded as	EE 56x or EE 66x.
Courses in the area of Communication Systems are coded as	EE 57x or EE 67x.

EE 520 Power Systems 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 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. Hugen'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 dispath of generation 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 dispath and allocation.

Prerequisite: EE 463 or equivalent

EE 623 HVDC Transmission System (3-0-3)

Comparison between AC and DC transmission. Convert 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 measurement. 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 architecutres, 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. 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 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 manipulators.

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 to 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, Multiplexing. 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
Dr. Faleh Al-Sulaiman

PROFESSORS

Abualhamayel	Eleiche	Said
Al-Garni	El-Shaarawi	Sheikh
Badr	Habib	Thomas
Budair	Khulief	Yilbas
Dincer	Sahin	Zubair

ASSOCIATE PROFESSORS

Ahmad, Z.	Al-Qutub	Kalyon
Al-Bedoor	Al-Sulaiman	Khan
Al-Farayedhi	Antar	Merah
Allam	Gandhidasan	Shuaib
		Sunar

ASSISTANT PROFESSORS

Al-Dheylan	Al-Qahtani	Jamjoom
Al-Haddad	Arif	Mezghani
Al-Hadhrami	Ben-Mansour	Mokheimer
Al-Kaabi	El-Sinawi	Shuja
Al-Nassar	Gasem	Spuzic

LECTURERS

Abdul Aleem	Doxford	O'Neil
Abdul Samad	Hamilton	Rashid
Ahmed, M.	Hussaini	Raza
Ahmed, M.F.	Hatfield	Shaw
Alzaharnah	Khan, J.R.	Thomas, A.A.
Anis	Mahmood	Thomas, A.K.
Bazoune	Monte	Yaqub
Cahil	Muhammad, I.	Younas
Davies	O'Brien	

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 (MS) 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 student is expected to demonstrate competence in a series of professional requirements that require an element of creativity. Consequently, the graduate programs 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 programs 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 Applied Materials, Engineering Mechanics, and Thermal Sciences. 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 improves 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. The Department concentrates on three basic research fields listed below:

1. Thermofluid Sciences, including Thermodynamics, Fluid Mechanics, Aerodynamics, Heat Transfer, Combustion, Refrigeration and Air Conditioning and Energy Conversion.

ME Courses in Thermofluid Sciences

ME 351	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 555 Advanced Fluid Mechanics II

ME 556 Industrial Aerodynamics

ME 557 Thermal Environment and Energy Analysis

ME 558 Combustion Phenomena

ME 611 Statistical Thermodynamics

ME 612 Phase Change Heat Transfer & Two Phase Flow

ME 613 Advanced Compressible Fluid Flow

2. Engineering Mechanics, including Mechanics of Deformable, Solids, Dynamics, Vibrations, and Control.

ME Courses in Engineering Mechanics

ME 520 Fundamentals of Astronautics

ME 541 Continuum Mechanics

ME 542 Elasticity

ME 543 Finite Element Analysis for Large Deformation Problems

ME 552 Advanced Dynamics

ME 553 Advanced Vibrations

ME 562 Vibration Measurement and Analysis

ME 564 Noise and Vibration Control

ME 640 Dynamics and Control of Mechanical Systems

ME 642 Plasticity

ME 651 Nonlinear and Random Vibrations

ME 658 Analytical Fracture Mechanics

3. Applied Materials, including Manufacturing, Materials Science, Corrosion, and Tribology.

ME Courses in Applied Materials

ME 512 Experimental Methods in Materials and Processes

ME 543 Finite Element Analysis for Large Deformation Problems

ME 572 Analysis of Manufacturing Processes

ME 573 Probabilistic Concepts in Design & Production

ME 574 Advanced Materials Science

ME 576 Tribology

ME 646 Control of Manufacturing Processes

ME 652 Plasticity and Metal Forming

ME 658 Analytical Fracture Mechanics

ME 671 Electrode Kinetics

ME 672 Advanced Corrosion Engineering

ME 673 Metallurgical Processes and Thermodynamics

ME 674 Solidification

ME 675 Structure of Metals and Phase Transformation

A student and his advisor may develop a program of studies relevant to the student's interest from the elective courses offered by the Mechanical Engineering Department or the relevant elective courses offered by other departments. In addition, the Department offers the following special topics courses:

ME 510 Numerical Methods in Mechanical Engineering

ME 590 Special Topics I

ME 591 Special Topics II

ME 690 Special Topics III

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 instruments, 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, rotor kits, vibration meters, recorders, analyzers, amplifiers accelerometers and transducers, electron and scanning electron microscopes. 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 nonlinear systems, and modal identification
- Control of vibrations including active control techniques
- Dynamic analysis and design of elastic multi-body systems
- Laser machining and other laser-related applications
- Corrosion and material damage processes and reliability modeling
- Manufacturing process planning and system analysis, evaluation, and optimization
- Automation and Computer Aided Manufacturing systems modeling and control
- Bifurcation and chaos in nonlinear dynamical systems

- Thermal energy storage systems and applications
- Refrigeration systems and applications
- Drying systems and applications
- Exergy analysis of thermal systems
- Energy use and environmental impact
- Fracture and life assessment
- Fatigue at higher temperature
- Convective and conjugate heat transfer about confined and unconfined rotating bodies
- Absorption refrigeration
- Metal matrix composites, mechanical behavior
- Tribology and wear testing
- Performance of propulsion systems
- Ultrasonic non-destructive evaluation

DEPARTMENTAL ADMISSION REQUIREMENTS

Admission Requirements for the M.S. Program

The minimum requirements for possible admission to the Master of Science program in the Deanship of Graduate Studies as a regular graduate student with full standing in Mechanical Engineering are:

1. a Bachelor's Degree in Mechanical Engineering from an institution whose undergraduate program is equivalent in length, content, and quality to that of KFUPM.
2. achieving minimum score of 550 in GRE (Quantitative), and
3. satisfactorily meeting the University M. S. Admission requirements.

Admission Requirements for the Ph.D. Program

Students applying to the doctoral program must provide evidence of exceptional scholastic ability, intellectual creativity, and research motivation.

The minimum requirements for possible admission to the Doctoral Program in the Deanship of Graduate Studies as a graduate student with full standing in Mechanical Engineering are:

1. a Master's degree from a university of recognized standing,
2. a major in mechanical engineering or evidence of suitable background for entering the field of mechanical engineering,
3. achieving minimum score of 550 in GRE (Quantitative), and
4. satisfactorily meeting the University Ph.D. admission requirements.

ACADEMIC PROGRAM

MASTER OF SCIENCE PROGRAM

The M. S. Degree requires the successful completion of core courses, elective courses, and a thesis. The requirements of the M. S. program can be completed in two years. All requirements for the Master's Degree, however, must be completed during a total elapsed period of three years.

All candidates for the M. S. Degree in Mechanical Engineering must complete four core courses (12 credit hours); these courses are ME 532, ME 534, ME 541, and MATH 513. In addition, the program of study includes three Mechanical Engineering elective courses (9 credit hours). The technical elective could be taken from courses offered by the Mechanical Engineering Department or other departments in the Colleges of Engineering and Sciences. To complete the 30-hour program of study, the candidate must also complete a research thesis (6 credit hours) and seminar requirements.

M. S. DEGREE PLAN

COURSE	#	TITLE	LT	LB	CR	
First Semester						
MATH	513	Mathematical Methods I	3	0	3	
ME	541	Continuum Mechanics	3	0	3	
ME	5xx	Elective	3	0	3	
ME	xxx	Elective	3	0	3	
			12	**0**	**12**	**12**
Second Semester						
ME	532	Advanced Fluid Mechanics I	3	0	3	
ME	534	Conduction Heat Transfer	3	0	3	
ME	5xx	Elective	3	0	3	
XX	5xx	Technical Elective	3	0	3	
ME	599	Seminar	1	0	0	
			13	**0**	**12**	**12**
Summer Session And Following Semester						
ME	610	Thesis	0	0	6	
			0	**0**	**6**	**6**
						30

PH.D. PROGRAM

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 dissertation and seminar requirements. The maximum load for the Ph.D. student is 12 graduate credit-hours per semester. 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.

The Ph.D. Degree requires the graduate student to initially pass a preliminary examination, 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.

One of the departmental requirements is that the Ph.D. students must take two-thirds of the credits in the field of Mechanical Engineering. The remaining one-third can be taken in a minor field or a combination of more than one field in consultation with the student's research advisor. The minor must be in a field related to the professional activities of the mechanical engineer and must be selected from specific areas in mathematics, physics, computer sciences, statistics, or any related field of engineering.

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 areas from the following three basic fields:

1. **Thermofluid Sciences:** Includes research areas in Thermodynamics, Fluid Mechanics, Aerodynamics, Heat Transfer, Combustion, Refrigeration and Air Conditioning, and Energy Conversion.

2. **Engineering Mechanics:** Includes research areas in Mechanics of Deformable Solids, Dynamics, Vibration and Control.

3. **Applied Materials:** Includes research areas in Manufacturing, Materials 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 areas.

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: All students are required to take this examination to demonstrate their competence and uncover minor deficiencies in the areas of thermal sciences, engineering mechanics, and applied materials. 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 at most twice.

The student is required to select the preliminary examination courses which must consist of a higher mathematics course (MATH 513 or its equivalent), plus three undergraduate courses from the specialized fields listed above. No more than two courses can be selected from any single field.

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 and 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 department 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: Upon successful completion of all course work, 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 Deanship of Graduate Studies. The committee should consist of at least four members that include: the Dissertation Advisor (Chairman), two 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.

COURSE DESCRIPTION

ME 510 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 selected from computational fluid mechanics, solid mechanics, structural analysis, and plasma dynamics.

Prerequisite: SE 301 (also offered under MATH 574)

ME 512 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 520 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 heating considerations.

Prerequisites: Graduate Standing, Consent of the Instructor

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. Lagendre transformations and extremum principle. Maxwell relations and thermodynamic derivatives. Stability. Phase transitions. Nernst postulate. Chemical equilibrium. Applications.

Prerequisite: ME 204

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.

Prerequisites: ME 311, MATH 513

ME 533 Ideal Fluid Flow (3-0-3)

Kinematics and dynamics of inviscid fluids in steady and unsteady motion. Two-dimensional and axi-symmetric potential flows. Singularities. Complex potential and various transformation techniques. Free-stream line flow. Airfoils and wings.

Prerequisite: ME 311

ME 534 Conduction Heat Transfer (3-0-3)

General heat conduction equation, thermal conductivity. Steady one-dimensional conduction, resistance concept, heat source systems, extended surfaces. Steady two-an three-dimensional conduction. Unsteady heat conduction and multi-dimensional systems. Time varying boundary conditions. Phase change with moving boundaries. Solution methods. Laplace transform. Fourier series. Bessel functions. Legendre series, numerical methods.

Prerequisites: ME 315; MATH 513 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.

Prerequisites: ME 315, SE 301

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 315

Corequisite: 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 432

ME 539 Solar Energy Utilization (3-0-3)

Design considerations of various concentrating collectors for thermal and photovoltaic applications. Solar thermal/electric power conversion. 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

ME 541 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 542 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 541

ME 543 Finite Element Analysis for Large Deformation Problems (3-0-3)

Introduction. Formulation for elastic deformation elastic-plastic analysis. Finite-strain formulation. Implementation of the finite-strain formulation. Practical applications in metal forming processes and structural component design.

Prerequisite: Graduate Standing

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 robit.

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)

Influence coefficients and functions. Matrix methods. Normal coordinates. Natural modes of discrete undamped systems. Orthogonality. The eigenvalue problem. Forced vibrations and forced vibrations of continuous systems, such as uniform strings, rods, and beams.

