Republic of Yemen
Ministry of Higher Education & Scientific Research
Council for Accreditation & Quality Assurance
Sana'a University

Faculty: Faculty of Petroleum and Natural Resources
Program: Master of Earth Sciences

Earth Sciences Master's Program Specification Document

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Faculty: Faculty of Petroleum and Natural Resources
Program: Master of Earth Sciences

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University: Sana'a University **Faculty:** Faculty of Petroleum and Natural Resources

Project: Development of the Master's Program in Earth Sciences

Introduction

The Department of Geology was established in 1978 as part of the Faculty of Science and began awarding master's and doctoral degrees by the late 1980s. Its name was changed to the Department of Earth and Environmental Sciences with five specialized divisions in 2006. Following the establishment of the Faculty of Petroleum and Natural Resources in September 2019, the Department of Earth and Environmental Sciences was transferred from the Faculty of Science at Sana'a University to the Faculty of Petroleum and Natural Resources, under the name of the Department of Earth Sciences. The master's program is designed so that graduates receive a Master of Science in Earth Sciences with specialized tracks in petroleum, water, and geophysics. To obtain this degree, students must complete coursework over two semesters, successfully earning 24 credit hours, and then register for a master's thesis worth 6 credit hours to complete the requirements for the Master of Science in Earth Sciences. The team tasked with developing the Master's program ensured that the graduate students acquire all the necessary information, practical and applied skills that qualify them to conduct various geological assessments. This equips them to compete and succeed in the job market related to earth sciences, as well as in general employment opportunities related to this field, in accordance with global quality standards. These qualifications serve as a springboard for a wide range of career opportunities and postgraduate research pursuits (PhD).

Justifications for Developing the Program

The primary justifications for developing a master's program in earth sciences can be summarized as follows:

- Updating the curriculum to align with scientific advancements and labor market demands.
- Transferring the oversight of the program from the Faculty of Science to the Faculty of Petroleum and Natural Resources, with a focus on programs aligned with the new faculty's aims.

University: Sana'a University **Faculty:** Faculty of Petroleum and Natural Resources

Earth Sciences Master's Program Specification

Basic Information about the Program

1	Program Title and Final Award	M.Sc. In Earth Sciences
2	Awarding Body/Institution:	Faculty of Petroleum and Natural Resources
3	Teaching Institution/ Responsible Department:	Department of Earth Sciences
4	Other Departments Involved in Teaching the Program:	Department of Petroleum and Gas Engineering - Department of Educational Sciences
5	Medium of Instruction:	English
6	Program Start Year	2021-2022
7	Study Mode:	(Full-time) Regular
8	Master's Program Type	Coursework and Thesis
9	Place of Study	University Campus
10	System of Study	Semester-based
11	Duration of the Program:	2 years
12	Possible Future Career Options for Graduates:	Geologist, researcher in earth sciences
13	Levels of Award/ Final Award	Diploma Certificate: Awarded upon successful completion of the preparatory courses (coursework). Master's Degree: Awarded upon successful completion of the degree requirements, including coursework and thesis.
14	Prerequisite Qualifications:	Bachelor's degree in Geology, Earth Sciences, Engineering Geology, or Petroleum and Gas Engineering.
15	Required GPA/ Grade for Admission:	Good
16	Other Requirements:	Admission exam - complementary courses
17	Program Coordinator:	Associate Prof. Adel Mohammed Al-Matari
18	Date of Program Specification/ Latest Accreditation	2021

University Vision, Mission, and Aims

▪ University Vision

Sana'a University (SU) aspires to achieve a national leading role in teaching, learning, scientific research and community service; and to be among the best regional universities and the foremost house of expertise and think tank in Yemen.

▪ University Mission

To contribute to the sustainable development efforts by providing an accredited higher education environment and excellent research services within a fruitful national partnership based on transparency, professionalism and creativity.

▪ University Aims

Sana'a University aims to:

1- To provide specialized and in-depth academic opportunities for students in different fields of knowledge to meet the country's needs of specialists, technicians and experts.
2- To cherish Arabic language, its teaching and development; and mainstream its use as the language of science and education in various arenas of knowledge, as a vehicle for cultural meanings, values and ethics of the Arab-Islamic civilization.
3- To develop knowledge through engaging in multidisciplinary research, both individually and collectively, and directing them towards serving the community needs and development plans.
4- To nurture the development of technology and its utilization in the community development.
5- To promote the activities of authorship, translation and publishing in various fields of knowledge with special emphasis on the Yemeni heritage.
6- To contribute to the promotion of arts, literature and the advancement of sciences.
7- To offer an academic atmosphere conducive to the freedom of thought, expression and publication in a way that does not contradict with the lofty values and elevated ideals of Islam.
8- To strengthen relations with universities and public and private institutions in the country to ensure a mutual and constructive interaction of knowledge, expertise, resources and participation that will guarantee effective contribution to the comprehensive development of the country.
9- To strengthen scientific and cultural ties with Arab and foreign universities, scientific bodies, and research and development centers, with a view to developing Sana'a University and enhancing its prominence.
10- To offer technical and specialized studies and consultations for various public and mixed-sector institutions.
11- To contribute to the development of policies and ways of work in institutions of both public and private sectors, providing models and innovative experiments to solve various problems.
12- To promote the efficiency of employees in public and private institutions and agencies, by contributing to the development of in-service preparation and qualification programs.

Faculty Vision, Mission and Aims

- **Faculty Vision**

Attaining local leadership and regional excellence in the field of petroleum and natural resources sciences and contributing to sustainable development.

- **Faculty Mission**

Preparing qualified cadres in the field of petroleum and natural resources, capable of competing in the local and regional labor market, by providing distinguished educational, research, and community services in a stimulating learning environment that encourages creativity and innovation.

- **Faculty Aims**

1- Providing high-quality education to keep pace with the developments in the fields of petroleum and natural resources;
2- Qualifying specialized, highly proficient graduates capable of competing in local, regional, and global markets;
3- Building capacities and attracting specialized teaching staff to enhance educational performance;
4- Promoting partnerships with relevant institutions and companies;
5- Contributing to community service and providing consultations and technical and research studies.
6- Promoting scientific research and offering targeted postgraduate programs.

Department Mission and Aims

- **Department Mission:**

Preparing graduates equipped with the knowledge and skills to become productive members of their communities, capable of efficiently exploring the natural resources of the earth at both local and regional levels, innovating solutions to societal problems, and contributing to the support of the national economy.

- **Department Aims**

This department aims to prepare graduates in the field of earth sciences who can contribute to:
1. Discovering the earth's resources in alignment with sustainable development.
2. Equipping students with technological skills that enable them to comprehend and apply cutting-edge techniques.

3. Developing the scientific and applied capabilities of students through collaboration with scientific and applied institutions.
4. Providing consultancy services to both the public and private sectors in various geological specializations.
5. Developing the capacities of the teaching staff and their assistants to enhance the educational process.
6. Pursuing excellence in the educational process and actively supporting and encouraging scientific research that contributes to addressing societal problems.

Program Mission and Aims

- **Program Mission**

The mission of the master's program in Earth science is to continue a student's training in one of a broad range of earth science disciplines and to prepare students for either a professional career or doctoral studies.

- **Program Aims**

1. To provide a sound basis of knowledge and understanding for the study the Geological Sciences applying to the natural environment and industry.
2. To develop practical and professional skills to the analysis of the geological data in a responsible and safe manner, paying due attention to risk assessment, rights of access, and the relevant health and safety regulations.
3. To recognize applicable theories for the interpretation of geological information.
4. To prepare an attitude for innovation and research through laboratory and field applications and participation in research projects, scientific competitions and conferences.
5. To support and execution of academic and applied research projects to explore and develop the petroleum, mineral and groundwater resources in Yemen

Program Standards & Benchmarks

Program Standards

- Standards set by the German Accreditation Commission (ASIIN) for geoscience programs.
- Standards set by ABET for geological engineering programs.
- Benchmarks from comparable geoscience programs at accredited Arab and international universities.

Program Benchmarks

- Yemeni Universities Law No. 17 of 1995
- Executive Regulations of Law No. 32 of 2007
- Prime Minister's Decision No. 40 of 2008 regarding the Postgraduate Studies System in Yemeni Universities
- Standards of Postgraduate Programs issued by the Council for Accreditation and Quality Assurance
- Academic Program and Course Specification Forms issued by the Council for Accreditation and Quality Assurance.
- National Vision for Building a Modern Yemeni State

Similar Reference Programs:

1. Master of Science in Applied Geosciences, German University of Technology (Oman) GUtech. Oman
2. Master in Geology, University of Leicester, UK
3. Master in Earth Science, The University of Memphis, USA
4. M.Sc. Geological Engineering, Missouri S&T University, USA
5. MSc Geology, UNIVERSITY OF KERALA, India
6. MS in Geology, King Saud University, Saudi Arabia
7. M.Sc. EARTH SCIENCE, Yarmouk University, Jordan
8. Master of Science in Geosciences, Colorado State University, USA

Annex (1) Academic Standards of the Program for an International Accreditation Board
Annex (2) A Survey of Names of Accredited Reference Programs Similar to the Current Program.
Annex (3) A Survey of Learning Outcomes for Similar Reference Programs and Their Alignment with Current Program Outcomes.
Annex (4) A Survey and Alignment of Aims of Similar Reference Programs with the Current Program Aims
Annex (5) A Survey of Credit Hours of Similar Reference Programs.
Annex (6) A Survey of Courses in Similar Reference Programs.

A Survey Summary of Comparable Benchmark Programs to the Current Program

Required Data	Similar Reference Programs								Current Program
	First Program	Second Program	Third Program	Fourth Program	Fifth Program	Sixth Program	Seventh Program	Eighth Program	
Program:	Geology	Earth Sciences	Applied Geology	Geology	Geosciences	Earth Sciences	Engineering Geology	Geology	Earth Sciences
faculty/Center	Science	Earth Sciences	Science	Science	Natural	Science	Engineering and	Science	Petroleum and Natural Resources

					Resources		Computer Science		
University:	King Saud	Memphis	German university	University of Leicester	Colorado State	Yarmouk University	Missouri S&T	UNIVERSITY OF KERALA	Sana'a University
Country	Saudi Arabia	United States	Oman	England	United States	Jordan	United States	Indian	Republic of Yemen
System of Study	Course work and Thesis	Coursework and Thesis	Coursework and Thesis	Coursework and Thesis	Course work and Thesis + Course work only	Coursework and Thesis	Coursework and Thesis + Coursework only	Coursework and Thesis	Coursework and Thesis
Study Mode	(Full-time) Regular	(Full-time) Regular	(Full-time) Regular	(Full-time) Regular	(Full-time) Regular	(Full-time) Regular	(Full-time) Regular	(Full-time) Regular	(Full-time) Regular
Number of Semesters	4	-	6	2	-	6	-	-	4
Total Credit Hours (Without Thesis)	24	26	120 ECTS credit points	32	24	24	24	32	30
Total Credit Hours for Compulsory Courses	24	12	60	24	9	15	9	32	21
Total Credit Hours for Elective Courses	0	14	40	-	15	9	15	0	9
Number of Compulsory Courses	8		12	6	3	7	3	16	7
Number of Elective Courses	0		7	-	12	15	7	0	3
Existence of additional prerequisite courses for program admission and their number	No	No	No	YEAR 3/BSc FINAL YEAR	Yes	No	No	No	No
Number of credit hours for the thesis	6	6	20	-	6	9	6	2	6
Number of Credit Hours (Coursework + Thesis)	30	32	140	32	30	33	30	34	36
Specified duration for thesis completion	One semester	One semester	One semester	1	2 semesters	2 semesters	2 semesters	3 semesters	2 semesters
Minimum Duration for	2 years	2 years	3 years	1	2 years	2 years	2 years	2 years	2 years

Program Completion									
Maximum Duration for Program Completion				**4 to 5 years**		**3 years**			**3 years**

Program Intended Learning Outcomes (PILOs)

First: Knowledge and Understanding:

	Upon successful completion of the program, the graduates will be able to:
A1.	Show advanced knowledge and understanding of the core earth science technical disciplines, notably in geology and in geophysics
A2.	Provide essential knowledge of the key applied geoscience and engineering disciplines (i.e., geostatistics, petrophysics, and modelling) and to appreciate their relationship and inter-dependency with the core geoscience subjects
A3.	Demonstrate advanced understanding of earth system relevant to deeper knowledge of a chosen specialization
A4.	Show understanding of the complexity of natural resources environments for sustainable management in exploration and production.

