Sana’a University

Faculty of Petroleum and Natural Resources

Department of Earth Sciences

Bachelor Dgree Handbook of the Geosciences Program

2024-2025

Introduction

Yemen, with its unique location in the southern Red Sea, characterize by diverse geological nature, represented by different types of rocks whose ages ranged from Holocene to Precambrian, is considered an ideal place for geological sciences study.

The Geological Sciences Program is considered one of the most important programs developed within the establishment of the College of Petroleum and Natural Resources. This program falls within the Department of Earth Sciences and was developed to accommodate scientific and practical variables and the requirements of the labor market. It is essentially obligated to provide students with an integrated scientific subject of modern theories and technical skills as a solid foundation for their practical future.

These rocks formed a ground for the establishment of various industries, such as cement, rocks and minerals industries, in addition to the oil and. Over the past five decades, the Department of Earth and Environmental Sciences has supported development with various cadres of scientists in several fields. The most important of which are oil and gas, minerals, and other sectors such as water, roads, and specialist in natural hazards and environmental assessments.

This program consists of 133 credit hours, including a graduation project of 4 hours. This program leads to three specialized tracks at the fourth level, as the following:

1. Geophysics; 2. Hydrogeology; 3. Petroleum Geology

The goal of these tracks is to create a diversity of specializations to accommodate the desires and trends of students and the labor market.

We will strive during the coming years to create and develop new sources of learning that are compatible with the development of new programs capable of creating a scientific movement capable of advancing the individual and the Yemeni society to the heights of advanced societies.

Department Mission

Prepare graduates equipped with knowledge and skills to be productive in their communities, able to explore the Earth's natural resources efficiently at the local and regional levels, contribute to the growth of national economy, and innovate solutions for societal problems.

Department Aims

1. To discover the earth's resources in proportion to sustainable development.
2. Providing students with technological skills that help them to understand and apply modern technologies.
3. Developing the scientific and applied capabilities of students in partnership with applied scientific institutions.
4. Providing consulting services to the public and private sectors in various fields of geological specializations.
5. Developing the capabilities of the faculty members and teacher assistants to serve the purposes

Program Mission

This program is dedicated to offering an outstanding teaching curriculum and conducting research of high standard quality. The primary goal is to produce professional geoscientists who have the knowledge, skills, and values required to serve the needs of society and to supplement the national economy with the necessary competencies

Program Aims

1. Provide high-standard and widely recognized academic program in geosciences.
2. Prepare students equipped with sufficient knowledge of fundamental principles of geosciences.
3. Graduating students who are able to work in the various fields of earth sciences, and in a way that contributes to community services.
4. Prepare students for innovation and research through laboratory and field applications and participation in research projects, scientific competitions and conference.
5. Practice the ethics of the profession and recognize the geoscience impact on the society and the environment.

Student learning outcomes

The graduate of the Geological Sciences program will be able to:

1. Describe the basic principles of geology, which include the origin, structure, formation and evolution of the Earth during different Eras, and how the Earth's systems are affected by the internal and external forces that form on the Earth.
2. Full knowledge of the requirements of geological skills, such as identifying minerals, rocks and soil, as well as the ability to read topographic and geological maps and photographs, and construct geological sections and maps, in addition to collecting and presenting of field and laboratory data.
3. Utilize concepts of physics, chemistry, biology, and mathematics to understand geological processes.
4. Apply geological knowledge and critical thinking skills to address various problems.
5. Communicating scientific principles as well as the results of scientific research in writing or orally in an effective manner.
6. Use of computers and various programs, as well as laboratory and field equipment and devices used in the fields of geological sciences.
7. Proficiency in dealing with sources of scientific knowledge related to geological sciences and able to use them in geological sciences and allied specializations.