Prerequisite: ME 413, ME 482, or equivalent

ME 555 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 556 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 532

ME 557 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 430

ME 558 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 531

ME 562 Vibration Measurement and Analysis (3-0-3)

Analysis of lumped and distributed parameter models. Random vibration: spectral analysis and frequency response methods. Vibration data processing. Digital Fourier analysis and Fast Fourier Transform. Vibration monitoring and testing methods.

Prerequisite: ME 482 or equivalent

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 control: Noise criteria, sound absorption and insulation, noise barriers, acoustic enclosures, silencers. Vibration control: 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 572 Analysis of Manufacturing Processes (3-0-3)

Theories and analytical treatment of metal cutting, metal forming and non-traditional manufacturing processes. Friction and lubrication in machining and metal working. Machine tool dynamics and vibrations. Concepts of automation and studies of automated manufacturing systems.

Prerequisite: Undergraduate Manufacturing Processes, Consent of the Instructor

ME 573 Probabilistic Concepts in Design and Production (3-0-3)

Probability and Statistics as applied to mechanical engineering systems. Review of probability theory, functions of random variables. Systems reliability models. Probabilistic design for manufacturing. Stress-strength interference theory and reliability computations. Methods of parameter estimation and confidence limits. Application.

Prerequisite: STAT 315 or Consent of the Instructor

ME 574 Advanced Materials Science (3-0-3)

Review of basic principles of metals and alloy systems. Physical and mechanical properties. Cold working, polygonization, recovery and recrystallization. Advanced treatment of Iron-Carbon system. Binary and ternary systems. Alloying elements in steel, copper, and aluminum. Influence of alloying in transformation and critical cooling rates of steels. Surface treatment of metals and alloys. Metallurgy of cast iron. Special alloys for biomedical aerospace and nuclear application and recent developments. Polymers.

Prerequisite: Graduate Standing

ME 576 Tribology (3-0-3)

Laws of friction. Theories of lubrication. Typical lubricants. Types of wear, adhesive, abrasive, erosive and fretting-rolling contact. Heat transfer calculations Friction and wear of polymers. Friction and wear of elastomers. Friction materials. Dry bearings. Bio-Tribology. Dental tribology.

Prerequisites: ME 215, ME 311, ME 315

ME 590 Special Topics I (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 591 Special Topics II (3-0-3)

See description of ME 590.

ME 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.

Prerequisite: Graduate Standing

ME 610 M.S. 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: ME 531

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.

Prerequisites: ME 534, ME 536 (Also offered under CHE 568)

ME 613 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

ME 640 Dynamics and Control of Mechanical Systems (3-0-3)

Dynamics of mechanical systems, including ground and flight vehicles. Theory of inertial guidance and navigation. Controllability, observability and stability concepts. Modification of system performance utilizing various control techniques. Optimal control. Pontryagin's maximum principle. Application of computer techniques to selected case studies.

Prerequisites: ME 488, ME 552

ME 642 Plasticity (3-0-3)

Basic stress-strain curves, criterion of yielding. Plastic flow rules. Complete stress-strain relations. Theorems of limit analysis, applications of Prandtl-Reuss theory. Plastic bending of beams. Torsion of prismatic bars. Thick-walled tubes. Rotating discs. Plastic analysis of frames. Plastic instability. Theory of slip-line fields. Plane strain indentation and compression. Sheet drawing and sheet extrusion. Finite element methods in plasticity.

Prerequisite: ME 541, CE 510, or equivalent

ME 646 Control and Manufacturing Processes (3-0-3)

Application of computer-based control system techniques to batch manufacturing processes. A brief view 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 651 Nonlinear and Random Vibrations (3-0-3)

Vibrations of systems having nonlinear characteristics. The phase-plane method. Piecewise linear systems. Nonlinear damping. The perturbation method. Method of Krylov and Boguliubov. Averaging methods. Nonlinear resonance. Response of discrete and continuous dynamic systems to random excitation. Stationary and non-stationary excitation. Random parameters. Applications to earthquake excitation, gust response, etc.

Prerequisite: ME 553

ME 652 Principles of Metal Forming (3-0-3)

Stress-strain behavior of metals. Introduction to plasticity. Homogeneous and redundant works. Slab method of analysis. Open and closed die forgings. Extrusion of metals. Mechanics of wire drawing, cold rolling and hot rolling, strength forming, sheet bending. Analysis of deep drawing, tube drawing and tube making. Lubrication of metal forming. Numerical methods in metal forming.

Prerequisite: ME 542

ME 658 Analytical Fracture Mechanics (3-0-3)

Mechanisms of failure for brittle and ductile materials. Griffith and Irwin relations. Crack nucleation and propagation. Crack arrest. Fracture tests, fracture toughness. Fatigue. Analytical and numerical methods for calculations of crack-tip stress intensity factors. Fracture in engineering structures.

Prerequisite: ME 541 (also offered under CE 616)

ME 671 Electrode Kinetics (3-0-3)

Application of Principles of Thermodynamics. Reversible and irreversible electrode processes. Inter-facial 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 472

ME 672 Advanced Corrosion Engineering (3-0-3)

Corrosion processes and mechanisms. Effect of mechanical factors on major forms of corrosion. Temperature corrosion. Environmental conditioning. Mass transfer and corrosion. Anodic and cathodic protection of metals. Design for corrosion prevention. Testing, monitoring, and inspection. Development of corrosion resistant materials.

Prerequisite: ME 671

ME 673 Metallurgical Processes and Thermodynamics (3-0-3)

Thermodynamic principles. Solutions. Heterogeneous reactions in metallurgy. Kinetics and catalysis. Physio-chemical principles as applied to extraction. Conversion and refining of metals. Applications of Metallurgical processes.

Prerequisite: ME 478

ME 674 Solidification (3-0-3)

Solidification as an atomic process. Thermodynamics of solidification. Nucleation and inter-phase kinetics. Redistribution of solute, macroscopic heat flow and fluid flow. Polyphase solidification. Solidification of ingots.

Prerequisite: ME 673

ME 675 Structure of Metals and Phase Transformation (3-0-3)

Structure of liquids and solids. Binary equilibrium diagrams. Solid-liquid interactions. Solid-liquid transformations. Grain shape and phase distribution. Solid-solid interaction. Solid state transformations. Theories of diffusional growth processes and nucleation. Martensitic transformations. Precipitation phenomenon.

Prerequisite: ME 574

ME 690 Special Topics III (3-0-3)

See description of ME 590

ME 710 Ph.D. Dissertation (0-0-12)

PETROLEUM ENGINEERING

CHAIRMAN

Dr. Khalid Al-Fossail

PROFESSORS

Aggour

Al-Marhoun

ASSOCIATE PROFESSORS

Abu-Khamsin

Al-Fossail

Al-Hashim

Al-Majed

Al-Yousef

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 September 1, 1997, the department graduated 45 students. The department has a multinational enrollment of students in both its M.S. and Ph.D. programs.

The programs are designed to broaden the student's knowledge in the areas of Petroleum Engineering and to strengthen and deepen the student's understanding in one or more areas of specialty. Particular emphasis is placed on developing the student's potential for research, and on achieving professional competence in the areas of specialization.

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. Research Lab
8. Fluid Properties Lab
9. Rock Properties Lab
10. Oil Well Cementing Lab
11. Production Lab
12. Minerals Processing Lab
13. Thin Section Lab
14. Drilling Simulation Lab
15. Personal Computer 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.

MASTER OF SCIENCE PROGRAM

Acceptance requirements, in addition to the Deanship of Graduate Studies requirements outlined in this bulletin, include:

- 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 a

closely related engineering science. Applicant will make up any deficiencies without earning graduate credit.

The program requires a minimum of 30 credit hours viz. core courses of 12 credit hours, elective courses of 12 credit hours, and thesis work equivalent to 6 credit hours. The presentation of a satisfactory 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 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.

ACADEMIC PROGRAM

COURSE	#	TITLE	LT	LB	CR	
First Semester						
PETE	511	Advanced Drilling Fluid Technology*	3	0	3	
PETE	520	Advanced Well Testing**	3	0	3	
PETE	540	Advanced Reservoir Engineering	3	0	3	
PETE	542	Reservoir Simulation	3	0	3	
			12	**0**	**12**	**12**
Second Semester						
PETE	5xx	PETE Elective I	3	0	3	
PETE	5xx	PETE Elective II	3	0	3	
XXX	xxx	Elective I***	3	0	3	
XXX	xxx	Elective II***	3	0	3	
			12	**0**	**12**	**12**
Summer Session And Following Semester						
PETE	610	M.S. Thesis	0	0	6	
			0	**0**	**6**	**6**
						30

*** Or PETE 530 - Advanced Production Engineering**
**** Or PETE 521 - Intermediate Well Logging**
***** Petroleum Engineering Elective or any other technical elective**

PH.D. PROGRAM

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, are:

- An M.S. degree in Petroleum Engineering equivalent to the current KFUPM Petroleum Engineering Master's Program in scope and quality, or

- A Master's degree in other engineering and closely related sciences. In the latter case, applicants will be required to make up deficiency courses, if any, with no graduate credit.

ACADEMIC REQUIREMENTS

1. Completion of a minimum of 30 credit hours.

i. A minimum of 21 credit hours in 500 or higher level petroleum engineering courses;

ii. A minimum of 9 credit hours in 500 or higher level courses in other engineering disciplines or sciences.

2. Successfully pass the Entrance Examination to be held before the end of the first semester of study.

3. Present two satisfactory seminars.

4. Maintain a cumulative GPA of 3.00 or above in all graduate courses.

5. Maintain a cumulative GPA of 3.00 or above in all undergraduate deficiency courses.

6. Successfully pass the comprehensive examination in the major and minor fields given upon completion of the course work, i.e. 30 credit hours.

7. Successfully complete a dissertation and its defense.

GRADUATE COURSES

The graduate courses are grouped according to the recognized areas of petroleum engineering:

Drilling Engineering

PETE 510	Advanced Drilling Engineering
PETE 511	Advanced Drilling Fluid Tech.
PETE 615	Drilling Models
PETE 616	Offshore Drilling Engineering

Fomation Evaluation

PETE 520	Advanced Well Testing
PETE 521	Intermediate Well Logging
PETE 522	Reservoir Description
PETE 625	Advanced Well Logging
PETE 626	Gas Well Testing

Production Engineering

PETE 530	Adv.Production Engineering
PETE 531	Production Facility Design
PETE 635	Well Stimulation Techniques
PETE 636	Artificial Lifting Methods

Reservoir Engineering

PETE 540	Adv. Reservoir Engineering
PETE 541	Enhanced Oil Recovery I
PETE 542	Reservoir Simulation I
PETE 645	Fluid Flow in Porous Media
PETE 646	Reservoir Simulation II
PETE 647	Enhanced Oil Recovery II

Petroleum Economics

PETE 550	Petroleum Economics
PETE 551	Petroleum Economic Analysis

Other Courses

PETE 590	Special Topics in Petroleum Engineering
PETE 599	Seminar
PETE 610	M.S. Thesis
PETE 710	Ph.D. Dissertation

COURSE DESCRIPTION

PETE 510 Advanced Drilling Engineering (3-0-3)

Drilling assemblies, rotary drilling bits, the theory of elasticity in drilling operations. Fatigue and failure of drill pipes. Directional drilling, hydraulics, and casing design. Optimization of drilling parameters and related problems. Well control. Novel techniques in drilling.

PETE 511 Advanced Drilling Fluids (3-0-3)

Drilling fluids rheology, mud program design, clay mineralogy and colloid chemistry, chemistry of drilling fluids. Shale stability problems and their solutions. Practical problems of conventional and thermally stable mud formulation. Mud corrosivity and rheological properties of cement slurries.