Second: Cognitive/ Intellectual Skills

	Upon successful completion of the program, the graduates will be able to:
B1.	Describe, identify and interpret a range of geological materials in the laboratory and field.
B2.	Determine and interpret the geology of a region via a range of field-based techniques.
B3.	Utilize geological knowledge and data for modeling purposes (for example, for evaluation of scientific hypotheses, for hazard mitigation, or for resource estimation).
B4.	Apply a diverse range of methods of analysis, evaluation and promotion, including quantitative and qualitative (e.g. empirical social research), IT-based (e.g., GIS applications, petroleum basin modelling, hydrogeological modelling).

Third: Practical and Professional Skills

	Upon successful completion of the program, the graduates will be able to:
C1.	Carry out a range of field-based studies (e.g., geological mapping, sample collection and recording of field observations).
C2.	Draw and describe geological features, specimens and thin sections.
C3.	Use appropriate numerical, statistical and graphical methods or software effectively to solve numerical, spatial, temporal and geometrical problems.
C4.	Assess and carefully consider the cultural, environmental, and economic impact of global business activities on natural resources.

Fourth: General and Transferable Skills:	
Upon successful completion of the program, the graduates will be able to:	
D1.	Present work and findings with clarity and accuracy, orally (including presentation) and in writing
D2.	Participate effectively, either independently or as a member of an integrated team demonstrating a knowledge of a number of research techniques and procedures
D3.	Use appropriate software packages to prepare written reports, essays, posters and presentations
D4.	Use the internet critically for information retrieval and to communicate geological knowledge effectively.
Annex (7): Alignment of Program Aims with the Program Intended Learning Outcomes (PILOs). Annex (8) Attributes of the Program Graduates and Career Opportunities. Annex (9) Alignment of PILOs with the National Academic Reference Standards (NARS). Annex (10) Alignment of PILOs with International Reference Standards.	

Program Structure

The program structure consists of the following requirements:

Requirements	Number of Courses	Credit Hours	%
Complementary Courses (if any)	-	-	-
Compulsory Courses	7	21	58
Elective Courses (if any)	3	9	25
Thesis	1	6	17
Field Training (if any)	-	-	-
Others (.....)	-	-	-
Total	10	36	100.00%

The program structure requirements are detailed below:

First: Complementary Courses (if any)

Applicants who are not.... .. must complete complementary courses, which may include any or all of the following courses (depending on the equivalence of transferred courses and the decision of the admissions committee):

Course Title			Credit Hours				Pre-Requisites
			Th.	Pr.	Tut./ Semi	Total C.H	
1	Arabic	En					
Total credit hours							

Second: Elective Courses (18 Credit Hours)

	Course Title	COURSE CODE	Credit Hours				PREREQUISITES
			Th.	Pr.	Tut./ Semi	Total C.H	
1	Advanced Sedimentology & Stratigraphy	GEOL 611	3	0	0	3	
2	Advanced Igneous & Metamorphic Petrology	GEOL 613	3	0	0	3	
3	Advanced Structural Geology	GEOL 615	3	0	0	3	
4	Advanced Petroleum Geology	GEOL 617	3	0	0	3	
5	Exploration Geophysics	GEOL 619	3	0	0	3	
6	Applications of Remote Sensing and GIS	GEOL 620	3	0	0	3	
7	Applied Hydrogeology	GEOL 622	3	0	0	3	
Total credit hours			21	0	0	21	

Third: Elective Courses (9 Credit Hours) (Students select three elective courses only)

	Course Title	COURSE CODE	Credit Hours				Pre-Requisites
			Th.	Pr.	Tut./ Semi	Total C.H	
1	Advanced Engineering Geology	GEOL 624	3	0	0	3	
2	Advanced Ore Mineralogy	GEOL 626	3	0	0	3	
3	Integrated Water Management	GEOL 628	3	0	0	3	
4	Well Log Analysis	GEOL 630	3	0	0	3	

5	Natural Hazards and Their Assessment	**GEOL 632**	**3**	**0**	**0**	3	
6	Sedimentary Basin Analysis	**GEOL 634**	**3**	**0**	**0**	3	
7	Exploration Geochemistry	**GEOL 636**	**3**	**0**	**0**	3	
Total credit hours			**21**	**0**	**0**	**21**	

Fourth: Thesis

The student is required to write and defend a scientific thesis, carrying a weight of six credit hours.

Curriculum Map:

Curriculum Map (Alignment of Course Intended Learning Outcomes (CILOs) to the Program Courses)

Illustrated by Annex (11).

Annex (11) Alignment of Program Courses with PILOs (Curriculum Map Matrix)

The following table illustrates the Curriculum Map of the Program

Courses	Program ILOs																
	A1	A2	A3	A4	A5	B1	B2	B3	B4	C1	C2	C3	C4	C5	D1	D2	D3	D4
Advanced Sedimentology & Stratigraphy	1	1	1	0		1	1	0	0	1	1	0	0		1	0	1	1
Advanced Igneous & Metamorphic Petrology	1	0	1	0		1	1	0	0	1	1	0	0		1	0	0	0
Advanced Structural Geology	1	1	1	0		1	1	0	0	1	1	0	0		1	0	1	1
Advanced Petroleum Geology	1	1	1	1		1	1	1	1	1	0	1	0		1	0	1	1
Applications of Remote Sensing and GIS	1	1	1	0		1	0	1	1	1	0	1	0		1	0	0	0
Applied Hydrogeology	1	1	1	1		1	1	0	1	1	0	0	1		1	0	1	0

Courses	Program ILOs																	
	A1	A2	A3	A4	A5	B1	B2	B3	B4	C1	C2	C3	C4	C5	D1	D2	D3	D4
Exploration Geophysics	1	1	1	1		1	1	1	0	1	0	1	1		1	1	1	0
Advanced Engineering Geology	1	0	1	0		1	1	0	0	1	1	0	0		1	0	0	0
Advanced Ore Mineralogy	1	0	1	1		1	1	1	0	1	1	0	1		1	0	0	0
Integrated Water Management	1	1	1	0		1	0	1	1	0	0	1	1		1	1	1	0
Well Log Analysis	1	1	1	1		1	0	1	1	0	0	1	1		1	0	1	1
Natural Hazards and Their Assessment	1	1	1	0		1	1	1	0	1	0	0	1		1	1	1	0
Sedimentary Basin Analysis	1	1	1	1		1	1	1	1	0	1	1	1		1	1	1	0
Exploration Geochemistry	1	1	1	1		1	1	1	0	1	0	1	1		1	1	1	0

Teaching Strategies:

No.	Teaching Strategy	Description of Usage
1	**Interactive lectures**	They emphasize reciprocal face-to-face interactions, group processing, social skills development, positive interdependence, and individual accountability.
2	**Seminar**	Students are assigned to research a specific topic and are then evaluated on the presentation of their findings.
3	**Discussion and Debate**	An issue or topic is presented, followed by an exchange of different opinions and a discussion between students and the lecturer. The lecturer then provides feedback on the accuracy of the points raised and summarizes the key points.
4	**Problem-Solving**	Students are trained in scientific and logical thinking skills by being presented with unfamiliar problems or situations that challenge their cultural framework. They are then guided to develop solutions through reflection,

		research, and discussion under the supervision of the lecturer.
5	**Practical Demonstrations**	Students are tasked with conducting experiments, writing reports on their findings, and discussing the results.
6	**Field training**	Field trips to entities related to environmental specializations.

Alignment of Teaching Strategies with Program Learning Outcomes

Teaching Strategy	Program ILOs																
	A1	A2	A3	A4	A5	B1	B2	B3	B4	C1	C2	C3	C4	C5	D1	D2	D3	D4
Interactive lectures	✓	✓	✓	✓		✓	✓	✓	✓									
Group Discussion	✓	✓	✓	✓		✓	✓	✓	✓									
Seminar	✓	✓	✓												✓	✓	✓	✓
Discussion and Debate	✓	✓	✓	✓		✓	✓	✓	✓									
Brainstorming																		
Simulation						✓	✓											
Practical Demonstrations										✓	✓	✓	✓					
Problem-Solving						✓	✓	✓	✓									
Practical Application										✓	✓	✓	✓					
Self-Learning															✓	✓	✓	✓
Cooperative learning															✓	✓	✓	✓
Tasks and Assignments						✓	✓										✓	✓
Case Study									✓									
Field training															✓			

Assessment Strategies:

No.	**Assessment Strategy:**	Description (courses in which it is used and frequency of use)

1	**Written Exams**	They serve as a valuable method to assess the students' comprehension and understanding of the theoretical and practical topics covered in the courses through written answers to questions on midterm or final exams.
2	**Oral Exams**	----
3	**Quizzes**	----------
4	**Practical Exams**	For the professional skills courses that involve a laboratory, the use and control of equipment, or the development of physical and psychomotor dexterity skills, it is evident that such work must be assessed through practical experiments of some kind. There are two methods of practical assessment: 1. Continuous Observation: *Continuous observation* stands as the preferred method for courses emphasizing practical or motor skills, which constitute the majority of intended learning outcomes. By assessing each performance or product, instructors can attain a more comprehensive understanding of student performance and capabilities. In addition, timely and immediate feedback can be provided for improvement purposes whenever possible. This type of formative continuous assessment is particularly well-suited for practical skills courses. 2. Formative Presentation: This method involves demonstrating practical skills to an examiner. This assessment method resembles written closed-book exams in many respects, albeit with a practical orientation. However, it may pose challenges for students prone to test anxiety. Yet, many professional qualifications necessitate proficiency tests of this nature, underscoring the importance of thorough student preparation.