The Study Plan:

The program of Geosciences constructed of core courses as well as faculty and university requirements courses as the following:

University Requirements

No.	Course	C.H.
1	Islamic Culture	3
2	Arabic Language (1)	3
3	Arabic Language (2)	3
4	English Language (1)	3
5	English Language (2)	3
6	Arabic Zionist Conflict	2
7	National Culture	2
Total Credit Hours (C.H.)		**19**

Faculty Requirements		
No.	Course	C.H.
1	General Geology (1)	3
2	General Geology (2)	3
3	General Math	3
4	General Chemistry	3
5	General Physics	2
6	Principles of Environmental Sciences	3
7	Computer Programming	3
8	Sedimentology & Stratigraphy	3
9	Geophysics	3
10	Statistics	3
11	Principles of Engineering Geology	2
12	Structural Geology	3
13	Remote Sensing and GIS	3
14	Geology of Yemen	3
Total Credit Hours (C.H.)		**40**

There are a number of compulsory specialized requirements that the student should pass in order to complete the program, and the total credit hours of these courses amount to 73, and these courses are:

Program Requirements		
No.	Course	C.H.
1	Geomorphology	3
2	Metamorphic and Igneous Rocks	3
3	Differential Equations	3
4	Mineral Crystallography	3
5	Sedimentary Rocks	3
6	Geophysical Exploration	3
7	Optical Mineralogy	3
8	Invertebrate Paleontology	3
9	Optics	2
10	Petroleum Geology	3
11	Environmental Geology	2
12	Marine Geology	3
13	Hydrogeology	3
14	Field Geological Survey	3
15	Geodynamic	3
16	Well loging	3
Total Credit Hours (C.H.)		**50**

The Geosciences Program branched into 3 tracks in the fourth year: 1. Hydrgogeology, 2. Petroleum Geology, and 3. Geophysis. The courses assigned for each track as the following:

Geophysical Track:

Track Requirements		
No.	Course	C.H.

1	Gravity and Magnetic Exploration	3
2	Reservoir Characterization and Modeling	3
3	Geophysical Data Processing	3
4	Engineering and Environmental geophysics	3
5	Electrical and Electromagnetic Exploration	3
6	Seismic Exploration	3
7	Earthquake Seismology	3
8	Geoscience and Computers	3
9	Graduation Project (1) & (2)	4
Total Credit Hours (C.H.)		**28**

Hydrogeology Track:

Track Requirements		
No.	Course	C.H.
1	Hydrology	3
2	Hydrogeology of Yemen	3
3	Hydrogeochemistry	3
4	Integrated water Resources Management	3
5	Environmental Hazards	3
6	Aquatic Pollution	3
7	Optical Mineralogy	3
8	Environmental Management & EIA	3
9	Graduation Project (1) & (2)	4
Total Credit Hours (C.H.)		**28**

Petroleum Track:

Track Requirements

No.	Course	C.H.
First Semester		
1	Depositional Systems	3
2	Clastic Rocks	3
3	Reservoir Characterization and Modeling	3
4	Micropaleontology	3
5	Paleoclimatology and paleoecology	3
6	Carbonate and Evaporites	3
7	Petroleum Geochemistry	3
8	Basin Analysis	3
9	Graduation Project (1) & (2)	4
Total Credit Hours (C.H.)		**28**

The above program courses were distributed by taking into account the balance between specialized courses and university and faculty requirements. Also, it was taking into account the pre-requisites of each course separately in a way that did not affect the logical sequence of learning and the acquisition of knowledge and skills of the environmental specialization. The study plan for the B.Sc. Geosciences Program courses are distributed as follows:

First Year:

No.	Course Title	Code	Credit Hours			Pre-requested
			Th.	Pr.	Total	
First Semester						
1	English Language (1)	UR103	3	0	3	-
2	Geophysics	PNR213	2	1	3	PNR112
3	General Maths	PNR215	2	0	2	-
4	Mineralogy and Crystallography	GEOS222	2	1	3	-
5	Differential Equations	GEOS241	2	1	3	PNR114
6	Geomorphology	GEOS231	2	1	3	PNR112
Total Credit Hours					**17**	
Second Semester						
No.	Course Title	Code	Credit Hours			Pre-requested
			Th.	Pr.	Total	
1	Computer Programming	PNR211	2	1	3	-
2	Statistics	PNR214	2	1	3	-
3	Environmental Geology	GEOS232	2	0	2	-
4	Principles of Engineering Geology	PNR113	2	0	2	-
5	General Physics	PNR115	2	1	3	-
6	Principles of Environmental Sciences	PNR116	2	0	2	-
7	National Culture	UR106	2	0	2	-
Total Credit Hours					**19**	