PETE 520 Well Test Analysis (3-0-3)

Fundamental fluid flow equation and its solution for slightly compressible fluids in the cases of infinite and finite reservoir. Theory of superposition and its application. Dimensionless variables and type curves. Applications to buildup, drawdown, multi-rate, interference, pulse, and drillstem tests. Gas well testing. Average reservoir pressure, extension to multiphase flow. Effect of reservoir heterogeneities on pressure behavior.

Prerequisite: PETE 401: Well Testing

PETE 521 Intermediate Well Logging (3-0-3)

Open hole logging: review of petrophysical parameters, rapid initial interpretation, log interpretation in complex lithology, computer processed interpretation. Cased hole logging: review of porosity tool principles, thermal decay time log, cement bond logging, and production logs.

PETE 522 Reservoir Description (3-0-3)

The integration of open-hole log and well-test data. Qualitative and quantitative reservoir evaluation and effect of changes in lithology. Reservoir heterogeneities such as permeability variation and layering of the reservoir. Preparation of the reservoir rock data into parameters required for reservoir study and simulation.

PETE 530 Advanced Production Engineering (3-0-3)

Comprehensive study of well completion design, sub-surface control equipment. Perforation of oil and gas wells. Completion and workover fluids. Squeeze cementing, sand control, introduction to stimulation methods.

PETE 531 Production Facilities Design (3-0-3)

Selected topics in fluid mechanics. Well control equipment, workover rigs and equipment. Corrosion control, emulsion formation and related problems. Surface and separation facilities for oil, water, and gas. Integrated field processing for offshore platforms. Choice of optimal production methods. Introduction to multiphase flow in pipes and gas lift.

PETE 540 Advanced Water Flooding (3-0-3)

Presentation of the equations governing the fluid flow in porous media. The importance of the viscous, gravity, and capillary forces. Reservoir and individual well performance, fractional flow theory, and introduction to simulation.

PETE 541 Enhanced Oil Recovery (3-0-3)

Review of water flooding. Overview of thermal techniques including steam stimulation, steam injection, and in-situ combustion. Introduction to different types of miscible and immiscible displacement including chemical flooding.

PETE 542 Reservoir Simulation I (3-0-3)

Discussion of the general equations of flow, continuity equations, equations of state. Final system of partial differential equations, assumptions, and boundary conditions. Single and two phase flow in one and two dimensions, finite difference methods, use of direct and interactive methods.

PETE 550 Petroleum Economics (3-0-3)

Principles of economics estimation of costs, evaluation of oil and gas reserves, oil operations optimization, cost and risk analysis. Profitability analysis and payout time.

PETE 551 Petroleum Economic Analysis (3-0-3)

Statistical methods and operations research, application to project screening and management decision, evaluation of processing facilities. Engineering justification for capital outlay in the petroleum industry.

Prerequisite: PETE 550

PETE 590 Special Topics in Petroleum Engineering (3-0-3)

Advanced topics selected from the major areas of petroleum engineering covering recent developments.

PETE 599 Seminar (1-0-0)

Graduate students working towards either M.S. or Ph.D. degrees are required to present at least one seminar covering the general area of their research. Grades are Pass or Fail

PETE 610 M. S. Thesis (0-0-6)

The student has to undertake and complete a research topic, under the supervision of a graduate faculty member, to investigate a specific problem in Petroleum Engineering.

PETE 615 Drilling Models (3-0-3)

Analytical models of physical phenomena encountered in oil well drilling such as fatigue and failure or drilling equipment, mud filtration, dog-legs, corrosion, wellhead loads and buoyancy of tubular equipment. Rotary drilling optimization.

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.

PETE 625 Advanced Well Logging (3-0-3)

Study of current computer processing interpretation. Detailed study of shaleysands together with case studies. Introduction to special logging devices designed to solve specific problems. Dipmeter interpretation. Application to field studies.

Prerequisite: PETE 521

PETE 626 Gas Well Testing (3-0-3)

Mathematical formulation of fundamental gas flow equations and solutions. Theory of superposition and application to gas well testing. Dimensionless variable land type-curve analysis. Pseudo-pressures. Gas well pressure buildup and drawdown tests. Deliverability tests. Fractured systems and non-Darcy flow.

PETE 636 Artificial Lifting Methods (3-0-3)

Inflow performance, multiphase flow in pipes, flowing wells. Theory and application of gas lift. Gas lift installation design and analysis. Compressor systems. Submersible, sucker rod other types of pumping systems.

PETE 645 Fluid Flow in Porous Media (3-0-3)

Generalization of Darcy's law and multiphase fluid flow in porous media. Concept of relative permeability. Performance of displacement mechanisms. Buckley-

Leverett theory and frontal advance calculations. Dietz method, original and modified Style's methods.

PETE 646 Reservoir Simulation II (3-0-3)

Single and multiphase flow in two and three dimensions. Single well model. Finite difference methods. Direct and interactive solutions of general linear system of equations. Problems related to numerical treatment. Data preparation and history matching. Compositional simulation.

Prerequisite: PETE 542

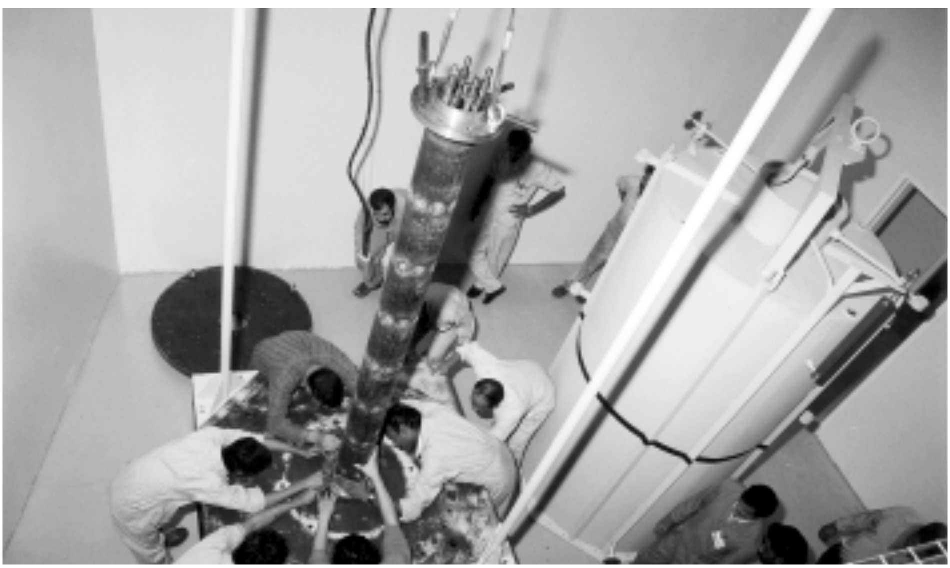
PETE 647 Enhanced Oil Recovery II (3-0-3)

Detailed thermal techniques. Different types of in-situ combustion and related problems. Miscible displacements, high pressure gas drive, and condensate gas drive. Use of carbon dioxide and nitrogen in enhanced oil recovery methods, novel techniques. Polymer flooding, micellars and alkaline flooding, process selection, case study, cost analysis and related economics.

Prerequisite: PETE 541

PETE 710 Ph.D. Dissertation (0-0-12)

Involves original research on a chosen problem within the field of petroleum engineering. Although the work can be theoretical, experimental research is encouraged. The overall result should be a scientific contribution adding to further knowledge in petroleum engineering.



College of ENVIRONMENTAL DESIGN

ARCHITECTURAL ENGINEERING

CHAIRMAN

Dr. Ismail M. Budaiwi

PROFESSORS

Al-Hammad

ASSOCIATE PROFESSORS

Al-Hamoud

Budaiwi

ASSISTANT PROFESSORS

Abdou

Hassanain

Khaiyat

Konash

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 educational 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.

ACADEMIC PROGRAMS

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 course 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.

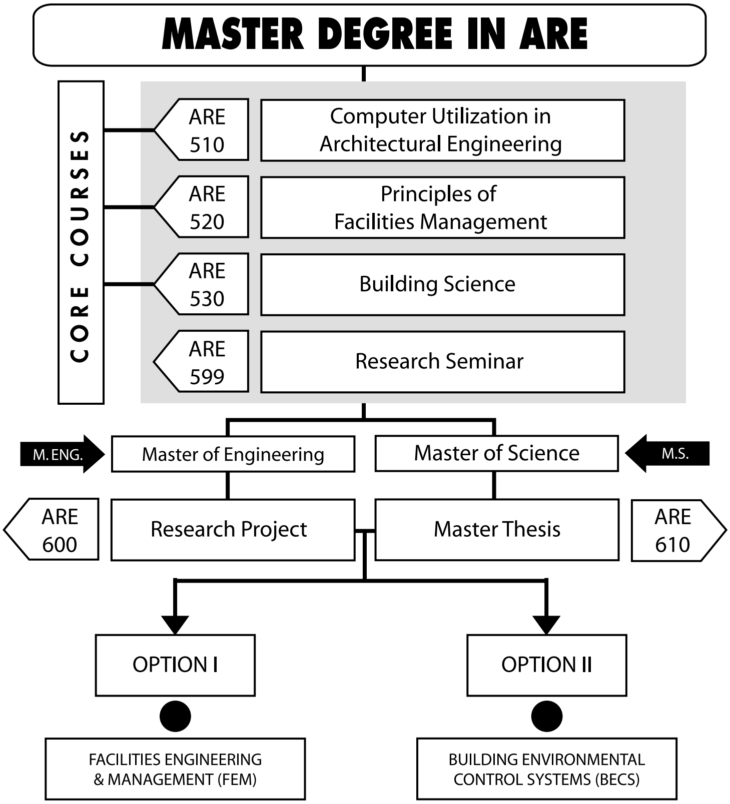


Figure 1. The structure and options of the Master Degree program in ARE

AREAS OF EMPHASIS

Emphasis is given to the areas of study that are related to the postconstruction 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:

- Facilities Engineering and Management **(FEM)**
- Building Environmental Control Systems **(BECS)**

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*.