Alignment of Assessment Strategies with Program Learning Outcomes

Assessment Strategy	Program ILOs																
	A1	A2	A3	A4	A5	B1	B2	B3	B4	C1	C2	C3	C4	C5	D1	D2	D3	D4
Written Exams	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓					
Quizzes	✓	✓	✓	✓	✓	✓	✓	✓	✓									
Oral Exams						✓	✓	✓	✓	✓	✓	✓	✓					
Practical Exams						✓	✓	✓	✓	✓	✓	✓	✓					
Observation of Performance										✓	✓	✓	✓					
Assessment of Reports							✓	✓	✓						✓	✓	✓	✓
Portfolio										✓	✓	✓	✓		✓	✓	✓	

System of Study

Type of Program (Coursework/ Thesis/ Coursework and Thesis)	Coursework and Thesis		
Study Mode (Regular/ Distance Learning)	(Full-time) Regular		
Program Duration (coursework and thesis)	Min.	2	
	Max.	3	
Total Credit Hours Required for Program Completion (coursework and thesis)	(36) Credit Hours		

Annex (11) Coding of Program Courses and Alignment with PILOs (Curriculum Map Matrix)
Annex (12) Program Study Plan
Annex (13) Description of the Program's Courses

Program Study Plan

First Semester

	Course Title	COURSE CODE	Credit Hours				Prerequisites
			Th.	Pr.	Tut./ Semi	Total C.H.	
1	Advanced Sedimentology & Stratigraphy	GEOL 611	3	0	0	3	
2	Advanced Igneous & Metamorphic Petrology	GEOL 613	3	0	0	3	
3	Advanced Structural Geology	GEOL 615	3	0	0	3	

4	Advanced Petroleum Geology	GEOL 617	3	0	0	3	
5	Exploration Geophysics	GEOL 619	3	0	0	3	
	Total Credit Hours		15	0	0	15	

Second Semester

	Course Title	COURSE CODE	Credit Hours				Prerequisites
			Th.	Pr.	Tut./ Semi	Total C.H.	
1	Applications of Remote Sensing and GIS	GEOL 620	3	0	0	3	
2	Applied Hydrogeology	GEOL 622	3	0	0	3	
3	Elective Course	GEOL 696	3	0	0	3	
4	Elective Course	GEOL 697	3	0	0	3	
5	Elective Course	GEOL 698	3	0	0	3	
	Total Credit Hours		15	0	0	15	

Course Title	COURSE CODE	Credit Hours
Thesis	GEOL 699	6

Admission Requirements

Eligible Specializations	Bachelor of Science in Earth Sciences, Environmental Geology, Petroleum and Gas Engineering, Environmental Geology
English Language Proficiency Requirement: TOEFL / IBT	TOEFL
Computer Skills (ICDL	-
Other Requirements:	Admission Exam - Completion of complementary courses after making equivalence of the transferred courses.

Graduation Requirements

Total credit hours required for graduation: 36 credit hours
Minimum Passing Grade for Each Course
Total marks or overall grade required for graduation:

Grading System

Grading System:
From 90% to 100% of total marks: Excellent
From 80% to less than 90%: Very Good
From 75% to less than 80%: Good
From 65% to less than 75%: Pass
Less than 65%: Poor/Fail
Student must The minimum score for the average of all courses is 75% degree
The minimum average grade required for all courses must be 75%.

Learning Resources, Facilities, and Equipment for Program Implementation.

Learning Resources
Books, references, and other reference materials, including electronic internet resources, etc
Facilities and Equipment
Library, laboratories, equipment, apparatus, materials, medical or engineering facilities, classrooms, etc.

Teaching staff

	Professor	Associate Professor	Assistant Professor
Required staff	**3**	**5**	**5**
Available Staff	**3**	**9**	**2**
Note:	The department may seek assistance from specialized professors in the facult ..... at Sana'a University.		

Names of Teaching Staff in the Department

No.	Name	Academic Qualification	Academic Rank
1.	Khalid Ahmed Al-Subaie	Ph.D.	Professor
2.	Abdulkareem Ahmed Al-Subari	Ph.D.	Professor
3.	Khalid Mohammed Khanbari	Ph.D.	Professor
4.	Mahyoub Abdulrahman Saeed	Ph.D.	Associate Professor
5.	Ahmed Saif Al-Mikhlafi	Ph.D.	Associate Professor
6.	Ahmed Ali Al-Aidrous	Ph.D.	Associate Professor
7.	Adel Mohammed Ali Al-Matari	Ph.D.	Associate Professor
8.	Bassim Shaif Al-Khirbash	Ph.D.	Associate Professor
9.	Khalid Mohammed Thabet Al-Selwi	Ph.D.	Associate Professor
10.	Adnan Abdulaziz Baraheem	Ph.D.	Associate Professor
11.	Muneef Mohammed Amin Awn	Ph.D.	Associate Professor
12.	Ibrahim Abdulhameed Al-Akhali	Ph.D.	Associate Professor
13.	Al-Khateeb Yahya Al-Kebsi	Ph.D.	Assistant Professor
14.	Tariq Hishem Al-Hebshi	Ph.D.	Assistant Professor

Program evaluation and improvement

Evaluation Areas/Aspects	Evaluation Methods	Evaluation Time	Sample
The program has not been evaluated.			

Course Description

Advanced Sedimentology & Stratigraphy (3 Cr.H)

Description, genesis, correlation, and age of sediments, sedimentary rocks and layered rock sequences. Composition, identification, and classification of sedimentary rocks; geochemical processes affecting sedimentary rocks and surficial deposits. Mineralogy of sandstones, heavy minerals, diagenetic and burial depth history, and the geochemistry of major, minor and trace elements. Recognition of carbonate grains, cement types, and carbonate depositional environments, and their response to sea-level changes. Recognize and interpret mud and mudstone facies and their depositional environments. Observe stacking patterns and reconstruct sea-level fluctuations from mudstone/shale successions and their impact on the 3D distribution of mudstones/shales.

Advanced Igneous & Metamorphic Petrology (3 Cr.H)

Introduction to thermodynamics, phase equilibria in igneous processes, magmatic processes, igneous rock associations of different tectonic settings, metamorphic reactions and facies, material transport during metamorphism, geothermometry and geobarometry, pressure-temperature-time paths in regional metamorphic rocks.

Advanced Structural Geology (3 Cr.H)

Structures of the crust; geometry of folds and faults, rock deformation, criteria for recognizing structures, solution of geometrical problems. Rheology, deformation mechanisms, structural associations and advanced methods of structural analysis. Continuum mechanics applied to understanding of deformation within the earth. Stress and strain as tensors, with application to various geological settings; plate flexure and isostasy; steady state and time dependent heat conduction in a geological context; fluid mechanics of the earth.

Advanced Petroleum Geology (3 Cr.H)

Comprehensive treatment of the petroleum system with a focus on hydrocarbon exploration and production data and methods. Advanced techniques for creating subsurface geological maps based on seismic reflection and well log data. Introduction to opportunities and challenges of modern gas and oil development, including synergies with other energy sources.

Exploration Geophysics (3 Cr.H)

Geophysical exploration methods emphasizing hydrocarbon and mineral exploration, hydrogeology, and engineering applications. Seismic exploration methods, including theory, data acquisition, and data processing. Geophysical Exploration methods: gravity, Magnetic, Electrical and Electromagnetic, and Seismic Methods; Analyses and Interpretation of Geophysical Data; Recent developments in the processing and quantitative interpretation of geophysical Data; seismic stratigraphy.

Application of Remote Sensing & GIS (3 Cr.H)

Introduction to theory and application of using color, infrared, thermal, and RADAR images generated from satellite and aerial photographs for geographic, geologic, environmental, and planning purposes. Introduction to theoretical and practical understanding of fundamental GIS concept, capabilities, and applications with emphasis on nature of geographic data and issues of data input, data models, database design, spatial analysis, and data output using ArcGIS software.

Applied Hydrogeology (3 Cr.H)

Current literature, new techniques, legislative and political developments in hydrogeology, and appropriate case histories. Groundwater modeling from a geologic perspective. Conceptual models and computer modeling of groundwater flow and solute transport. Groundwater aquifers systems, characteristics, movement, aquifers recharge, discharge and contamination processes, groundwater and urbanization, karst hydrogeology, and human activities, impacts, consequences and implications, artificial groundwater recharge and water harvesting principles, problems and development, mapping groundwater vulnerability, hydrogeology of mineral and thermal waters, salt water intrusion, management of hazardous waste and groundwater protection zones.

Advanced Engineering Geology (3 Cr.H)

Advanced engineering geology focused on engineering practice. Interpretation of in-situ testing and laboratory test data (including groundwater) for the derivation of design parameters for input into numerical modeling software. The topics include design and analysis of site investigation for foundations, roads and dams, slope stability analysis and assessment, introduction to numerical modeling, engineering geological hazard assessment.

Advanced Ore Mineralogy (3 Cr.H)

Occurrence, origin, and exploration of economic metallic mineral deposits. Geochemical techniques applied to the geology, exploration, and environmental analysis of ore deposits.

Integrated Water Management (3 Cr.H)

Study of hydrologic processes and their application to needs of cities, industry, agriculture, and recreation. The course will introduce the new generation of methods used for investigating

groundwater systems. The primary focus would be on methods for estimating the components of the aquifer water balance, which are critical elements needed for reliable projections of future conditions.

Well Logs Analysis (3 Cr.H)

Petrophysics and well log interpretation as it relates to hydrocarbon exploration and production. Wireline logs, calculating rock and fluid properties from log measurements, and recognizing zones of potential hydrocarbons. Map and calculate volumes of hydrocarbons in the subsurface using the analysis of petrophysical properties from wireline well logs.

Natural Hazard Assessment (3 Cr.H)

Environmental hazard and disaster experiences to investigate the nature, impact, and social responses to environmental hazards; focus is placed on relationship between nature, society, and technology in how people and places perceive, experience, and cope with environmental hazards. Considers range and types of adjustments communities can participate in to manage risk associated with hazards such as earthquakes, floods, radiological and chemical hazards; emphasizes a multihazard approach to mitigation.

Sedimentary Basin Analysis (3 Cr.H)

Sedimentologic data base, correlation, mapping, facies models, classification, and evolution of sedimentary basins. Applications to petroleum exploration. Integration of depositional models using subsurface correlation, seismic stratigraphy, and sequence stratigraphy in analysis of basin-scale sedimentary systems and their fluids.

Supporting Annexes:

- Annex (1)Academic Standards of the Program for an International Accreditation Board
- Annex (2) A Survey of Names of Similar Reference Programs
- Annex (3) A Survey of Learning Outcomes for Similar Reference Programs and Their Alignment with Current Program Outcomes
- Annex(4) A Survey and Alignment of Aims of Similar Reference Programs with the Current Program Aims
- Annex (5) A Survey of Credit Hours of Similar Reference Programs
- Annex (6) A Survey of Courses in Similar Reference Programs
- Annex (7) Alignment of Program Aims with the Program Intended Learning Outcomes (PILOs)
- Annex (8) Attributes of the Program Graduates and Career Opportunities.
- Annex (9) Alignment of PILOs with the National Academic Reference Standards (NARS) (If applicable).
- Annex (10) Alignment of PILOs with International Reference Standards
- Annex (11) Coding of Program Courses and Their Alignment with PILOs (Curriculum Map Matrix)
- Annex (12) Program Study Plan
- .Annex (13) Description of the Program's Courses
- Annex (14) Teaching Staff Involved in Developing the Program Specification Document.