4	Invertebrate Paleontology	GEOS223	2	1	3	PNR114
5	Optical Mineralogy	GEOS224	2	1	3	PNR112
6	Optics	GEOS242	2	1	3	PNR113
Total Credit Hours					**17**	

Second Year:

Third Year:

First S	First Semester						
No.	No.	Course Title	Code	Credit Hours			Pre-requested
				Th.	Pr.	Total	
1	1	Depositional Systems	GEOS471	2	1	3	PNR112
2	2	Clastic Rocks	GEOS472	2	1	3	
3	3	Reservoir Characterization and Modelling	GEOS455	2	1	3	-
4	4	Micropaleontology	GEOS474	2	1	3	-
5	5	Graduation Project (1)	GEOS431	2	0	2	
6	Well Logging		GEOS331	2	1	3	PNR116
Total Credit Hours						14	
Total Credit Hours					16		

Second Semester							
No.	No.	Course Title	Code	Credit Hours			Pre-requested
				Th.	Pr.	Total	
1	1	Paleoecology	GOES473	2	1	3	-
2	2	Carbonate and Evaporites	GOES475	2	1	3	PNR116,
3	3	Petroleum Geochemistry	GEOS476	2	1	3	PNR116,
4	4	Basin Analysis	GOES477	2	1	3	-

No.	Course Title	Code	Th.	Pr.	Total	Pre-requested
1	Paleontology and Paleoecology	GOES473	2	1	3	-
2	Carbonate and Evaporites	GOES475	2	1	3	PNR116,
3	Petroleum Geochemistry	GEOS476	2	1	3	PNR116,
4	Basin Analysis	GOES477	2	1	3	-

No.	Course Title	Code	Th.	Pr.	Total	Pre-requested
1	Structural Geology	PNR311	2	1	3	PNR112
2	Sedimentary Petrology	GEOS322	2	1	3	-
3	Geology of Yemen	PNR313	2	1	3	
4	Geodynamics	GEOS332	2	1	3	
5	Principles of Geochemistry	GEOS333	2	1	3	PNR215
6	Geophysical Exploration	GEOS334	2	1	3	-
Total Credit Hours					18	

5	Graduation Project (2)	GEOS432	0	2	2	GEOS431
Total Credit Hours					**14**	

Fourth Year: Petroleum Geology track courses

First Semester						
No.	Course Title	Code	Credit Hours			Pre-requested
			Th.	Pr.	Total	

Fourth Year: Hydrogeology track courses

1	Hydrology	GEOS471	2	1	3	
First Semester						
2	Hydrogeology of Yemen		2	1	3	
3	Water Wells Technique	GEOS455	2	1	3	
4	Hydrogeochemistry	GEOS474	2	1	3	-
5	Graduation Project(1)	GEOS471	0	2	2	
Total Credit Hours					**14**	
Second Semester						
No.	**Course Title**	**Code**	**Credit Hours**			**Pre-requested**
			Th.	**Pr.**	**Total**	
1	Integrated Water Resources Management	GEOS465	2	1	3	-
2	Environmental Hazards	GEOS466	3	0	3	
3	Aquatic Pollution	GEOS467	2	1	3	
4	Environmental Management & EIA	ENV455	2	1	3	-
5	Graduation Project (2)	GEOS432	0	2	2	**GEOS471**
Total Credit Hours					**14**	

Fourth Year: Geophysics track courses

No.	Course Title	Code	Credit Hours			Pre-requested
			Th.	Pr.	Total	
1	Gravity and Magnetic Exploration	GEOS451	2	1	3	
2	Reservoir Characterization and Modeling	GEOS455	2	1	3	
3	Geophysical Data Processing	GEOS454	2	1	3	
4	Engineering and Environmental Geophysics	EG465	2	1	3	-
5	Graduation Project (1)	GEOS431	0	2	2	
Total Credit Hours					**14**	

Second Semester

No.	Course Title	Code	Credit Hours			Pre-requested
			Th.	Pr.	Total	
1	Electrical and Electromagnetic Exploration	GEOS452	2	1	3	-
2	Seismic Exploration	GEOS453	2	1	3	PNR116
3	Earthquake Seismology	GEOS457	2	1	3	PNR116,
4	Geoscience and Computers	GEOS456	2	1	3	-
5	Graduation Project (2)	GEOS432	0	2	2	GEOS431
Total Credit Hours					**14**	

Courses Description

Geomorphology GEOS231

Providing students with the main concepts of the geomorphology and it's applied, and explain geomorphological factors and processesthat Influencing Earth's surface formation. Introduce students to methods of measuring surface phenomena and sign them on appropriate maps and figures. Providing students with methods for identifying geomorphological phenomena and determining the stages of their development, Identify the relation between geologic structure and existing landforms.

