DEPARTMENT OF GEOSCIENCES

Chairman

Dr. Abdulaziz M. Al-Shaibani

Faculty

Abdulghani	Abdullah	Abdullatif
Abokhodair	Dogan	Hariri
Kaka	Kaminski	Korvin
Makkawi	Al-Ramadan	Al-Shaibani
Al-Shuhail A	Al-Shuhail A A	Tawabini
Vesnaver		

The Earth Sciences Department offers both undergraduate and graduate studies in geology and geophysics. 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 course 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 on current and new trends in geosciences research if supported by faculty specialties, projects, and interests.

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.

In addition to above programs, the the Department of Earth Sciences also offers Master of Science and Master of Environmental Sciences. These two programs are administed by active involvement of the Department of Chemistry in the College of Sciences.

Teaching and Research Facilities

Facilities currently available in the department include several well equipped lecture, seminar, audio-visual and resources rooms. The resource room contains a wide selection of professional journals, memories, reference textbooks and other publications. In addition, the department has a good collection of audio-visual and other instruction materials. The Earth Sciences' museum located in building 26, has a huge inventory of geological specimens (rocks, minerals, fossils, fossil fuels) collected from different areas in the Kingdom and worldwide. The department owns several 4-wheel drives and dune buggies for field trips. These vehicles are used both for local course-related field trips as well as geological itineraries during the Summer Field camp.

Laboratory facilities and equipment available in the department include thin section, reflection petroscopy, scanning electron microscopy (SEM), Xray defactometry (XRD), ground penetrating radar (GPR), paleomagnetism, remote sensing, aerial photography, resistivity, gravimeter, magnetometer, seismograph, passive seismic acquisition system 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, Petrel, 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.

Admission Requirements

All applicants for admission to the department must satisfy the general Graduate School admission requirements. Graduates in Earth Sciences or related disciplines 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. Students with inadequate background are expected to take the deficiency courses determined by the department.

PHD IN GEOPHYSICS

Degree Requirements

(a) Core Courses (27 credit hours)		Credit Hours
Geophysical wave propagation	GEOP 602	3
Numerical Modeling in Geophysics	GEOP 603	3
Geophysical Signal Analysis	GEOP 604	3
Seminar	GEOP 699	0
Directed Research I	GEOP 701	3
Directed Research II	GEOP 702	3
PhD Pre-Dissertation	GEOP 711	3
PhD Dissertation	GEOP 712	9

(b) Elective Courses (15 credit hours)		Credit Hours
GEOP Electives	Two GEOP xxx Courses	6
Math Elective	MATH xxx	3
Free Electives	Two XXX xxx Courses	6

Degree Plan

COURSE	TITLE	LT	LB	CR	COURSE	TITLE	LT	LB	CR
First Year									
GEOP 602	Geophysical Wave Propagation	3	0	3	GEOP 604	Geophysical Signal Analysis	3	0	3
GEOP 603	Numerical Modeling in Geophysics	3	0	3	GEOP xxx	Geophysics Elective I	3	0	3
XXX xxx	Free Elective I	3	0	3	MATH xxx	Math Elective	3	0	3
		9	**0**	**9**			**9**	**0**	**9**
Second Year									
GEOP 699	Seminar	1	0	0	GEOP 702	Directed Research II	0	0	3
GEOP xxx	Geophysics Elective II	3	0	3	GEOP 711	PhD Pre-Dissertation	0	0	3
GEOP 701	Directed Research I	0	0	3					
XXX xxx	Free Elective II	3	0	3					
		7	**0**	**9**			**0**	**0**	**6**
Third Year									
GEOP 712	PhD Dissertation	0	0	IP	GEOP 712	PhD Dissertation	0	0	9
		0	**0**	**0**			**0**	**0**	**9**
Total credit hours required in Degree Program : 42									

GEOLOGY

GEOL 591 Special Topics in Geology I (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 Instructor

GEOL 593 Special Topics in Geology II (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 Instructor

GEOL 594 Special Topics in Geology III (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 Instructor

GEOPHYSICS

GEOP 602 Geophysical Wave Propagation (3-0-3)
Geophysical wave equations and their solutions in various curvilinear coordinates, effects of layer heterogeneity, inelasticity, and anisotropy, full-waveform and ray methods, optical sensing, and advanced geophysical research topics in wave propagation.
Prerequisite: MATH 513

GEOP 603 Numerical Modeling in Geophysics (3-0-3)
Numerical solutions to geophysical wave equations in various media in common 2D and 3D geophysical geometries, effective use of multiple programming languages, data structures, multicore systems, and computer memory in programming numerical solutions of geophysical wave equations. This course relies heavily on exercises that require experience in programming in Matlab, Mathematica, or other programming languages.
Prerequisite: Graduate Standing

GEOP 604 Geophysical Signal Analysis (3-0-3)
Diversity and weighted stacking, Radon transforms, wavelet shaping, multiple suppression, interferometric processing, velocity model building. The course includes several exercises that use industry-standard geophysical software packages available at the department.
Prerequisite: GEOP 510

GEOP 613 Multiscale Rock Physics (3-0-3)
Students will study poroelasticity, Biot theory, Gassmann fluid substitution, advanced rock physics numerical modeling, dispersion effects, fracture networks, effective medium theory, upscaling and how geophysical measurements can be related to hydraulic properties such as porosity, permeability, saturation, and pore pressure.
Prerequisite: GEOP 545

GEOP 618 Microseismic Geophysics (3-0-3)
This course is designed to examine the use of microseismic technology. It begins with a review of the history of microseismic applications as well as recent advances in microseismic technology. Topics include background on microseismic theory, acquisition, processing workflows, analysis and interpretation of microseismic data.
Prerequisite: GEOP 503