Appendices to the Program Specification Document

Annex (1)Academic Standards of the Program for an International Accreditation Board

Name of Accreditation Body:	**ASIIN - Global Leader in Quality Assurance in Higher Education**
Year of Standards Issuance:	**2011**
URL:	https://www.asiin.de/en/

Standards

Requirements for Master's Degree Programmes

As a continuation of an initial university degree Master's degree programs lead to a consolidation the analytic-methodical competences acquired in first-cycle degree programs. At the same time, the technical competences gained in initial degree programs are advanced and extended. In addition to the learning outcomes mentioned above, graduates of Master's degree programs in the field of geosciences typically have acquired the following:

No.	
1	advanced knowledge and understanding of the principles of Geosciences
2	deeper knowledge of a chosen specialization
3	critical awareness of the forefront of their specialization
4	advanced understanding of earth system relevant to their specialization
5	appreciation of the learning capacity needed to progress to independent research
6	ability to specify and complete geological tasks that are complex, incompletely defined or unfamiliar
7	some ability to formulate and solve problems in new and emerging areas of their discipline
8	ability to apply state of the art or innovative methods in problem solving, possibly involving use of other disciplines
9	ability to think creatively to develop new and original approaches and methods
10	ability to design appropriate experiments, to analyze and interpret data and draw conclusions
11	ability to use advanced, and to develop customized, quantitative methods
12	comprehensive understanding of applicable techniques and methods for a particular specialization, and of their limits



13	awareness of the limits of current knowledge and the practical application of the state-of-the-art techno
14	knowledge and understanding of Geosciences to create models of complex systems and processes

No.	
15	basic ability to contribute to the further development of Geosciences in practice and research
16	ability to produce independent work in their professional and scientific fields
17	ability to manage and work effectively as leader of teams that may be composed of different disciplines and level
18	basic ability to work effectively and communicate in national and international contexts
19	appreciation of the role of Geosciences in the development of knowledge, wealth creation and improving quality of life
20	ability to evaluate performance as an individual and a team member
21	ability to identify individual and collective goals and responsibilities and to perform in a manner appropriate to these roles
22	ability to evaluate critically of professional and research papers
23	ability to plan and appropriate program of continuing professional development

Annex (2) A Survey of Names of Accredited Reference Programs Similar to the Current Program

Similar Program		University	College/center/institute	Department	Country	Program Accrediting Body	Degree Awarded at Program Completion	Year of Accreditation
First Program	MS in Geology	King Saud	Science	Geology	Saudi Arabia	ASIIN	M.Sc.	2011
Second Program	Master in Earth Science	The University of Memphis	Earth Sciences	Earth Sciences	U.S.A	ASIIN	M.Sc.	
Third Program	Master of Science in Applied Geosciences	German University of Technology	Science	Geosciences	Oman	ASIIN	M.Sc.	
Fourth Program	Master in Geology	University of Leicester	School of Geography, Geology and the Environment.	Geology	U.K	Geological Society of London	M.Sc. (MGeol)	
Fifth Program	Master of Science in Geosciences	Colorado State	Warner College of Natural Resources	Geosciences	U.S.A		M.Sc.	
Sixth Program	M.Sc. EARTH SCIENCE	Yarmouk University	Science	Earth & Environmental Sciences	Jordan		M.Sc.	
7	M.Sc. Geological Engineering	Missouri S&T	COLLEGE OF ENGINEERING AND COMPUTING	Geosciences and Geological and Petroleum Engineering	U.S.A	ABET	M.Sc.	
8	MSc Geology	UNIVERSITY OF KERALA	Faculty of Science	Geology	India		M.Sc.	

The Websites (URLs) of the Similar Reference Programs

University Name	Website
King Saud University	https://www.ksu.edu.sa/
The University of Memphis	https://www.memphis.edu/earthsciences/
German University of Technology in Oman	https://www.gutech.edu.om/
University of Leicester	https://le.ac.uk/geology

Colorado State University	http://colostate.edu/
Yarmouk University	*www.yu.edu.jo*
Missouri S&T University	*http://catalog.mst.edu/graduate/graduatedegreeprograms/* *https://www.mst.edu/*
UNIVERSITY OF KERALA	*https://www.keralauniversity.ac.in/*

Summary of a Survey of Credit Hours and Courses in Reference Programs Similar to the Current Program

University	King Saud	Memphis	German university	University of Leicester	Colorado State	Yarmouk University	Missouri S&T	UNIVERSITY OF KERALA	Current Program (Sana'a University)
Country	Saudi Arabia	United States	Oman	England	United States	Jordan	United States	Indian	Republic of Yemen
Faculty/Institute	Science	Earth Sciences	Science	Science	Natural Resources	Science	Engineering and Computer Science	Science	Petroleum and Natural Resources
Program	Geology	Earth Sciences	Applied Geology	Geology	Geosciences	Earth Sciences	Engineering Geology	Geology	Earth Sciences
System of Study	Coursework and Thesis	Coursework and Thesis	Coursework and Thesis	Coursework and Thesis	Coursework and Thesis + Coursework only	Coursework and Thesis	Coursework and Thesis + Coursework only	Coursework and Thesis	Coursework and Thesis
Number of Semesters (if any)	4	-	6	2	-	6	-	-	4
Total Credit Hours (Without Thesis)	24	26	120 ECTS credit points	32	24	24	24	32	30
Number of Credit Hours for Compulsory Courses (if any)	24	12	60	24	9	15	9	32	21
Number of Credit Hours for Elective Courses (if any)	0	14	40	-	15	9	15	0	9
Number of Compulsory Courses (if any)	8		12	6	3	7	3	16	7
Number of Elective Courses (if any)	0		7	-	12	15	7	0	9
Existence of Complementary Courses for program Admission and Their Number (Yes/No)	No	No	No	YEAR 3/BSc FINAL YEAR	Yes	No	No	No	No
Number of Credit Hours for the Thesis	6	6	20	-	6	9	6	2	6

Specified Duration for Thesis Completion	One semester	One semester	One semester	1	2 semesters	2 semesters	2 semesters	3 semesters	2 semesters
Minimum Duration for Program Completion	2 years	2 years	3 years	1	2 years	2 years	2 years	2 years	2 years
Maximum Duration for Program Completion				4 to 5 years		3 years			3 years

Annex (3) A Survey of Learning Outcomes for Similar Reference Programs and Their Alignment with Current Program Outcomes

Current Program		Similar Reference Programs					
		First Program	Second Program	Third Program	Fourth Program	Fifth Program	Sixth Program
Current Program	M.Sc. in Earth Sciences	Master of Science in Applied Geosciences	Master in Geology	Master in Earth Science	M.Sc. Geological Engineering	MSc Geology	
Faculty/center/institute:	Petroleum and Natural Resources	Faculty of science-	School of Geography, Geology and the Environment.	Earth Sciences, The	COLLEGE OF ENGINEERING AND COMPUTING,	Faculty of Science,	
University:	Sana'a University	German University of Technology (Oman) GUtech	University of Leicester	University of Memphis	Missouri S&T	UNIVERSITY OF KERALA	
Country	Republic of Yemen	Oman	England	United States	United States	Indian	
Program Intended Learning Outcomes (PILOs)	Upon successful completion of the program, the graduates shall be able to:						
Knowledge and Understanding	A1. Show advanced knowledge and understanding of the core earth science technical disciplines, notably in geology and in geophysics	√	√	√	√	√	
	A2. Provide essential knowledge of the key applied geoscience and engineering disciplines (i.e. geostatistics, petrophysics, and modelling) and to appreciate their relationship and inter-dependency with the core geoscience subjects	√		√	√	√	
	A3. Demonstrate advanced understanding of earth system relevant to deeper knowledge of a		√	√		√	

		chosen specialization						
	A4.	Show understanding of the complexity of natural resources environments for sustainable management in exploration and production.	√			√	√	
B. Cognitive/ Intellectual Skills:	B1.	Describe, identify and interpret a range of geological materials in the laboratory and field.	√	√	√			
	B2.	Determine and interpret the geology of a region via a range of field-based techniques.	√			√	√	
	B3.	Utilize geological knowledge and data for modeling purposes (for example, for evaluation of scientific hypotheses, for hazard mitigation, or for resource estimation).			√		√	
	B4.	Apply a diverse range of methods of analysis, evaluation and promotion, including quantitative and qualitative (e.g. empirical social research), IT-based (e.g. GIS applications, petroleum basin modelling, hydrogeological modelling).	√	√	√	√	√	
Practical and Professional Skills:	C1.	Carry out a range of field-based studies (e.g., geological mapping, sample collection and recording of field observations).	√	√			√	
	C2.	Draw and describe geological		√	√			

		features, specimens and thin sections.						
	C3.	Use appropriate numerical, statistical and graphical methods or software effectively to solve numerical, spatial, temporal and geometrical problems.	√	√		√		
	C4.	Assess and carefully consider the cultural, environmental, and economic impact of global business activities on natural resources.	√		√		√	
Transferable Skills	D1.	Present work and findings with clarity and accuracy, orally (including presentation) and in writing			√		√	
	D2.	Participate effectively, either independently or as a member of an integrated team demonstrating a knowledge of a number of research techniques and procedures	√	√	√	√		
	D3.	Use appropriate software packages to prepare written reports, essays, posters and presentations		√				
	D4.	Use the internet critically for information retrieval and to communicate geological knowledge effectively.			√	√	√	

PILOs of Similar Programs

PILOs of the First Reference Program:

First Reference Program:	**Master of Science in Applied Geosciences**
Faculty & University:	Faculty of science- German University of Technology (Oman) GUtech
Country	Oman
URL	Master of Science in Applied Geosciences (GUtech - Oman) https://www.gutech.edu.om/academic/geoscience/applied-geosciences/master-applied-geosciences/

Program Intended Learning Outcomes (PILOs)	
Code or Number	
1. Interdisciplinary thinking	The nature of the study program requires the students to develop interdisciplinary skills which allow them to see issues from different perspectives and understand the influence of one discipline on another. These skills enable the students to effectively solve complex issues using creative solutions from different disciplinary approaches.
2. Theoretical knowledge	Comprehension of the theoretical concepts underpinning the study of applied geosciences with focus on the petroleum and mining industry. The program also allows the students to relate such theories to wider national and international economic and environmental issues.
3. Methodological diversity	Skills for applying a diverse range of methods of analysis, evaluation and promotion, including quantitative and qualitative (e.g. empirical social research), IT-based (e.g. GIS applications, petroleum basin modelling, hydrogeological modelling), and communication-driven approaches (e.g. expert interview or discussion moderation).
4. Communication skills	Expertise in incorporating views and interests of various stakeholders from business, regional and central government, private companies, and representatives of local communities into strategic concepts.
5. Innovation and entrepreneurial skills	Application of innovative approaches in acquiring and presenting knowledge and dealing with business cases and projects. A focus is set on developing entrepreneurial skills matching national priorities.
6. Analytical and reflective thinking	Understanding the complexity of natural resources environments for sustainable management in exploration and production. The programme also enables the students to critically assess and carefully consider the cultural,

	environmental, and economic impact of global business activities on natural resources. Participants should be able to use critical and analytical thinking in selecting appropriate development models and rejecting others depending on the profile of the region and communities they are dealing with.
7. ethical issues	The degree program addresses ethical issues in applied geosciences in particular in the environmental sector related to petroleum exploration, mining and water resources at several levels during the study with focus on sustainability.
8.	Use their knowledge and skill to enhance understanding of earth for the well-being of society and the environment
9.	Exhibit honesty in professional actions at all times
10.	Work to enhance the prestige of the geoscience profession
11.	Support the profession and technical societies of the profession

PILOs of the Second Reference Program:

Second Reference Program:	Master in Geology
Faculty & University:	School of Geography, Geology and the Environment. University of Leicester
Country	U.K
URL	*https://le.ac.uk/geology*

Program Intended Learning Outcomes (PILOs)	
Code or Number	
1. 1	Demonstrate knowledge of the general principles and techniques of Geology, including the structure, composition and evolution of the Earth and its interrelationships with the hydrosphere, crysosphere, biosphere, and atmosphere.
2.	Describe, identify and interpret a range of geological materials in the laboratory and field; utilise appropriate techniques to enable this; and demonstrate an understanding of any relationship with the field area from where they were recovered.
3.	Determine and interpret the geology (senso lato) of a region via a range of field-based techniques.
4.	Demonstrate an understanding of geological time, rates and fluxes, and the techniques required to determine them.
5.	Utilise geological knowledge and data for modeling purposes (for example, for evaluation of scientific hypotheses, for hazard mitigation, or for resource estimation).
6.	Demonstrate and apply knowledge of safety procedures in the field.
7.	Demonstrate a knowledge of a number of research techniques and procedures
8.	Ability to recognise theories paradigms, concepts and principles; apply scientific principles to evaluate current geological paradigms; and evaluate environmental and societal aspects of the Earth's resources.
9.	Synthesise and interpret results, in order to effectively communicate (via written, oral, graphical means) data and ideas to a range of audiences.
10.	Develop and sustain geological arguments. Construct and test scientific hypotheses and appropriately use geological data.
11	Carry out a range of field-based studies (e.g., geological mapping, sample collection and recording of field observations).
12	Give effective presentations using appropriate methods.
13	Participate effectively in tutorial and other group discussions, and an ability to respond effectively to questioning.