Mineralogy and Crystallography GEOS222

Study the structure chemistry and chemical, physical and optical properties of minerals. Also definition and basic concepts - crystal and its constituents - the law of interfacial angle constancy - crystal symmetry - crystal axes - parameters and indices - projections - crystal systems and classes.

Differential Equations **GEOS 241**

Differential equations are considered one of the most important mathematical tools to model a wide range of complex problems in biology, engineering, physical and geosciences. Thus, the aims of this course areto introduce student to the basic concepts of the ordinary differential equations (ODEs), and to develop student's skills in the formulation, solution and understanding of ODE models. The contents of the course are: first order and second order ODEs and their applications, systems of linear ODEs and their applications, Laplace transforms. In addition to that, a special attention would be considered tothe solution methodsof ODEs including some numerical methods.

Environmental Geology GEOS232

Different concepts of environment and introduction to different schools of environment and ecosystem diverse, a mutual relationship resulting from human impact on environment or the impact of environment on human beings, and identify all geological processes (internal , external) and its relations with geological hazards such as earthquakes, volcanoes, storms, floods and land breakdown (landslides), as well as the definition of different types of natural resources (rocks, metals), sources and types of environmental pollution and various forms of waste disposal resulting from quarrying operations, as well as urban waste landfills or industrial wastes, and determining of potable water supply (surface and groundwater).

Invertebrate Paleontology GEOS223

Invertebrate Paleontology is an essential course for all Earth sciences students with their various specializations. It provides a simple, comprehensive overview of paleontology (its basics and applications). It is introducing the terms and basics of this science and how fossils form over the geological time. This courseintroduces the groups of invertebrate fossils and theirsystematic classification; as well as addresses the importance of each fossil group and related applications in stratigraphy, paleoenvironments andpaleobiology. The course establishes the idea of

using the fossils to construct and establish the sequential stratigraphy and provides preliminary information on the role of fossils in oil exploration.

Optical Mineralogy GEOS224

Initial concepts of light, the nature of light, Snell's law, polarization of light, and polarized microscopy. Double refractive index and refractive index. Isotropic and anisotropic media. The three dimensions, mono-axial and bi-axial. Optical properties of mono- and bi-axial minerals. Birefringence color chart and their uses. Overlapping shapes. Optical orientation in single-axis and double-axis minerals. Describe the textures and shapes of minerals. Study the properties of minerals individually and aggregated, and extract the environments of geological formation.

Optics GEOS242

The aim of this course tocover general principles and concepts of wave optics, and laser principle. The first part of the course covers the wave nature of light through diffraction and interference effect, and the transfer nature of electromagnetic wave through polarization. The second part gives an introduction to leaser physics with emphases on the Pasic principles of amplification by simulated emission.

Igneous and Metamorphic Rocks GEOS321

This course is designed to give a fundamental background in hard rocks petrology. In igneous petrology part, students review the essentials of the origin, formation, properties, chemical composition, and properties of magmas; igneous textures and structures; igneous petrography and classification; tectonics and igneous processes. In the metamorphic petrology part, students review and study agents, types, processes, and conditions of metamorphism; structures, textures, and mineral assemblages; metamorphic facies and regional occurrence and tectonic significance of metamorphic rocks.

Sedimentary Petrology GEOS322

This course provide essential concepts for understanding of the processes involved in the genesis of the sedimentary rocks, and outlines on the Identification and description of the various classification schemes for siliciclastic and carbonate rocks; in addition to the weathering processes that alter original properties of primary sediments, sedimentary textures, fabric, composition; sedimentary structures, depositional environments, diagenetic processes and the economic importance of sedimentary geological resources.