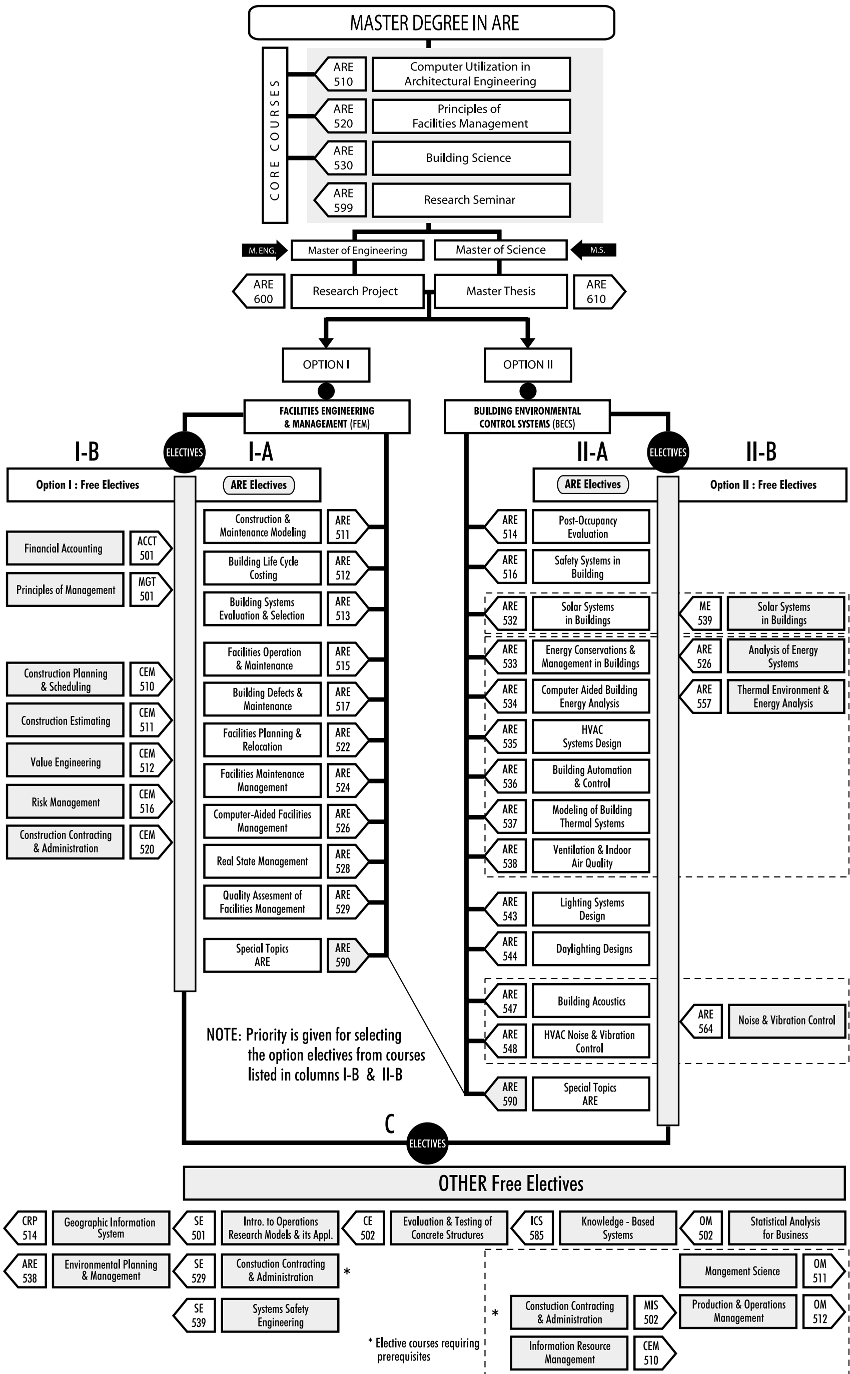


Figure 2. The course requirements in the two options of the Master Degree program

MASTER OF SCIENCE (M. S.) PROGRAM

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).

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.

MASTER OF ENGINEERING (M. ENG.) PROGRAM

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 option 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).

DEGREE PLANS

MASTER OF SCIENCE (M. S.)

COURSE	#	TITLE	LT	LB	CR	TOT
First Semester						
ARE	510	Computer Utilization in Architectural Engineering	3	0	3	
ARE	520	Principles of Facilities Management	3	0	3	
			6	**0**	**6**	**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**	**15**
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**	**21**
Fourth Semester						
XXX	xxx	Free Elective	3	0	3	
ARE	610	Master Thesis	0	0	6	
			3	**0**	**9**	**30**
						30

MASTER OF ENGINEERING (M. ENG.)

COURSE	#	TITLE	LT	LB	CRT	OT
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**	**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**	**24**
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**	**36**
Fourth Semester						
XXX	xxx	Free Elective	3	0	3	
ARE	600	Research Project	0	0	3	
			3	**0**	**6**	**42**
						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	**(Prereq: None)**
OM	511	Management Science	**(Prereq: OM 502, or waiver)**
OM	512	Production & Operations Management	**(Prereq: OM 511)**
ICS	585	Knowledge-Based Systems	**(Prereq: Grad. & Prog. Knowledge)**
SE	501	Intro. to Operations Research	**Models & its application (Prereq: Grad. Stand.)**
SE	529	Adv. Maintenance Planning & Control	**(Prereq: SE 429 or Consent of Instructor)**
SE	539	Systems Safety Engineering	**(Prereq: Grad. Stand. & Consent of the Instructor)**
CE	502	Eval. and Testing of Concrete Structures	**(Prereq: Grad. Standing)**
CRP	514	Geographic Information Systems	**(Prereq: CRP 507, or Consent of Instructor)**
CRP	538	Environmental Planning and Management	**(Prereq: Grad. Standing)**
MIS	502	Management Information Systems	**(Prereq: None)**
MIS	510	Information Resource Management	**(Prereq: 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 problem 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 selec tion. 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, non-ferrous 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 plan ning 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. Plantroom 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 graduate faculty member in Architectural engineering.

Prerequisite: ARE 599

CITY & REGIONAL PLANNING

CHAIRMAN

Dr. Abdulgader O. Amir

ASSOCIATE PROFESSOR

Al-Dosary

Alshuwaikhat

ASSISTANT PROFESSORS

Al-Kadi

Al-Mubaiyedh

Al-Naser

Al-Ramadan

Amir

LECTURERS

Nkwenti

INTRODUCTION

Planning is concerned with the forces that generate social de velopment, 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 mater'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 multi-disciplinary and problem-solving education provides them with the ability to grasp the effects of new technology on all aspects of our society. They have found employment with government agencies, consulting firms, as well as in academic institutions.

MASTER OF CITY & REGIONAL PLANNING

A Master 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. degree, 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.

Admission will be based on the respective student's academic record.

ACADEMIC PROGRAM

The requirements of the program are spread on 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
CR	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	507	Computer-Aided Planning	3	0	3
CRP	599	Seminar	1	0	0
B- Final Planning Project (6 credit hours)					
CRP	601	Final Planning Project	1	12	6
Total Required Courses Credit Hours					**27**
Part II: Elective Courses					**15**
Total Program 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	511	Urban Models
CRP	512	Advanced Quantitative Methods
CRP	513	Cartography and Photogrammetry
CRP	514	Geographic Information Systems (GIS)
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 System
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.

A typical degree plan for a full time Master of City & Regional Planning graduate student.

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	507	Computer-Aided Planning	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 Program Credit Hours					**42**

* At least one of these three elective courses must be from relevant graduate courses offered outside CRP.

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 Sharia 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 Landuse (3-0-3)

History and definition of landuse planning. The concept of policy, programming and planning. Determinants and systems guiding landuse development. Socio-economic development and Landuse. Space requirements, spatial distribution and localization concepts. Landuse planning models, and procedures for formal landuse 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, programs 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 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/landuse models, spatial interaction models, gravitational models, employment analysis and economic base and regional income models.

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: CRP 507 or Consent of the Instructor

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: CRP 507

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 socio-cultural 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; Intra-Regional 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 as well as modern districts.

Prerequisite: CRP 503

CRP 526 Planned Cities and Towns (3-0-3)

The origin of new-towns 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 new towns in Arab, Islamic and the Western World. Review of new 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, from small towns, 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, concepts, analysis and designing plans of a city-district (harah) or a city, in small groups of students as teams to offer experience with group dynamics. Application of 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)

History principles of legislation and regulations of Public Works Management. 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 reuse, 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, technology, 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 sites problems; economically related aspects of urbanized regions. Specific problems of construction and site selection; the design of specific urban physical city-scape 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 selected concentration area. The Final Planning Project report will be presented and evaluated by a faculty committee representing the student's area of concentration.

Prerequisites: All required courses, at least four elective courses.

CONSTRUCTION ENGINEERING & MANAGEMENT

CHAIRMAN
Dr. Soliman A. Almohawis

PROFESSORS
Assaf
Jannadi

ASSOCIATE PROFESSORS
Al-Harbi
Almohawis
Bubshait
Shash

ASSISTANT PROFESSORS
Al-Khalil

LECTURERS
Jalaluddin

Graduate Program in CONSTRUCTION ENGINEERING & MANAGEMENT

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.

ACADEMIC PROGRAM

There are two master's degree options in Construction Engineering & Management, the Master of Science (M.S.) and the Master of Engineering (M.E.).

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.E. 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.E. requirements is shown in the following tables.

MASTER OF SCIENCE in CEM Option

COURSE	#	TITLE	LT	LB	CR
CEM	510	Construction 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 Equipment & Methods	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					**30**

MASTER OF ENGINEERING CEM Option

COURSE	#	TITLE	LT	LB	CR
CEM	510	Construction 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 Equipment & Methods	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	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	3	0	3
XXX	xxx	Non-CEM Elective	3	0	3
CEM	600	Master of Engineering Report	0	0	3
Total					**42**

DEGREE PLAN

The CEM Department offers the M.S. and M.E. 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.E. degrees plan are shown in the following table.

MASTER OF SCIENCE (Degree Plan for Full-Time Students)

COURSE	#	TITLE	LT	LB	CR	
First Semester						
CEM	510	Construction 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**	**12**
Second Semester						
CEM	530	Construction Equipment & Methods	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	1	0	0	
			13	**0**	**12**	**24**
Summer Session and Following Semester						
CEM	610	Thesis	0	0	6	
Total						**30**

MASTER OF ENGINEERING (Degree Plan for Full Time Students)

COURSE	#	TITLE	LT	LB	CR	
First Semester						
CEM	510	Construction 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**	**12**
Second Semester						
CEM	511	Construction Estimating	3	0	3	
CEM	530	Construction Equipment & Methods	3	0	3	
OM	502	Statistical Analysis for Business	3	0	3	
CEM	xxx	Approved Elective	3	0	3	
			12	**0**	**12**	**24**
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*	3	0	3	
XXX	xxx	Approved Elective*	3	0	3	
			13	**0**	**12**	**36**
Fourth Semester						
CEM	540	Construction Project Management	3	0	3	
CEM	600	Master of Engineering Report	0	0	3	
Total						**42**

*** From Approved KFUPM non-CEM Graduate Courses**

MASTER OF SCIENCE (For Part-Time Students)

COURSE	#	TITLE	LT	LB	CR	
First Semester						
CEM	510	Construction Planning and Scheduling	3	0	3	
CEM	520	Construction Contracting and Administration	3	0	3	
			6	**0**	**6**	**6**
Second Semester						
CEM	511	Construction Estimating	3	0	3	
CEM	xxx	Approved Elective	3	0	3	
			6	**0**	**6**	**12**
Third Semester						
CEM	530	Construction Equipment & Methods	3	0	3	
CEM	xxx	Approved Elective	3	0	3	
			6	**0**	**6**	**18**
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**	**24**
Fifth Semester						
CEM	610	Thesis	0	0	6	
Total						**30**

MASTER OF ENGINEERING (For Part-Time Students)

COURSE	#	TITLE	LT	LB	CR	
First Semester						
CEM	510	Construction Planning and Scheduling	3	0	3	
CEM	520	Construction Contracting and Administration	3	0	3	
			6	**0**	**6**	**6**
Second Semester						
CEM	511	Construction Estimating	3	0	3	
ACCT	501	Financial Accounting	3	0	3	
			6	**0**	**6**	**12**
Third Semester						
CEM	530	Construction Equipment & Methods	3	0	3	
MGT	501	Principle of Management	3	0	3	
			6	**0**	**6**	**18**
Fourth Semester						
CEM	xxx	Approved Elective	3	0	3	
OM	502	Statistical Analysis for Business	3	0	3	
			6	**0**	**6**	**24**
Fifth Semester						
XXX	xxx	Approved Elective*	3	0	3	
CEM	xxx	Approved Elective	3	0	3	
			6	**0**	**6**	**30**
Sixth Semester						
CEM	599	Research Seminar	1	0	0	
XXX	xxx	Approved Elective*	3	0	3	
CEM	540	Const. Project Management	3	0	3	
			7	**0**	**6**	**36**
Seventh Semester						
CEM	xxx	Approved Elective	3	0	3	
CEM	600	Master of Engineering Report	0	0	3	
Total						**42**

*** From Approved KFUPM non-CEM Graduate Courses**

COURSE DESCRIPTION

CEM 510 Construction 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 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.

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: Graduate Standing

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.

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: CEM 510

CEM 515 Construction Quality Assurance (3-0-3)

Quality Management, benefits of quality design and construction, types of existing programs, identification and role of participating organizations, peer review. Statistical quality control: collection and organization of data, sampling, application of normal distribution, process control concepts, acceptance sampling plans.