14	Effectively lead and direct discussion of controversial subject-specific topics.
15	Communicate effectively and appropriately in a variety of written formats including essays, reports, projects, CVs and posters
16	Draw and describe geological features, specimens and thin sections.
17	Use spreadsheets to enter, manipulate and display numerical data.
18	Use appropriate software packages to prepare written reports, essays, posters and presentations (e.g., PowerPoint)
19	Author a web-page to communicate geological knowledge effectively.
20	Organize and work effectively within a team, and evaluate performance of self and of team.
21	Solve numerical, spatial, temporal and geometrical problems.
22	An ability to plan and execute an independent research project.

PILOs of the Third Reference Program:

Third Reference Program:	Master in Earth Science
Faculty & University:	Earth Sciences, The University of Memphis
Country	USA
URL	https://www.memphis.edu/earthsciences/programs/graduate/graduate.php ASSIN

Program Intended Learning Outcomes (PILOs)	
Code or Number	
1	advanced knowledge and understanding of the principles of Geosciences
2	deeper knowledge of a chosen specialization
3	critical awareness of the forefront of their specialization
4	advanced understanding of earth system relevant to their specialization
5	appreciation of the learning capacity needed to progress to independent research
6	ability to specify and complete geological tasks that are complex, incompletely defined or unfamiliar
7	some ability to formulate and solve problems in new and emerging areas of their discipline
8	ability to apply state of the art or innovative methods in problem solving, possibly involving use of other disciplines
9	ability to think creatively to develop new and original approaches and methods
10	ability to design appropriate experiments, to analyze and interpret data and draw conclusions
11	ability to use advanced, and to develop customized, quantitative methods
12	comprehensive understanding of applicable techniques and methods for a particular specialization, and of their limits
13	awareness of the limits of current knowledge and the practical application of the state-of-the-art techno
14	knowledge and understanding of Geosciences to create models of complex systems and processes
15	basic ability to contribute to the further development of Geosciences in practice and research
16	ability to produce independent work in their professional and scientific fields
17	ability to manage and work effectively as leader of teams that may be composed of different disciplines and level
18	basic ability to work effectively and communicate in national and international contexts

19	appreciation of the role of Geosciences in the development of knowledge, wealth creation and improving quality of life
20	ability to evaluate performance as an individual and a team member
21	ability to identify individual and collective goals and responsibilities and to perform in a manner appropriate to these roles
22	ability to evaluate critically of professional and research papers
23	ability to plan and appropriate program of continuing professional development

PILOs of the Fourth Reference Program:

Fourth Reference Program:	M.Sc. Geological Engineering
Faculty & University:	COLLEGE OF ENGINEERING AND COMPUTING, **Missouri S&T**
Country	USA
URL	http://catalog.mst.edu/graduate/graduatedegreeprograms/geologicalengineering/ ABET

Program Intended Learning Outcomes (PILOs)	
Code or Number	
1	an ability to apply knowledge of mathematics, science, and engineering
2	an ability to design and conduct experiments, as well as to analyze and interpret data
3	an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
4	an ability to function on multidisciplinary teams
5	an ability to identify, formulate, and solve engineering problems
6	an understanding of professional and ethical responsibility
7	an ability to communicate effectively the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
8	a recognition of the need for, and an ability to engage in life-long learning
9	a knowledge of contemporary issues
10	an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

PILOs of the Fifth Reference Program:

Fifth Reference Program:	MSc Geology
Faculty & University:	Faculty of Science, UNIVERSITY OF KERALA
Country	India
URL	https://www.keralauniversity.ac.in/dept/dept-home

Program Intended Learning Outcomes (PILOs)	
Code or Number	
PSO1	Understand the basic concepts of physical geology, geomorphology, structural geology, engineering geology and environmental geology and apply this knowledge to analyze geological formations and structures for effective human use.
PSO2	Understand the minerals, and the economic significance of mineral deposits, apply the concepts of exploration geology to analyze the formation and significance of ore deposits
PSO3	Understand how rocks are formed, the underlying geochemical and petrological principles and apply this knowledge to analyze sedimentary, igneous and metamorphic rocks for unravelling earth history and economic utilization, understand how water behaves within the Earth, and apply this knowledge to analyze groundwater resources.
PSO4	Understand the principles of stratigraphy and palaeontology, and apply this knowledge to analyze the evolution of the Earth and life on it.
PSO5	Understand how Earth can be sensed remotely, resources mapped and analysed, with the aid of geoinformatics tools, and how disasters can be mitigated and managed.
PSO6	Analyze and apply the knowledge gained through studies into a thesis that incorporates scientific planning and execution of work, methodology, analyses, and presentation of results, all within the ambit of research ethics, possibly leading to the creation of new knowledge in geosciences.

Annex (4) A Survey and Alignment of Aims of Similar Reference Programs with the Current Program Aims

Current Program		**Similar Reference Programs**					
		First Program	**Second Program**	**Third Program**	**Fourth Program**	**Fifth Program**	**Sixth Program**
Current Program	**M.Sc. in Earth Sciences**	Master of Science in Applied Geosciences	Master in Geology	Master in Earth Science	M.Sc. Geological Engineering	MSc Geology	MS in Geology

Faculty/center/institute:	Faculty of Petroleum and Natural Resources	Faculty of science-	School of Geography, Geology and the Environment.	Earth Sciences, The	COLLEGE OF ENGINEERING AND COMPUTING,	Faculty of Science,	Science
University:	Sana'a University	German University of Technology (Oman) GUtech	University of Leicester	University of Memphis	Missouri S&T	UNIVERSITY OF KERALA	King Saud
Country	Republic of Yemen	Oman	England	United States	United States	Indian	Saudi Arabia
Current Program Aims							
6. To provide a sound basis of knowledge and understanding for the study the Earth Sciences applying to the natural environment and industry.		√	√		√	√	√
7. To develop practical and professional skills to the analysis of the geological data in a responsible and safe manner, paying due attention to risk assessment, rights of access, and the relevant health and safety regulations.		√	√		√	√	√
8. To recognize applicable theories for the interpretation of geological information.		√	√			√	
9. To prepare an attitude for innovation and research through laboratory and field applications and participation in research projects, scientific competitions and conferences.		√	√		√		
10. To support and execution of academic and applied research projects to explore and develop the petroleum, mineral and groundwater resources in Yemen			√		√	√	√

Aims of Similar Programs:

Aims of the First Reference Similar Program:

First Reference Program:	Master of Science in Applied Geosciences
Faculty/center/institute:	Faculty of science-
University:	German University of Technology (Oman) GUtech
Country	Oman
URL	https://www.gutech.edu.om/academic/geoscience/applied-geosciences/master-applied-geosciences/

No.	Program Aims
1	The program also allows the students to relate such theories to wider national and international economic and environmental issues.
2	applying a diverse range of methods of analysis, evaluation and promotion, including quantitative and qualitative
3	Application of innovative approaches in acquiring and presenting knowledge and dealing with business cases and projects
4	Understanding the complexity of natural resources environments for sustainable management in exploration and production. The program also enables the students to critically assess and carefully consider the cultural, environmental, and economic impact of global business activities on natural resources.
5	Participants should be able to use critical and analytical thinking in selecting appropriate development models and rejecting others depending on the profile of the region and communities they are dealing with.
6	Use their knowledge and skill to enhance understanding of earth for the well-being of society and the environment;
7	Exhibit honesty in professional actions at all times
8	Work to enhance the prestige of the geoscience profession; and Support the profession and technical societies of the profession

Aims of the Second Reference Similar Program:

Second Reference Program:	Master in Geology
Faculty/center/institute:	School of Geography, Geology and the Environment.
University:	University of Leicester
Country	U.K
URL	*https://le.ac.uk/geology*

No.	Program Aims
1	provide students with a breadth of knowledge of Geology, and exposure to areas of research at the cutting edge of the Earth Sciences;
2	provide students with a thorough understanding of the theoretical and practical applications of Geology in the study of the Earth, and environmental and societal issues
3	equip students with transferable and subject-specific skills necessary primarily for a career in the Earth Sciences, or a closely related field

4	promote the development of ICT and written, oral and presentation skills appropriate for a science graduate at the MGeol level
5	stimulate students to develop a wide range of independent and team skills
6	ensure that students benefit from an extensive program of work in the field, developing fundamental geological knowledge through observation and critical analysis as well as developing personal and character skills
7	provide students, via the curriculum and research expertise of staff, with a first training in research and research techniques appropriate for further postgraduate study or a research position in industry
8	provide students with the environment in which to develop their interest in Geology
9	enthuse and motivate all students to achieve their full potential in their degree course
10	Provide breadth and depth, via advanced M-level modules, in the subject area of Geology
11	provide students with a training in, and appreciation of, research methods in Geology

Aims of the Third Reference Similar Program:

Third Reference Program:	**Master in Earth Science**
Faculty/center/institute:	**Earth Sciences,**
University:	**The University of Memphis**
Country	USA
URL	https://www.memphis.edu/earthsciences/programs/graduate/graduate.php ASSIN

No.	Program Aims
1	
2	

Aims of the Fourth Reference Similar Program:

Fourth Reference Program:	**M.Sc. Geological Engineering**
Faculty/center/institute:	COLLEGE OF ENGINEERING AND COMPUTING,
University:	**Missouri S&T**
Country	USA
URL	http://catalog.mst.edu/graduate/graduatedegreeprograms/geologicalengineerig/ ABET

No.	Program Aims
1	assessing and mitigating geologic hazards (subsidence, landslides, flooding, etc.),
2	evaluating and improving groundwater resources, sustainably developing mineral and energy resources
3	selecting appropriate sites for civil and military infrastructure, and analyzing land use and environmental impacts.