Petroleum Geology GEOS323

This course provides an introduction to the principles of petroleum geology and methods used for discovery of oil in the subsurface environment. Topics include historical overview, properties of oil and natural gas, geologic environments, generation and migration, reservoir properties, traps and seals, methods of exploration, drilling techniques and extraction, and case studies of classic petroleum

producing regions of the world. Laboratory activities include geologic maps, well log analysis, geophysical logs, seismic stratigraphy and quantitative approaches to geologic problem solving .

Hydrogeology GEOS335

This course aims to acquire the student general knowledge about groundwater occurrences, origin and flow, interpretation of hydrogeologic conditions in different groundwater environs and identification of important processes in water-rock and surface water – groundwater interactions. It aims to give students a sound understanding of how water moves below the surface, including soil and groundwater flow. The teaching focuses on a physical understanding of key processes in the hydrological cycle that control the state and movement of water in the subsurface. The knowledge that is the basis for addressing practical aspects such as: how to apply common and advanced techniques in hydrogeology, how to solve practical problems and which tools can be used in each case.

Well Logging GEOS331

This course is aim to give understanding of the meaning of well logging and work of the bore hole environmental tool. The main topics are Definitions of well logs, importance of well logs, logging techniques and measurements, well logging tools (principle, geological factors affecting each tool, environmental corrections of each tool, and applications), well logs interpretations.

Field Geology and Survey GEOS325

This course introduces the basic concepts of surveying and field geology. The surveying by longitudinal instruments, compass, dumby leveling, plane table, tachometric will be studied to draw land features. Which including base map, geologic map and structural maps. Understanding of field investigation, data and sampling collections. Field and laboratory applications to identify these conceptions.

Geodynamics GEOS332

Geodynamics is the study of the forces and processes that shape the "solid" part of our planet. The course gives a better idea about the plate tectonics and the nature of the Earth's lithosphere.The main aim of this course is to improve the knowledge of geodynamics with emphasis on plate boundaries and deformation styles. The course introduces a wide range of concepts necessary for integrating mantle and lithospheric processes into a plate tectonic framework. This course considers several rheological descriptions of Earth materials such as brittle and ductile deformation.

Principles of Geochemistry GEOS333

An introduction to the principle of chemistry applied to geologic systems, including overviews of the chemistry of rocks and minerals, isotopes in the geologic environment, processes that control the speciation and mobility of elements in different geological environments, and the use of geochemical data in solving geologic and environmental problems.

Geophysical Exploration GEOS334

This course includes the study of factors that control the selection of the area to be explored, as well as a review of prospecting and exploration operations and stages, in addition to that offers this course an overview of the applied geophysical techniques used in geophysical prospecting where the use of these techniques in environmental studies, and exploration of resources (oil and gas, mineral deposits, water).

This course also discusses devices in geophysics, including process amplifiers, sensors, and device applications on geophysical equipment, and also discusses types of geophysical surveys and their field application.

Graduation Project (1) GEOS 431 and GEOS 432

Students conduct supervised, independent research in geosciences. It is carried out through an integrated field and laboratory study of an area or topic chosen by the student and his supervisor. This course provides unique opportunities outside the regular classroom for upper level students to engage in independent research in their fourth year of study.

Students will develop a research plan, carry out data collection using field and/or laboratory studies, and complete a final report/presentation. Field studies, Laboratory studies/data processing, reference work and work presentation are four major components of this study. Examination committee will be held at the end of each semester to evaluate the Progress.

Geophysics track

Gravity and Magnetic Exploration GEOS451

Geophysics depends on employing all the geological information with the data obtained from the various geophysical methods and then obtaining the desired results according to the problem presented, for this purpose a special course has been designed in this program which develops the student's capabilities to examine the data and to process and then interpret it.

Emphasis will be placed on potential methods, particularly the gravity and magnetic methods, in addition to seismic and electrical methods, for their wide applications in various geological, oil fields, water investigation, and engineering and environmental applications.

Geophysical Data Processing GEOS454

Geophysical data analysis is a very practical subject and this course is intended to be a simple guide to the techniques of parameter estimation and error analysis. We have placed emphasis on the reconciliation of theory and practical data to enable the student to understand how to tackle typical problems in data analysis. It is hoped that a mastery of the simple techniques described in this course will inspire confidence to consult the more classical treatment of the subject.