Prerequisite: Graduate Standing

CEM 516 Risk Management in Construction (3-0-3)

The application of risk management in construction. Risk identification, risk treatment alternatives, risk administration, prediction of future losses, loss retention capacity, criteria for selection of a risk retention plan. Examples from construction.

Prerequisite: Graduate Standing

CEM 517 Construction 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 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.

Prerequisite: Graduate Standing

CEM 522 Management of International Construction and Engineering (3-0-3)

Organization and Management of major projects in international and multi-national construction and engineering. Planning, investigation, procurement, logistics, construction geography, personnel, relations to host area, environmental consideration, communications, financing, special engineering and management controls. Construction under adverse climatic conditions including tropical, mountainous and Arctic, with special emphasis on desert regions, case studies.

Prerequisite: CEM 520

CEM 530 Construction Equipment & Methods (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: CE 353

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 Construction 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 520

CEM 542 Technological Change in Construction (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 deployment; support techniques. Construction technology in Saudi Arabia: innovative behavior; strategy; policy; support systems; university/industry interaction. Research projects for industry applications.

Prerequisites: Graduate Standing, Consent of the Instructor for non-CEM students.

CEM 545 Construction Management Efficiency Analysis (3-0-3)

Assessing the measures of efficiency indices for multi-input multi-output construction operation, processes, and business through and single-input single-output model, regression model, and production theory Data Environment Analysis (DEA). The theory underlying the DEA, applications and related computer software.

Prerequisite: 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 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 (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)

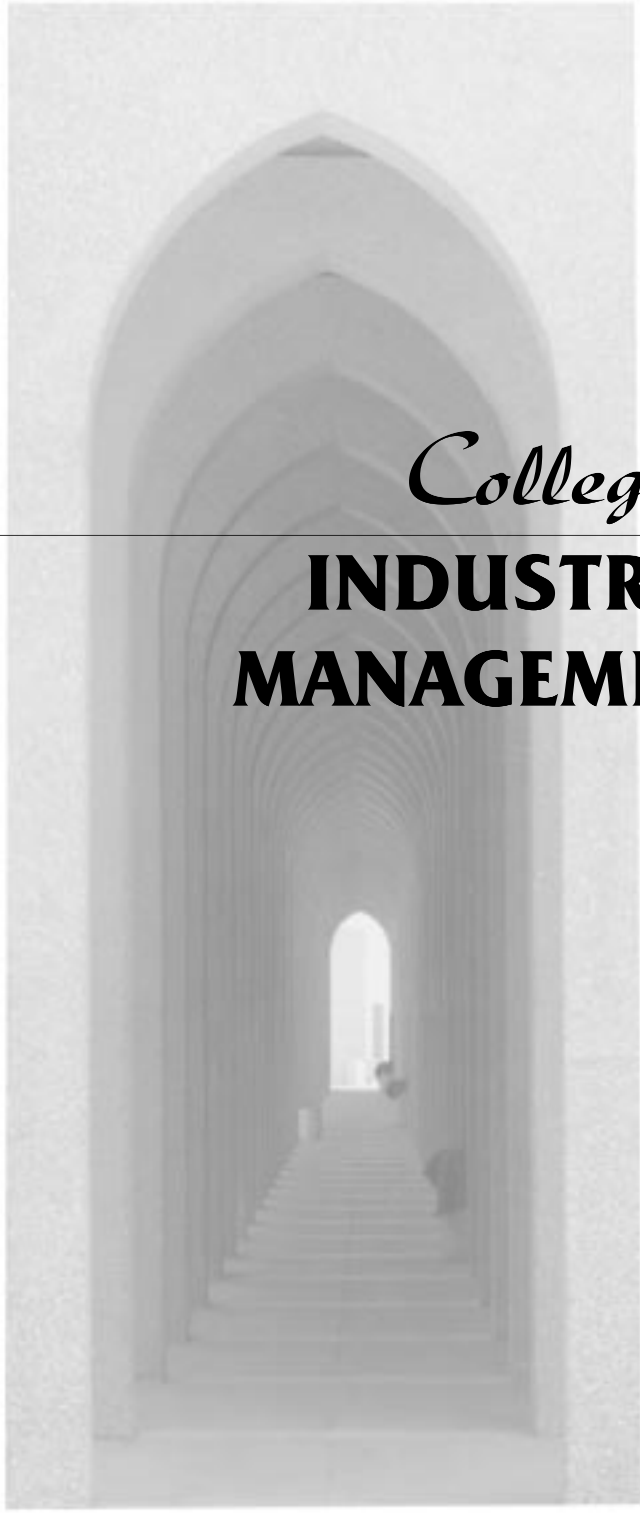
A report on an independent study performed under the supervision of a CEM faculty advisor. This paper should include an introduction to the topic, literature review, research methodology, analysis of data, conclusions and recommendations, appendices and references. The report will be presented and orally examined by a faculty committee.

Prerequisites: CEM 510, CEM 511, CEM 520, CEM 530, CEM 599

CEM 610 Thesis (3-0-3)

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.

Corequisite: CEM 599



College of INDUSTRIAL MANAGEMENT

GRADUATE PROGRAMS

ASSISTANT DEAN FOR GRADUATE PROGRAM
Dr. Aref A. Al-Ashban

PROFESSORS

Al-Abdul-Gader	Carrada-Bravo	Wallace
Al-Meer	Essayyad	Zaid
Azad	Masih	

ASSOCIATE PROFESSORS

Abdulmuhmin	Al-Jabri	Mirza
Abraham	Al-Zayer	Ramady
Achoui	Bu-Bushait	Sadi
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Al-Faraj	Cooper	Uthman
Al-Ghamdi	Mirghani	

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Al-Ghamdi, M.A.	Fraihat	Yamani
Al-Hajji	Hamdan	
Al-Hazmi	Kayal	

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Al-Ghamdi, M	Murteza
Al-Mulhem	Nehari-Talet
Al-Zamel	Raza
Hammad	Siddiqui

INSTRUCTORS

Abu-Musa
Khan
Menon

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 Hours	CLASSES MEETING TIME *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 Hours	CLASSES MEETING TIME *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. Acc) 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 Informa-

tion 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

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**	**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**	**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**	**12**
Fourth Semester						
XXX	xxx	Elective	3	0	3	
ACCT	600	Written Comprehensive Exam	0	0	0	
			3	**0**	**3**	**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: Com-

puterized 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-contract 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

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.

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 Operations 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**	**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**	**12**

MASTER OF BUSINESS ADMINISTRATION
MBA REQUIREMENTS

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**

COURSE	#	TITLE	LT	LB	CR	
SECOND YEAR						
First Semester						
MKT	512	Applied Marketing Research	3	0	3	
		ELECTIVE 1	3	0	3	
		ELECTIVE2	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**
						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, statis tical 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 theanalysis of demand for and supply of oil, in particular, under the assumptions ofthe theory of Cartels. It also includes analysis of short-and long-run costs ofinvestments 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 businessresearch. 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 andfinancing. 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 NeutralNetwork Systems. Applications of MSS. Integration of Management Support Systems. Behavioral and technical issues in the implementation and operation ofMSS.

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 congru ency among organizational structure, strategies, and environments; and the understanding of the impact of alternative design configurations and strategies on the individual, group, and intergroup 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 assessinginternational 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

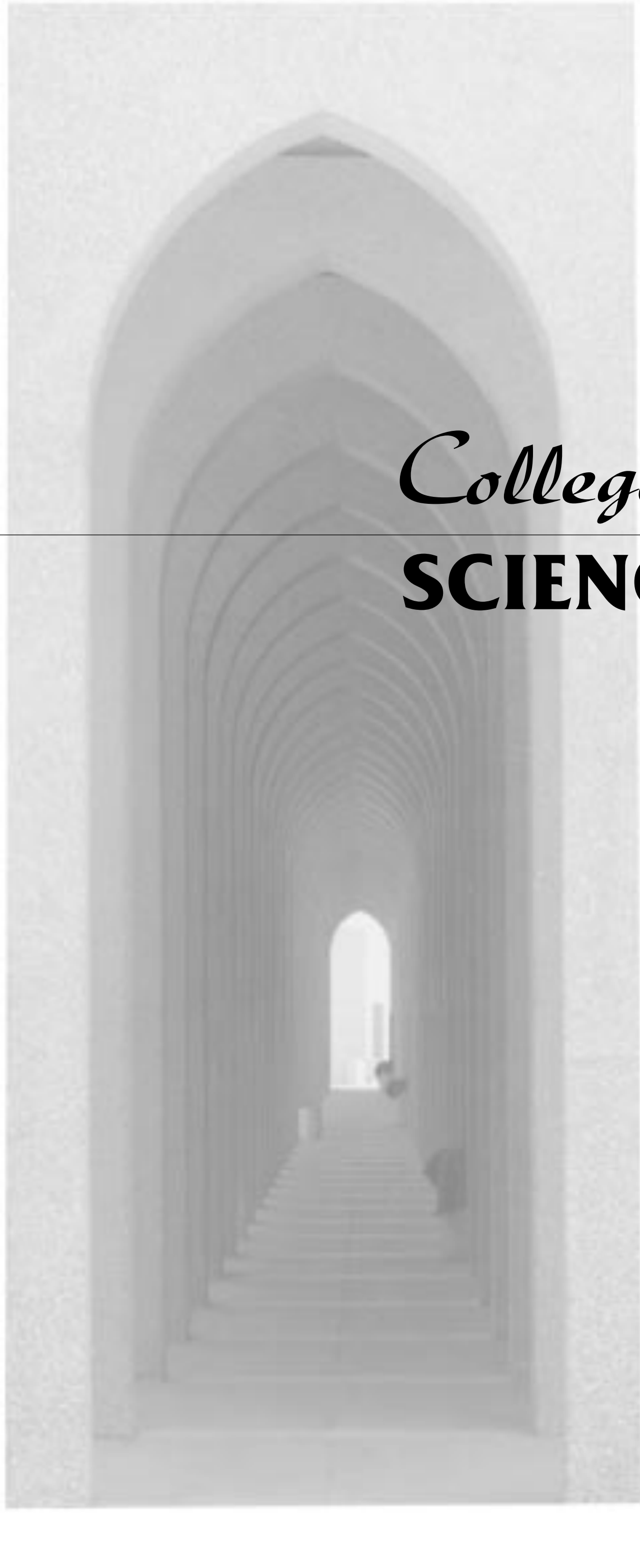
OM 521 Management of Inventory Systems (3-0-3)

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.



College of SCIENCES

CHEMISTRY

CHAIRMAN

Dr. Assad Al-Thukair

PROFESSORS

Abulkibash	El-Faer	Klein
Ali, M. F.	Förner	Oweimreen
Ali, S. A.	Hussain	Sultan
Al-Arfaj	Hwang	Wazeer
Al-Suwaiyan	Isab	
Badawi	Jaber	

ASSOCIATE PROFESSORS

Barri	Perzanowski
Morsy	El Ali

ASSISTANT PROFESSORS

Al-Thukair	Hamdan
Al-Muallem	Khaled
Fettouhi	Maung
Forristal	Seddigi

INSTRUCTORS

Pasl	Saeed	Siddiqui

LECTURERS

Lounici	Shihab

Graduate Programs in CHEMISTRY

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 at KFUPM have an impressive record of teaching and research accomplishments.

The thrust of the Graduate Program in Chemistry is both academic and professional. It is aimed 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. The program also prepares students for careers in research and development. While the research areas can be broadly classified as analytical, inorganic, organic, physical, industrial, and theoretical chemistry, the program is designed to strengthen the students' background in all areas through course offerings, research projects and seminars.