GEOP 621 Advanced Electromagnetic Fields (3-0-3)
Topics covered in this course include quasi-analytic solutions to classical problems in resistivity, induced polarization, magnetotellurics, controlled source inductive EM, and ground penetrating radar, two-dimensional and three-dimensional numerical modeling of EM fields; physical scale modeling; survey planning and experimental design; processing and interpretation of data; applications, limitations, and inversion methods.
Prerequisite: GEOP 525

GEOP 625 Advanced Petrophysics (3-0-3)

This course is designed to examine the use of geophysical logs (e.g., caliper, SP, gamma ray logs, sonic logs, density, neutron; resistivity, NMR and image logs) to characterize geological materials, structures, and formation fluids in the region surrounding a well bore. Emphasis will be given on well log Interpretation methods.
Prerequisite: GEOP 501

GEOP 629 Computing in Geosciences (2-3-3)
This course is designed to develop advanced computing practices for geosciences students. Topics include structures of geoscientific data, design of geoscientific algorithms, programming for geoscientific problems, and geoscientific optimization problems. Laboratory sessions will include programming applications on petroleum geoscience data sets from Saudi Arabia and the World.
Prerequisite: Graduate Standing

GEOP 630 Integrative Geosciences (3-0-3)
The course will bring together graduate students in geology, geophysics and petroleum engineering to work together on real world and relevant issues in hydrocarbon exploration and production. Activities include case studies, computer modeling, joint inversion, artificial intelligence methods, written exercises and a final report and presentation.
Prerequisite: Graduate Standing

GEOP 633 Geomechanics and Fluid Flow (3-0-3)
Mechanical properties of porous rocks: dynamic problems of seismic velocity, dispersion, attenuation; quasi-static problems of faulting, fluid transport, crustal deformation, and loss of porosity.
Prerequisite: GEOP 550

GEOP 642 Near-Surface Field Geophysics (3-0-3)
Design and implementation of data acquisition of various near-surface geophysical surveys. Data from each survey is processed and modeled using tomographic and other techniques followed by a discussion on the integration and joint inversion of multi-physics near-surface models.
Prerequisite: GEOP 510

GEOP 645 Geophysical Laboratory Techniques (2-3-3)
This course consists of lectures and laboratory experimental exercises aimed at the measurement of physical properties of rocks under standard and reservoir conditions. Properties include density, porosity, elastic wave velocity, anisotropy, electrical resistivity, dielectric constant, radioactivity, heat flow, and magnetic susceptibility. Scale effects and how small-scale laboratory environment is related to the scale of field geophysical investigations will be discussed.
Prerequisite: GEOP 501, GEOP 502

GEOP 647 Seismic Imaging (3-0-3)
Imaging applications are developed from first principles to practical methods applicable to seismic wavefield data including reverse-time migration, migration by wavefield extrapolation, angle-domain imaging, migration velocity analysis, velocity

model building, full waveform inversion, global inversion, and tomography.
Prerequisite: GEOP 510

GEOP 690 Special Topics in Geophysics I (3-0-3)
Advanced topics selected from current literature that deals with theoretical foundations and advances in geophysics. The specific content of an offering of the course should focus on a specific area of geophysics.
Prerequisite: Consent of Instructor

GEOP 691 Special Topics in Geophysics II (3-0-3)
Advanced topics selected from current literature that deals with theoretical foundations and advances in geophysics. The specific content of an offering of the course should focus on a specific area of geophysics.
Prerequisite: Consent of Instructor

GEOP 699 Ph.D. Seminar (1-0-0)
Ph.D. students are required to attend Departmental seminars delivered by faculty, visiting scholars and graduate students. Additionally, each Ph.D. student should present at least one seminar on a timely research topic. Ph.D. students are required to pass the comprehensive examination as part of this course. This course is a pre-requisite to registering the Ph.D. Pre-dissertation GEOP 711. The course is graded as Pass or Fail. IC grade is awarded if the Ph.D. comprehensive exam is not yet passed.
Prerequisite: Graduate Standing

GEOP 701 Directed Research I (0-0-3)
This course is intended to allow the student to conduct research in advanced problems in his Ph.D. research area. The faculty offering the course should submit a research plan to be approved by the Graduate Program Committee at the academic department. The student is expected to deliver a public seminar and a report on his research outcomes at the end of the course. This course is graded on a Pass or Fail basis.
Prerequisite: Prior Arrangement with an Instructor

GEOP 702 Directed Research II (0-0-3)
This course is intended to allow the student to conduct research in advanced problems in his Ph.D. research area. The faculty offering the course should submit a research plan to be approved by the Graduate Program Committee at the academic department. The student is expected to deliver a public seminar and a report on his research outcomes at the end of the course. This course is graded on a Pass or Fail basis.
Prerequisite: Prior Arrangement with an Instructor

GEOP 711 Pre-Dissertation (0-0-3)
This course enables the student to submit his Ph.D. Dissertation Proposal and defend it in public. The student passes the course if the Ph.D. Dissertation committee accepts the submitted dissertation proposal report and upon successfully passing the Dissertation proposal public defense. The course grade can be NP, NF or IC.
Prerequisite: Ph.D. Candidacy
Corequisite: GEOP 699

GEOP 712 Dissertation (0-0-9)

This course enables the student to work on his Ph.D. Dissertation as per the submitted dissertation proposal, submit its final report and defend it public. Students are required, as part of the Dissertation preparation, to submit three publications as conference presentations and/or to peer reviewed Journals. The course grade can be NP, NF or IP.

Prerequisite: GEOP 711