This course discusses in depth the analysis of digital data for the basic signal that is usually applied in processing geophysical data for the signal, such as Fourier transform, Fast Fourier transform, Discrete Fourier transform, Convolution, Correlation, Sampling theory and filtering.

Engineering and Environmental Geophysics EG465

This course provides a description of the geophysical techniques or methods used in engineering and environmental applications, and the use of those technologies as an integrated exploration method, through the use of the logical methodology (physics, mathematics and geology, with engineering techniques, information engineering, and devices). This course will also discuss how to choose and estimate geophysical techniques appropriate for specific applications.

Electrical and Electromagnetic Exploration GEOS452

For students undertaking this course, the aim isto introduce the basic concepts and applications of electricity and magnetism. Geophysicists are employed in a wide range of industries, including petroleum and mineral exploration, groundwater, contaminants and salinity evaluation. This course investigates geophysical techniques, covering topics in electrical and electromagnetics. The course also involves methods of geophysical data analysis, visualization and interpretation through a series of laboratories.

Seismic Exploration GEOS453

This course is intended to provide students with the concepts of geophysical seismic methods. It covers the seismic exploration methods. The basic field procedures which are followed during the acquisition of seismic data and their processing sequence will be covered in the course. Special attention will also be given to the various interpretation techniques of the seismic methods. The specific advantages, limitations, applications and case histories of these methods will be considered. Also this course gives the students an introduction to the interpretation of seismic reflection data.

Earthquake Seismology GEOS457

This course aims to provide the student with knowledge about the interior structure the earth, the seismicity map of the world and its relation to global tectonics, determination of earthquake size in terms of magnitudes and intensity, and assessment of seismic hazard.

Geoscience and Computers GEOS456

The basic mains are to use many of computer programs that used in geology and subspecialties in geology and geophysics to demonstrate the advantage of these programs. The student should be aware of how the program works, means of entering, storing and correcting geological data by computer and how to deal with a number of data formats, programs and various problem-solving techniques. Using of geological software in structural geology, stratigraphy, geophysics, hydrology, climatology, and

environmental geology. Practical application of geological information systems through a project is prepared by students.

Hydrogeology track

Hydrology GOES461

Water is one of our most important natural resources. Hydrology deals with the waters of the earth, their occurrence, circulation, and distribution. Hydrology is also encompasses chemical and physical properties of water and waters interactions with their environment, including their relation to living beings. Hydrological investigations, including the collection and interpretation of data on precipitation, evapotranspiration, discharge etc., are essential for the practical planning and design of water development schemes.

Hydrogeology of Yemen GEOS462

This course aims to acquire the student general knowledge about water resources in Yemen and their occurrences, and distributions. Also to know how to manage and use these resources in a sustainable way.

Water Wells Technique GEOS463

Introducing the student to the different types of boreholes, methods of drilling, design, developing, cleaning and rehabilitating the wells.

Hydrogeochemistry GEOS464

Hydrogeochemistry course is a multidisciplinary course uses the chemistry tools to investigate the natural waters and the processes that alter their composition. Basic principles of hydrogeochemistry are introduced and then used to describe the main controls on the chemistry of pristine and polluted soil, surface, and ground water environments. The course covers quality of waters, chemical equilibria of solutions, including speciation, solubility, sorption, complexation, acid and bases, carbonate chemistry, ion exchange, and redox; thermodynamics and kinetics of reactions; water-rock reactions, reaction progress indicators; the chemistry of groundwater contaminants, andgeochemical speciation modeling.

Integrated Water Resources Management GEOS465

IWRM is a process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital eco-systems

Environmental Hazards GEOS466

This course provides the students with basic concepts and principles of environmental risks, disasters, and Hazards, its classification, types, either Natural (Geological, and Climatic) or man-made, and the ways of predicting, identifying, and avoiding them through proper management .

Aquatic Pollution GEOS467

This course provides the students with basic concepts and principles of environmental risks, disasters, and Hazards, its classification, types, either Natural (Geological, and Climatic) or man-made, and the ways of predicting, identifying,and avoiding them through proper management.