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 major branches of chemistry: analytical, industrial, inorganic, organic and physical chemistry. The on-going research programs cover most areas of study in modern chemistry as well as 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 a mechanical workshop and repair of electronic equipment are available on campus. 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, a 200 MHz NMR instrument, atomic absorption spectrometers, gas chromatographs and a high pressure liquid chromatography unit. The major research facilities of the Department are given below:

1. Bruker Single Crystal X-Ray Diffractometer.
2. Jeol LA-500 NMR Mass Spectrometer.
3. Bruker AC-80 NMR Spectrometer.

4. Bruker 200D-SRC EPR Spectrometer.
5. Varian E-109 EPR Spectrometer.
6. Perkin-Elmer Inductively Coupled Plasma Spectrophotometer.
7. Siemens D-5005 X-Ray Diffractometer .
8. Perkin-Elmer 16F PC FTIR-Infrared Spectrophotometer.
9. EG&G 273A Electrochemical Analytical system.
10. EG&G 246A Electrochemical Analytical system.
11. FISONS EA – 1108 C, H, N, S Elemental Analyzer.
12. Varian AA-20 Atomic Absorption Spectrometer.
13. Conventional and Capillary GAS Chromatographs.
14. Perkin-Elmer Lambda 5 UV/VIS Spectrophotometers.
15. Waters HPLC.
16. CAD-4 X-Ray Diffractometer.
17. Perkin-Elmer Optical Rotation Polarimeter.

DEPARTMENTAL ADMISSION REQUIREMENTS

All applicants must fulfill the Graduate School admission requirements such as TOEFL, with a score of 520 or above for M.S. and 550 or above for Ph.D and GRE –Subject as well as, GRE in Chemistry with a level acceptable to the Chemistry Department.

M.S. REQUIREMENTS

The Master of Science course in Chemistry is available to students who meet the requirements for admission to the university with a B.S. in Chemistry or equivalent. Every entering student must pass the Placement Examination conducted by the department for evaluation of the candidate's background in chemistry. Candidates with deficiencies are required to take, within the first year, all remedial courses for which no credit will be given towards the M.S. degree. A minimum of 24 (500 level) credit hours of course work plus six credit hours of research towards the preparation of an M.S. thesis will be required. Teaching of one semester in an undergraduate laboratory course and attendance of all seminars given in the department are also required.

PH.D. REQUIREMENTS

1. Entering students sit in an Entrance Examination consisting of four papers in basic areas of chemistry, of three hours length each. Applicants must take this examination during the first semester of study.
2. Towards the end of their first semester in residence, students must select their research topic and advisor.
3. Students who demonstrate satisfactory proficiency in the entrance examination may proceed to complete the PhD course requirements of 30 credit hours, maintaining a cumulative GPA of 3.0 at all times. Departmental requirements for 30 credit hours are:

a. a minimum of 15 credit hours must be in the major area.

b. a minimum of 9 credit hours must be in the minor area,

c. six credit hours may be in related areas within or outside the department.

4. The minor must be in a field within the department.
5. Ph.D students are required to attend departmental seminar every semester, and present a seminar once during the program.
6. The students must pass a written examination in their minor. This examination is conducted by the respective division in the department.
7. A written comprehensive examination in the major area of specialization must be passed on completion of the course work.
8. The candidate shall prepare a dissertation on an approved topic under the guidance of his supervisor and his dissertation supervising committee.
9. The Dissertation Examining 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.

Summary of the chronological sequence of events in the Ph.D. program:

1. Admission
2. Entrance Examination
3. Fulfillment of remedial courses (if any) within the first year of enrollment
4. Choice of dissertation advisor; orientation in research, choice of field of research
5. Fulfillment of course requirements
6. Written Comprehensive Examinations
7. Oral Comprehensive Examination (proposal)
8. Admission to candidacy, forming Dissertation Examining Committee
9. Dissertation preparation and review
10. Dissertation defense; Graduation

ACADEMIC PROGRAM

MASTER OF SCIENCE PROGRAM

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.

SAMPLE M.S. DEGREE PLAN

COURSE	#	TITLE	LT	LB	CR
First Semester					
CHEM	510	Advanced Physical Chemistry	3	0	3
CHEM	520	Physical Methods in Inorganic Chemistry	3	0	3
Second Semester					
CHEM	530	Advanced Organic Chemistry	3	0	3
CHEM	540	Advanced Analytical Chemistry	3	0	3
CHEM	xxx	Elective	3	0	3
Third Semester					
CHEM	xxx	Electives	3	0	3
CHEM	xxx	Elective	3	0	3
CHEM	599	Graduate Seminar	0	0	0
Fourth Semester					
CHEM	xxx	Electives	3	0	3
CHEM	610	MS Thesis	0	0	6
		Non-Credit Teaching Practice	0	0	0
Total credit hours					**30**

PH. D. PROGRAM

Thirty (30) credit hours of course work (500 and 600 level) beyond the M.S. degree as given under the Ph.D requirements plus 12 credit hours for a dissertation.

SAMPLE PH.D. DEGREE PLAN

COURSE	#	TITLE	LT	LB	CR
Courses in Major Area					
CHEM	xxx	Courses in Major Area of Chemistry	15	0	15
Courses in Minor Area					
CHEM	xxx	Courses in Minor area Chemistry	9	0	9
Elective Courses					
CHEM	XXX	Electives	3	0	3
Free Elective Courses					
XXX	xxx		3	0	3
General Requirements					
CHEM	699	Graduate Seminar	1	0	0
CHEM	710	Ph.D Dissertation	0	0	12
		Non-Credit Teaching Practice	0	0	0
Total credit hours					**42**

List of Graduate Courses

Physical Chemistry Courses (Second Digit: 1)

CHEM	510	Advanced Physical Chemistry
CHEM	511	Chemical Kinetics
CHEM	512	Chemical Thermodynamics
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	615	Statistical Thermodynamics
CHEM	616	Quantum Chemistry II
CHEM	618	Advanced Magnetic Resonance Techniques

Inorganic Chemistry Courses (Second Digit: 2)

CHEM	520	Physical Methods in Inorganic Chemistry
CHEM	521	Advanced Chemistry of Coordination Compounds
CHEM	522	Organometallic Chemistry
CHEM	523	Chemical Crystallography
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	623	Photochemistry of Coordination Compounds
CHEM	624	Solid State Chemistry
CHEM	626	Bio-Inorganic Chemistry

Organic Chemistry Courses (Second Digit: 3)

CHEM	530	Advanced Organic Chemistry
CHEM	531	Physical Organic Chemistry
CHEM	532	Synthetic Organic Chemistry
CHEM	533	Nuclear Magnetic Resonance Spectroscopy
CHEM	534	Catalysis in Industry
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

Analytical Chemistry Courses (Second Digit: 4)

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 (Second Digit: 5)

CHEM	550/EnvS	Advanced Environmental Chemistry
CHEM	551/EnvS	Analytical Geochemistry
CHEM	552/EnvS	Organic Geochemistry
CHEM	553/Envs	Environmental Pollution
CHEM	554/EnvS	Environmental Geochemistry
CHEM	555/EnvS	Environmental Ecology

Seminars and Research

CHEM	599	Graduate Seminar (M. S.)
CHEM	699	Graduate Seminar (Ph. D.)
CHEM	610	M. S. Thesis
CHEM	710	Ph. D. Dissertation

COURSE DESCRIPTION

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:Two Semesters of Undergraduate Physical Chemistry

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)

An overview of the fundamental principles of chemical thermodynamics and their application to chemical problems. An introduction to statistical methods.

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, ab initio, 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 difussion, rheology of dispersions, adsorption from solution, colloidal structures and surfactant solutions, electrical double layer, electrophoresis, electrostatic and polymer-induced colloid stability.

Prerequisite: CHEM 510 or equivalent.

CHEM 519 Special Topics in Physical Chemistry (3-0-3)

Recent topics in Physical Chemistry. Approval of the Graduate Council required.

Prerequisites: CHEM 510, Graduate Standing.

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. Basics concepts of X-ray diffraction. Ionization methods (mass spectrometry and photoelectron spectroscopy).

Prerequisite: Two semesters of undergraduate inorganic chemistry.

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 p-bond ligands, oxidative addition and reductive elimination, insertion and elimination, nucleophilic and electrophilic addition and substraction. Homogeneous catalysis. Characterization of organometellic compounds, carbenes, metathesis and polymeri zation, 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 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, recemization, isomerization, oxidation-reduction, and photochemical reactions.

Prerequisite: CHEM 520

CHEM 529 Special Topics in Inorganic Chemistry (3-0-3)

Recent topics in Inorganic Chemistry. Approval of the Graduate Council required

Prerequisites: CHEM 520, Graduate Standing.

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: Two Semesters of Undergraduate Organic Chemistry.

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, stereospecifity, 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 Catalysis in Industry (3-0-3)

Theory of homogeneous versus heterogeneous catalysis. Hydrogenation-dehydrogenation, oxidation, alkylation, addition reactions, catalytic polymerization and the catalysts used. Preparation and characterization of catalysts.

Prerequisites: CHEM 520, Graduate Standing in Chemistry or Chemical Engineering

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 in Chemistry or Chemical Engineering

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

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.

Prerequisites: CHEM 530, Graduate Standing

CHEM 538 Natural Products Chemistry (3-0-3)

Classification of natural products, physico-chemical data, structure 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. Approval of the Graduate Council required

Prerequisites: CHEM 530, Graduate Standing.

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 of GC, HPLC. Mass spectrometry

Prerequisite: One Semester of Undergraduate Analytical Chemistry

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. Approval of the Graduate Council required

Prerequisites: CHEM 540, Graduate Standing.

CHEM 550 / EnvS 520 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.

Prerequisite: Graduate Standing

CHEM 551 / EnvS 521 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: Graduate Standing

CHEM 552 / EnvS 522 Organic Geochemistry (3-0-3)

The objective of this course is to provide an up-to-date overview on the composition of 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 ex ploration. Application of organic geochemistry in quaternary research and an assessment of present-day problems and future perspectives in organic geochemistry are discussed.

Prerequisite: Graduate Standing

CHEM 553 / EnvS 523 Environmental Marine Pollution (3-0-3)

The course will mainly deal with problem related to marine pollution. Some of the topics are: different marine habitat, sources of marine pollution, types of pollution, effects of pollution to marine life, prevention and remedies for problems of pollution.

Prerequisites: Graduate Standing, Consent of the Instructor

CHEM 554 / EnvS 524 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.

Prerequisites: Graduate Standing, Consent of the Instructor

CHEM 555 / EnvS 525 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, microbial ecology as well.

Prerequisites: Graduate Standing, Consent of the Instructor

CHEM 599 Graduate (M.S) Seminar (0-0-0)

Attendance of departmental seminars given by faculty and graduate students and visiting scholars. An M.S. student is expected to give seminar on a literature topic of current interest in Chemistry

Prerequisite: Graduate Standing

CHEM 610 M.S. Thesis (6-0-6)

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 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: CHEM 520

CHEM 621 Heterogeneous Catalysis in Chemistry (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.

Prerequisites: Graduate Standing, Consent of the Instructor

CHEM 623 Photochemistry of Coordination Compounds (3-0-3)

Physical background, selection rules, applications, general survey; recent developments.

Prerequisite: CHEM 520

CHEM 624 Solid State Chemistry (3-0-3)

Status solidi, shape of particles, lattice energy and Born-Haber cycle, concept of symmetry, crystal chemistry, structure of elements and parent structure of compounds, covalent solids, lattice defects and their thermodynamics, non stoichiometry, alloys and intermetallic compounds, doping and semiconductors, order-disorder phenomena, phase diagrams, magnetic and electric properties, fast-ionic conductivity, industrial chemicals, minerals, overview of 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 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 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 (MATLAB 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 (0-0-0)

Attendance of departmental seminars given by faculty, graduate students and visiting scholars. A Ph.D. student is expected to give seminar on a literature topic of current interest in Chemistry

CHEM 710 Ph.D. Dissertation (12-0-12)

EARTH SCIENCES

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Dr. Mustafa M. Hariri

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Al-Hinai

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Korvin

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Al-Shuhail

Hariri

Makkawi

INSTRUCTOR

Ghaleb

LECTURERS

Al-Ramadhan

Jarad

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 training 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 Earth Sciences Department now offers both undergraduate and graduate studies. 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, Economic Geology and Geochemistry, Hydrogeology, Environmental Geology, 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.