Aims of the Fifth Reference Similar Program:

Fifth Reference Program:	**MSc Geology**
Faculty/center/institute:	**Faculty of Science,**
University:	**UNIVERSITY OF KERALA**
Country	India
URL	https://www.keralauniversity.ac.in/dept/dept-home

No.	Program Aims
1	Creation of a pool of skilled and technically qualified geologists who would be industry ready, both in core geology as well as in IT-oriented geology fields like geoinformatics etc.
2	Creation of skilled geologists who can meld core geology with IT skills, thereby contributing directly to the Make-in-India endeavor
3	Creation of resourceful geologists who would be grounded in science, but technically equipped to tackle geological challenges, adopt spatial planning techniques in problem solving, and disaster management

Aims of the Sixth Reference Similar Program:

Sixth Reference Program Name:	**MS in Geology**
Faculty/center/institute:	**Science**
University:	**King Saud**
Country	Saudi Arabia
URL	*https://www.ksu.edu.sa*

No.	Program Aims
1	To achieve excellence in imparting higher education in the fields of earth sciences, with due emphasis on the quality of students at undergraduate and graduate levels.
2	To develop applied scientific research through geological, geophysical and hydrogeological projects as per the national plan

Annex (5) A Survey of Credit Hours of Similar Reference Programs

Required Data	Similar Reference Programs						Current Program
	First Program	Second Program	Third Program	Fourth Program	Fifth Program	Sixth Program	
Program:	Geology	Earth Sciences	Geosciences	Earth Sciences	Engineering Geology	Geology	M.Sc. in Earth Sciences
Faculty/center/institute:	Science	Earth Sciences	Natural Resources	Science	Engineering and Computer Science	Science	Petroleum and Natural Resources
University:	King Saud	Memphis	Colorado State	Yarmouk University	Missouri S&T	UNIVERSITY OF KERALA	Sana'a University
Country	Saudi Arabia	United States	United States	Jordan	United States	Indian	Republic of Yemen
System of Study	Coursework and thesis	Coursework and thesis	Coursework and Thesis	Coursework and Thesis + Coursework only	Coursework and Thesis	Coursework and Thesis + Coursework only	Coursework and Thesis
Study Mode	(Full-time) Regular	(Full-time) Regular	(Full-time) Regular	(Full-time) Regular	(Full-time) Regular	(Full-time) Regular	(Full-time) Regular
Number of Semesters (if any)	4	-	-	6	-	-	4
Total Credit Hours (Without Thesis)	24	26	24	24	24	24	30
Total Credit Hours for Compulsory Courses	24	12	9	15	9	32	21
Total Credit Hours for Elective Courses	-	14	15	9	15	0	9
Number of Compulsory Courses	8		3	7	3	16	7
Number of Elective Courses	0		12	15	7	0	9
Existence of additional prerequisite courses for program admission and their number	-	-	Yes	No	No	No	No
Total Credit Hours for Courses	24	26	24	24	24	24	30

Number of credit hours for the thesis	6	6	6	9	6	2	6
Number of Credit Hours (Coursework + Thesis)	30	32	30	33	30	26	36
Specified duration for thesis completion	One semester	One semester	2 semesters	2 semesters	2 semesters	3 semesters	2 semesters
Minimum Duration for Program Completion	2	2	2 years	2 years	2 years	2 years	2 years
Maximum Duration for Program Completion				3 years			3 years

The Websites (URLs) of the Similar Reference Programs

No.	Program Name	University Name	Website (URL)
1	Geology	King Saud	*https://www.ksu.edu.sa/*
2	Earth Sciences	Memphis	*https://www.memphis.edu/earthsciences/programs/graduate/graduate.php*
3	Geosciences	Colorado State	*http://colostate.edu/*
4	Earth Sciences	Yarmouk University	*www.yu.edu.jo*
5	Engineering Geology	Missouri S&T	*http://catalog.mst.edu/graduate/graduatedegreeprograms/geologicalengineering/*
6	Geology	UNIVERSITY OF KERALA	*https://www.keralauniversity.ac.in/dept/dept-home*

Annex (6) A Survey of Course Titles in Similar Reference Programs

	Program	Current Program	First Program	Second Program	Third Program	Fourth Program	Fifth Program	Sixth Program	Seventh Program	Eighth Program
Course Title in the Current Program	Program:	M.Sc. in Earth Sciences	M.Sc. in Geology	M.Sc. Geological Engineering	M.Sc. in EARTH SCIENCE	MGeol	MSc Geology	M.Sc. Applied Geosciences	M.Sc. Earth Sciences	M.Sc. Geosciences
	Faculty/Center:	Petroleum and Natural Resources	Science	COLLEGE OF ENGINEERING AND COMPUTING	Science	School of Geography, Geology and the Environment.	Sciences	Sciences	Earth Sciences	Warner College of Natural Resources
	University:	Sana'a University	KSU	Missouri S&T	YARMOUK	Leicester	UNIVERSITY OF KERALA	GUtech	Memphis	Colorado State
	Country	Yemen	Saudi Arabia	United States	Jordan	Britain	Indian	Oman	United States	United States
	System of Study	Coursework and Thesis	Coursework and Thesis	Coursework and Thesis/ Coursework only	Coursework and Thesis	Coursework and Thesis	Coursework and Thesis	Coursework and Thesis	Coursework and Thesis	Coursework and Thesis/ Coursework only
	Specified Duration for Coursework Completion	2 semesters	2 semesters	-	-	-		-	-	-
	Total Credit Hours for the Courses	30	24	24	24	32	32	120 ECTS	22	24
1.	Advanced Igneous & Metamorphic Petrology		Advanced Igneous Petrology	-	Advanced Igneous & Metamorphic Petrology	Igneous Petrogenesis	Igneous and Metamorphic Petrology		Igneous/ Metamrphic Petr	Advanced Petrology
2.	Advanced Sedimentology & Stratigraphy		Advanced Stratigraphy Advanced Sedimentary	-	Advanced Sediments and Sedimentary Rocks	Evolutionary Palaeobiology	Sedimentology, Stratigraphy and Palaeontology	Applied Sedimentology and Stratigraphy	Sedimentary Petrology	Advanced Petrology Carbonate Sedimentology

Course Title in the Current Program	Program	Current Program	First Program	Second Program	Third Program	Fourth Program	Fifth Program	Sixth Program	Seventh Program	Eighth Program
	Program:	M.Sc. in Earth Sciences	M.Sc. in Geology	M.Sc. Geological Engineering	M.Sc. in EARTH SCIENCE	MGeol	MSc Geology	M.Sc. Applied Geosciences	M.Sc. Earth Sciences	M.Sc. Geosciences
	Faculty/Center:	Petroleum and Natural Resources	Science	COLLEGE OF ENGINEERING AND COMPUTING	Science	School of Geography, Geology and the Environment.	Sciences	Sciences	Earth Sciences	Warner College of Natural Resources
	University:	Sana'a University	KSU	Missouri S&T	YARMOUK	Leicester	UNIVERSITY OF KERALA	GUtech	Memphis	Colorado State
	Country	Yemen	Saudi Arabia	United States	Jordan	Britain	Indian	Oman	United States	United States
	System of Study	Coursework and Thesis	Coursework and Thesis	Coursework and Thesis/ Coursework only	Coursework and Thesis	Coursework and Thesis	Coursework and Thesis	Coursework and Thesis	Coursework and Thesis	Coursework and Thesis/ Coursework only
	Specified Duration for Coursework Completion	2 semesters	2 semesters	-	-	-		-	-	-
	Total Credit Hours for the Courses	30	24	24	24	32	32	120 ECTS	22	24
			petrology							
3.	Advanced Structural Geology		Geodynamics	-	Advanced Structural Geology and Tectonics	Advanced Field Course	Structural Geology	Tectonics and Structural Geology	Structural Geology	Advanced Structural Geology
4.	Remote Sensing and GIS			Remote Sensing Technology-Applications Of GIS	Advanced Remote Sensing and GIS		Remote Sensing and Photogrammetry +Geographical Information Systems		GIS Analyses Remote Sensing	

Course Title in the Current Program	Program	Current Program	First Program	Second Program	Third Program	Fourth Program	Fifth Program	Sixth Program	Seventh Program	Eighth Program
	Program:	M.Sc. in Earth Sciences	M.Sc. in Geology	M.Sc. Geological Engineering	M.Sc. in EARTH SCIENCE	MGeol	MSc Geology	M.Sc. Applied Geosciences	M.Sc. Earth Sciences	M.Sc. Geosciences
	Faculty/Center:	Petroleum and Natural Resources	Science	COLLEGE OF ENGINEERING AND COMPUTING	Science	School of Geography, Geology and the Environment.	Sciences	Sciences	Earth Sciences	Warner College of Natural Resources
	University:	Sana'a University	KSU	Missouri S&T	YARMOUK	Leicester	UNIVERSITY OF KERALA	GUtech	Memphis	Colorado State
	Country	Yemen	Saudi Arabia	United States	Jordan	Britain	Indian	Oman	United States	United States
	System of Study	Coursework and Thesis	Coursework and Thesis	Coursework and Thesis/ Coursework only	Coursework and Thesis	Coursework and Thesis	Coursework and Thesis	Coursework and Thesis	Coursework and Thesis	Coursework and Thesis/ Coursework only
	Specified Duration for Coursework Completion	2 semesters	2 semesters	-	-	-		-	-	-
	Total Credit Hours for the Courses	30	24	24	24	32	32	120 ECTS	22	24
5.	Applied Hydrogeology		Advanced Hydrogeology	Subsurface Hydrology	Applied Hydrogeology		Hydrogeology	Water Resources	Physical Hydrology	Advanced Topics in Hydrogeology
6.	Advanced Ore Deposits		Mineral Geochemistry	-	Advanced Applied Geochemistry	Ore Genesis	Mineralogy & Geochemistry	Ore Mineralogy		Ore Deposit Geochemistry
7.	Advanced Petroleum Geology		Advanced Petroleum Geology	Subsurface Exploration	Advanced Petroleum Geology			Petroleum Resources		Petroleum Geology

Course Title in the Current Program	Program	Current Program	First Program	Second Program	Third Program	Fourth Program	Fifth Program	Sixth Program	Seventh Program	Eighth Program
	Program:	M.Sc. in Earth Sciences	M.Sc. in Geology	M.Sc. Geological Engineering	M.Sc. in EARTH SCIENCE	MGeol	MSc Geology	M.Sc. Applied Geosciences	M.Sc. Earth Sciences	M.Sc. Geosciences
	Faculty/Center:	Petroleum and Natural Resources	Science	COLLEGE OF ENGINEERING AND COMPUTING	Science	School of Geography, Geology and the Environment.	Sciences	Sciences	Earth Sciences	Warner College of Natural Resources
	University:	Sana'a University	KSU	Missouri S&T	YARMOUK	Leicester	UNIVERSITY OF KERALA	GUtech	Memphis	Colorado State
	Country	Yemen	Saudi Arabia	United States	Jordan	Britain	Indian	Oman	United States	United States
	System of Study	Coursework and Thesis	Coursework and Thesis	Coursework and Thesis/ Coursework only	Coursework and Thesis	Coursework and Thesis	Coursework and Thesis	Coursework and Thesis	Coursework and Thesis	Coursework and Thesis/ Coursework only
	Specified Duration for Coursework Completion	2 semesters	2 semesters	-	-	-		-	-	-
	Total Credit Hours for the Courses	30	24	24	24	32	32	120 ECTS	22	24
8.	Well Logging		Interpretation of Well Logging	Subsurface Exploration	Advanced Exploration Geophysics		Advanced Mapping Techniques & Exploration	Well Log Analysis		Petrophysics and Well Log Interpretation
9.	Water Resources Management		-	-	-			Hydrogeological Modelling	Water Resources	Groundwater Modeling
10.	Advanced Engineering Geology			Engineering Geology And Geotechnics	Advanced Engineering Geology		Engineering Geology		Multihazard Mitigation	