Environmental Management & EIA ENV455

This course will introduce students to the underlying key environmental processes and services, ecosystem management, techniques of optimization overtime, optimal allocation and management of non-renewable and renewable resources. Also, to introduce students to the proper ways and internationally recognized methods and approaches of environmentally assessing small and large development projects for their impacts on the surrounding environment including impacts on humans.

Petroleuim Geology Track

Depositional Systems GEOS471

This course explains and describes the interrelationships of various forms of the physical, chemical, or biological processes involved in the development of stratigraphic sequences. This description is usually made based on an understanding of the depositional environments and syndepositional tectonics which controlled the sequences formation.

The goal of this course is to provide a concise overview of the most common depositional systems and sedimentary environments(fluvial, marine, eolian, lacustrine, alluvial….).with particular emphasis on the processes and conditions under which different types of deposits form, and the characteristics (e.g., geometry, sedimentary structures, grain size relationships, fossils) by which they can be recognized. It also gives the ability to make careful observations and skills necessary to describe and interpret sediment paleo-environments, through time. In order to establish the criteria for the recognition of the different depositional environments, modern settings will be emphasized.

Clastic Rocks GEOS472

This course introduces the study of the origin of clastic sedimentary rocks and the various depositional environments in which they form. Classification and mineralogical composition, Petrographic features and diagenetic processes for different types of clastic rocks. The course begin by covering the basic principles of sediment transport and the formation of sedimentary structures, and then examines specific

depositional settings and their associated deposits including fluvial, deltaic, coastal and deep marine environments. The course will conclude with a consideration of larger-scale stratigraphic concepts associated with filling of sedimentary basins . Laboratories focus on the identification of sedimentary rocks and structures in hand specimen.

Reservoir Characterization and Modelling GEOS455

The objective of this course is to teach the basic science, technology and related assumptions involved in carrying out an integrated reservoir characterization study. It will prepare students to understand and interpret techniques that underlie commercial software (but will not teach software usage itself). The emphasis is on providing students with knowledge of a 'toolkit' for, but not a prescriptive approach to, the ultimate goal of constructing 3D static models.

The course has three main components. 1) Data sources, quality and analysis, including spatial analysis. 2) Generating 3D models of reservoir properties - classical gridding and mapping. Simulation techniques are introduced as a means of assessing uncertainty resulting from heterogeneity. 3) Scaling of grids and property models for the purpose of reservoir simulation. The integration and application of all the major ideas is illustrated by a case study.

Micropaleontology GEOS474

The course presents knowledge of the most important groups of micro fossils, taxonomy, skeletal morphology and their importance in Earth Sciences. Their use for biostratigraphy and as proxies for the reconstruction of the paleoenvironment, and paleoclimate. It also provides basic knowledge of extracting fossil from sediments, distinguish and identify them under a light microscope.

Paleoclimatology and Paleoecology GOES473

The course aims to explain the importance of the reconstruction of ancient climate and ecology to understand natural variation and the evolution of the current climate and environment. it provides the basis to understand the relationship between fossil assemblages and past climate changes in the framework of depositional environment. Evidences on ancient climate and ecology changes and theinteractions between organisms and/or interactions between organisms and their environments across geologic timescales will be presented during the course.As a discipline, paleoclimate and paleoecology interacts a variety of fields including paleontology, ecology and biology.

Carbonate and Evaporites GOES475

This course will introduce students to themineralogy, classification, diagenesis, structures and depositional environments of carbonate and evaporite rocks. Laboratory work to identify the different characteristics of carbonate and Evaporite rocks will be conducted.

Petroleum Geochemistry GEOS476

This course provides an overview of basic petroleum geochemistry fundamentals with strong emphasis on applications to exploration and production. Various aspects of hydrocarbon generation and accumulation are discussed and this is followed with lectures on geochemical methods, markers, modeling, coal-bed methane and case studies.

Basin Analysis GOES477

The course presents theories of basin formation in various types of geotectonic setting, basin infill dynamics, subsidence history and consequences for reservoir and source rock development and the petroleum system. Subjects to be discussed include physical state of lithosphere, mechanisms of sedimentary basin formation by stretching, strike-slip, flexure and compression, effects of mantle dynamics, basin infill mechanisms and depositional systems, basin stratigraphy, subsidence and thermal history, changes of reservoir and petrophysical parameters during burial and tectonic processes, and application to the petroleum system, leading towards the play concept