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 selections 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.

The university central library has an inventory of over 250,000 books; 37,000 bound periodicals; 37,000 reels of microfilm containing journals, 24,000 films and other non-print items and 500,000 microfiches. A total of eleven (11) CD-ROM databases are also available. In addition, about 1,800 periodical subscriptions are maintained, and on-line search facility is provided free of charge.

Laboratory facilities and equipment available in the department include thin section, reflection petroscopy, scanning electron microscopy (SEM), X-ray defactometry (XRD), ground penetrating radar (GPR), paleo-magnetism, 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. 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. Master of Science in Geology

(1) Requirements

Total credit hours required for the Master of Science in Geology 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 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 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 the degree of Master of Science in Geology:

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

A candidate of a Master of Science degree in Geology is required to take at least (9) credits from the following Geology elective courses:

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 by the student's academic advisor.

(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

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 Science in Geophysics

(1) Requirements

Total credit hours required for the Master of Science in Geophysics 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 the degree of Master of Science in Geophysics:

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

A candidate of a Master of Science degree in Geophysics is required to take at least (6) credit hours from the following Geophysics elective courses:

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 by the student's academic advisor.

(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

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**

C. Master of Geology

(1) Requirements

Total credit hours required for the Master of Geology is 42 credit hours. 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 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 the degree of Master of Geology:

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

All students are required to complete five electives (15 credit hours) from the following elective geology courses:

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 by the student's academic advisor.

(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

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 II	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**

D. Master of Geophysics

(1) Requirements

Total credit hours required for the Master of Science in Geophysics is 42 credit hours. 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 required for the degree of Master of Geophysics:

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

All students are required to complete five electives (15 credit hours) from the following Geophysics elective courses:

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

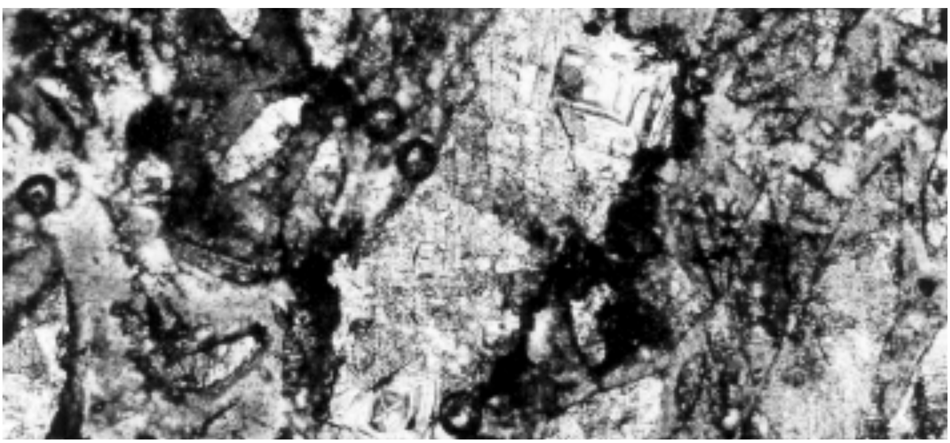
(4) Mathematics and Free Elective courses

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 by the student's academic advisor.

(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

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.

Prerequisites: GEOL 307, 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; engineering geological mapping, 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 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 e quipment 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.

Prerequisites: GEOL 201, 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 compression, multiple suppression, and automated static correction. Processing packages such as Seismic Unix, Hampson-Russell, 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 in verse 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.

Prerequisites: GEOL 201, 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, sedimantary 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 program.

Prerequisite: Graduate Standing

GEOP 610 Thesis (0-0-6)

Preparation of a thesis, oral presentation and defense.

MATHEMATICAL SCIENCES

CHAIRMAN
Dr. Khaled M. Furati

PROFESSORS

Akca	Chanane	Rahimov
Al-Bar	Chaudhry, Aslam	Siddiqi
Azad	Kabbaj	
Boucherif	Muttlak	

ADJUNCT PROFESSOR

Ahsan	Al-Daffa'	Qadir

ASSOCIATE PROFESSOR

Abu-Sbeih	Boudjelkha	Khan, A.
Al-Gwaiz	Chaudhry, Anwar	Kharab
Al-Shuaibi	El-Gebeily	Laradji
Attili	Fiagbedzi	Messaoudi
Bokhari, A.	Ibrahim	Sarhan
Bokhari, M.	Iqbal	Thaheem
	Joarder	Zaman

ASSISTANT PROFESSOR

Alassar	Beg	Latif
Al-Homidan	Cherid	Lyaghfouri
Al-Jasem	Fairag	Miller
Al-Rasasi	Farhat	Samman
Al-Sabah	Furati	Tatar
Al-Shakhs	Jibril	Umar

LECTURERS

Ahmad	Demir	Saleh
Al-Absi	Furaidan	Sharqawi
Al-Labadi	Khan, S.	Al-Shallali
Al-Momani	Malik	Shehadeh
Alaimia	Maslamani	Siddiqui
Awad	Omar	Yushau
Bader	Raburu	Alzoubi
Dehwah	Saifullah	

Master of Science Program

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:
   - (i) at least **18** credits must be in the Department of Mathematical Sciences, and
   - (ii) 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:

1. Math 531 Real Analysis
2. Math 533 Complex Variables I
3. Math 550 Linear Algebra

The remaining courses are chosen by the student under the guidance of the academic advisor.

Master of Science (M.S.) Degree Plan

First Semester		TITLE	LT	LB	CR
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 … cont'd.	0	0	0
Fourth Semester					
Math	610	Thesis	0	0	6
TOTAL CREDIT HOURS					**30**

PH.D. PROGRAM

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 REQUIRE-MENTS

Applicants should have a Masters's 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 Entrance 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
   (i) 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.
   (ii) A minimum of 6 credit hours must be taken in a minor field from outside the student's chosen area.
   (iii) 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.

PH. D. DEGREE PLAN

First Semester		Title	LT	LB	CR
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	Seminar	1	0	0
Sixth Semester					
Math	710	Ph.D. Dissertation … cont'd.	0	0	0
Seventh Semester					
Math	710	Ph.D. Dissertation … cont'd.	0	0	0
Eighth Semester					
Math	710	Ph.D. Dissertation	0	0	12
TOTAL CREDIT HOURS					**42**

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 spaces. 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 simplical 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 squaresummable 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)

MATH553 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 science 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 nonsmooth 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 Experiment (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 M.Sc. 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 Fre'chet 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; Gröbner 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 supline 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

Dr. Ali Mohammad Al-Shukri

PROFESSORS

Al-Adel	Dabbousi	Mavromatis
Bahlouli	Khattak	Nasser

ASSOCIATE PROFESSORS

Abdelmonem	Al-Nasser	Maalej
Al-Harthi	Binbrek	Nagadi
Al-Jarallah	Faiz	Tabet
Al-Ohali	Garwan	Ziq

ASSISTANT PROFESSORS

Al-Aithan	Al-Nahdi	Mekki, A.
Al-Amoudi	Al-Quraishi	Musazay
Al-Haidari	Al-Ramadhan	Nassar
Al-Jalal	Al-Shukri	Yamani
Al-Karmi	Al-Solami	
Al-Kuhaili	Al-Sunaidi, A.	

LECTURERS

Al-Saadah	Kariapper	Mekki, M.
Dasa Nova	Khateeb-ur-Rahman	Salem
Enaya	Khodja	
Ghannam	Kidwai	

Graduate 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. Particle Physics (Theoretical)
6. Radiation Physics

TEACHING AND RESEARCH FACILITIES

The Department has the following facilities:

- A VG ESCA-LAB MKII Angle Resolved Photoelectron Spectrometer (ARPES) with a multi-channel detection system. This is a multi-technique instrument allowing complete surface analysis of samples under the same experimental conditions by using X-ray Photoelectron Spectroscopy (XPS), high resolution XPS, using a monochromatized x-ray source, Auger Electron Spectroscopy (AES) and scanning AES, Ultraviolet Photoelectron Spectroscopy (UPS), High-Resolution Electron Energy Loss Spectroscopy (HR-EELS), Ion-Scattering Spectroscopy (ISS), Thermal Desorption Spectroscopy (TDS), and Low-Energy Electron Diffraction (LEED).
- A Leybold-Heraeus LS-10 custom built system for High Resolution Electron Energy Loss Spectroscopy (HR-EELS). This instrument also offers XPS, UPS, AES, and ISS.
- Condensed matter research facilities: magnetic properties of alloys and compounds, phase transitions, High-Tc superconductors, spin-glasses and induced anisotropy are under investigation in this laboratory. Facilities include a nine Tesla vibrating sample magnetometer.
- The Department also has a computer room containing fast PC's which are connected directly to the University Data Processing Computer Facilities.
- Spectrophotometer
- Radiation Protection Research Equipment (α-guard)

The Department has access to and is supported by the following major research facilities at the Energy Research Laboratory:

1. Nuclear Physics Facility

This consists mainly of a 350 kV high-current accelerator and a 3 MV Tandetron accelerator. The main areas of research at the 350 kV ion accelerator are Fast Neutron Activation studies and Nuclear Reaction studies using polarized and unpolarized beams of neutrons, protons and deuterons. At the 3 MV tandetron Lab, Material Analysis is carried out using RBS, PIXE, as well as Microbeam facilities. Nuclear Reaction studies are also carried out with light ions from the 3 MV Tandetron accelerator.It is dead

2. Laser Research Laboratory

The Laser Research Laboratory which houses a variety of Molecular and Atomic activities supported by advanced equipment that includes several dye lasers pumped by Excimer/ Yag/Argon ion lasers, and that are suitable for frequency resolved (500 khz) or time resolved studies (femtosecs).

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 plus six credit hours of research towards the preparation of an M.S. thesis will be required.

ACADEMIC PROGRAM

The graduate 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

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		3	0	3	
			12	**0**	**12**	**12**
Second Semester						
PHYS	503	Graduate Laboratory	0	6	3	
PHYS	505	Classical Electrodynamics I	3	0	3	
PHYS	5xx		3	0	3	
PHYS	5xx		3	0	3	
PHYS	599		1	0	0	
			10	**6**	**12**	**12**
Summer Session And Following Semester						
PHYS	610	Thesis	0	0	6	
			0	**0**	**6**	**6**
						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.

PRESENT RESEARCH INTERESTS

Present research interests are in the areas of:

A. Theoretical Physics

1. Atomic Physics
2. Condensed Matter Physics
3. Nuclear Physics
4. Particle Physics

B. Experimental Physics

1. Atomic, Molecular, and Laser Physics
2. Low Temperature Physics:
   - i. Calorimetric and magnetic stud ies of materials at low temperature
   - ii. Investigation of high Tc superconductors
3. Medical Physics
4. Nuclear Physics
5. Surface Physics
6. Radiation Physics
7. Optical Properties of Thin Films & Applications

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 momenta, Clebsch–Gordan techniques, scattering of spin $\frac{1}{2}$ 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 $\frac{1}{2}$ 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 and continuous systems and fields.

Prerequisite: PHYS 302

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.

Corequisite: 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 521 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 super-conductivity.