Course Title in the Current Program	Program	Current Program	First Program	Second Program	Third Program	Fourth Program	Fifth Program	Sixth Program	Seventh Program	Eighth Program
	Program:	M.Sc. in Earth Sciences	M.Sc. in Geology	M.Sc. Geological Engineering	M.Sc. in EARTH SCIENCE	MGeol	MSc Geology	M.Sc. Applied Geosciences	M.Sc. Earth Sciences	M.Sc. Geosciences
	Faculty/Center:	Petroleum and Natural Resources	Science	COLLEGE OF ENGINEERING AND COMPUTING	Science	School of Geography, Geology and the Environment.	Sciences	Sciences	Earth Sciences	Warner College of Natural Resources
	University:	Sana'a University	KSU	Missouri S&T	YARMOUK	Leicester	UNIVERSITY OF KERALA	GUtech	Memphis	Colorado State
	Country	Yemen	Saudi Arabia	United States	Jordan	Britain	Indian	Oman	United States	United States
	System of Study	Coursework and Thesis	Coursework and Thesis	Coursework and Thesis/ Coursework only	Coursework and Thesis	Coursework and Thesis	Coursework and Thesis	Coursework and Thesis	Coursework and Thesis	Coursework and Thesis/ Coursework only
	Specified Duration for Coursework Completion	2 semesters	2 semesters	-	-	-		-	-	-
	Total Credit Hours for the Courses	30	24	24	24	32	32	120 ECTS	22	24
11.	Natural Hazards and Their Assessment			Risk Assessment In Environmental Studies	Advanced Environmental Geology	Methods and Modelling in Palaeoclimatology	Geology and Disaster Management		Environmental Hazards	
12.	Exploration Geophysics		Applied Geophysics	Geophysical Field Methods	Advanced Engineering and Environmental Geophysics	Global and Crustal Seismology	Advanced Mapping Techniques & Exploration	Exploration Geophysics		Subsurface Geophysical Mapping
13.	Sedimentary Basin Analysis								Basin Analysis	Sedimentary

Course Title in the Current Program	Program	Current Program	First Program	Second Program	Third Program	Fourth Program	Fifth Program	Sixth Program	Seventh Program	Eighth Program
	Program:	M.Sc. in Earth Sciences	M.Sc. in Geology	M.Sc. Geological Engineering	M.Sc. in EARTH SCIENCE	MGeol	MSc Geology	M.Sc. Applied Geosciences	M.Sc. Earth Sciences	M.Sc. Geosciences
	Faculty/Center:	Petroleum and Natural Resources	Science	COLLEGE OF ENGINEERING AND COMPUTING	Science	School of Geography, Geology and the Environment.	Sciences	Sciences	Earth Sciences	Warner College of Natural Resources
	University:	Sana'a University	KSU	Missouri S&T	YARMOUK	Leicester	UNIVERSITY OF KERALA	GUtech	Memphis	Colorado State
	Country	Yemen	Saudi Arabia	United States	Jordan	Britain	Indian	Oman	United States	United States
	System of Study	Coursework and Thesis	Coursework and Thesis	Coursework and Thesis/ Coursework only	Coursework and Thesis	Coursework and Thesis	Coursework and Thesis	Coursework and Thesis	Coursework and Thesis	Coursework and Thesis/ Coursework only
	Specified Duration for Coursework Completion	2 semesters	2 semesters	-	-	-		-	-	-
	Total Credit Hours for the Courses	30	24	24	24	32	32	120 ECTS	22	24
										Basin Analysis
14.	Exploration Geochemistry				Exploration Geochemistry			Exploration Geochemistry		
	Credit Hours for Thesis	6	6	9	6	2	6	6	6	

Summary of Course Titles for the Current Program after Surveying Similar Reference Programs

No.	Course Title after Survey		Theoretical	Practical	Tut./Semi	Total credit hours	Remarks
1.	Advanced Sedimentology & Stratigraphy		3			3	Compulsory
2.	Advanced Igneous & Metamorphic Petrology		3			3	Compulsory
3.	Advanced Structural Geology		3			3	Compulsory
4.	Advanced Petroleum Geology		3			3	Compulsory
5.	Exploration Geophysics		3			3	Compulsory
6.	Applications of Remote Sensing and GIS		3			3	Compulsory
7.	Applied Hydrogeology		3			3	Compulsory
8.	Advanced Engineering Geology		3			3	Elective
9.	Advanced Ore Mineralogy		3			3	Elective
10.	Integrated Water Management		3			3	Elective
11.	Well Log Analysis		3			3	Elective
12.	Natural Hazards and Their Assessment		3			3	Elective
13.	Sedimentary Basin Analysis		3			3	Elective

No.	Course Title after Survey		Theoretical	Practical	Tut./Semi	Total credit hours	Remarks
14.	Exploration Geochemistry		3			3	Elective
....	Total		42	..	..	42	CH

Annex (7) Alignment of Program Aims with the Program Intended Learning Outcomes (PILOs)

No.	Aim	PILOs Codes															
		A1	A2	A3	A4	B1	B2	B3	B4	C1	C2	C3	C4	C5	D1	D2	D3	D4
1	To provide a sound basis of knowledge and understanding for the study the E Sciences applying to the natural environment and industry.	√	√	√	√	√	√			√								
2	To develop practical and professional skills to the analysis of the geological data in a responsible and safe manner, paying due attention to risk assessment, rights of access, and the relevant health and safety regulations.					√	√	√	√	√	√	√	√					
3	To recognize applicable theories for the interpretation of geological information.					√	√	√	√									

4	To prepare an attitude for innovation and research through laboratory and field applications and participation in research projects, scientific competitions and conferences.								√	√	√	√	√	√		√		√
5	To support and execution of academic and applied research projects to explore and develop the petroleum, mineral and groundwater resources in Yemen		√			√				√	√				√	√		

PILOs:

A1. Show advanced knowledge and understanding of the core earth science technical disciplines, notably in geology and in geophysics

A2. Provide essential knowledge of the key applied geoscience and engineering disciplines (i.e., geostatistics, petrophysics, and modelling) and to appreciate their relationship and inter-dependency with the core geoscience subjects

A3. Demonstrate advanced understanding of earth system relevant to deeper knowledge of a chosen specialization

A4. Show understanding of the complexity of natural resources environments for sustainable management in exploration and production.

B1. Describe, identify and interpret a range of geological materials in the laboratory and field.

B2. Determine and interpret the geology of a region via a range of field-based techniques.

B3. Utilize geological knowledge and data for modeling purposes (for example, for evaluation of scientific hypotheses, for hazard mitigation, or for resource estimation).

B4. Apply a diverse range of methods of analysis, evaluation and promotion, including quantitative and qualitative (e.g. empirical social research), IT-based (e.g. GIS applications, petroleum basin modelling, hydrogeological modelling).
C1. Carry out a range of field-based studies (e.g., geological mapping, sample collection and recording of field observations).
C2. Draw and describe geological features, specimens and thin sections.
C3. Use appropriate numerical, statistical and graphical methods or software effectively to solve numerical, spatial, temporal and geometrical problems.
C4. Assess and carefully consider the cultural, environmental, and economic impact of global business activities on natural resources.
D1. Present work and findings with clarity and accuracy, orally (including presentation) and in writing
D2. Participate effectively, either independently or as a member of an integrated team demonstrating a knowledge of a number of research techniques and procedures
D3. Use appropriate software packages to prepare written reports, essays, posters and presentations
D4. Use the internet critically for information retrieval and to communicate geological knowledge effectively

Annex (8) Attributes of the Program Graduates and Career Opportunities.

First: Graduate Attributes:

Field	
Knowledge and Understanding	The graduate of this program should be able to demonstrate knowledge and understanding of:
	▪ Show advanced knowledge and understanding of the core earth science technical disciplines, notably in geology and in geophysics ▪ Provide essential knowledge of the key applied geoscience and engineering disciplines (i.e., geostatistics, petrophysics, and modelling) and to appreciate their relationship and inter-dependency with the core geoscience subjects ▪ Demonstrate advanced understanding of earth system relevant to deeper knowledge of a chosen specialization

	▪ Show understanding of the complexity of natural resources environments for sustainable management in exploration and production.
B. Cognitive/ Intellectual Skills:	The graduate of this program should be able to:
	▪ Describe, identify and interpret a range of geological materials in the laboratory and field. ▪ Determine and interpret the geology of a region via a range of field-based techniques. ▪ Utilize geological knowledge and data for modeling purposes (for example, for evaluation of scientific hypotheses, for hazard mitigation, or for resource estimation). ▪ Apply a diverse range of methods of analysis, evaluation and promotion, including quantitative and qualitative (e.g. empirical social research), IT-based (e.g. GIS applications, petroleum basin modelling, hydrogeological modelling).
Practical and Professional Skills:	The graduate of this program should be able to:
	▪ Carry out a range of field-based studies (e.g., geological mapping, sample collection and recording of field observations). ▪ Draw and describe geological features, specimens and thin sections. ▪ Use appropriate numerical, statistical and graphical methods or software effectively to solve numerical, spatial, temporal and geometrical problems. ▪ Assess and carefully consider the cultural, environmental, and economic impact of global business activities on natural resources.
General Skills:	The graduate of this program should be able to:
	▪ Present work and findings with clarity and accuracy, orally (including presentation) and in writing ▪ Participate effectively, either independently or as a member of an integrated team demonstrating a knowledge of a number of research techniques and procedures

	▪ Use appropriate software packages to prepare written reports, essays, posters and presentations ▪ Use the internet critically for information retrieval and to communicate geological knowledge effectively

Second: Employment Opportunities for Graduates of the Program:

- A geologist for exploring and identifying rocks in areas under study or exploration.
- Mineral and ore exploration.
- Exploration and extraction of industrial minerals and rocks.
- Petroleum exploration and production, and evaluation of reservoir rocks, source rocks, and sedimentary basins.
- Exploration, supervision, and evaluation of groundwater wells.
- Study and assessment of natural hazards such as landslides, earthquakes, and volcanoes.
- Site investigation for construction projects and dams.