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; $K^0 - \overline{K}^0$ 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 sta bility; 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)

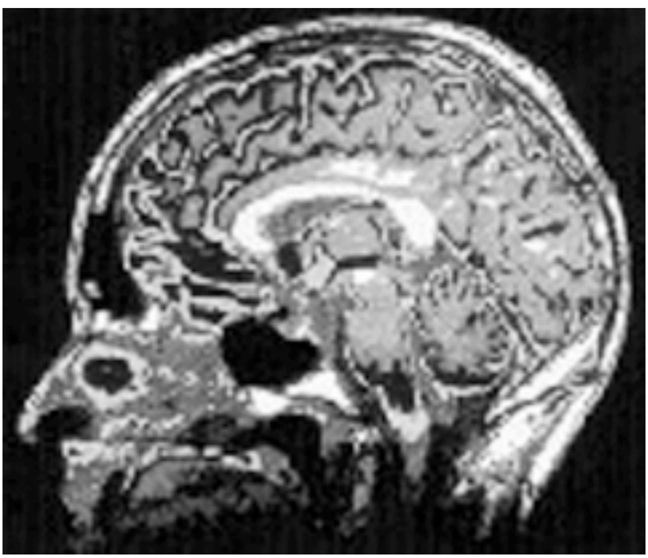
MASTER'S PROGRAM IN MEDICAL PHYSICS

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), and Physiology (BIOL 202). 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	CREDITS
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	**42**

Core Courses

The following six core courses are required for the Master's degree in Medical Physics.

COURSE	#	TITLE	CR
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	3
MEPH	569	Health Physics	4
			18

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:

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

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

COURSE	#	TITLE	LT	LB	CR	
First Semester						
MEPH	510	Radiobiology	2	0	2	
MEPH	561	Radiological Physics and Dosimetry	3	0	3	
MEPH	563	Radioisotopes in Medicine and Biology	2	3	3	
MEPH	567	Diagnostic Radiology Physics	2	3	3	
			9	**6**	**11**	**11**
Second Semester						
MEPH	566	Radiotherapy Physics	2	3	3	
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	
XXX	xxx	Elective	3	0	3	
			8	**9**	**11**	**11**
Third Semester						
MEPH	569	Health Physics	3	3	4	
MEPH	58x	Elective Lab in Radiological Physics	0	3	1	
XXX	xxx	Elective	3	0	3	
XXX	xxx	Elective	3	0	3	
MEPH	599	Seminar	1	0	0	
			10	**6**	**11**	**11**
Fourth Semester						
MEPH	590	Clinical Training	0	0	6	
MEPH	600	Medical Physics Project	0	0	3	
			0	**0**	**9**	**9**
						42

COURSE DESCRIPTION

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.

Corequisite: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 (2-3-3)

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-energy 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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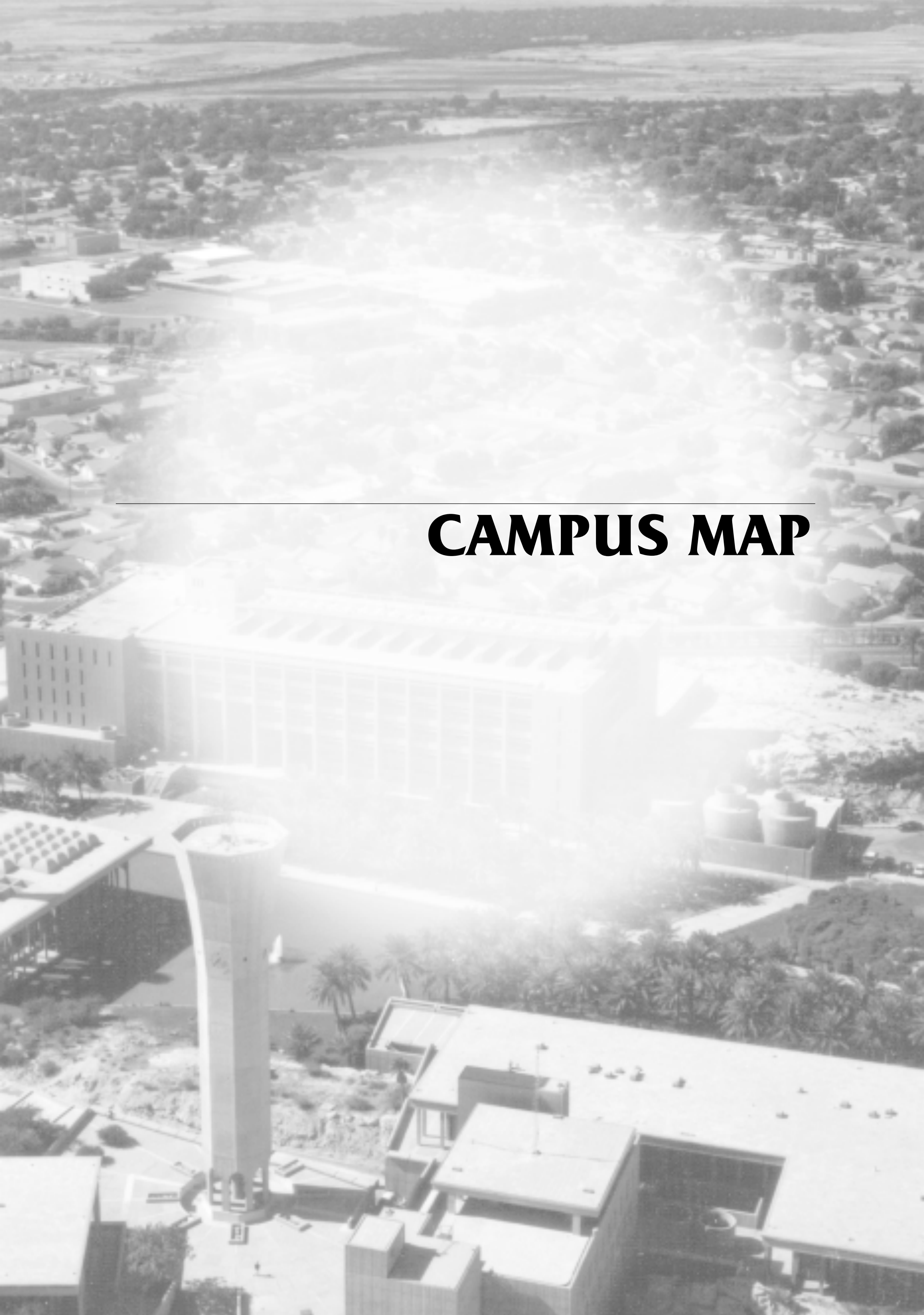
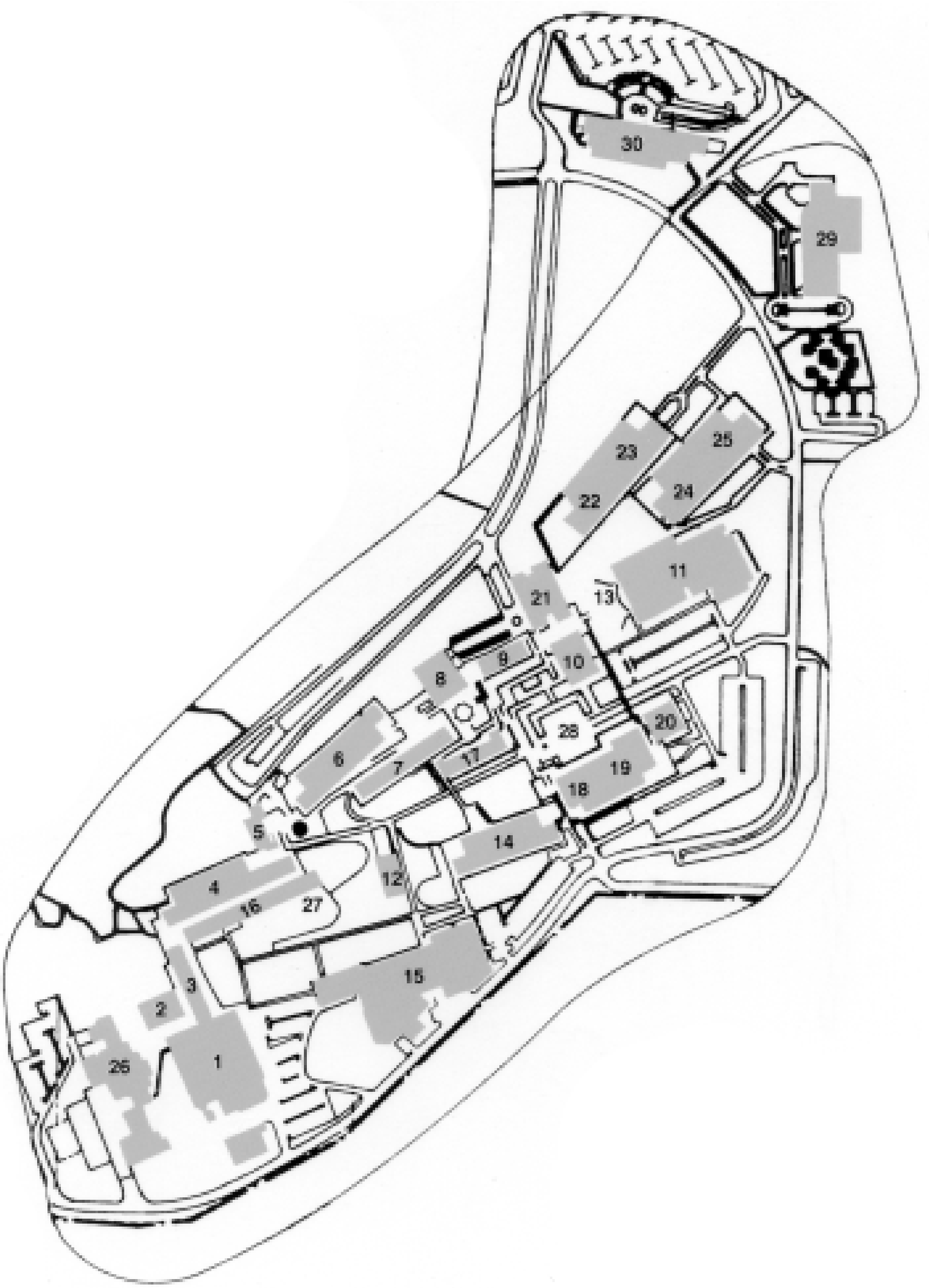


ACADEMIC CAMPUS



LEGEND

1. Labs of Chemical Engineering, Civil Engineering, Electrical Engineering, Mechanical Engineering, Chemistry /
Faculty Offices / Boiler House of Operations & Maintenance
2. Petroleum Engineering Labs
3. Petroleum Engineering Offices / Labs / Classrooms
4. Chemistry Labs / Faculty Offices / Classrooms
5. Mathematical Sciences Offices / Labs / Classrooms
6. Physics Offices / Labs / Classrooms
7. Electrical Engineering Offices / Labs / Classrooms
8. Central Library
9. Faculty & Student Center: Book Services / Mail Center /
Faculty & Staff Cafeteria / Bookshop / Student Activities /
Offices of the Dean of Admissions & Registration
10. Auditorium
11. Gymnasium
12. Mosque
13. Amphitheater
14. Information Technology Center / Electrical Engineering Offices
15. Research Institute
16. Faculty & Staff Offices of Chemical Engineering / Civil Engineering / College of Sciences / College of Graduate Studies / College of Engineering Sciences
17. Student Affairs Offices / Islamic & Arabic Studies Offices
18. Parking Garage
19. College of Environmental Design
20. Conference Center Complex
21. Administration Building
22. Offices of College of Computer Sciences & Engineering /
Offices of Mechanical Engineering, Earth Sciences, Museum of Earth Sciences / Faculty Offices / Labs / Classrooms
23. Parking Garage / Labs
24. College of Industrial Management Offices
25. Parking Garage
26. Heavy Equipment Laboratory Building
27. Oasis
28. Conference Center *Medan*
29. Energy Research Laboratory
30. Clinic

KFUPM CAMPUS

- Academic Areas
- Faculty and Staff Housing Areas
- Student Housing Areas