Key Ministries and Institutions are as follows:

- Ministry of Oil and Minerals
- Geological Survey and Mineral Resources Authority
- Petroleum Exploration and Production Authority
- Ministry of Water and Environment
- Ministry of Public Works
- Environmental Protection Authority
- Remote Sensing Center
- Roads and Bridges Authority

Annex (10) Alignment of the PILOs with the Standards of an International Accreditation Body (Global Leader in Quality Assurance in Higher Education)

Name of Accreditation Body: ASIIN Year of Standards Issuance: 2011

No.	Standard Number and Text for the International Accreditation Body	PILOs Codes														
		A1	A2	A3	A4	B1	B2	B3	B4	C1	C2	C3	C4	C5	D1	D2	D3
1	advanced knowledge and understanding of the principles of Geosciences	✓															
2	deeper knowledge of a chosen specialization		✓														
3	critical awareness of the forefront of their specialization					✓											
4	advanced understanding of earth system relevant to their specialization		✓	✓													
5	appreciation of the learning capacity needed to progress to independent research						✓										
6	ability to specify and complete geological tasks that are complex, incompletely defined or unfamiliar							✓		✓							
7	some ability to formulate and solve problems in new and emerging areas of their discipline								✓			✓					
8	ability to apply state of the art or innovative methods in problem solving, possibly involving use of other disciplines										✓						
9	ability to think creatively to develop new and original approaches and methods						✓										
10	ability to design appropriate experiments, to analyze and interpret data and draw conclusions							✓									
11	ability to use advanced, and to develop customized, quantitative methods									✓							
12	comprehensive understanding of applicable techniques and methods for a particular specialization, and of their limits						✓			✓							
13	awareness of the limits of current knowledge and the practical application of the stateof-the-art techno										✓						
14	knowledge and understanding of Geosciences to create models of complex systems and processes						✓										
15	basic ability to contribute to the further development of Geosciences in practice and research	✓															✓

16	ability to produce independent work in their professional and scientific fields													✓	
17	ability to manage and work effectively as leader of teams that may be composed of different disciplines and level											✓			
18	basic ability to work effectively and communicate in national and international contexts											✓			
19	appreciation of the role of Geosciences in the development of knowledge, wealth creation and improving quality of life													✓	
20	ability to evaluate performance as an individual and a team member											✓			
21	ability to identify individual and collective goals and responsibilities and to perform in a manner appropriate to these roles					✓									✓
22	ability to evaluate critically of professional and research papers														✓
23	ability to plan and appropriate program of continuing professional development													✓	

Program Intended Learning Outcomes (PILOs):

A1. Show advanced knowledge and understanding of the core earth science technical disciplines, notably in geology and in geophysics

A2. Provide essential knowledge of the key applied geoscience and engineering disciplines (i.e. geostatistics, petrophysics, and modelling) and to appreciate their relationship and inter-dependency with the core geoscience subjects

A3. Demonstrate advanced understanding of earth system relevant to deeper knowledge of a chosen specialization

A4. Show understanding of the complexity of natural resources environments for sustainable management in exploration and production.

B1. Describe, identify and interpret a range of geological materials in the laboratory and field.

B2. Determine and interpret the geology of a region via a range of field-based techniques.

B3. Utilize geological knowledge and data for modeling purposes (for example, for evaluation of scientific hypotheses, for hazard mitigation, or for resource estimation).

B4. Apply a diverse range of methods of analysis, evaluation and promotion, including quantitative and qualitative (e.g. empirical social research), IT-based (e.g. GIS applications, petroleum basin modelling, hydrogeological modelling).

C1. Carry out a range of field-based studies (e.g., geological mapping, sample collection and recording of field observations).

C2. Draw and describe geological features, specimens and thin sections.

C3. Use appropriate numerical, statistical and graphical methods or software effectively to solve numerical, spatial, temporal and geometrical problems.

C4. Assess and carefully consider the cultural, environmental, and economic impact of global business activities on natural resources.

D1. Present work and findings with clarity and accuracy, orally (including presentation) and in writing

D2. Participate effectively, either independently or as a member of an integrated team demonstrating a knowledge of a number of research techniques and procedures

D3. Use appropriate software packages to prepare written reports, essays, posters and presentations

D4. Use the internet critically for information retrieval and to communicate geological knowledge effectively

Annex (11) Coding of Program Courses and Their Alignment with PILOs (Curriculum Map Matrix)

No	Course Title	Cr. H	Course Code	Semester	PILOs Codes																Total number of PILOs
					A1	A2	A3	A4	B1	B2	B3	B4	C1	C2	C3	C4	D1	D2	D3	D4	
1.	Advanced Sedimentology & Stratigraphy	3	GEOL 611	S1	1	1	1	0	1	1	0	0	1	1	0	0	1	0	1	1	10
2.	Advanced Igneous & Metamorphic Petrology	3	GEOL 613	S1	1	0	1	0	1	1	0	0	1	1	0	0	1	0	0	0	7
3.	Advanced Structural Geology	3	GEOL 615	S1	1	1	1	0	1	1	0	0	1	1	0	0	1	0	1	1	10
4.	Advanced Petroleum Geology	3	GEOL 617	S1	1	1	1	1	1	1	1	1	1	0	1	0	1	0	1	1	13
5.	Exploration Geophysics	3	GEOL 619	1	1	1	1	1	1	1	1	0	1	0	1	1	1	1	1	0	13
6.	Applications of Remote Sensing and GIS	3	GEOL 620	S2	1	1	1	0	1	0	1	1	1	0	1	0	1	0	0	0	9

No	Course Title	Cr. H	Course Code	Semester	PILOs Codes																Total number of PILOs
					A1	A2	A3	A4	B1	B2	B3	B4	C1	C2	C3	C4	D1	D2	D3	D4	
7.	Applied Hydrogeology	3	GEOL 622	S2	1	1	1	1	1	1	0	1	1	0	0	1	1	0	1	0	11
8.	Advanced Engineering Geology	3	GEOL 624	S2	1	0	1	0	1	1	0	0	1	1	0	0	1	0	0	0	7
9.	Advanced Ore Mineralogy Advanced Ore Mineralogy	3	GEOL 626	S2	1	0	1	1	1	1	1	0	1	1	0	1	1	0	0	0	10
10	Integrated Water Management	3	GEOL 628	S2	1	1	1	0	1	0	1	1	0	0	1	1	1	1	1	0	11
11	Well Log Analysis	3	GEOL 630	S2	1	1	1	1	1	0	1	1	0	0	1	1	1	0	1	1	12
12	Natural Hazards and Their Assessment	3	GEOL 632	S2	1	1	1	0	1	1	1	0	1	0	0	1	1	1	1	0	11
13	Sedimentary Basin Analysis	3	GEOL 634	S2	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	0	14

No	Course Title	Cr. H	Course Code	Semester	PILOs Codes																Total number of PILOs
					A1	A2	A3	A4	B1	B2	B3	B4	C1	C2	C3	C4	D1	D2	D3	D4	
14	Exploration Geochemistry	3	GEOL636	S2	1	1	1	0	1	1	1	0	1	0	0	1	1	1	1	0	11
15	Thesis	6	GEOL699		1	1	1	1	1	0	1	1	1	1	1	1	1	1	1	1	15
	Total number of courses contributing to the achievement of PILOs	14			15	12	15	7	15	11	10	7	12	7	7	9	15	6	11	5	0

1= The course contributes to achieving the PILOs.

PILOs:

A1. Show advanced knowledge and understanding of the core earth science technical disciplines, notably in geology and in geophysics

A2. Provide essential knowledge of the key applied geoscience and engineering disciplines (i.e., geostatistics, petrophysics, and modelling) and to appreciate their relationship and inter-dependency with the core geoscience subjects

A3. Demonstrate advanced understanding of earth system relevant to deeper knowledge of a chosen specialization

A4. Show understanding of the complexity of natural resources environments for sustainable management in exploration and production.

B1. Describe, identify and interpret a range of geological materials in the laboratory and field.

B2. Determine and interpret the geology of a region via a range of field-based techniques.

B3. Utilize geological knowledge and data for modeling purposes (for example, for evaluation of scientific hypotheses, for hazard mitigation, or for resource estimation).

B4. Apply a diverse range of methods of analysis, evaluation and promotion, including quantitative and qualitative (e.g. empirical social research), IT-based (e.g., GIS applications, petroleum basin modelling, hydrogeological modelling).

C1. Carry out a range of field-based studies (e.g., geological mapping, sample collection and recording of field observations).

C2. Draw and describe geological features, specimens and thin sections.

C3. Use appropriate numerical, statistical and graphical methods or software effectively to solve numerical, spatial, temporal and geometrical problems.

C4. Assess and carefully consider the cultural, environmental, and economic impact of global business activities on natural resources.

D1. Present work and findings with clarity and accuracy, orally (including presentation) and in writing

D2. Participate effectively, either independently or as a member of an integrated team demonstrating a knowledge of a number of research techniques and procedures

D3. Use appropriate software packages to prepare written reports, essays, posters and presentations

D4. Use the internet critically for information retrieval and to communicate geological knowledge effectively

Annex (11) Study Plan for Master's Program in Earth Sciences

Program Title and Final Award:	M.Sc. in Earth Sciences
Total Number of Credit Hours required for Program Completion	36 credit hours
Faculty/center/institute to which the program belongs:	Faculty of Petroleum and Natural Resources
Duration of the Program:	2 years
System of Study:	Semester-based

Remark: All hours in the study plan are credit hours. One credit hour = an actual hour in theory; two hours in practice and exercises, and three hours in field training.

Program Structure

Requirements	Number of Courses	Credit Hours	Relative Weight (%)
Complementary Courses	-	-	As per the decision of the Admissions Committee
Compulsory Courses	7	21	58
Elective Courses	3	9	25
Thesis	1	6	17
Total	10	36	100.00%

First Semester

	Course Title		COURSE CODE	Credit Hours				Prerequisites
				Th.	Pr.	Tut./Semi	Total C.H.	
1	Advanced Sedimentology & Stratigraphy		GEOL 611	3	0	0	3	
2	Advanced Igneous & Metamorphic Petrology		GEOL 613	3	0	0	3	
3	Advanced Structural Geology		GEOL 615	3	0	0	3	
4	Advanced Petroleum Geology		GEOL 617	3	0	0	3	
5	Exploration Geophysics		GEOL 619	3	0	0	3	
	Total Credit Hours			15			15	

Second Semester

	Course Title		COURSE CODE	Credit Hours				Prerequisites
				Th.	Pr.	Tut./Semi	Total C.H.	
1	Applications of Remote Sensing and GIS		GEOL 620	3	0	0	3	
2	Applied Hydrogeology		GEOL 622	3	0	0	3	
3	Elective Course		GEOL 696	3	0	0	3	
4	Elective Course		GEOL 697	3	0	0	3	
5	Elective Course		GEOL 698	3	0	0	3	
	Total Credit Hours			15			15	

Course Title	COURSE CODE	CREDIT HOURS
Thesis	**GEOL 699**	**6**

Elective Courses (if any)

The student has the right to choose (three courses) for a total of (9) credit hours:

	Course Title		COURSE CODE	CREDIT HOURS				Prerequisites
				Th.	Pr.	Tut.	Total C.H.	
1	Advanced Engineering Geology		**GEOL 624**	**3**	**0**	**0**	3	
2	Advanced Ore Mineralogy		**GEOL 626**	**3**	**0**	**0**	3	
3	Integrated Water Management		**GEOL 628**	**3**	**0**	**0**	3	
4	Well Log Analysis		**GEOL 630**	**3**	**0**	**0**	3	
5	Natural Hazards and Their Assessment		**GEOL 632**	**3**	**0**	**0**	3	
6	Sedimentary Basin Analysis		**GEOL 634**	**3**	**0**	**0**	3	
7	Exploration Geochemistry		**GEOL 636**	**3**	**0**	**0**	**3**	
	Total Credit Hours			**21**			**21**	

Program Course Description: