1. **Title of Degree Program: BS in Geology**

2. **Program Learning Objectives:**

The BS Geology program is structured to help students become knowledgeable about the Earth's processes and history. Through this program, students learn how to analyze and solve problems related to the Earth's dynamics. They also develop skills like identifying different types of rocks and minerals, using advanced geological tools and technologies, and interpreting geological maps and data. The program aims to equip students with practical abilities in fieldwork, research, and data analysis, which can be applied to real-world geological challenges. These accomplishments will prepare students for careers in fields like as energy resources exploration, mineral resources exploration, Mega structure and Dams construction, surface and subsurface water resources management and geohazards studies.

3. **Program Structure:**

Duration	Minimum 4-Years (8-Semesters), Maximum 6-Years (12-Semesters)
Admission Requirements:	Atleast 45% Marks in HSSC (Part I/II) I- FSc (Pre-Engineering)/ FSc (Pre-Medical) II- ICS(Math, Physics, Computer Science) III- DAE in Mining (1st & 2nd Year) 2 seats reserved
Degree Completion Requirement	Students are required to study 133 credit hours and pass all courses of BS program for the completion of this degree as notified below securing a minimum CGPA 2.5 out of 4.00 to obtain degree after 8 semesters.

4. **General Education (Gen Ed) Requirements: (Mandatory/Core Curses):**

Sr. No.	Semester	Course Code	Course Title	Credit Hours	Prerequisite
1.	2	URCG-5112	Fable, Wisdom Literature, and Epic	2(2-0)	Nil
2.	4	URCG-5114	Basic Science	3(2-1)	Nil
3.	2	URCG-5116	Science of Society-I	2(2-0)	Nil
4.	1	URCG-5118	Functional English	3(3-0)	Nil
5.	3	URCG-5119	Expository Writing	3(3-0)	Nil
6.	2	URCG-5120	Exploring Quantitative Skills	3(3-0)	Nil
7.	3	URCG-5121	Tools for Quantitative Reasoning	3(3-0)	Nil
8.	1	URCG-5105 URCG-5126	Islamic Studies (OR) Religious Education/Ethics	2(2-0)	Nil
9.	3	URCG-5122	Ideology and Constitution of Pakistan	2(2-0)	Nil
10.	1	URCG-5123	Applications of Information and Communication Technologies (ICT)	3(2-1)	Nil
11.	4	URCG-5124	Entrepreneurship	2(2-0)	Nil
12.	4	URCG-5125	Civics and Community Engagement	2(2-0)	Nil
13.	1-	URCG-5111	Translation of Holy Quran	NC	Nil
14.	2	URCG-5127	Seerat of the Holy Prophet (SAW)	1(1-0)	Nil
			GE Courses Credit Hours Total	31	

5. **Single Major Courses:**

Sr. No.	Course Code	Course Title	Credit Hours	Prerequisite
1.	GEOL-5101	Introduction to Geology	3(3-0)	Nil
2.	GEOL-5102	Geomorphology	3(3-0)	Nil
3.	GEOL-5103	Mineralogy	3(3-0)	Nil
4.	GEOL-5104	Introduction to Paleontology	3(2-1)	Nil
5.	GEOL-5105	Stratigraphy	3(3-0)	Nil
6.	GEOL-5106	Geological Fieldwork-I	3(0-3)	Nil
7.	GEOL-5107	Structural Geology	3(2-1)	Nil

8.	GEOL-5108	Petrography	3(2-1)	Nil
9.	GEOL-5109	Introduction to GIS and RS	3(2-1)	Nil
10.	GEOL-5110	Igneous and Metamorphic Petrology	3(3-0)	Nil
11.	GEOL-5111	Geotectonics	3(0-3)	Nil
12.	GEOL-5112	Geological Fieldwork-II	3(2-1)	Nil
13.	GEOL-6111	Sedimentology	3(2-1)	Nil
14.	GEOL-6112	Geophysics	3(2-1)	Nil
15.	GEOL-6113	Geochemistry	3(2-1)	Nil
16.	GEOL-6114	Micropaleontology	3(2-1)	Nil
17.	GEOL-6115	Sequence Stratigraphy	3(2-1)	Nil
18.	GEOL-6116	Petroleum Geology	3(2-1)	Nil
19.	GEOL-6117	Engineering Geology	3(2-1)	Nil
20.	GEOL-6118	Geological Fieldwork –III	3(3-0)	Nil
21.	GEOL-6119	Hydrogeology	3(0-3)	Nil
22.	GEOL-6120	Geology of Pakistan	3(3-0)	Nil
23.	GEOL-6121	Economic Geology	3(3-0)	Nil
24.	GEOL-6122	Environmental Geology	3(3-0)	Nil
25.	*GEOL-61--	Elective Course-I	3(3-0)	Nil
26.	*GEOL-61--	Elective Course-II	3(3-0)	Nil
27.	*GEOL-61--	Elective Course-III	3(3-0)	Nil
28.	*GEOL-61--	Elective Course-IV	3(3-0)	Nil
Major Courses Credit Hours Total			**84**	

* As notified by chairman from List A

6. Interdisciplinary/Allied courses: minimum 12 credit hours:

1.	GEOG-5101	Fundamentals of Geography	3(3-0)	Nil
2.	PHYS-5101	Mechanics I	3(3-0)	Nil
3.	CHEM-5101	Physical Chemistry	3(3-0)	Nil
4.	URCM-5107	Mathematics I	3(3-0)	Nil
Interdisciplinary Courses Credit Hours Total			**12**	

7. Field experience/internship: Minimum 03 credit hours:

1.	GEOL-6190	Field experience	3(0-3)	Nil

8. Capstone project: Minimum 03 credit hours:

1.	GEOL-6191	Capstone project	3(3-0)	Nil

List A: List of Elective Groups

Group Option	Course Code	Course Title	Credit Hours	Prerequisite
Group- I **Mineralogy and Petrology**	GEOL-6130	Geochemistry II	3(3-0)	Nil
	GEOL-6131	Metamorphic Petrology-II	3(3-0)	Nil
	GEOL-6132	Sedimentary Petrology-II	3(3-0)	Nil
	GEOL- 6133	Mineralogy II	3(3-0)	Nil
	GEOL- 6134	Mineral Deposits	3(3-0)	Nil
	GEOL- 6135	Igneous Petrogenesis	3(3-0)	Nil
	GEOL- 6136	Isotope Geochemistry	3(3-0)	Nil
	GEOL- 6137	Industrial Minerals and Rocks of Pakistan	3(3-0)	Nil
Group-II **Engineering Geology**	GEOL- 6140	Rock Mechanics	3(3-0)	Nil
	GEOL- 6141	Soil Mechanics	3(3-0)	Nil
	GEOL- 6142	Seismotectonics	3(3-0)	Nil
	GEOL- 6143	Engineering Geology II	3(3-0)	Nil
	GEOL- 6144	Introduction to Geotechnical Engineering	3(3-0)	Nil
	GEOL- 6145	Dam Engineering	3(3-0)	Nil
	GEOL- 6146	Excavation and Tunneling	3(3-0)	Nil
	GEOL- 6147	Mining Engineering: Engineering Geological Applications	3(3-0)	Nil
Group- III **Petroleum Geosciences**	GEOL- 6150	Petroleum Engineering	3(3-0)	Nil
	GEOL- 6151	Reservoir Geology	3(3-0)	Nil
	GEOL- 6152	Petroleum Geology of Pakistan	3(3-0)	Nil
	GEOL-6153	Geological and Geophysical Software Applications	3(3-0)	Nil
	GEOL- 6154	Basin Modeling	3(3-0)	Nil
	GEOL- 6155	Petroleum Geology and Subsurface Methods	3(3-0)	Nil
	GEOL- 6156	Advance Structural Geology	3(3-0)	Nil
	GEOL- 6157	Applied Sedimentology	3(3-0)	Nil
Group- IV **Applied Geophysics**	GEOL- 6160	Earthquake Seismology	3(3-0)	Nil
	GEOL- 6161	Electrical and Radiometric Exploration Methods	3(3-0)	Nil
	GEOL- 6162	Borehole Geophysics	3(3-0)	Nil
	GEOL- 6163	Seismic prospecting	3(3-0)	Nil
	GEOL- 6164	Gravity and Magnetic Methods	3(3-0)	Nil
	GEOL- 6165	Marine Geophysics	3(3-0)	Nil
	GEOL- 6166	Environmental and Engineering Geophysics	3(3-0)	Nil
	GEOL- 6167	Hydrogeophysics	3(3-0)	Nil

Scheme of Studies

BS in Geology

Semester-I

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
GE-1	URCG-5118	Functional English	3(3-0)	Nil
GE-2	URCG-5105 URCG-5126	Islamic Studies (OR) Religious Education/Ethics	2(2-0)	Nil
GE-3	URCG-5123	Applications of Information and Communication Technologies (ICT)	3(2-1)	Nil
Major-1	GEOL-5101	Introduction to Geology	3(3-0)	Nil
Major-2	GEOL-5102	Geomorphology	3(3-0)	Nil
Major-3	GEOL-5103	Mineralogy	3(3-0)	Nil

Semester Total Credit Hours: 17

Semester-II

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
GE-4	URCG-5112	Fables, Wisdom and EPICS	2(2-0)	Nil
GE-5	URCG-5116	Science of Society-I	2(2-0)	Nil
GE-6	URCG-5120	Exploring Quantitative Skills	3(3-0)	Nil
GE-7	URCG-5127	Seerat of the Holy Prophet (SAW)	1(1-0)	Nil
GE-8	URCG-5111	Translation of Holy Quran-I	NC	Nil
Major-4	GEOL-5104	Introduction to Paleontology	3(2-1)	Nil
Major-5	GEOL-5105	Stratigraphy	3(3-0)	Nil
Major-6	GEOL-5106	Geological Fieldwork-I	3(0-3)	Nil

Semester Total Credit Hours: 17

Semester-III

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
GE-9	URCG-5119	Expository Writing	3(3-0)	Nil
GE-10	URCG-5121	Tools for Quantitative Reasoning	3(3-0)	Nil
GE-11	URCG-5122	Ideology and Constitution of Pakistan	2(2-0)	Nil
Major-7	GEOL-5107	Structural Geology	3(2-1)	Nil
Major-8	GEOL-5108	Petrography	3(2-1)	Nil
Major-9	GEOL-5109	Introduction to GIS and RS	3(2-1)	Nil

Semester Total Credit Hours: 17

Semester-IV

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
GE-8	URCG-5111	Translation of Holy Quran-II	NC	Nil
GE-12	URCG-5114	Basic Science	3(2-1)	Nil
GE-13	URCG-5124	Entrepreneurship	2(2-0)	Nil
GE-14	URCG-5125	Civics and Community Engagement	2(2-0)	Nil
Major-10	GEOL-5110	Igneous and Metamorphic Petrology	3(3-0)	Nil
Major-11	GEOL-5111	Geotectonics	3(2-1)	Nil
Major-12	GEOL-5112	Geological Fieldwork-II	3(0-3)	Nil

Semester Total Credit Hours: 16

Summer Semester *(For student existing program to have Associate Degree)*

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
Compulsory	GEOL-5113	Internship	3(3-0)	Completion of minimum 60 credit hours

Semester-V

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
ID-1	GEOG-5101	Fundamentals of Geography	3(3-0)	Nil
ID-2	PHYS-5101	Mechanics I	3(3-0)	Nil
Major-13	GEOL-6111	Sedimentology	3(2-1)	Nil
Major-14	GEOL-6112	Geophysics	3(2-1)	Nil
Major-15	GEOL-6113	Geochemistry	3(2-1)	Nil
Major-16	GEOL-6114	Micropaleontology	3(2-1)	Nil

Semester Total Credit Hours: 18

Semester-VI

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
GE-8	URCG-5111	Translation of Holy Quran-III	NC	Nil
ID-3	CHEM-5101	Physical Chemistry	3(3-0)	Nil
ID-4	URCM-5107	Mathematics I	3(3-0)	Nil
Major-17	GEOL-6115	Sequence Stratigraphy	3(2-1)	Nil
Major-18	GEOL-6116	Petroleum Geology	3(2-1)	Nil
Major-19	GEOL-6117	Engineering Geology	3(2-1)	Nil
Major-20	GEOL-6118	Geological Fieldwork –III	3(0-3)	Nil

Semester Total Credit Hours: 18

Semester-VII

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
Major-21	GEOL-6119	Hydrogeology	3(3-0)	Nil
Major-22	GEOL-6120	Geology of Pakistan	3(3-0)	Nil
Major-23	GEOL-6121	Economic Geology	3(3-0)	Nil
Major-24	*GEOL-61--	Elective Course-I	3(3-0)	Nil
Major-25	*GEOL-61--	Elective Course-II	3(3-0)	Nil

Semester Total Credit Hours: 15

Semester-VIII

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
GE-8	URCG-5111	Translation of Holy Quran-IV	NC	Nil
Major-26	GEOL-6122	Environmental Geology	3(3-0)	Nil
Major-27	*GEOL-61--	Elective Course-III	3(3-0)	Nil
Major-28	*GEOL-61--	Elective Course-IV	3(3-0)	Nil
Compulsory	GEOL-6190	Field experience	3(0-3)	Nil
Compulsory	GEOL-6191	Capstone project	3(3-0)	Nil

Semester Total Credit Hours: 15
Degree Program Total: 133

URCG-5118	Functional English	3(3-0)

Course Brief:

The course aims at providing understanding of a writer's goal of writing (i.e. clear, organized and effective content and to use that understanding and awareness for academic reading and writing. The objectives of the course are to make the students acquire and master the grammatical academic writing skills. The course would enable the students to develop argumentative writing techniques. The students would be able to logically add specific details on the topics such as facts, examples and statistical or numerical values.

Course Learning Objectives :

The course will provide insight to convey the knowledge and ideas in an objective and persuasive manner. Furthermore, the course will also enhance the students' understanding of ethical considerations in writing academic assignments and topics including citation, plagiarism, formatting and referencing the sources as well as the technical aspects involved in referencing.

Course Contents:

1. Developing Analytical Skills
2. Transitional devices (word, phrase and expressions)
3. Development of ideas in writing
4. Reading Comprehension
5. Precis Writing
6. Developing argument
7. Sentence structure: Accuracy, variation, appropriateness, and conciseness
8. Appropriate use of active and passive voice
9. Organization and Structure of a Paragraph
10. Organization and structure of Essay
11. Types of Essays

Recommended Texts:

1. Bailey, S. (2011). Academic writing: A handbook for international students (3rd ed.). New York: Routledge.
2. Eastwood, J. (2011). A Basic English grammar. Oxford: Oxford University Press.
3. Swales, J. M., & Feak, C. B. (2012). *Academic writing for graduate students: Essential tasks and skills* (3rd ed.). Ann Arbor: The University of Michigan Press.
4. Swan, M. (2018). *Practical English usage* (8th ed.). Oxford: Oxford University Press.

Suggested Readings:

1. Biber, D., Johansson, S., Leech, G., Conrad, S., Finegan, E., & Quirk, R. (1999). *Longman grammar of spoken and written English*. Harlow Essex: MIT Press.
2. Cresswell, G. (2004). *Writing for academic success*. London: SAGE.
3. Johnson-Sheehan, R. (2019). *Writing today*. Don Mills: Pearson.
4. Silvia, P. J. (2019). *How to write a lot: A practical guide to productive academic writing*. Washington: American Psychological Association
5. Thomson, A. J., & Martinet, A. V. (1986). *A Practical English Grammar*. Oxford: Oxford University Press

URCG-5105	Islamic Studies (Compulsory)	2(2-0)

Course Brief:

Introductory/compulsory foundation course

Islamic Studies engages in the study of Islam as a textual tradition inscribed in the fundamental sources of Islam; Qur'an and Hadith, history and particular cultural contexts. The area seeks to provide an introduction to and a specialization in Islam through a large variety of expressions (literary, poetic, social, and political) and through a variety of methods (literary criticism, hermeneutics, history, sociology, and anthropology). It offers opportunities to get fully introductory foundational bases of Islam in fields that include Qur'anic studies, Hadith and Seerah of Prophet Muhammad (PBUH), Islamic philosophy, and Islamic law, culture and theology through the textual study of Qur'an and Sunnah.

Course Learning Objectives

- To make students understand the relevance and pragmatic significance of Islam in their lives.
- To make learners comprehend the true spirit of Islam with reference to modern world.
- To generate a sense of Islamic principles as a code of living that guarantee the effective solutions to the current challenges of being.
- To provide Basic information about Islamic Studies
- To enhance understanding of the students regarding Islamic Civilization
- To improve Students skill to perform prayers and other worships
- To enhance the skill of the students for understanding of issues related to faith and religious life.

Course Contents

Introduction to Qur'anic Studies

1) Basic Concepts of Qur'an
2) History of Quran
3) Uloom-ul- Quran

مطالعہ قرآن (تعارف قرآن ، منتخب آیات کا ترجمہ و تفسیر: سورۃ البقرہ آیات 1-5، 284-286؛ سورۃ الحجرات آیات 1-18؛ ،سورۃ الفرقان آیات 63-77؛ سورۃ المومنون آیات 1-11؛ ،سورۃ الاحزاب آیات 6، 21، 32- 33؛، 40، 56- 59؛ سورۃ الانعام آیات 151-153؛، سورۃ الصف آیات 1- 14؛ الحشر آیات 18- 20؛ آل عمران آیات 190- 192؛ النحل آیات 12-14؛ لقمن آیت 20، حم السجدہ آیت 53)

Introduction to Sunnah

1) Introduction of Hadith
2) Legal Status of Hadith
3) History of the compilation of Hadith
4) Kinds of Hadith

حدیث کا تعارف، حدیث کی دینی حیثیت، حفاظت و تدوین حدیث، حدیث کی اقسام
متن، حدیث: 1درج ذیل موضوعات پر احادیث کا مطالعہ
1- اعمال کا اجر نیت پر منحصر ہے۔ 2- بہترین انسان قرآن کا طالب علم اور اس کا معلم ہے۔3.کتا ب وسنت گمراہی سے بچنے کا ذریعہ ہیں4- ارکان اسلام 5- اسلام ، ایمان ، احسان اور قیامت کی نشانیاں، 6.بچوں کی نماز کی تلقین 7- دین کا گہرا فہم اللہ کی خاص عنایت ہے 8- حصول علم، تلاوتِ قرآن اور عمل کی اہمیت و فضیلت، 9 .روز محشرکا محاسبہ، 10- حقوق اللہ کے ساتھ ساتھ حقوق العباد کا لحاظ رکھنا بھی لازم ہے11- حسن خلق کی عظمت اور فحش و بد گوئی کی مذمت 12- دنیا و آخرّت کی بھلائی کی ضامن چار چیزیں، 13- ہلاک کر دینے والی سات چیزیں،14- بے عمل مبلغ کا عبرت ناک انجام 15- ہر شخص نگران ہے اور ہر شخص مسئول

1) Sirah of the Prohet
2) Importance of the Study of Sirah
3) Character building method of the Prophet

(سیرت النبیﷺ(مطالعہ سیرت کی ضرورت و اہمیت ، تعمیر ،سیرت و شخصیت کا نبوی منہاج اور عملی نمونے ، اقامت دین کا نبوی طریق کار، اقامتِ دین بعہدِ خلافت راشدہ، میثاق مدینہ ، خطبہ حجۃ الوداع، اخلاقی تعلیمات ، تشکیل اجتماعیت اور اسوہ حسنہ ،قرآن مجید میں سیرت سرور عالم کا بیان، غزواتِ نبوی ﷺ کے مقاصد و حکمتیں)

Islamic Culture & Civilization
1) Basic Concepts of Islamic Culture & Civilization
2) Historical Development of Islamic Culture & Civilization
3) Characteristics of Islamic Culture & Civilization
4) Islamic Culture & Civilization and Contemporary Issues

4. اسلامی تہذیب و تمدن (اسلامی تہذیب کا مفہوم، اسلامی کے عوامل و عناصر، اسلامی تہذیب کی خصوصیات، ، اسلامی تہذیب ، علمی ، معاشرتی اور سماجی اثرات ، تہذیبوں کے تصادم کے نظریے کا تنقیدی جائزہ، تہذیبی تصادم کے اثرات و نتائج، طبعی ، حیاتیاتی اور معاشرتی علوم میں مسلمانوں کا کردار، نام ور مسلمان سائنسدان)

Pre-Requisite: Nil

Recommended Books

1) Hameed ullah Muhammad, ―Emergence of Islam‖ , IRI, Islamabad
2) Hameed ullah Muhammad, ―Muslim Conduct of State
3) Hameed ullah Muhammad, _Introduction to Islam
4) Ahmad Hasan, ―Principles of Islamic Jurisprudence‖ Islamic Research, Institute, International Islamic University, Islamabad (1993)
5) Dr. Muhammad Zia-ul-Haq, ―Introduction to Al Sharia Al Islamia‖ Allama Iqbal Open University, Islamabad (2001)
6) Dr. Muhammad Shahbaz Manj, Teleeemat-e- Islam

URCG-5126	ETHICS	2(2-0)

Course Contents:

1. Meaning and Scope of Ethics.
2. Relation of Ethics with:
   - (a) Religion
   - (b) Science
   - (c) Law
3. Historical Development of
   Morality: (a). Instinctive
   Moral Life.
   (b). Customary Morality.
   (c). Reflective Morality.
4. Moral Theories:
   (a). Hedonism (Mill)
   (b). Intuitionism
   (Butler)
   (c). Kant's Moral Theory.
5. Moral Ethics and Society.
   (a). Freedom and
   Responsibility. (b). Tolerance
   (c). Justice
   (d). Punishment (Theories of Punishment)
6. Moral Teachings of Major
   Religions: a). Judaism
   b). Christianity
   c). Islam
7. Professional Ethics:
   a). Medical Ethics
   b). Ethics of
   Students
   c). Ethics of Teachers
   d). Business Ethics

Recommended Texts:

1. William Lille. An Introduction to Ethics., London Methuen & Co. latest edition.
2. Titus, H.H. Ethics for Today. New York: American Book, latest edition.
3. Hill, Thomas. Ethics in Theory and Practice. N.Y. Thomas Y. Crowel, latest edition
4. Ameer Ali, S. The Ethics of Islam. Culcutta: Noor Library Publishers, latest edition
5. Donaldson, D.M. Studies in Muslim Ethics. London: latest edition. 6. Sayeed, S.M.A.(Tr.) Ta'aruf-e-Akhlaqiat. Karachi: BCC&T, Karachi University of

URCG-5123	Applications of Information Communication Technologies (ICT)	3 (2-1)

Course Brief:

The course introduces students to information and communication technologies and their application in the workplace. Objectives include basic understanding of computer software, hardware, and associated technologies. How computers can be used in the workplace, how communications systems can help boost productivity, and how the Internet technologies can influence the workplace.

Course Learning Objectives:

Students will get basic understanding of computer software, hardware, and associated technologies. They will also learn how computers are used in the workplace, how communications systems can help to boost productivity, and how the Internet technologies can influence the workplace.

Course Contents

1. Introduction, Overview of Information Technology.
2. Hardware: Computer Systems & Components, Storage Devices.
3. Software: Operating Systems, Programming and Application Software.
4. Databases and Information Systems Networks.
5. File Processing Versus Database Management Systems.
6. Data Communication and Networks.
7. Physical Transmission Media & Wireless Transmission Media.
8. Applications of smart phone and usage.
9. The Internet, Browsers and Search Engines.
10. Websites and their types.
11. Email Collaborative Computing and Social Networking.
12. E-Commerce.
13. IT Security and other issues.
14. Cyber Laws and Ethics of using Social media.
15. Use of Microsoft Office tools (Word, Power Point, Excel) or other similar tools depending on the operating system.
16. Other IT tools/software specific to field of study of the students if any.

Recommended Texts::

1. Discovering Computers 2022: Digital Technology, Data and Devices by Misty E. Vermaat, Susan L. sebok; 17^{th} edition.

Suggested Readings:

1. Computing Essentials 2021 by Timothy J. O'Leary and Linda I. O'Leary, McGraw Hill Higher Education; 26^{th} edition.
2. Computers: Understanding Technology by Fuller, Floyd; Larson, Brian: edition 2018.

GEOL - 5101	Introduction to Geology	3(3-0)

Course Brief:

This course is designed to acquire the knowledge about the basic concepts of geology. This will help the students to get knowledge about various types of rocks, minerals and the processes of their formation. Geology is the core discipline of the earth sciences and encompasses many different phenomena, including plate tectonics and mountain building, volcanoes and earthquakes, and the long-term evolution of Earth's atmosphere, surface and life.

Course Learning Objectives:

The goal of the Geology undergraduate program is to equip students with the fundamental knowledge of the diverse fields of Geology (encompassing Geomorphology & Surface Processes, Hydrology & Low-Temperature Geochemistry, Sedimentology & Paleoecology, and Tectonics and Solid-Earth Processes). In addition, it is critical that students learn to think like a scientist and to apply the scientific method in their coursework and in their lives. It helps to know the geologic time scale and place important geologic events in a temporal framework.

Course Contents:

1. Introduction and scope of geology; importance and relationship with other sciences;
2. History and philosophy of geology; Earth as a member of the solar system;
3. Earth's origin, age, composition and internal structure;
4. Introduction to plate tectonics, Isostasy; mountain building processes;
5. Earthquakes and volcanoes; weathering and erosion;
6. Introduction, identification and classification of rocks and minerals;
7. Sedimentary, igneous and metamorphic structures;
8. Introduction to fossils in sedimentary rocks;
9. Introduction to folds, faults, joints, cleavage, foliation, lineation and unconformities;
10. Geological Time Scale; Law of Superposition, present is key to the past and Law of Faunal Succession;
11. Concept and techniques of geological dating, relative and absolute dating; evolution of life on earth;
12. Use of Brunton Compass and GPS, etc.

Recommended Texts

1. Plummer, C. C., Carlson, D. H., & Hammersley, L. (2016). *Physical geology*. New York: McGraw-Hill.
2. Plummer, C. C., McGeary, D., & Carlson, D. H. (2000). *Physical Geology: Earth Revealed*. New York: McGraw-Hill.

Suggested Readings

1. McGeary, D., Carlson, D. H., & Plummer, C. C. (2011). *Physical geology*. New York: McGraw-Hill.
2. Smith, G., & Pun, A. (2013). *How Does Earth Work? Physical Geology and the Process of Science: Pearson New International Edition*. London: Pearson Higher Education.
3. McClay, K. R. (1999). *The mapping of geological structures*. Hoboken: John Wiley & Sons.

GEOL - 5102	Geomorphology	3(3-0)

Course Brief:

This course is designed to acquire the knowledge about the formation of various landforms on the surface of the earth. This will help the students to understand the processes by which the various types of structures developed on the earth surface due to erosional and depositional processes. In addition, it is critical that students learn to think like a scientist and to apply the scientific method in their coursework and in their lives. It helps to know the geologic time scale and place important geologic events in a temporal framework. Identify and interpret common fossils, common rock-forming minerals and rock-forming processes, Interpret environments of deposition of sedimentary rocks, Identify common rocks and interpret them with respect to tectonics.

Course Contents:

1. Geomorphological processes
2. Weathering and erosion
3. Glaciers and their erosional and depositional landforms
4. Geological work of wind and associated features
5. Erosional and depositional work of surface and subsurface water
6. Valley and base-level development and its types
7. Drainage pattern, stream and erring and development of flood plains
8. The erosional and depositional work of sea
9. Development of coastal landform: Geomorphic cycles and associated landforms produced by tectonics and volcanic activity
10. Introduction to tectonic geomorphology
11. Introduction to topographic maps
12. Aerial photographs and satellite imageries

Lab. Work

1. Identification of geomorphic features by using topographic maps,
2. Relief maps and interpretation of 3D relief diagrams on computer.

Recommended Texts:

1. Summerfield, M. A. (2014). *Global geomorphology*. Vale of White Horse: Routledge.
2. Bierman, P. R., Montgomery, D. R., & Massey, C. A. (2013). *Key Concepts in Geomorphology*-NSF supports community-based creation of a new style of textbook. In AGU Fall Meeting Abstracts.

Suggested Readings:

1. Adrian, A. (2012). *Introducing geomorphology: a guide to landforms and processes*. London: Routledge.
2. Gregory, K. J., & Lewin, J. (2014). *The basics of geomorphology: key concepts*. London: Routledge.
3. Moses, A. (2013). *Geomorphology.* London: Routledge.

GEOL - 5103	Mineralogy	3(3-0)

Course Brief:

This course is a graduate level course of Mineralogy. As mineralogy is the sub discipline of geology which deals with the study of minerals. So the course is designed to acquire the knowledge about the physical and optical properties of various rock forming minerals and related phase diagrams. This will help the students in learning how various silicate and non-silicate minerals can be identified and how these are formed during different P-T conditions.

Course Learning Objectives:

This course will equip students with the important traditional content of mineralogy including crystallography, chemical bonding, controls on mineral structure, mineral stability, and crystal growth to provide a foundation that enables students to understand the nature and occurrence of minerals. Physical, optical, and X-ray powder diffraction techniques of mineral study will also be described in detail.

Course Contents:

1. Introduction to mineralogy and crystallography
2. Classification of minerals
3. physical and optical properties of the common silicate and non-silicate mineral group
4. study of internal structure of minerals
5. Isomorphism, polymorphism and pseudomorphism
6. crystal systems
7. Elements of symmetry
8. Crystal notation
9. Study of normal classes of crystallographic systems.
10. crystal chemistry paragenesis
11. introduction to X-Ray diffractometry and universal stage and their application
12. Phase equilibrium studies
13. one component, binary and ternary system

Lab. Work

1. Megascopic and microscopic identification of common rock forming minerals
2. Construction and interpretation of phase diagrams from given experimental data
3. Lab work related to XRD and Universal stage.

Recommended Texts:

1. Blackburn, W. H., & Dennen, W. H. (1994). *Principles of mineralogy*. New York: McGraw-Hill.
2. Dana, J. D. (2004). *Manual of Mineralogy.* Hoboken: John Wiley.

Suggested Readings:

1. Nesse, W. D. (2016). *Introduction to mineralogy*. Oxford: Oxford University Press.
2. Nesse, W. D. (1991). *Introduction to optical mineralogy*. Oxford: Oxford University Press.
3. Pichler, H., & Schmitt-Riegraf, C. (2012). *Rock-forming minerals in thin section*. Berlin: Springer Science & Business Media.

URCG-5112	Fables, Wisdom and EPICS	2(2-0)

Course Brief:

The course will enable students to explore human experiences, cultivate an appreciation of the past, enrich their capacity to participate in the life of their times, and enable an engagement with other cultures and civilizations, both ancient and modern. But independently of any specific application, the study of these subjects teaches understanding and delight in the highest achievements of humanity.

Course Learning Objectives:

The three components of the course, including fables, wisdom literature and epic, will enable the learners to explore and understand the classic tradition in literature. Development of personal virtue, a deep Sufi ethic and an unwavering concern for the permanent over the fleeting and the ephemeral are some of the key themes explored in the contents that will develop an intimate connection between literature and life.

Course Contents:

1. Fables
   The Fables of Bidpai
   The Lion and the Bull
   The Ring-dove
   The Owls and the Crows

   Selected poem from Bang-i-Dara

2. Gulistan-e- Sa'di
   Ten ḥikāyāt from John T. Platts, The Gulistan

3. Epic THE SHĀHNĀMA OF FIRDAUSI

Recommended Texts:

1. John T. P. (1876). *The Gulistan; or, Rose Garden of Shaikh Muslihu'd- Dīn Sa'dī of Shīrāz*.
   London: Wm. II. Allen.
2. Chishti, Y.S. (1991). *Sharaḥ-i bāng-i darā.* Lāhaur: Maktaba-i taʿmīr-i insāniyat

Suggested Readings:

1. Thackston, W. (2000). A Millennium of Classical Persian Poetry. Maryland: Ibex Publishers.
2. Wood, R. (2013). Kalila and Dimna: Fables of Conflict and Intrigue. United Kingdom: Medina
   Publishing, Limited.

URCG-5116	Science of Society-I	2 (2-0)

Course Brief:

This course will introduce students with the subject matter of social science, its scope, nature and ways of looking at social phenomenon. It will make the participants acquaintance with the foundations of modern society, state, law, knowledge and selfhood. While retaining a focus on Pakistani state and society, students will encounter theoretical concepts and methods from numerous social science disciplines, including sociology, politics, economics anthropology and psychology and make them learn to think theoretically by drawing on examples and case studies from our own social context. Students will be introduced to the works of prominent social theorists from both western and non-western contexts. Instruction will include the use of written texts, audio-visual aids and field visits.

Course Learning Objectives:

The course has following outcomes: It will

- Introduce student with the nature of human social behavior and foundations of human group life
- Analyze the reciprocal relationship between individuals and society.
- Make student aware with the nature of societies existing in modern world
- Make students familiar with the philosophy of knowledge of social sciences
- Introduce students with the works of prominent theories explain human group behavior
- Help students to understand the foundations of society including culture, socialization, politics and economy
- Introduce students with various dimensions of social inequalities with reference to gender, race, ethnicity and religion
- Make them aware about the understanding of various themes pertains to social science in local context
- Help them recognize the difference between objective identification of empirical facts, and subjective formulation of opinionated arguments
-

Course Contents:

1. **Introduction to Social Sciences**
   - Social world, Human Social behavior, Foundations of society
   - Evolution of Social sciences
   - Philosophy of Science
   - Scope and nature of social sciences
   - Modernity and social sciences
   - Branches of social science: Sociology, Anthropology, Political Science, Economics

Society and Community, Historical evolution of Society

   - Types of Societies
   - Foraging society, Horticultural society, Pastoralist society
   - Agrarian societies, Industrial society, Postindustrial society

2. **Philosophy of Knowledge in social Science and social inquiry**
   - Understanding social phenomenon
   - Alternative ways of knowing
   - Science as a source to explore social reality
   - Objectivity, Value-Free research
   - Positivism vs Interpretivism
   - Qualitative vs Quantitative
3. **Culture and Society**
   - Idea of Culture, Assumptions of Culture

- Types, Components, Civilization and culture
- Individual and culture. Cultural Ethnocentrism, Cultural Relativism
- Outlook of Pakistani culture
- Global Flows of culture, Homogeneity, Heterogeneity

4. Social Stratification and Social inequality

- Dimensions of inequality, Social class
- Gender, Race, Religion, Ethnicity, Caste
- Patterns of social stratification in Pakistan
- Class, caste system in agrarian society
- Ascription vs Achievement, Meritocracy
- Global stratification in modern world, Global patterns of inequality

5. Personality, Self and Socialization

- Concept of self, Personality
- Nature vs Nurture, Biological vs Social
- Development of Personality
- Socialization as a process, Agents of socialization
- Socialization and self/group identity

6. Gender and Power

- Understanding Gender
- Social construction of Patriarchy
- Feminism in Historical context, Gender Debates
- Gender and Development
- Gender issues in Pakistani society, Women Participation in politics, economy and education
- Toward a gender sensitive society, Gender mainstreaming

7. Pakistan: State, Society, Economy and Polity

- Colonialism, colonial legacy, National identity
- Transformation in Pakistani society: Traditionalism vs Modernism
- Economy, Informality of Economy, Modern economy and Pakistan
- Political Economy, Sociology of Economy

Recommended Texts:

1. Giddens, A. (2018). Sociology (11th ed.). UK: Polity Press.
2. Henslin, J. M. (2018). Essentials of Sociology: A Down-to-Earth Approach.(18th Edition) Pearson Publisher.
3. Macionis, J. J. (2016). Sociology (16th ed.). New Jersey: Prentice-Hall.
4. Qadeer, M. (2006) Pakistan - Social and Cultural Transformation in a Muslim Nation.
5. Smelser, N.J. and Swedburg, R., The Handbook of Economic Sociology, Chapter 1 'Introducing Economic Sociology', Princeton University Press, Princeton.
6. Systems of Stratification | Boundless Sociology (no date). Available at: https://courses.lumenlearning.com/boundless-sociology/chapter/systems-of-stratification/
7. Jalal, A. (ed.) (1995) 'The colonial legacy in India and Pakistan', in Democracy and Authoritarianism in South Asia: A Comparative and Historical Perspective. Cambridge: Cambridge University Press (Contemporary South Asia)
8. Zaidi, S. A. (2015) Issues in Pakistan's Economy: A Political Economy Perspective. Oxford University Press. Chapter 26
9. Akhtar, A. S. (2017) The Politics of Common Sense: State, Society and Culture in Pakistan. Cambridge: Cambridge University Press.
10. Smelser, N.J. and Swedburg, R., The Handbook of Economic Sociology, Chapter 1 'Introducing Economic Sociology', Princeton University Press, Princeton.

URCG-5120	Exploring Quantitative Skills	3(3-0)

Course Brief:

Since ancient times, numbers, quantification, statistics and mathematics has played a central role in scientific and technological development. In the 21st century, Quantitative Reasoning (QR) skills are essential for life as they help to better understand socio-economic, political, health, education, and many other issues, an individual now faces in daily life.

Course Learning Objectives:

The skills acquired by taking this course will help the students to apply QR methods in their daily life and professional activities. This course will also change student's attitude about statistics and mathematics. It will not only polish their QR skills, but also enhance their abilities to apply these skills.

Course Contents:

1. Introduction to quantitative reasoning
2. Overview of contributions of Mathematicians and Statisticians especially Muslim scholars.
3. Types of standard numbers
4. Proportions, rates, ratio and percentages
5. Odds and odds ratio
6. Scale of measurements
7. Number sequence and series
8. Unit analysis as a problem-solving tool
9. Data handling (small and large)
10. Data errors, absolute and relative and their applications
11. Descriptive statistics
12. Rules of counting: multiplication rule, factorial, permutation and combination
13. Probability and its application in real life
14. A graphical perspective through Venn Diagram
15. Financial indicator analysis, and money management (profit, loss, simple and compound interest)
16. Practical scenarios involving algebraic expressions: linear and quadratic

Recommended Texts:

1. Akar, G. K., Zembat, İ. Ö., Arslan, S., & Thompson, P. W. (2023). *Quantitative Reasoning in Mathematics and Science Education*. 1st Ed., Springer, USA.
2. Peck, R., Olsen, C., & Devore, J. L. (2015). *Introduction to statistics and data analysis*. 5th Ed., Brooks Cole, USA.
3. Devlin, K. J. (2012). *Introduction to mathematical thinking*. Palo Alto, CA: Keith Devlin.

Suggested Readings:

1. Triola, M. F., Goodman, W. M., Law, R., & Labute, G. (2006). *Elementary statistics*. Reading, MA: Pearson/Addison-Wesley.
2. Blitzer, R., & White, J. (2005). *Thinking mathematically*. Pearson Prentice Hall.

Seerat of the Holy Prophet مطالعہ سیرت النبی صلی اللہ علیہ وسلم

Course Code URCG-5127

Title	Description
Semester	
Nature of Course	
No. of C.Hrs.	1(1-0)
Total Teaching weeks	18
Objectives of the Course	۱۔ طلباء کو مطالعہ سیرۃ طیبہ کی ضرورت واہمیت سے آگاہ کرنا ۲۔ تعمیر شخصیت میں مطالعہ سیرۃ طیبہ کے کردار کو واضح کرنا ۳۔ بعثت نبوی کے موقع پر اقوام عالم کی عمومی صورت حال سے آگاہ کرنا ۴۔ رسول اکرم صلی اللہ علیہ وسلم کی مکی اور مدنی زندگی کا اس طرح مطالعہ کروانا کہ طلباء ان واقعات سے نتائج کا استنباط کر سکیں ۵۔ طلباء کو عہد نبوی کی معاشرت، سیاست، معیشت سے آگاہ کرنا

Course Description

S.No.	Title	Description
1	حضور صلی اللہ علیہ وسلم کے ابتدائی حالاتِ زندگی	۱۔ حضور صلی اللہ علیہ وسلم کا خاندانی حسب ونسب ۲۔ پیدائش اور ابتدائی تربیت ۳۔ لڑکپن اور جوانی کے حالات زندگی
2	بعثت نبوی کے وقت دنیا کے حالات (۱)	۱۔ بعثت نبوی کے وقت اہم تہذیبیں ۲۔ عرب، مصر، حبشہ، بازنطینی، ساسانی
3	بعثت نبوی	۱۔ مکی عہد میں دعوت اسلام
4	بعثت نبوی	۱۔ مدنی عہد میں دعوت اسلام
5	خصائص النبیؐ	آپؐ بطور پیغامبر امن
6	خصائص النبیؐ	بحثیت استاد و معلم
7	خصائص النبیؐ	بحثیت تاجر
8	خصائص النبیؐ	بحثیت سربراہ ریاست
9	خصائص النبیؐ	ذاتی محاسن اور عالمگیر اثرات

ناموس رسالتؐ	خصائص النبیؐ	10
غیر مسلموں سے تعلقات	اسوہ حسنہ اور عصر حاضر	11
اسوہ حسنہ کی روشنی میں گھریلو زندگی	اسوہ حسنہ اور عصر حاضر	12
مستشرقین اور مطالعہ سیرت	اسوہ حسنہ اور عصر حاضر	13
وطن سے محبت اور سیرت	اسوہ حسنہ اور عصر حاضر	15
مستشرقین کے اعتراضات اور ان کے جوابات	اسوہ حسنہ اور عصر حاضر	16

نصابی کتب

نمبر شمار	نام مؤلف	نام کتاب
1	ابن ہشام	السیرۃ النبویۃ
2	مولانا شبلی نعمانی، حمید سلمان ندوی	سیرۃ النبی صلی اللہ علیہ وسلم
3	قاضی محمد سلیمان سلمان منصور پوری	رحمۃ للعالمین
4	مولانا سید ابوالحسن علی ندوی	نبی رحمت صلی اللہ علیہ وسلم
5	ڈاکٹر یسین مظہر صدیقی	عہد نبوی کا نظام حکومت
6	ڈاکٹر خالد علوی	انسان کامل ؐ

حوالہ جاتی کتب

نمبر شمار	نام مؤلف	نام کتاب
1	سید ابوالاعلیٰ مودودی	سیرت سرور عالم صلی اللہ علیہ وسلم
2	مولانا صفی الرحمن مبارکپوری	الرحیق المختوم
3	پیر محمد کرم شاہ الازہری	ضیاء النبی صلی اللہ علیہ وسلم
4	ڈاکٹر اکرم الضیاء العمری	السیرۃ النبویۃ الصحیحۃ
5	مولانا عبدالرؤف داناپوری	اصح السیر

URCG-5111	Translation of the Holy Quran – I	Non-Credit

Topic	Details
Semester/Level	In some discipline 1st semester and in some discipline 2nd Semester/ ADP Program 1st Year
Course Code	URCG-5111
Course Title	Translation of the Holy Quran – I
Credit Hours	Non-Credit
Objectives	◦ To familiarize the students to keys and fundamentals of recitation of the holy Quran. ◦ To develop the skill of the students of recitation the last revelation. ◦ Students will learn the basic Arabic grammar in a practical way. ◦ To develop an eagerness among the students to explore the last divine Book.
Course Contents:	• تیسواں پارہ - ناظرہ مع تجوید • بنیادی عربی گرامر اسم اور اسکے متعلقات : اسم فاعل ،مفعول ،تفضیل ،مبالغہ فعل اور اسکی اقسام : ماضی ،مضارع ،امر ، نہی حرف اور اسکی اقسام : حروف علت ،حروف جارہ ،مشبہ بالفعل
Memorization:	تیسویں پارے کی آخری بیس سورتیں (حفظ مع ترجمہ)

GEOL - 5104	Introduction to Paleontology	3(2-1)

Course Brief:

This course is designed to acquire the knowledge about the various types of fossils and their significance. This will help the students to understand various morphological features of fossils; their classification, identification and distribution in geologic time. This course will provide interested students with a better understanding of one of the most valuable tools in stratigraphic and paleo environmental analyses, fossils. The course will introduce the major marine and non-marine invertebrate taxonomic groups found in the fossil record and what we know about them – their stratigraphic range, modes of life, and environmental preferences. This course is designed to acquire the knowledge about the various types of fossils and their significance.

Course Learning Objectives:

This course will help the students to understand various morphological features of fossils; their classification, identification and distribution in geologic time. The main objectives of this subject are to identify the major fossil invertebrate groups and their stratigraphic and paleo environmental significance, to apply the techniques used in the processing of samples for paleontological analyses. to apply fossil data analyses and statistical applications used for biostratigraphic and paleo environmental interpretation, to use paleontological data to solve biostratigraphic, paleo environmental, paleo ecological, environmental, and ecological problems.

Course Contents:

1. Introduction to fossils and their significance;
2. Modes of fossilization,
3. Study of morphology, range and broad classification of major invertebrate phyla i .e Coelenterata, Brachiopoda, Mollusca, Arthropoda (trilobite) and Echinodermata (echinoidea);
4. Introduction to micro fossils;
5. Introduction to paleobotany;
6. Introduction and classification of major vertebrates i.e. mammals, amphibians, reptiles and picies;
7. Introduction to Micropaleontology i.e. Foraminifera, Briozone, Ostrocodes and Conodonts etc.
8. Index fossils;
9. Introduction to major invertebrate and microfossils of Pakistan.

Recommended Texts:

1. Moore, R. C., Lalicker, C. G., Lalicker, C. G., & Fischer, A. G. (2000). *Invertebrate fossils*. New York: McGraw-Hill.
2. Woods, H. (1926). *Palaeontology, invertebrate*. Cambridge: CUP Archives.

Suggested Readings:

1. Raup, D. M., Raup, D., & Stanley, S. M. (1978). *Principles of paleontology*. New York: Macmillan.
2. Clarkson, E. N. K. (2009). *Invertebrate palaeontology and evolution*. Hoboken: John Wiley & Sons.
3. Levinton, J. S., & Levinton, J. S. (2000). *Genetics, paleontology, and macroevolution.* Cambridge: Cambridge University Press.

GEOL - 5105	Stratigraphy	3(3-0)

Course Brief:

This course is a graduate course of stratigraphy. The rocks are formed during the full geological time from oldest Precambrian to Recent Quaternary. This course is designed to understand the basic division of geological time scale (GTS). Different litho, bio and chorono stratigraphic divisions of time scale. This course is designed to acquire the knowledge about the various stratigraphic successions formed during different geological time.

Course Learning Objectives:

This course will help the student to understand the stratigraphic set up of various regions, especially Pakistan. Initially, the basic principles and laws of stratigraphic will be teach in the class. Then the application of these laws/ principles is used to evaluate the structures and correlations of different geological features formed during the geological time will be understand by the students. This course also includes the principles of correlations.

Course Contents:

1. Principles of stratigraphy;
2. Laws of superposition and faunal succession;
3. Geological time scale with divisions;
4. Classification and nomenclature of stratigraphic units
5. Lithostragraphic
6. Biostratigraphy and chrono stratgraphic units; contacts; litho-and-biofacies;
7. Principle of stratigraphy correlation;
8. Stratigraphy code of Pakistan;
9. Outline of stratigraphy of Pakistan; principles of biostratigraphy and biostratigraphy zones; biostratigraphy techniques and procedures; biostratigraphy of Pakistan.

Recommended Texts:

1. Shah, S. I. (2000). *Stratigraphy of Pakistan*. Quetta: Geological Survey of Pakistan.
2. Kazmi, A. H., & Abbasi, I. A. (2008). *Stratigraphy & historical geology of Pakistan*. Peshawar: Department & National Centre of Excellence in Geology.

Suggested Readings:

1. Boggs Jr, S. (2014). *Principles of sedimentology and stratigraphy*. London: Pearson Education.
2. Kazmi, A. H., & Abbasi, I. A. (2008). *Stratigraphy & historical geology of Pakistan*. Peshawar: Department & National Centre of Excellence in Geology.
3. Shah, S. M. I. (1980). *Stratigraphy and economic geology of Central Salt Range*. Quetta: Geological Survey of Pakistan.

GEOL - 5106	Geological Fieldwork-I	3(0-3)

Course Brief:

This course is designed to identify various types of rocks, field stratigraphy, fossils, structural features and landforms in the field. This will help the students to understand various types of criteria to recognize rocks and other geological features in the field. The course emphasizes the basic skills essential to identify rocks according to different aspects, correlation & features also to locate yourself in the field and make essential field observations and measurements.

Course Learning Objectives:

The geological field build confidence and practical knowledge in the students to elaborate geological structures in the field during their field survey, which will give them more energy for the future. As geology is the subject of field and to explore the earth which is not possible without fieldwork. During the first two years, students will perform about two weeks of fieldwork. It will lead to becoming familiar with major rocks and basic geological mapping techniques. Each field trip will be followed by report writing and Viva Voce / Evaluation.

Course Contents:

1. Field based exercises
2. Identification different rock types.
3. Identification of different geological features
4. Identification of different geomorphic features
5. Identify different mass wasting phenomenon in field
6. Basic concept of relief and elevation
7. Essential field observations and measurements
8. Utilization of different types of maps in field
9. Topographic maps
10. Basic geological mapping techniques
11. Each field trip will be followed by report writing and Viva Voce / Evaluation.

Recommended Texts:

1. Coe, A. L. (Ed.). (2010). *Geological field techniques*. Hoboken: John Wiley & Sons.
2. Lambert, D. (2000). *The field guide to geology*. New York: Infobase Publishing.

Suggested Readings:

1. Barnes, J. W., & Lisle, R. J. (2013). *Basic geological mapping*. Hoboken: John Wiley & Sons.
2. Lahee, F. H. (2000). *Field geology*. New York: McGraw-Hill.
3. Compton, R. R., & Compton, R. R. (2000). *Geology in the Field.* New York: Wiley.

URCG- 5119	Expository Writing	3(3-0)

Course Brief:

This course prepares undergraduates to become successful writers and readers of English. The course helps students develop their fundamental language skills with a focus on writing so that they can gain the confidence to communicate in oral and written English outside the classroom. The course is divided into five units and takes a Project-based Learning approach. Unit themes target the development of 21st century skills and focus on self-reflection and active community engagement.

Course Learning Objectives:

The course completion will enable the students to develop communication skills as reflective and self-directed learners. They will be able to intellectually engage with different stages of writing process, and develop analytical and problem-solving skills to address various community-specific challenges.

Course Contents:

1. Self-Reflection
   - Introduction to the basics of the writing process
   - Introduction to the steps of essay writing
   - Prewriting activities: Brainstorming, listing, clustering and freewriting
   - Practicing Outlining of the essay
2. Personalized Learning
   - Learning Process, Learning Styles, Goal Setting and Learning Plan
3. Oral Presentation
   - Structure and Significance, Content Selection and Slide Presentation, Peer Review
4. Critical Reading Skills
   - Introducing Authentic Reading (Dawn and non-specialist academic books/texts)
   - Reading Strategies and Practice: Skimming, scanning, SQW3R, Annotating, Detailed reading and note-taking, Standard Test Practice: TOEFL and IELTS, Model Review Reports and Annotated Bibliographies
5. Community Engagement
   - Student-led brainstorming on local versus global issues, Identifying research problems
   - Drafting research questions, Drafting interview/survey questions for community research (in English or L1)
   - Engaging students in Critical reading, Presenting interview/ survey information, Field work
   - Writing Community Engagement Project
6. Letter to the Editor
   - Types of letters, Format and purpose of letter to the editor, Steps in writing letter-to-editor

Recommended Texts:

1. Bailey, S. (2011). Academic writing: A handbook for international students (3rd ed.). New York: Routledge.
2. Swales, J. M., & Feak, C. B. (2012). *Academic writing for graduate students: Essential tasks and skills* (3rd ed.). Ann Arbor: The University of Michigan Press.

Suggested Readings:

1. Cresswell, G. (2004). *Writing for academic success*. London: SAGE.
2. Johnson-Sheehan, R. (2019). *Writing today*. Don Mills: Pearson.
3. Silvia, P. J. (2019). *How to write a lot: A practical guide to productive academic writing*. Washington: American Psychological Association.

URCG-5121	Tools for Quantitative Reasoning	3(3-0)

Course Brief:

This course is based on quantitative reasoning 1 course. It will enhance the quantitative reasoning skills learned in quantitative reasoning 1 course. Students will be introduced to more tools necessary for quantitative reasoning skills to live in the fast paced 21st century. Students will be introduced to importance of statistical and mathematical skills in different professional settings, social and natural sciences.

Course Learning Objectives:

These quantitative reasoning skills will help students to better participate in national and international issues like political and health issues. This course will prepare the students to apply quantitative reasoning tools more efficiently in their professional and daily life activities. This course will help them to better understand the information in form of numeric, graphs, tables, and functions.

Course Contents:

1. Types of data and its graphical representation (Histogram, Stem and Leaf display, Box Plot, Scatter diagram, Historigam, Bar chart, etc)
2. Solving practical problems using linear and exponential models
3. Population growth models
4. Analytical approach to solve simultaneous equations
5. Inequalities and their application
6. Comparing quantities using analytical tools
7. Logical reasoning and their application in modern age
8. Logical reasoning and decision making
9. Data tendencies via measure of location
10. Variability and Measure of dispersion
11. Measuring relationships via Regression analysis and correlation
12. Statistical inference: sampling techniques, estimation techniques and hypothesis testing for decision and policy making

Recommended Texts:

1. Akar, G. K., Zembat, İ. Ö., Arslan, S., & Thompson, P. W. (2023). *Quantitative Reasoning in Mathematics and Science Education*. 1st Ed., Springer, USA.
2. Sharma, A. K. (2005). *Text book of elementary statistics*. Discovery Publishing House.
3. Blitzer, R. (2014). *Precalculus*, 5th Ed.. Pearson Education, Limited. New York

Suggested Readings:

1. Gupta, S. C., & Kapoor, V. K. (2020). *Fundamentals of mathematical statistics*. 12th Ed, Sultan Chand & Sons.
2. Aufmann, R. N., Lockwood, J., Nation, R. D., & Clegg, D. K. (2007). *Mathematical thinking and quantitative reasoning*. Cengage Learning
3. Blitzer, R., & White, J. (2005). *Thinking mathematically*. Pearson Prentice Hall.

URCG-5122	Ideology and Constitution of Pakistan	2(2-0)

Course Brief:

This course focuses on ideological background of Pakistan. The course is designed to give a comprehensive insight about the constitutional developments of Pakistan. Starting from the Government of India Act, 1935 till to date, all important events leading to constitutional developments in Pakistan will be the focus of course. Failure of the constitutional machinery and leading constitutional cases on the subject. Moreover, students will study the process of governance, national development, issues arising in the modern age and posing challenges to Pakistan.

Course Learning Objectives:

This course will also cover the entire Constitution of Pakistan 1973. However, emphasis would be on the fundamental rights, the nature of federalism under the constitution, distribution of powers, the rights and various remedies, the supremacy of parliament and the independence of judiciary

- **Course Contents:**
  - **Ideology of Pakistan**
    - Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-e-Azam Muhammad Ali Jinnah.
    - Two Nation Theory and Factors leading to Muslim separatism.
  - **Constitutional Developments**
    - Salient Feature of the Government of India Act 1935
    - Salient Feature of Indian Independence Act 1947
    - Objectives Resolution
    - Salient Feature of the 1956 Constitution
    - Developments leading to the abrogation of Constitution of 1956
    - Salient features of the 1962 Constitution
    - Causes of failure of the Constitution of 1962
    - Comparative study of significant features of the Constitution of 1956, 1962 and 1973
  - **Fundamental rights**
  - **Principles of policy**
  - **Federation of Pakistan**
    - President
    - Parliament
    - The Federal Government
  - **Provinces**
    - Governors
    - Provincial Assemblies
    - The Provincial Government
  - **The Judicature**
    - Supreme Court
    - High Courts
    - Federal Shariat Courts
    - Supreme Judicial
    - Council
    - Administrative Courts and tribunals
  - **Islamic Provisions in Constitution**
  - **Significant Amendments of Constitution of Pakistan 1973**

- **Recommended Texts:**

1. Constitutional and Political History of Pakistan by Hamid Khan
2. Mahmood, Shaukat and Shaukat, Nadeem. Constitution of the Islamic Republic of Pakistan, 3rd re edn. Lahore: Legal Research Centre, 1996.
3. Munir, Muhammad. Constitution of the Islamic Republic of Pakistan: Being a Commentary on the Constitution of Pakistan, 1973. Lahore, Law Pub., 1975.

4. Rizvi, Syed Shabbar Raza. Constitutional Law of Pakistan: Text, Case Law and Analytical Commentary. 2nd re edn. Lahore: Vanguard, 2005.
5. The Text of the Constitution of the Islamic Republic of Pakistan, 1973 (as amended).
6. Fundamental Laws of Pakistan by A.K. Brohi

GEOL - 5107	Structural Geology	3(2-1)

Course Brief:

This course is a graduate course of structural geology. Different natural structures of earth are formed by the forces acting on the earth crust. This course is designed to acquire the knowledge about the deformational structures and their kinematics in the crust. This will help in understanding the deformational mechanism of various types of rocks and the mapping of the resultant structures. The major forces its classification is also included in this course. Different structures for example folds, faults, unconformities are formed by the forces acting on the surface of the earth.

Course Learning Objectives:

This course is designed to first understand the phenomenon by which these structures are formed, their terminologies and classification of different structures. The lab work is included to enhance the knowledge about the practical use of the applications of engineering for the purpose of structural interpretations.

Course Contents:

1. Stress, concept, classes, Mohr circle of stress,
2. Strain, types of strain, measures of strain, stress-strain diagram
3. Factor controlling the mechanical behavior of rocks
4. Fold Geometry
5. Mechanism of fold formation
6. Faults
7. Classification of faults
8. Foliation: Terminology, Classification
9. Lineation: Terminology, Classification
10. Unconformity: Terminology, Classification
11. Tectonites

Lab. Work

1. Map Exercise and construction of geological cross sections
2. Stereographic projections
3. Use of structural computer software.

Recommended Texts:

1. Twiss, R. J., & Moores, E. M. (1992). *Structural geology*. New York: Macmillan.
2. Ragan, D. M., & Ragan. (2000). *Structural geology*. New York: John Wiley & Sons.

Suggested Readings

1. Davis, G. H., Reynolds, S. J., & Kluth, C. F. (2011). *Structural geology of rocks and regions*. Burlington: John Wiley & Sons.
2. Park, R. G. (2013). *Foundation of structural geology*. London: Routledge.
3. Fossen, H. (2016). *Structural geology*. Cambridge: Cambridge University Press.

GEOL - 5108	Petrography	3(2-1)

Course Brief:

Petrography is a branch of petrology that focuses on detailed descriptions of rocks. Someone who studies petrography is called a petrographer. This course is designed to help the students to identify the minerals in sedimentary, igneous and metamorphic rocks using polarizing microscope and also classifying the rocks on the basis of rock texture and mineral composition. The mineral content and the textural relationships within the rock will be described in detail. The classification of rocks is based on the information acquired during the petrographic analysis.

Course Learning Objectives:

This course will enable studentds to do Petrographic descriptions, which start with the field notes at the outcrop and include macroscopic description of hand specimens. However, the most important tool for the petrographer is the petrographic microscope. The detailed analysis of minerals by optical mineralogy in thin section and the micro-texture and structure are critical to understanding the origin of the rock.

Course Contents:

1. Introduction to polarizing microscope
2. Optical properties of opaque and non-opaque minerals in plane polarized light and under crossed nicol including metallic under reflected light
3. Description of optical properties of common rock forming minerals
4. Mineralogy and common texture of igneous, sedimentary and metamorphic rocks.

Lab. Work

1. Identification and description of common minerals
2. Study of rocks and minerals in thin section, texture and composition
3. Classification of rocks using different techniques, volume estimates and other elementary petrographic techniques.

Recommended Texts:

1. MacKenzie, W. S., Adams, A. E., & Brodie, K. H. (2017). *Rocks and Minerals in Thin Section: A Colour Atlas*. Boca Raton: CRC Press.
2. Perkins, D., (2000), *Minerals in Thin Sections*. Upper Saddle River: Prentice Hall.

Suggested Readings:

1. Klein, C. (2000). *Minerals and rocks: exercises in crystallography, mineralogy, and hand specimen petrology*. New York: Wiley.
2. Best, M. G. (2013). *Igneous and metamorphic petrology.* New York: John Wiley & Sons.
3. MacKenzie, W. S., & Guilford, C. (2014). *Atlas of the Rock-Forming Minerals in Thin Section*. London: Routledge.

GEOL - 5109	Introduction to GIS and RS	3(2-1)

Course Brief:

This course is designed to introduce principles, concepts and applications of Geographic Information Systems (GIS) and Remote Sensing (RS): a decision support tool for planners and managers of spatial information and to obtain information on the earth from decimeter level to km level locally and globally. The catalog description is to introduction concepts, terminology, methods of Geographic Information System (GIS) technology and mapping science.

Course Learning Objectives:

The main Purpose and Objectives of Course is to gain a basic, practical understanding of GIS concepts, techniques and real world applications Class discussions, reading assignments, and class lectures prepare students to develop a mapping project based on the assumptions and interpretations of data selected by the student.

Course Contents:

1. Introduction to Geographical Information System
2. Data types, data models and structures
3. Data sources and capturing techniques
4. Displaying and manipulating spatial information
5. Introduction to the concept of RS
6. Technology of Remote Sensing (Orbits, Satellites, Sensors and Platforms)
7. Applications of Remote Sensing, satellite image processing cycle
8. Mosaicing and information extraction (classification and vectorization)
9. Have a basic, practical understanding of GIS concepts, techniques and real world Applications.
10. Have an understanding of the technical language of GIS.
11. Know how GIS is utilized in the larger context of business needs and IT strategies.
12. Understand the basic concepts of geography necessary to efficiently and
13. Accurately use GIS technology.
14. Understand basic GIS data concepts.
15. Have an ability to perform basic GIS analysis of concepts.
16. Have demonstrated a practical application of GIS.
17. Have practical experience using basic GIS tools.
18. Have an understanding of GIS and its relationship to mapping software development.
19. Have an appreciation of GIS career options and how to pursue them.

Recommended Texts:

1. Gupta, R. P. (2017). *Remote sensing geology*. Heidelberg: Springer.
2. Chang, K. T. (2008). *Introduction to geographic information systems*. Boston: McGraw-Hill.

Suggested Readings:

1. Duckham, M., Goodchild, M. F., & Worboys, M. (Eds.). (2004). *Foundations of geographic information science*. Boca Raton: CRC Press.
2. DeMers, M. N. (2008). *Fundamentals of geographic information system*s. Hoboken: John Wiley & Sons.

URCG-5111	Translation of the Holy Quran- II	Non-Credit

Topic	Details
Semester/Level	In some discipline 3rd semester and in some discipline 4th Semester/ ADP Program 2nd Year
Course Code	URCG-5111
Course Title	Translation of the Holy Quran – II
Credit Hours	Non-Credit
Objectives	▪ Students will come to know about the real nature, significance and relevance of the Islamic beliefs in light of the text of the Holy Quran. ▪ Students will seek knowledge of translation and transliteration of the Holy Book Quran. ▪ To familiarize the students with the concept of Ibādah (Its significance, scope and relevance) and its types in Islam. ▪ Students will learn literal and idiomatic way of translation of the Holy Book. ▪ Students will learn about the polytheism and its incompatibility in Islam highlighted by the Holy Quran. ▪ To highlight the significance of learning through using all human faculties provided by the almighty Allah and familiarize the students about condemnation of ignorance mentioned in the Quranic text. ▪ To develop Awareness among the students about rights and duties of different circles of society in the light of Holy Quran. ▪ To introduce the students to Quranic Arabic grammar in practical manner.
Course Contents:	○ ایمانیات اور عبادات اللہ پر ایمان ،فرشتوں پر ایمان ،رسولوں پر ایمان ،آسمانی کتابوں پر ایمان یوم آخرت پر ایمان ، تقدیر پر ایمان نماز ،روزہ ،زکوۃ،حج ،جہاد ○ معاشرے کے حقوق • خاندان کی تکوین • حق مہر • رضاعت و حمل • اولاد کو قتل کرنے کے ممانعت • شوہرکی نافرمانی • طلاق • بیوہ کی عدت کے احکام • نکاح کا پیغام بھیجنا • عورت کی وراثت (اس کے شوہر کی طرف سے) • والدین کے حقوق • بیویوں اور اولاد کے بیچ عداوت ○ خاندان کے حقوق • مہمان کی عزت • اجازت طلب کرنے کے اصول • مجلس کے آداب • تعاون اور بھائی چارہ • گروہ بندی • محبت • لوگوں کے درمیان صلح • عفو ودرگزر، غصہ پر قابو اور معاف کرنا • شعوب و قبائل • لوگوں کے بیچ اختلافات • حمایت و نگہبانی
Grammar:	• قرآنی عربی گرامر کے اصول اور انکے اطلاقات (متن قرآنی پر اطلاق سے

	توضیحات)
Details of Chapters and verse Numbers:	▪ منتخب آیات مع ترجمہ وتجوید ▪ البقرہ ((۱۷۷، ۲۳۸، ۳۵، ۲۷۷، ۲۱۹، ۱۱۰، ۳۵، ۱۵۳، ۲۳۷، ۲۰۱، ۲۸۵، ۳۳، ۲۸۵، ۱۵، ۱۲۹، ۲۵۳، ۹۸، ۶۲، ۱۲۶، ۲۸۵، ۲۵۶، ۱۷۷، ۱۳۶، ۱۸۹، ۲۰۰، ۱۸۳، ۲۱۸، ۱۵۸، ۲۳۱،۱۹۹، ۲۲۷، ۲۲۶، ۲۳۷، ۲۲۸، ۲۲۹، ۲۳۱، ۲۳۷، ۲۳۵، ۲۳۰ ، ۸۲ ، ۱۸۳، ۲۳۳، ۱۸۲، ۱۶۰، ۸۳) ▪ النساء (۹۵، ۹۲، ۵۹، ۱۳۶، ۶۹، ۸۰، ۱۳، ۶۹، ۸۶،۸۰، ۳۶، ۱۷۶، ۱۲، ۳۵، ۱۲۸، ۳۴، ۱۱، ۳، ۱۷۶، ۲۳، ۲۵، ۱۱، ۱۱، ۱۲۸، ۱۹۱، ۳۵، ۲۰، ۳۵، ۱۹۱، ۶، ۱، ۲۰، ۱، ۱۶، ۱۲۶، ۵۳، ۱۲۸، ۸۱) ▪ الانعام (۲۲، ۱۳۷،۱۴،۹۲، ۱۵۱، ۳۸، ۵۳) ▪ آل عمران (۹۷، ۳۹، ۸۵، ۱۲۵، ۸۳، ۱۳۳، ۱۹،۱) ▪ المائدہ (۵۳، ۲، ۹۲، ۳۹،۱۹، ۸۲، ۲، ۵) ▪ الاعراف (۳۵، ۱۸۹، ۱۸۹) ▪ التوبہ (۲۰، ۷۱،۱۶) ▪ ہود (۱۲) ▪ الزمر (۶) ▪ النور (۵۳، ۲۸،۵۲، ۲۷، ۶۰، ۲۹) ▪ محمد (۳۳) ▪ انفال (۸۲، ۲۰) ▪ الرعد (۳) ▪ الطلاق (۴) ▪ الحج(۵) ▪ ابراہیم ((۳۳،۲۳) ▪ الاسراء (۲۳، ۲۴) ▪ الاحقاف (۱۵) ▪ المومنون (۲۷) ▪ العنکبوت (۲۵،۳۸، ۸) ▪ النحل (۲۲) ▪ لقمان (۱۵،۳، ۱۴) ▪ الاحزاب ((۳۵، ۵۰،۳۸، ۳۹) ▪ الشعراء (۷) ▪ الروم (۲۱) ▪ مریم (۱۴،۲۶) ▪ المجادلہ (۱۲، ۱۱)

URCG-5114	Basic Science	3 (2-1)

Course Brief:

Life, its characteristics, natural science, biology and its branches; Importance of Flora & Fauna in biodiversity; Importance of Natural Compounds in daily life, medicine and human health; Latest developments in natural sciences (Biotechnology); Ecosystem and its components; Environment and its components; Pollutants and their effect on the environment (Greenhouse effect, global warming, acid rains, water pollution and ozone depletions etc); Introduction to micro-organism and its types (bacteria, fungi, viruses)

Practical:

1: Field Survey of Flora & Fauna and their identification

2: Study of herbarium

3: Study of Museum

Recommended Texts:

l. Keddy, P.A. (2017). *Plant ecology origins, processes, consequences.* Cambridge, University Press.

2. Canadell, J.G., Diaz, S., Heldmaier, G., Jackson, R.B., Levia, D.F., Schulze, E.D. & Sommer, U. (2019). *Ecological studies.* Springer.

3. Bhat, S.V., Nagasampagi, B.A. & Sirakumar, M. (2006). Chemistry of Natural Products. Springer Science

4. De, A.K. (2019). *Environmental Chemistry*. New Age International Press

Suggested Readings:

l. Fath, B. (2018). *Encyclopedia of' ecology.* Elsevier.

2. Ajith, H .. Urmas. P., Pastur, G. M & Iversion L. R. (2018). *Ecosystem services from forest landscpes:* broadsclaes consideration. 1st Edition. Springer International Publishing AG.

3. Xu, R., Ye, Y. & Zhao, W. (2011). *Introduction to Natural Product Chemistry*. CRC Press

4. Tayler, D.J., Green, N.P.O. & Stout, G.W. (1997). *Biological Science* 1&2. Cambridge University Press

5. Tayler, M.R., Simon, E.J., Dickey, D.J. & Hogan, K.A. (2020). *Campbell Biology: Concepts & Connections* (10th Edition). Pearson

URCG-5124	Entrepreneurship	2(2-0)

Course Brief:

This course addresses the unique entrepreneurial experience of conceiving, evaluating, creating, managing, and potentially selling a business idea. The goal is to provide a solid background with practical application of important concepts applicable to the entrepreneurial environment. Entrepreneurial discussions regarding the key business areas of finance, accounting, marketing and management include the creative aspects of entrepreneurship. The course relies on classroom discussion, participation, the creation of a feasibility plan, and building a business plan to develop a comprehensive strategy for launching and managing a new venture.

Course Learning Objectives

1. To enhance the 'entrepreneurial intentions' of the students by improving their natural willingness to start a business.
2. To understand the process of entrepreneurship and learn the ways to manage it by working individually in the class and in the form of groups outside the class to conduct field assignments.
3. To educate the students about the practical underpinnings of the entrepreneurship with the aid of practical assignments and idea pitching.

Course Contents:

1. **Background:** What is an Organization, Organizational Resources, Management Functions, Kinds of Managers, Mintzberg's Managerial Roles.
2. **Forms of Business Ownership:** The Sole proprietorship, Partnership, Joint Stock Company
3. **Entrepreneurship:** The World of the Entrepreneur, what is an entrepreneur? The Benefits of Entrepreneurship, The Potential Drawbacks of Entrepreneurship, Behind the Boom: Feeding the Entrepreneurial Fire.
4. **The Challenges of Entrepreneurship:** The Cultural Diversity in Entrepreneurship, The Power of "Small" Business, Putting Failure into Perspective, The Ten Deadly Mistakes of Entrepreneurship, How to Avoid the Pitfalls, Idea Discussions & Selection of student Projects, Islamic Ethics of Entrepreneurship.
5. **Inside the Entrepreneurial Mind:** From Ideas to Reality: Creativity, Innovation, and Entrepreneurship, Creativity – Essential to Survival, Creative Thinking, Barriers to Creativity, How to Enhance Creativity, The Creative Process, Techniques for Improving the Creative Process, Protecting Your Ideas, Idea Discussions & Selection of student Projects.
6. **Products and technology, identification opportunities**
7. **Designing a Competitive Business Model and Building a Solid Strategic Plan:** Building a strategic plan, Building a Competitive Advantage, The Strategic Management Process, Formulate strategic options and select the appropriate strategies, Discussion about execution of Students' Project.
8. **Conducting a Feasibility Analysis and Crafting a Winning Business Plan:** Conducting a Feasibility Analysis, Industry and market feasibility, Porter's five forces model, Financial feasibility analysis. Why Develop a Business Plan, The Elements of a Business Plan, What Lenders and Investors Look for in a Business Plan, Making the Business Plan Presentation.
9. **Building a Powerful Marketing Plan:** Building a Guerrilla Marketing Plan, Pinpointing the Target Market, Determining Customer Needs and Wants Through Market Research. Plotting a Guerrilla Marketing Strategy: How to Build a Competitive Edge, Feed Back & Suggestions on Student Project, Islamic Ethics for Entrepreneurial Marketing
10. **E-Commerce and the Entrepreneur:** Factors to Consider before Launching into E-Commerce, Ten Myths of E-Commerce, Strategies for E-Success, Designing a Killer Web Site, Tracking Web Results, Ensuring Web Privacy and Security, Feed Back & Suggestions on Student Project.
11. **Pricing Strategies:** Three Potent Forces: Image, Competition, and Value, Pricing Strategies

and Tactics, Pricing Strategies and Methods for Retailers, The Impact of Credit on Pricing.

12. **Attracting Venture Capitalist:** Projected Financial Statements, Basic Financial Statements, Ratio Analysis, Interpreting Business Ratios, Breakeven Analysis, Feed Back &Suggestions on Student Project,
13. **Idea Pitching:** Formal presentation, 5-minutes pitch, funding negotiation and launching.

Recommended Texts:

1. Scarborough, N. M. (2011). *Essentials of entrepreneurship and small business management*. Publishing as Prentice Hall, One Lake Street, Upper Saddle River, New Jersey 07458..

Suggested Readings:

1. Burstiner, I. (1989). S*mall business handbook*. Prentice Hall Press.

URCG-5125	Civics and Community Engagement	2(2-0)

Course Brief:

The Civics and Community Engagement course is designed to provide students with an understanding of the importance of civic participation, culture and cultural diversity, basic foundations of citizenship, group identities and the role of individuals in creating positive change within their communities. The course aims at developing students' knowledge, skills and attitudes necessary for active and responsible citizenship.

Course Learning Objectives:

After completing this course, students will be able to

- Understand the concepts of civic engagement, community development, and social responsibility.
- Understand rights and responsibilities of citizenship
- Understand cultural diversity in local and global context
- Analyze the significance of civic participation in promoting social justice, equity, and
- democracy.
- Examine the historical and contemporary examples of successful civic and community engagement initiatives.
- Identify and assess community needs, assets, and challenges to develop effective strategies for community improvement.
- Explore the ethical implications and dilemmas associated with civic and community engagement.
- Develop practical skills for effective community organizing, advocacy, and leadership.
- Foster intercultural competence and respect for diversity in community engagement efforts.
- Collaborate with community organizations, stakeholders, and fellow students to design and implement community-based projects.
- Reflect on personal growth and learning through self-assessment and critical analysis of community engagement experiences.

Course Content:

Introduction to Civics & Community Engagement

- Overview of the course: Civics & Community Engagement
- Definition and importance of civics
- Key concepts in civics: citizenship, democracy, governance, and the rule of law
- Rights and responsibilities of citizens

Citizenship and Community Engagement

- Introduction to Active Citizenship: Overview of the Ideas, Concepts, Philosophy and Skills
- Approaches and Methodology for Active Citizenship

Identity, Culture, and Social Harmony

- Concept and Development of Identity, Group identities
- Components of Culture, Cultural pluralism, Multiculturalism, Cultural Ethnocentrism, Cultural relativism, Understanding cultural diversity, Globalization and Culture, Social Harmony,
- Religious Diversity (Understanding and affirmation of similarities & differences)
- Understanding Socio-Political Polarization
- Minorities, Social Inclusion, Affirmative actions

Multi-cultural society and inter-cultural dialogue

- Inter-cultural dialogue (bridging the differences, promoting harmony)
- Promoting intergroup contact/ Dialogue
- Significance of diversity and its impact
- Importance and domains of Inter-cultural dialogue

Active Citizen: Locally Active, Globally Connected

- Importance of active citizenship at national and global level
- Understanding community
- Identification of resources (human, natural and others)
- Utilization of resources for development (community participation)
- Strategic planning, for development (community linkages and mobilization)

Human rights, constitutionalism and citizens' responsibilities

- Introduction to Human Rights
- Human rights in constitution of Pakistan
- Public duties and responsibilities
- Constitutionalism and democratic process

Social Institutions, Social Groups, Formal Organizations and Bureaucracy

- Types of Groups, Group identities, Organizations
- Bureaucracy, Weber's model of Bureaucracy
- Role of political parties, interest groups, and non-governmental organizations

Civic Engagement Strategies

- Grassroots organizing and community mobilization
- Advocacy and lobbying for policy change
- Volunteerism and service-learning opportunities

Social issues/Problems of Pakistan

- Overview of major social issues of Pakistani society

Social Action Project

Recommended Books:

1. Kennedy. J. K., & Brunold, A. (2016). Regional context and Citizenship education in Asia and Europe. New Yourk: Routledge, Falmer.
2. Henslin, James M. (2018). Essentials of Sociology: A Down to Earth Approach (13th ed.). New York: Pearson Education
3. Macionis, J. J., & Gerber, M.L. (2020). Sociology. New York: Pearson Education

Suggested Readings:

1. Glencoe McGraw-Hill. (n.d.). Civics Today: Citizenship, Economics, and Youth.
2. Magleby, D. B., Light, P. C., & Nemacheck, C. L. (2020). Government by the People (16th ed.). Pearson.
3. Sirianni, C., & Friedland, L. (2005). The Civic Renewal Movement: Community-Building and Democracy in the United States. Kettering Foundation Press.
4. Bloemraad, I. (2006). Becoming a Citizen: Incorporating Immigrants and Refugees in the United States and Canada. University of California Press.
5. Kuyek, J. (2007). Community Organizing: Theory and Practice. Fernwood Publishing.
6. DeKieffer, D. E. (2010). The Citizen's Guide to Lobbying Congress. TheCapitol.Net.
7. Rybacki, K. C., & Rybacki, D. J. (2021). Advocacy and Opposition: An Introduction to Argumentation (8th ed.). Routledge.
8. Kretzmann, J. P., & McKnight, J. L. (1993). Building Communities from the Inside Out: A Path Towards Finding and Mobilizing a Community's Assets. ACTA Publications.
9. Patterson, T. E. (2005). Engaging the Public: How Government and the Media Can Reinvigorate American Democracy. Oxford University Press.
10. Love, N. S., & Mattern, M. (2005). Doing Democracy: Activist Art and Cultural Politics. SUNY Press.

GEOL-5110	Igneous - Metamorphic Petrology	3(3-0)

Course Brief:

This course is a graduate level course of Igneous - Metamorphic Petrology. It is the study of magma and the rocks that solidify from magma. The composition of igneous rocks and minerals can be determined via a variety of methods of varying ease, cost, and complexity. This course also includes the tectonic activities related to magmatic processes and different types of igneous rocks on different tectonic margins. . This course also includes different rock structures which developed due to metamorphism so it's beneficial for students to recognize different rock features in metamorphic rocks of field area. Metamorphic rocks are the most common rock type on Earth, and their study allows us to put constraints on the pressure, stress and temperature conditions in the crust and mantle. Metamorphism affects rocks in different ways by changing their composition and shapes.

Course Learning Objectives:

This course will enable students to understand the mechanism and factors affecting the magma, its magmatic evolution and the rocks that solidify from magma. Students will learn the composition of igneous rocks and minerals It also enables students to understand the mechanism and types of metamorphism as well as the factors that affect the process of metamorphism.

Course Contents:

1. Mantle-magma systems and source of magma
2. Physico-chemical factors in magmatic evolution.
3. Tectonism-magmatism relationship
4. Igneous activity related to convergent plate boundary and divergent plate boundary environments
5. Intracontinental hot spots
6. Petrogenesis of igneous rocks
7. Ophiolites
8. Introduction to metamorphism
9. Types, grades, zones and facies of metamorphism
10. Metamorphic diffusion and differentiation
11. Metamorphism in relation to plate tectonics
12. Study of textures and structures of metamorphic rocks
13. Differentiation between metamorphism and metasomatism
14. Paired metamorphic belts

Recommended Texts:

1. Best, M, G. (2013). Igneous and metamorphic petrology. Honoken: John Wiley & Sons.
2. Hyndman, D. W. (2000). Petrology of igneous and metamorphic rocks. New York: McGrawHill.
3. . McBirney, A. R. (1993). Igneous petrology. Burlington: Jones & Bartlett learning.

Suggested Reading:

1. Gillen, C. (2012). Metamorphic geology: an introduction to tectonic and metamorphic processes. Amsterdam: Springer Science & Business Media.
2. Philpotts, A. & Ague, J. (2009). Principles of igneous and metamorphic petrology. Cambridge: Cambridge University Press.

GEOL - 5111	Geotectonics	3(2-1)

Course Brief:

This course is designed to acquire the knowledge about the various types of plate boundaries, their kinematics and dynamics. The course comprises recent knowledge on structure and development of the Earth, especially of its crust and mantle. There are discussed older and new geological ideas concerning development of the crust, the accent is put on the plate tectonics.

Course Learning Objectives:

This course will help the students to understand the mountain building activity and changes that occurred on the earth with the passage of time. In particular, it describes the processes of mountain building, the growth and behavior of the strong, old cores of continents known as crotons, and the ways in which the relatively rigid plates that constitute the Earth's outer shell interact with each other. Tectonics also provides a framework for understanding the earthquake and volcanic belts.

Course Contents:

1. Concept of geosyncline and sedimentary basins
2. Sea floor spreading
3. Oceanic ridges and trenches
4. Continental rifts
5. Intra-oceanic islands
6. Hot spot and mantle plumes
7. Continental drift and reconstruction
8. Concept of plate tectonics
9. Historical perspective
10. Mechanism of plate tectonics
11. Plates and plate boundaries
12. Relative and absolute plate motions
13. Extensional, compressional and transpressional tectonics
14. Subduction zones
15. Transform and transcurrent faults
16. Introduction to neo-tectonics and related hazards
17. Application of geotectonic in natural resource explorations.

Lab Work

Specified assignments/projects.

Recommended Texts:

1. Belousov, V. V., & Maxwell, J. C. (2000). *Basic problems in geotectonics.* New York, McGraw-Hill.
2. Keary, P., Vine, F., & Panza, G. F. (2000). *Global Tectonics.* Hoboken: Wiley-Blackwell.

Suggested Readings

1. Turcotte, D., & Schubert, G. (2014). *Geodynamics.* Oxford: Cambridge university press.
2. Belousov, V. V. (2000). *Fundamentals of geotectonics*. Moscow: Izdatel'stvo Nedra.
3. Cox, A., & Hart, R. B. (2009). *Plate tectonics: how it works*. Hoboken: John Wiley & Sons.

GEOL - 5112	Geological Fieldwork-II	3(0-3)

Course Brief:

The second year field work will be performed for about two weeks. This course is designed to identify various types of rocks, field stratigraphy, fossils, structural features and landforms in the field. This will help the students to understand various types of criteria to recognize rocks and other geological features in the field. This course is designed to understand the geological mapping techniques in the field. This will help the students in learning the use of field equipments and data acquisition and preparation of geological maps and cross-sections.

Course Learning Objectives:

This course will help the students to get knowledge about various structures, features and other processes occurred in the field. The main goal of this subject is to acquire the fundamental geological field skill of mapping. The course emphasizes the basic skills essential to identify rocks according to different aspects , correlation & features also to locate yourself in the field and make essential field observations and measurements. Geological field build confidence and practical knowledge in the students to elaborate geological structures in the field during their field survey, which will give them more energy for the future.

Course Contents:

1. Field based exercises;
2. Identification of major rocks.
3. field stratigraphy,
4. Fossils,
5. Structures of Igneous Rocks
6. Structure of Sedimentary rocks
7. Relief features
8. Contours and its types
9. Regional and detailed mapping
10. Section measurement.
11. Basic geological mapping techniques.
12. Each field trip will be followed by report writing and Viva Voce / Evaluation

Recommended Texts:

1. Coe, A. L. (Ed.). (2010). *Geological field techniques*. Hoboken: John Wiley & Sons.
2. Lambert, D. (2000). *The field guide to geology*. New York: Infobase Publishing.

Suggested Readings:

1. Barnes, J. W., & Lisle, R. J. (2013). *Basic geological mapping*. Hoboken: John Wiley & Sons.
2. Lahee, F. H. (2000). *Field geology*. New York: McGraw-Hill.
3. Compton, R. R., & Compton, R. R. (2000). *Geology in the Field.* New York: Wiley.

GEOG- 5101	Fundamentals of Geography	3(3-0)

Course Brief:

This course is graduate-level course to expose students with the founding principles of Geography and geographical knowledge. A systematic descriptive introduction to the diverse elements of landscape including geomorphic, climatic, and biotic elements, human settlement and land-use patterns; cartographic approaches to the analysis of selected processes of landscape change. This course provides an opportunity for understanding part of the complex physical and biological environment in which human beings live.

Course Learning Objectives:

The students will learn about nature and processes of geo-system and its constituent parts: atmosphere, lithosphere, hydrosphere and biosphere; structure and composition of the atmosphere: atmospheric circulation, weather and climate, energy transmission, spatial variation of energy inputs and energy budget; structure and composition of the earth: tectonics and related processes; hydrological cycle and its components: precipitation, evapotranspiration, groundwater, surface water and the oceans; vegetation zones of the world: world soils, ecosystems, biomes, energy and matter flows.

Course Contents:

1. Introduction, Definitions, scope and branches of Geography
2. Roots of the discipline and basic geographic concepts
3. Themes and traditions of Geography
4. Tools of Geography, The Universe, Galaxies and solar system
5. The Earth as a planet, Celestial positions, its shape and size
6. Rotation, revolution and related phenomena
7. Spheres of the earth, Lithosphere, Atmosphere, Hydrosphere
8. Biosphere
9. Man-environment interaction
10. Population
11. Major Economic activities
12. Settlements
13. Pollution

Lab. Work

1. Comprehension of atlases
2. Map reading skills, location of places
3. Features and relevant work related to topics of the theoretical section.

Recommended Texts

1. Arbogast, A. F. (2007).Discovering physical geography.London: John Wiley and Sons.
2. Christopherson, R. W. (2009).Geo systems: an introduction to physical geography. New Jersey: Pearson Prentice Hall.

Suggested Readings

1. De Blij, H. J and Muller, P. O. (1996).Physical geography of the global environment.London: John Wiley and Sons.
2. Strahler, A. (2013).Introduction to physical geography. New Jersey: John Wiley & Sons.

PHYS-5101	Mechanics- I	3(3-0)

Course Brief:

Mechanics is all about motion of body. It deals with forces, motion, stress, strain and further to the laws of motion in inertial frames specifically. This course also provides the students a broad understanding of the physical principles of the classical dynamics, to describe mechanical events that involve forces acting on macroscopic objects with quantitative skills, to motivate them to think creatively and critically about scientific problems and experiments (thought as well real-life).

Course Learning Objectives:

A student studying this course will understand classical physics and will also develop the skills to apply principles to the practical life problems. Students are encouraged to share their thinking with teachers and the other students to examine different problem-solving strategies.

Course Contents:

1. Measuring things, displacement, average velocity and speed, acceleration, constant acceleration, free fall acceleration, graphical integration in motion analysis
2. Vectors and their components, adding vectors by components, multiplying vectors
3. Unit vector, vector representation of quantities, projectile motion, uniform circular motion
4. Relative motion in one dimension, relative motion in two dimensions
5. Newton's first and second law, some particular forces, applying newton laws, friction
6. Drag force, uniform circular motion, kinetic energy, work and kinetic energy
7. Work done by gravitational force, work done by a spring force
8. Work done by a general variable force, power, potential energy, conservation of energy
9. Conservation of mechanical energy, work done on a system by an external force
10. Conservation of energy, center of mass, newton's second law for system of particles
11. Linear momentum, collision and impulse, momentum and kinetic energy in collision
12. Elastic collision in one dimension, collisions in one/two dimensions
13. Conservation of linear momentum and system with varying mass
14. Modulus of rigidity by static & dynamic method (maxwell's needle, barton's apparatus)
15. To determine the value of "g" by compound pendulum/kater's pendulum
16. To study the conservation of energy (hook's law)
17. To determine elastic constants by spiral springs
18. To study the laws of vibration of stretched string using sonometer
19. Modulus of rigidity by static & dynamic method (maxwell's needle, barton's apparatus)

Recommended Texts:

1. Halliday, D., Resnick, R. & Walker, J. (2014). *Fundamentals of physics* (10^{th} ed.). New York: Wiley.
2. Halliday, D., Resnick, R. & Krane, K. S. (2003). *Physics* (5^{th} ed.). New York: Wiley.

Suggested Readings:

1. Young, H. D., Freedman, R. A. & Ford, A. L. (2019). *University physics* (15^{th} ed.). New York: Pearson.
2. Serway, R. A. & Jewelt, J. W. (2014). *Physics for scientist and engineers* (9^{th} ed.). New York: Brooks/Cole.
3. Melissinos, A.C. (2008). *Experiments in modern physics.* New York: Academic press.

GEOL - 6111	Sedimentology	3(2-1)

Course Brief:

This course is designed to acquire the knowledge about various types of sedimentary rocks and their digenesis. Sedimentary rocks illuminate many of the details of the earth's history: effects of sea level change, global climate, tectonic processes, and geochemical cycles are all recorded in the sedimentary strata of the earth. This course will cover basics of fluid flow and sediment transport, sedimentary structures and textures, and forming the bridge between modern landforms and ancient rocks' depositional sedimentary environments.

Course Learning Objectives:

This course will help the students to understand the classification and depositional system of the sedimentary rock as well as the provenance of sediments and sedimentary structures. It's also enable students to understand the role of tectonic for sedimentary rocks.

Course Contents:

1. Introduction to sedimentology
2. Origin, transportation and deposition of sediments
3. Texture of sedimentary rocks and their statistical parameters
4. Sedimentary structures, their classification, morphology, significance and paleocurrent analysis
5. Classification and description of sedimentary rocks
6. Provenance of sediments; diagenesis; concepts of sedimentary facies and facies association
7. Physical-chemical controls of the sedimentary environments
8. Diagnostic features of glacial, eolian
9. Fluvial, lagoonal, acustrine, deltaic, tidal, turbidites and marine environments
10. Tectonic controls of sedimentation.

Lab. Work

1. Grain size analysis of sediments and sedimentary rocks,
2. Megascopic and microscopic study of sedimentary rocks for classification,
3. Use of ternary diagrams, discrimination diagrams for tectonic setting,
4. Separation and identification of heavy minerals,
5. Study of primary sedimentary structures and their uses in facing or top bottom,
6. Rose diagrams and paleocurrent analysis.

Recommended Texts:

1. Prothero, D. R., & Schwab, F. (2004). *Sedimentary geology*. New York: Macmillan.
2. Pettijohn, F. J., Potter, P. E., & Siever, R. (2012). *Sand and sandstone*. Berlin: Springer Science & Business Media.

Suggested Readings:

1. Boggs Jr, S. (2014). *Principles of sedimentology and stratigraphy*. London: Pearson Education.
2. Reineck, H. E., & Singh, I. B. (2012). *Depositional sedimentary environments: with reference to terrigenous clastics*. Berlin: Springer Science & Business Media.
3. Selley, R. C. (2000). *Applied sedimentology*. Amsterdam: Elsevier.

GEOL - 6112	Geophysics	3(2-1)

Course Brief:

Geophysics is the branch of Earth sciences which explores and analyzes active processes of the Earth through physical measurement. The undergraduate and graduate programs are designed to provide a background of fundamentals in science, and courses to coordinate these fundamentals with the principles of geophysics. This course is designed to acquire the knowledge about the seismic waves, seismic refraction, gravity, magnetic and electrical prospecting.

Course Learning Objectives:

This course will demonstrate understanding of fundamental physics concepts such as thermodynamics, electricity, magnetism, work, and force in geophysics. This will help the students in learning the basic techniques in geophysics and the students will also work on the seismic images and interpretation of subsurface structures. This course will enable students to predict the characteristic geophysical signatures of different rock types and structures for a number of geophysical methods and choose appropriate geophysical techniques for a given geologic environment and problem

Course Contents:

1. Definition and relation of geophysics with other sciences
2. Classification and brief description of various branches of geophysics
3. Seismic reflection and refraction techniques
4. Geomagnetism
5. Geoelectricity
6. Tectonophysics
7. Gravimetry
8. Geothermy and geodesy
9. Geophysical data acquisition, processing and interpretation
10. Applications of geophysical techniques for exploration of mineral deposits
11. Oil, gas, subsurface water and engineering works
12. Introduction to earthquake seismology and geodynamics of earth

Recommended Texts:

1. Robinson, E.S., & Coruh, C. (2000), *Basic Exploration Geophysics*. Hoboken: John Wiley and Sons.
2. Burger, H. R., Sheehan, A. F., & Jones, C. H. (2000). *Introduction to applied geophysics: Exploring the shallow subsurface*. Manhattan: WW Norton.
3. Telford, W. M., Geldart, L. P., & Sheriff, R. E. (2000). *Applied geophysics*. Cambridge: Cambridge University Press.

Suggested Readings:

1. Dobrin, M.B. and Savit, C. H., (2000), *Introduction to geophysical prospecting*, New York: McGraw-Hill.
2. Sharma, P.V., (2000), *Geophysical methods in geology.* New York: Elsevier.
3. Kearey, P., and Brooks, M., (2000), *An introduction to geophysical exploration*. Oxford: John Wiley & Sons.
4. Robert J. Lillie, (2000), *Whole earth geophysics: an introductory textbook for geologists and geophysicists*. Upper Saddle River: Prentice Hall.

GEOL - 6113	Geochemistry	3(2-1)

Course Brief:

This is the sub discipline of geology which deals with the study of the chemical composition of the earth and its rocks and minerals. This course is designed to acquire the knowledge about the distribution of elements in minerals and rocks and their dispersion in different environments. This will help the students in learning the geochemical characteristic of various rocks and their role in mineral exploration.

Course Learning Objectives:

One of the goals of geochemistry is to determine the abundance of elements in nature, as this information is essential to hypotheses development about the origin and structure of our planet and the universe. An element is material which has a particular kind of atom with specific electronic structure and nuclear charge, factors that determine their abundance in the rocks. Regarding distribution, it can only have direct evidence on the composition of the Earth's crust and indirect on the mantle and core.

Course Contents:

1. Development of geochemistry as a discipline
2. Composition of meteorites, Origin and cosmic abundance of elements
3. Geochemical structure of the earth, Geochemical classification of elements
4. Polymorphism and pseudomorphism; geochemical cycle
5. Mobility and dispersion of elements under different geochemical environments
6. Introduction to geochemistry of igneous, metamorphic and sedimentary rocks
7. Geochemical anomalies and their application in mineral exploration
8. Introduction to geochemical analytical techniques
9. Introduction to organic geochemistry, organic matter, types, and its importance in petroleum industry.

Lab. Work

1. Processing and interpretation of geochemical data
2. Ternary diagrams interpretation.

Recommended Texts:

1. Krauskopf, K. B. (2000), *Introduction to geochemistr*. New York: McGraw-Hill.
2. Mason. B., (2000) *Principles of geochemistry*. Hoboken: John Wiley and Sons.
3. Beaumont, E.A. & Foster, N.H. (1988), *Geochemistry*. Texas: AAPG.

Suggested Readings:

1. Rose, A.W., Hawkes, H.H. and Webb, J.S. (2000), *Geochemistry in mineral exploration*. Tonbridge: Whitstable Litho Ltd.
2. Henderson, P. (2000). *Inorganic geochemistry*. *organic photonics and photovoltaics*. Upper Saddle River: Prentice Hall.
3. McSween, H. Y., Richardson, S. M., & Uhle, M. E. (2000). *Geochemistry: Pathways and processes*. New York: Columbia University Press.

GEOL - 6114	Micropaleontology	3(2-1)

Course Brief:

This course is designed to understand the micro-fossils found in geological formations and Tertiary biostratigraphy rock units in Pakistan. Micropaleontology is concerned with microfossils and nanno fossils, the study of which must, of necessity, be carried out using the light or electron microscope. To achieve this course, the microfossil must be studied in terms of morphology, structure, chemical and mineralogical composition and taxonomy to discover their origin and systematic affinities. The course is designed to acquire knowledge about the microfossils and micro-organisms and their role in interpretation of depositional environment.

Course Learning Objectives:

This course will enable the student to identify various types of microfossils and to understand their role in depositional systems of major sedimentary basins. Application of these microfossils in the field of oil-exploration, biostratigraphy, paleobiology and paleoclimatology is essential. This subject emphasizes on the microfossils that lived in or under sea water. Thus, interaction with the present-day physical, chemical and biological characteristics of the ocean water will be also addressed. The course will introduce the major marine and non-marine invertebrate taxonomic groups found in the fossil record and what we know about them – their stratigraphic range, modes of life, and environmental preferences.

Course Contents:

1. Introduction to Micropaleontology and its applications
2. Detail classification of marine environments,
3. Genus Miscellanea, Assilina, Ranikothalia, Lockhartia
4. Nummulites, Discocylina, Orbitolites, Globotrucana
5. Introduction to Foraminifera, Bryozoa, Conodonts,
6. Algae, pollen and spores;
7. Microfossils and nanoplanktons;
8. Principles of Biostratigraphy and Biostratigraphic zones;
9. Biostratigraphic techniques and procedures;
10. Morphological and taxonomic studies of selected micro fossils
11. KT Boundary and its presence in Pakistan
12. Tertiary biostratigraphy with special reference to Pakistan

Recommended Texts:

1. Saraswati, P. K., & Srinivasan, M. S. (2015). *Micropaleontology: principles and applications.* New York: Springer.
2. Brasier, M. D. (1980). *Microfossils*. London: G. Allen & Unwin.

Suggested Readings:

1. Haq, B. U., & Boersma, A. (Eds.). (2000). *Introduction to marine micropaleontology*. New York: Elsevier.
2. McGowran, B. (2000). *Biostratigraphy: microfossils and geological time*. Cambridge: Cambridge University Press.
3. Boggs Jr, S. (2014). *Principles of sedimentology and stratigraphy*. London: Pearson Education.

URCG - 5111	Translation of Holy Quran - III	Non-Credit

Topic	Details
Semester/Level	In some discipline 5th semester and in some discipline 6th Semester/ BS (5th Semester intake) 1st / 2nd
Course Code	URCG-5111
Course Title	Translation of the Holy Quran - III
Credit Hours	Non-Credit
Objectives	• To introduce ethics and highlight its importance, need and relevance for individual and collective life. • To illuminate the students with the Quranic norms of Morality i.e. truthfulness, patience, gratitude, modesty, forgiving, hospitality etc. • To familiarize the students with immoral values like falsify, arrogance, immodesty, extravagance, backbiting etc. • To inculcate ethical and moral values in our youth. • To develop a balanced dynamic and wholesome personality. • To introduce the students to Quranic Arabic grammar in practical manner.
Course Contents:	○ اخلاق (تعارف،ضرورت واہمیت ،اقسام،معنویت) اخلاق حسنہ : • برائی کو نیکی سے مٹانا • نیکی کے کاموں میں مسابقت • لوگوں کے درمیان صلح • عدل وانصاف • سچائی • ایثار • سلیم قلب • مہمان نوازی • لغویات سے اعراض • عاجزی و انکساری • نگاہ اور آوازکو پست رکھنا • چال میں میانہ روی • شرمگاہوں کی حفاظت • صبر • شکر • امور میں میانہ روی اخلاق سئیہ : • ظلم اور زیادتی • غرور و تکبر • نفسانی خواہشات کی پیروی • بدگمانی • جھوٹ • چغلی اور تہمت • تمسخر اور شیخی خوری • لہو و لعب • برے ناموں سے پکارنا • احسان جتانا اور تکلیف دینا • فضول خرچی اور حد سے بڑھنا • حسد اور تنگ دل • بے پردگی
Grammar:	• قرآنی عربی گرامر کے اصول اور انکے اطلاقات (متن قرآنی پر اطلاق سے توضیحات)

Details of Chapters and verse Numbers:	▪ منتخب آیات مع ترجمہ وتجوید ▪ البقرہ (۱۱۲، ۲۳۵، ۸۳، ۱۸۲، ۱۷۲، ۱۵۲، ۱۷۲، ۵۲، ۱۵۳، ۱۷۷، ۲۵۰، ۱۲۵، ۲۲۲، ۲۷، ۷۷، ۱۸۲، ۱۳۸، ۱۸۷، ۱۰۹، ۲۶۳، ۲۶۳، ۲۶۲، ۲۱۲، ۶۷، ۲۳۱، ۱۰، ۳۳، ۱۲۳، ۲۵۸، ۲۷، ۷۱، ۸۳، ۲۲۶، ۱۹۵، ۷۶) ▪ آل عمران (۱۵۴، ۱۴، ۲۳، ۱۸۵، ۱۳۲، ۱۳۸، ۱۳۴، ۱۳۵، ۱۷، ۲۰۰، ۱۲۵، ۱۳۳، ۱۱۴، ۱۰۳، ۱۰۳، ۲۶، ۷۸، ۱۳۱، ۱۳۷، ۱۵۹) ▪ النساء (۱۳۵، ۲۳، ۲۲، ۱۰۸، ۱۰۷، ۱۰۵، ۵۴، ۲۰، ۲۷، ۱۷۳، ۳۶، ۲۵، ۲۴، ۴۷، ۵۷، ۲۴) ▪ المائدۃ (۵۸، ۵۷، ۹۳، ۱۳، ۶، ۴۱، ۱۹) ▪ النحل (۱۲۶، ۹۰، ۱۰۵، ۱۱۳، ۳۰، ۱۲۶، ۱۲۵) ▪ الرعد (۲۵، ۲۰، ۲۴، ۲۲، ۶) ▪ الاعراف (۳۱، ۶۶، ۵۱، ۱۴۶، ۴۰، ۴، ۲۰، ۱۴۴، ۱۹۹، ۹۵، ۸۱) ▪ القصص (۵۴، ۸۴) ▪ فصلت (۳۴) ▪ الانعام (۳۲، ۷۰، ۷۰، ۱۳۰، ۱۵۵، ۱۶۰) ▪ النمل (۹۰، ۴۶) ▪ الحج (۳۰، ۵۸، ۶۰، ۸۸، ۷۷) ▪ الحجرات (۹، ۱۱، ۶، ۱۱، ۳، ۱۲، ۱۵، ۱۰) ▪ الاحزاب (۲۳، ۵۰، ۵۸، ۵۸، ۵۲، ۵۵، ۵۹، ۳۵، ۲۴، ۳۵) ▪ الحشر (۹) ▪ طہ (۷۲) ▪ الانعام (۱۶۴، ۱۴۱، ۱۱۶، ۱۵۱، ۶۳، ۱۲۷) ▪ ق (۳۴) ▪ الانفال (۲۷، ۴۶، ۶۱) ▪ الفتح (۱۵) ▪ یونس (۱۰، ۱۹، ۱۲، ۶۶، ۲۲، ۲۲) ▪ الفرقان (۶۳، ۲۱، ۶۷، ۶۳) ▪ النور (۲۳، ۶، ۴، ۳۰، ۳۱، ۳۳، ۳۳، ۶۱، ۳۱، ۲۲) ▪ لقمان (۶، ۳۳، ۱۹، ۳۲، ۱۸) ▪ الاسرا ء(۳۷، ۱۱۰، ۵، ۳۷) ▪ المزمل (۱۸) ▪ المدثر (۶، ۴) ▪ المدثر (۴۳) ▪ فاطر (۳۲) ▪ الفتح (۲۹) ▪ البلد (۱۷) ▪ الزمر (۳، ۱۰) ▪ الحجر (۸۵) ▪ النجم (۳۱) ▪ الرحمٰن (۶۰) ▪ هود (۸، ۱۰۲، ۳) ▪ الکہف (۲، ۵۶) ▪ الشوری (۳۷) ▪ غافر (۲۸، ۲۷) ▪ الحدید (۲۰، ۲۰) ▪ مریم (۵۹) ▪ النازعات (۳۱) ▪ التوبہ (۶۵، ۶۳، ۷۷) ▪ الهمزه (۱)

CHEM-5101	Physical Chemistry	3 (3-0)

Course Brief:

This course provides foundation and basic level knowledge of physical chemistry to under graduate students. This foundation course covers introduction of physical chemistry along with its application for learning principles of physico-chemical phenomenon. This offer complementary approaches to the fundamental understanding of chemical systems. Students will acquire knowledge to enable themselves to understand the elementary mathematics, physical state of matter, atomic structure, chemical thermodynamics, kinetic theory of gases, collision theory of reactions, fundamental principles and laws of thermodynamics, chemical equilibria and chemical kinetics and investigate the physical properties of ideal/non-ideal binary solutions. Students will also be able to study the rates of reactions and perform related calculations. Students will also be introduced about basics of electrochemistry.

Course Learning Objectives:

The general goal of learning this physical chemistry course is to obtain a vision of matter-energy relationship in physical and chemical systems. Learning objectives emphasized in this course involve developing an understanding of basic principles of physical chemistry.

Course Contents:

1. Elementary Mathematics: Logarithmic, exponential and trigonometric functions
2. Differentiation of elementary functions, Physical States of Mater
3. Atomic Structure, De Brogile equation, Pauli Exclusion Principle, Hund's Rule.
4. Schrodinger wave equation
5. Dipole moment,Chemical Thermodynamics, First and second law of thermodynamics
6. Chemical Equilibrium, Law of Mass Action and LeChaterlier's Principle.
7. Solutions, composition, ideal and non-ideal solutions, Raoult's law.
8. Chemical Kinetics, change of entropy, Zero, first and second order reaction, Arrhenius equation
9. Electrochemistry, Conductance, dependence of conductance
10. Kohlrausch's law and its applications

Recommended Texts:

1. Atkins, P., Paula, J., & Keeler, J. (2017). *Atkins' physical chemistry.* (11^{th} ed.). UK: Oxford University Press.
2. Kuhn, H., Försterling, H., & Waldeck, D.H. (2009). Principles of physical chemistry. (2nd ed.). USA: Wiley Publisher.

Suggested Readings

1. Akhtar, M.N., & Nabi, G. (2006). *Text book of physical chemistry.* Lahore: Ilmi Kitab Khawna.
2. Das, R.C., & Behera, B. (2003). *Experimental physical chemistry.* Delhi: Tata McGraw Hill.

URCM - 5107	Mathematics I	3(3-0)

Course Brief:

The goal of Mathematics I is to prepare students for first-year Calculus. Helping students gain proficiency in their understanding and ability to utilize real-valued functions, the primary tool in Calculus, accomplishes this goal. Students are presented a broad set of 'function tools', including a general understanding of function properties together with a 'library' of commonly used functions.

Course Learning Objectives:

This course intended that students will become skilled at recognizing the different families of functions and the primary properties that set each apart, are able to apply the general function properties to each type of function, and are able to use the special set of algebraic skills associated with each. Students are also expected to become adept in utilizing and interpreting the results from graphing calculators, as an important investigative tool.

Course Contents:

1. Preliminaries
2. Real-number system, complex numbers
3. Introduction to sets, set operations, functions, types of functions.
4. Matrices Introduction to matrices, types, matrix inverse, determinants, system of linear equations, Cramer's rule.
5. Quadratic Equations
6. Solution of quadratic equations, qualitative analysis of roots of a quadratice
7. Equations reducible to quadratic equations
8. Cube roots of unity, relation between roots and coefficients of quadratic
9. Sequences and Series
10. Arithmetic progression
11. Geometric progression
12. Harmonic progression
13. Binomial Theorem
14. Introduction to mathematical induction
15. Binomial theorem with rational and irrational indices.
16. Trigonometry, Fundamentals of trigonometry, Trigonometric identities.

Recommended Texts:

1. Thomas, G. B., & Finney, A. R. *(2005). Calculus.* Reading: Addison-Wesley.
2. Anton, H., Bevens. I., & Davis, S. (2005). *Calculus: A new horizon* (8th ed.). New York: John Wiley.

Suggested Readings:

1. Stewart, J. (1995). *Calculus* (3rd ed.). Pacific Grove, California: Brooks/Cole.
2. Swokowski, E. W. (1983). *Calculus and analytic geometry*. Boston: PWS-Kent Company.
3. Thomas, G. B., & Finney, A. R. (2005). *Calculus* (11th ed.). Reading: Addison-Wesley.

GEOL - 6115	Sequence Stratigraphy	3(2-1)

Course Brief:

This course is designed to acquire the knowledge about various types of stratigraphic sequences and their relation with the sea level changes. This will help the students to learn about the formation of various sedimentary rock sequences during geologic time. Within the course basic concepts, principles and methods in sequence stratigraphy are presented, including how sequences can be subdivided into genetic units and which processes controls the sequence development through time. The principles are illustrated with examples and students may participate the methods during geological fieldwork in outcrops. Students can describe and analyze sedimentary successions with focus on interpretation of sedimentary environments and sequence stratigraphy.

Course Learning Objectives:

The goal of the course is to introduce the students to sequence stratigraphy and show how sequence stratigraphy can be applied to better understand how sedimentary successions are structured in a temporal-spatial perspective and which controls play part in this structure. They may identify genetically related units and their intervening discontinuity surfaces. And can assess which control is instrumental for the stacking and geometry of sedimentary sequences.

Course Contents:

1. Sequence Stratigraphy – An Overview, Historical Development of Sequence Stratigraphy, Sequence Stratigraphic Approach
2. Methods of Sequence Stratigraphic Analysis, Introduction, Facies Analysis: Outcrops, Core and Modern Analogies, Well Logs, Seismic, Accommodation and Shoreline Shift, Allogenic Controls on Sedimentation, Sediment Supply and Energy Flux, Sediment Accommodation, Shoreline Trajectories.
3. Stratigraphic Surfaces, Types of Stratal Terminations, Sequence Stratigraphic Surfaces
4. System Tracts including HST, FSST, LST, TST, RST
5. Sequence Models: Types of Stratigraphic Sequences, Parasequences in Fluvial System, Parasequences in Coastal to Shallow Water Clastic System
6. Time attribute of Sequence Stratigraphic Surfaces
7. Hierarchy of Sequences and Sequences Boundaries
8. Discussions and Conclusions, Future Directions.

Recommended Texts:

1. Catuneanu, O. (2000). *Principles of sequence stratigraphy*. Amsterdam: Elsevier.
2. Miall, A. D. (2010). *The geology of stratigraphic sequences*. New York Springer Science & Business Media.

Suggested Readings:

1. Slatt, R. M. (2000). *Stratigraphic reservoir characterization for petroleum geologists, geophysicists, and engineers*. Amsterdam: Elsevier.
2. Emery, D. and Myers, K.J., (2000). *Sequence Stratigraphy*. Oxford: Blackwell.
3. Embry, A. F. (2009). *Practical sequence stratigraphy*. Alberta: Canadian Society of Petroleum Geologists.

GEOL - 6116	Petroleum Geology	3(2-1)

Course Brief:

This course is designed to acquire the knowledge about the processes involved in the formation, migration and accumulation of petroleum in the rocks and drilling and well logging techniques for petrophysical evaluation and production of oil and gas. With the changing nature of hydrocarbon exploration and production, both conventional and unconventional hydrocarbons are considered. The key concepts of the origin and generation of hydrocarbons, reservoir rocks and subsurface reservoir structures (traps) are introduced, together with some of the key techniques used within the industry (e.g. reservoir geology, petrophysics and formation evaluation).

Course Learning Objectives:

This course will introduce students to the key issues surrounding being a geologist in the petroleum industry. Practical issues such as how hydrocarbon wells are drilled and how rocks are sampled in the subsurface are also considered. This will help the students to learn about the global occurrences of oil and gas with special emphasis on Pakistan so that they can effectively use their knowledge in the exploration and development of the country's energy resources.

Course Contents:

1. Introduction and history of hydrocarbon exploration
2. The nature and classification of petroleum hydrocarbons
3. Origin, migration and accumulation hydrocarbon
4. Traps, seal and cap rocks
5. Source rock-evaluation; Kerogene and its types
6. Reservoir rocks characterization, reservoir fluid, reservoir conditions and dynamics; tight reservoirs
7. Exploration petroleum cycle in Pakistan; prospect and exploration in frontiers areas
8. Introduction to drilling operations, well site geology and mud logging
9. Well failure/success analysis
10. Petroleum prospect risk analysis
11. Nonconventional hydrocarbons
12. Introduction to play fairways and petroleum system

Recommended Texts:

1. North, F.K., (2000). *Petroleum geology*. Boston: Allen and Unwin.
2. Selley, R. C., & Sonnenberg, S. A. (2014). *Elements of Petroleum Geology*. Cambridge: Academic Press.

Suggested Readings:

1. Bjorlykke, K. (2010), *Petroleum geoscience: from sedimentary environments to rock physics*. Amsterdam: Springer.
2. Levorsen, A. I. & Berry, F. A. (2000). *Geology of petroleum*. San Francisco: WH Freeman.
3. Hyne, N. J. (2012). *Nontechnical guide to petroleum geology, exploration, drilling, and production*. Tulsa: PennWell Books.

GEOL - 6117	Engineering Geology	3(2-1)

Course Brief:

This course is a graduate course of engineering geology. This course is designed to acquire the knowledge about the rock mechanics and their role in the construction of huge structure. The construction of buildings, underground excavations, dams on different rock masses like igneous, sedimentary and metamorphic rocks requires the data of basic physical and geological and geotechnical parameters. So, this course will help the students in learning various techniques for the determination of physical and geotechnical parameters of soils and rocks for construction of buildings and foundations. The building code of Pakistan for the construction of various structures and buildings under various geological conditions is also included in this course. Lab work is also included to enhance the practical knowledge of students.

Course Learning Objectives:

This course enable students for how rocks work in construction. They will learn about different rock types and how they affect building. Discover methods to find facts about rocks and soil for building, and understand building codes in Pakistan. Also, explore solving common construction issues and get hands-on practice in the lab.

Course Contents:

1. Introduction to the engineering geology and its application
2. Weathering, physical and chemical
3. Earthquakes, causes and intensity scale
4. Rock mass classification
5. Geotechnical studies of rocks and soils
6. Geological factors and strength of rocks
7. Chemical and mechanical behavior of rocks
8. Geotechnical investigation; uses of sedimentary, igneous and metamorphic rocks as construction material
9. Building Code of Pakistan
10. Dam and tunnel engineering
11. Common engineering problems and their remedial measures

Lab. Work

1. Sieve analysis
2. Moisture, void ratios, porosity
3. Angle of repose, and other geotechnical properties of soils.
4. Uniaxial and Triaxial Testing; tensile, compressive and shear tests of rocks.

Recommended Texts:

1. Price, D. G. (2008). *Engineering geology: principles and practice*. Amsterdam: Springer Science & Business Media.
2. Bell, F. G. (2004). *Engineering geology and construction*. Boca Raton: CRC Press.

Suggested Readings:

1. Bell, F. G. (2016). *Fundamentals of engineering geology*. Amsterdam: Elsevier.
2. Beavis, F. C. (1985). *Rock weathering. Engineering Geology*. Melbourne: Blackwell Scientific.

GEOL - 6118	Geological Fieldwork- III	3(0-3)

Course Brief:

This course is designed to understand the geological mapping techniques in the field. This will help the students in learning the use of field equipment and data acquisition and preparation of geological maps and cross-sections. This course will help the students to get knowledge about various structures, features and other processes occurred in the field. The main goal of this subject is to acquire the fundamental geological field skill of mapping. The course emphasizes the basic skills essential to identify rocks according to different aspects, correlation & features also to locate yourself in the field and make essential field observations and measurements. Geological field build confidence and practical knowledge in the students to elaborate geological structures in the field during their field survey, which will give them more energy for the future. As geology is the subject of field and to explore the earth which is not possible without field work.

Course Learning Objectives:

The students will be able to carry out observation and plotting of geological information on topographic sheet. They will be able to study of geomorphic features in field and measurement of stratigraphic sections. Independently carry out recognition of structural features and study of fossils, primary and secondary structures. This geological fieldwork exercise will enable students to describe various features sedimentary, igneous and metamorphic rocks

Course Contents:

1. Field based exercises
2. Topographic sheets and its utilization in field.
3. Observation and plotting of geological information on topographic sheet.
4. Study of geomorphic features.
5. Measurement of stratigraphic sections.
6. Recognition of structural features.
7. Study of fossils
8. Study of primary and secondary geological structures.
9. Field description of sedimentary, igneous and metamorphic rocks.
10. Report writing based on geological mapping of an assigned area and fieldwork Viva Voce and Evaluation.

Recommended Texts:

1. Coe, A. L. (Ed.). (2010). *Geological field techniques*. Hoboken: John Wiley & Sons.
2. Lambert, D. (2000). *The field guide to geology*. New York: Infobase Publishing.

Suggested Readings:

1. Barnes, J. W., & Lisle, R. J. (2013). *Basic geological mapping*. Hoboken: John Wiley & Sons.
2. Lahee, F. H. (2000). *Field geology*. New York: McGraw-Hill.
3. Compton, R. R., & Compton, R. R. (2000). *Geology in the Field* . New York: Wiley.

GEOL - 6119	Hydrogeology	3(3-0)

Course Brief:

This course is a graduate course. One of the elective advance level courses in the group of specialization in Engineering Geology is Hydrology. This course is designed to acquire knowledge about the exploration of groundwater resources and their management. This will help the students to learn how to manage and conserve water resources, how to overcome the acute shortage of water supply and also how to maintain its purity for meeting the present demand as well as the demand of the further generation. The process of installation of tube wells, its techniques, designing and developments. Flow-net analysis using pumping tests.

Course Learning Objectives:

Students will gain a wide understanding of hydrological processes and phenomena, including but not limited to groundwater. Other associated topics taught will equip them the critical interrelationships of groundwater with surface water hydrology and vegetation, amongst others. After completing these courses, the students will be able to carry out their independent research on the site development for water issues.

Course Contents:

1. The hydrologic cycle
2. Aquifer system and types
3. Occurrence and movement of groundwater
4. Hydrological properties of rocks and their measurements
5. Fluctuation of groundwater levels and causes
6. Recharge and discharge of ground water
7. Groundwater exploration by geological, hydro-geological and geo-physical methods and remote sensing techniques
8. Well hydraulics
9. Tube well drilling techniques, designing, development
10. Flow-net analysis and pumping tests, water logging and causes of water table declination

Recommended Texts:

1. Davie, T. (2008). *Fundamentals of hydrology*. London: Routledge.
2. Hiscock, K. M. (2009). *Hydrogeology: principles and practice*. Hoboken: John Wiley & Sons.

Suggested Readings:

1. Todd, D. K., & Mays, L. W. (2005). *Groundwater hydrology*. Hoboken: Welly.
2. Prickett, T. A., & Lonnquist, C. G. (1971). Selected digital computer techniques for groundwater resource evaluation. Bulletin (Illinois State Water Survey) no. 55.
3. Franklin, J. A., & Dusseault, M. B. (1989). *Rock engineering*. New York: McGraw-Hill.

GEOL - 6120	Geology of Pakistan	3(3-0)

Course Brief:

This course is designed to acquire the knowledge about the tectono-stratigraphy of Pakistan with special emphasis on the tectonic elements and minerals and fuel deposits. It is the study which describes the Mineral exploration and its exploitation, exploration and development Oil and Gas resources, Metallic and non-metallic mineral resources, suitable aggregate study for construction materials, dams side studies, earthquake studies and mega Infrastructure related. It also describes about the various tectonics elements for collisional, extensional and transform plate boundary setting. From the formation of mighty Himalayas, it includes the detail tectonosedimentary, metamorphic and deformation mechanism. It will also focuses on the occurrences of Active Seismic Zones of Pakistan and earthquake seismology scenario.

Course Learning Objectives:

This will help the students to learn about the interaction of regional plates and blocks such as Indian Plate, Arabian Plate, Karakoram Plate, and Afghan Block through geological times and their influence on the stratigraphy and mineral deposits of Pakistan. The core objective of this subject is to provide the detail Geological and Tectonics Setting of Pakistan by introducing the Geodynamcis setting of Pakistan.

Course Contents:

1. Physiographic and tectonic divisions of Indo Pak Plate and its descriptions.
2. Geology and stratigraphy of the Indian plate, Karakoram plate.
3. Afghan block and Arabian plate.
4. Waziristan , Kohistan, Chagai and Ras Koh magmatic Arcs.
5. Sedimentary basins of Pakistan.
6. Makran subduction complex.
7. Chaman transform zone, arcs, oroclines and suture zones.
8. Tertiary Himalayan and pre-Himalayan orogenic events.
9. Late Precambrian to Early Cambrian Hazaran orogeny.
10. Regional metamorphism (Himalayan and pre-Himalayan).
11. Main episodes of magmatism and their relations to tectonics.
12. Economic mineral and fuel deposits of Pakistan.

Recommended Texts:

1. Kazmi, A. H., & Jan, M. Q (1997). *Geology and tectonics of Pakistan*. Karachi: Graphic publishers.
2. Bender, F.K. & Raza, H.A. (1997). *Geology of Pakistan*. Berlin: Oxford University Press.

Suggested Readings:

1. Farah, A., Abbas, G., De Jong, K. A., & Lawrence, R. D. (1984). Evolution of the lithosphere in Pakistan. *Tectonophysics*, *105*(1-4), 207-227.
2. Searle, M. (2013). *Colliding continents: a geological exploration of the Himalaya, Karakoram, and Tibet*. Oxford: Oxford University Press.
3. Kazmi, A. H., & Abbasi, I. A. (2008). *Stratigraphy & historical geology of Pakistan* . Peshawar: National Centre of Excellence in Geology.

GEOL - 6121	Economic Geology	3(3-0)

Course Brief:

This course is designed to acquire the knowledge about the formation of various types of economic mineral deposits and their significance. Relate overall geometry, zonation and alteration patterns of rock associations to specific classes of metallic mineral deposits. Evaluate different processes of element enrichment by fluids and melts to from ore bodies. Inform peer students and the wider public how understanding the formation of ore bodies is important in the current debates about global resources.

Course Learning Objectives:

This will help the students to understand the processes which are involved in the genesis of various ores deposits, hydrocarbons, gemstones and other industrial minerals. Upon successful completion, students will have the knowledge and skills to recognize common ore minerals in hand samples and under the microscope demonstrate familiarity with a wide range of mineral deposits, including recognizing the overall geometry, zonation and alteration patterns associated with specific classes of metallic mineral deposits

Course Contents:

1. Introduction to economic minerals and rocks and their classification,
2. Grade and reserve estimation of deposits, Introduction to ore microscopy
3. Environment and processes of formation of economic mineral deposits: magmatic segregation, hydrothermal solution, metasomatism, sedimentation, evaporation, residual and mechanical concentration and metamorphism,
4. Relationship of mineral deposits to plate tectonic settings,
5. Introduction of geological exploration/prospecting,
6. Brief description of economic minerals such as fuel minerals, gemstones, copper, lead, zinc, iron, gold, chromite, manganese, salt, gypsum, bauxite, sulphur, barite, fluorite, clays, phosphorite, building and dimension stones, industrial rocks and minerals, radioactive minerals and rocks with special reference to Pakistan.

Lab. Work

Identification and description of economic minerals, microscopic studies and lab exercises on grade and reserve estimation from provided data.

Recommended Texts:

1. Evans, A. M. (2009). *An introduction to economic geology and its environmental impact.* Hoboken: John Wiley & Sons.
2. Pohl, W. L. (2011). *Economic geology: principles and practice*. Hoboken: John Wiley & Sons.

Suggested Readings:

1. Moon, C. J., Whateley, M. K., & Evans, A. M. (2006). *Introduction to mineral exploration* (2^{nd} ed.). Hoboken: Blackwell publishing.
2. Park Jr, C. F., & MacDiarmid, R. A. (1975). *Ore deposits*. San Francisco, Freeman.
3. Evans, Anthony M. (2009). Ore geology and industrial minerals: an introduction. Hoboken: John Wiley & Sons.

URCG - 5111	Translation of Holy Quran - IV	Non-Credit

Topic	Details
Semester/Level	In some discipline 7th semester and in some discipline 8th Semester/ BS (5th Semester intake) 3rd / 4th
Course Code	URCG-5111
Course Title	Translation of the Holy Quran - IV
Credit Hours	Non-Credit
Objectives	• To familiarize the students with commandments of trade and inheritance mentioned in the Quranic text (with the help of Urdu translation). • Students • To introduce the students to scientific facts and miracles of the Holy Quran and Quranic stress on deep study of Allah's explored universe. • To motivate the students for reading and exploring the last Holy Book revealed by Almighty Allah. • Through memorization students will develop their relation with last revelation.
Course Contents:	○ تجارت اور وراثت: • مال کی تقسیم • نادان کا مال • عوام الناس کا مال • عورتوں کا مال • یتیموں کا مال • کفار کا مال • جائز مال • معاہدے • رہن • قرض ○ سائنسی حقائق: • تخلیقِ کائنات • اجرامِ فلکی • شجر و حجر • زمین و آسمان کے اسرار • ہوائیں اور طوفان • بہائم اور مویشی • حشرات الارض • پہاڑ اور سمندر
Grammar :	• قرآنی عربی گرامر کے اصول اور انکے اطلاقات (متن قرآنی پر اطلاق سے توضیحات)
Details of Chapters and verse Numbers:	▪ منتخب آیات مع ترجمہ وتجوید ▪ البقرہ (٢٦١، ٢٢١٥، ٢٦٥، ٢١٩، ٢٦٣، ٢٧٥، ١٨، ٢٦٥، ١٧٧، ٢٦٥، ١٦، ٢٧٥، ٢٨٢، ٢٦٢، ٢٧٣، ٢٧١، ٨٣، ١٧٧، ٢١٥، ٢٧٦، ٢٧٨، ١٦، ٢٧، ٢٢٣، ٢٩، ٢٥٥، ١٦٣، ٢٦٦، ١٦٣، ١٦٣، ٥٠، ٦٠، ١٦٣، ٥٧، ٢١٠، ١٩، ٢٦، ٧١، ٩٢، ٩٣) ▪ آل عمران (١١٧، ١٣٣، ١٣٠، ١٩٠، ٢٧، ٥٩) ▪ النساء (٢٩، ٢، ٢٩، ١٦١) ▪ المائدہ (٨٩، ٩٥، ٧٥، ٦٩، ٦٠) ▪ التوبہ (٩٨، ٢٣، ٦٩، ٢٣، ٢٣، ٦٠، ٣) ▪ الاعراف (١٧٢، ١٨٥، ٥٧، ٥٨، ١٦٣، ١٦٣، ١٦٠، ٣٠، ١٣٣، ١٧٦، ١٦٦) ▪ الرعد (١٧، ٣) ▪ الطور (٣٣) ▪ الانعام (٥٩، ٦٣، ١٣١، ١٣٦، ٣٨) ▪ الانفال (٢٨، ٣٦، ٣١)

▪ الكهف (٥١، ١٠٩، ٣٧، ٣٢، ٣٥، ١٧، ٣٥) ▪ الجاثيه (٥) ▪ فاطر (٢٧، ١٢، ١٣) ▪ العنكبوت (٢٠، ٦٣، ٣١) ▪ الروم (٥٠) ▪ الاسراء (٧٠، ٩٩) ▪ الرعد (٢) ▪ السبا(١٠، ٣، ٢٢) ▪ يونس (٨٨، ١٠١، ٢٣، ٢٣، ٥، ٢٢) ▪ يوسف (٩٣، ١٣) ▪ الفرقان (٦٢، ٥٣) ▪ لقمان (٢٩، ١٦) ▪ طه (١١٣، ٥٣) ▪ النحل (٧٥، ١١، ٦١، ٣٩، ٧٩، ٦٨، ٦٨، ١١٥، ٨، ٨) ▪ النمل (٦٣، ٦٣، ٨٨، ٦٠، ٨٢، ١٦، ١٧، ١٨) ▪ السجده (٢٧) ▪ الحديد (٦) ▪ هود (٣٣، ٦) ▪ يسين (٣٧، ٣١) ▪ الروم (٣٩، ٣٩، ٥٠، ١٩، ٢٣، ٣٦) ▪ فصلت (٣٩، ٣٩) ▪ الحج (٦١، ٦٥، ٢٢، ٧٣) ▪ الحجر (١٩، ٢٢) ▪ الانبياء (٣١، ٣٠، ٣٧) ▪ الزاريات (٣٧) ▪ الزلزله (١) ▪ القصص (٧٦، ٧٩، ٨٠، ٨١، ٨٢) ▪ النور (٣٧، ٢٢، ٢٢، ٣٠، ٣٥، ٣٣) ▪ الجمعه (١١، ٦٢، ١٠، ١١، ٥) ▪ القمر (٧) ▪ الواقعه (٦٩) ▪ الفاطر (٢٠، ١٣) ▪ الملک (١٩) ▪ الصف (١٠) ▪ الجن (١٣) ▪ الشورىٰ (٢٨) ▪ الزخرف (١١) ▪ الفيل (١)	

GEOL - 6122	Environmental Geology	3(3-0)

Course Brief:

This course is designed to acquire the knowledge about the role of geology in the environmental degradation. As a discipline, environmental geology deals with using geological knowledge to address interactions between humans and the physical environment: the biosphere, the lithosphere, the hydrosphere, and, to some degree, the atmosphere. Environmental geology is a multidisciplinary subject that covers a broad range of topics, ranging from Earth materials and their use to Earth processes, including natural hazards and their impact on human lives. The environmental effects of exploring Earth resources is also an integral component of the course.

Course Learning Objectives:

This course will enable the students to learn how the various geological processes and related human activities are involved in contaminating our ecosystem. managing geological and hydrogeological resources such as fossil fuels, minerals, water (surface and ground water), and land use. Studying the earth's surface through the disciplines of geomorphology, and defining and mitigating exposure of natural hazards on humans managing industrial and domestic waste disposal and minimizing or eliminating effects of pollution, and performing associated activities, often involving litigation.

Course Contents:

1. Introduction to environmental geology, management of natural resources, climatic changes.
2. Environmental controls for erosion, desertification and coastal degradation.
3. Introduction to environmental impact assessment and initial environmental examination.
4. Environmental impact of mining, dams, reservoirs.
5. Environmental impact of Highways, their assessment and controls.
6. Geological hazards such as floods, landslides.
7. Earthquakes, tsunamis, volcanoes.
8. Glaciers and shoreline processes and their remedial measures;
9. Industrial pollution, solid and liquid waste disposal.
10. Groundwater contaminations.
11. River lake and marine pollution and their impact on human health.
12. Clean sources of energy, introduction to acid mine drainage.

Recommended Texts:

1. Pipkin, B. W., Trent, D. D., Hazlett, R., & Bierman, P. (2013). *Geology and the Environment.* Boston: Cengage Learning.
2. Knödel, K., Lange, G., & Voigt, H. J. (2007). *Environmental geology: handbook of field methods and case studies.* Amsterdam: Springer Science & Business Media.

Suggested Readings:

1. Montgomery, C. W. (1992). *Environmental Geology*. Dubuque: Wm C. Brown Publishers.
2. Armand, N. A., & Polyakov, V. M. (2004). *Radio propagation and remote sensing of the environment*. New York: CRC Press.
3. Pipkin, B. W., Trent, D. D., Hazlett, R., & Bierman, P. (2013). *Geology and the Environment.* Boston: Cengage Learning.

GEOL-6190	Field Excursion	3(0-3)

The students shall carry out field survey on according to available resources in selected geology fields: Each student shall be required to collect data/information pertaining to his/her topic in a selected area.

GEOL-6191	Report Writing	3(0-3)

Each student shall be required to collect data/information pertaining to his/her topic in a selected area and write report on it.

GEOL - 6130	Geochemistry II	3(3-0)

Course Brief:

This is the sub discipline of geology which deals with the study of the chemical composition of the earth and its rocks and minerals. An element is material which has a particular kind of atom with specific electronic structure and nuclear charge, factors that determine their abundance in the rocks. Regarding distribution, it can only have direct evidence on the composition of the Earth's crust and indirect on the mantle and core.

Course Learning Objectives:

The course is designed to acquire the knowledge about the distribution of elements in minerals and rocks and their dispersion in different environments. This will help the students in learning the geochemical characteristic of various rocks and their role in mineral exploration. One of the goals of geochemistry is to determine the abundance of elements in nature, as this information is essential to hypotheses development about the origin and structure of our planet and the universe.

Course Contents:

1. Geochemistry of igneous, sedimentary and metamorphic rocks
2. Modal analysis for classification
3. Chemical characterization and identification of minerals
4. Classification and distribution of elements in the earth crust
5. Introduction to analytical geochemistry
6. Causes for geochemical diversity in the igneous rocks
7. Geochemical characteristics of igneous rocks as petrogenetic indicators
8. Processes which modify the composition of primary magmas
9. Geochemical characteristics of different magma series
10. Geothermometry and geobarometry
11. Metasomatic processes and environment.

Labs:

1. Characterization of igneous rocks on the basis of their (a) modal and (b) chemical composition
2. Calculation of normative composition from the major element chemistry of igneous rocks
3. The use of major and trace element composition of igneous rocks as a means to determine their paleotectonic setting
4. Graphical representation of metamorphic mineral parageneses (ACF and AKF diagrams)
5. Protolith of a variety of metamorphic rocks on the basis of their major and trace element geochemistry
6. The use of mineral chemical data for estimating pressure-temperature conditions of metamorphism.

Recommended Texts:s:

1. Rollinson, H. R. (2014). Using geochemical data: evaluation, presentation, interpretation. Routledge.
2. McSween, H. Y., Richardson, S. M., & Uhle, M. E. (2003). Geochemistry: Pathways and processes. Columbia University Press.

1. **Suggested Readings:**

2. Krauskopf, K. B., & Bird, D. K. (1982). Introduction to geochemistry (Vol. 72, No. 1). New York: McGraw-Hill.
3. Best, M. G. (2013). Igneous and metamorphic petrology. John Wiley & Sons.

GEOL - 6131	Metamorphic Petrology II	3(3-0)

Course Brief:

This course is a graduate level course of metamorphic petrology. Metamorphic petrology covers the chemical and physical work done in natural systems in response to changing physical conditions. Petrogenetic processes such as recrystallization, continuous and discontinuous reactions, mixed volatile reactions and deformation are addressed. The principles of metamorphic petrology are then applied to a number of orogenic events through geologic time, and modern advances in research in metamorphic petrology are explored.

Course Learning Objectives:

This corse will enables students to understand the mechanism and types of metamorphism as well as the factors that affect the process of metamorphism. This course also includes different rock structures which developed due to metamorphism so it's beneficial for students to recognize different rock features in metamorphic rocks of field area.

Course Contents:

1. Basic characteristics of metamorphic reactions and role of fluids
2. Concept of iso-grades and iso-reaction grades
3. Very low grade and ocean floor metamorphism
4. Cataclastic metamorphism
5. Metamorphic facies series
6. P-T gradients
7. Mineralogical charactersistics of individual facies
8. Progress metamorphism of pelites, basic rocks and carbonates
9. High grade metamorphism, anatexis and migmatites
10. Tectonics of regional metamorphic belts
11. Paired metamorphic belts
12. Metamorphic structure of continental crust.

Labs:

1. Construction and interpretation of ACF and AKF diagrams
2. Petrographicstudy of various rocks suites
3. Mineral and mineral phase equilibria and P-T conditions.

Recommended Texts:s:

1. Best, M. G. (2013). Igneous and metamorphic petrology. John Wiley & Sons.
2. Vernon, R. H., Vernon, R. H., Vernon, R., & Clarke, G. L. (2008). Principles of metamorphic petrology. Cambridge University Press.

Suggested Readings:

1. Gillen, C. (2012). Metamorphic geology: an introduction to tectonic and metamorphic processes. Springer Science & Business Media.
2. Philpotts, A., & Ague, J. (2009). Principles of igneous and metamorphic petrology. Cambridge University Press.
3. Yardley, B. W., & Yardley, B. W. D. (1989). An introduction to metamorphic petrology.

GEOL - 6132	Sedimentary Petrology-II	3(3-0)

Course Brief:

This course is designed to acquire the knowledge about various types of sedimentary rocks and their digenesis. Sedimentary rocks illuminate many of the details of the earth's history: effects of sea level change, global climate, tectonic processes, and geochemical cycles are all recorded in the sedimentary strata of the earth. This course will cover basics of fluid flow and sediment transport, sedimentary structures and textures, and forming the bridge between modern landforms and ancient rocks' depositional sedimentary environments.

Course Learning Objectives:

This course will enable the students to understand the classification and depositional system of the sedimentary rock as well as the provenance of sediments and sedimentary structures. It's also enable students to understand the role of tectonic for sedimentary rocks.

Course Contents:

1. Introduction of sedimentary rocks
2. Origin, transportation and deposition of sediments
3. Texture of sedimentary rocks
4. Structures of sedimentary rocks
5. Classification and description of sedimentary rocks
6. Provenance of sediments; diagenesis; concepts of sedimentary facies and facies association
7. Tectonic controls of sedimentation.
8. Environments of deposition of sedimentary rocks.

Recommended Texts:

1. Prothero, D. R., & Schwab, F. (2004). Sedimentary geology. New York: Macmillan.
2. Pettijohn, F. J., Potter, P. E., & Siever, R. (2012). Sand and sandstone. Berlin: Springer Science & Business Media.

Suggested Readings:

1. Boggs Jr, S. (2014). Principles of sedimentology and stratigraphy. London: Pearson Education.
2. Reineck, H. E., & Singh, I. B. (2012). Depositional sedimentary environments: with reference to terrigenous clastics. Berlin: Springer Science & Business Media.
3. Selley, R. C. (2000). Applied sedimentology. Amsterdam: Elsevie

GEOL - 6133	Mineralogy II	3(3-0)

Course Brief:

This course is a graduate level course of Mineralogy. Advance mineralogy is a subject of geology specializing in the scientific study of the chemistry, crystal structure, and physical (including optical) properties of minerals and mineralized artifacts. So the course is designed to acquire the knowledge about the physical and optical properties of various rock forming minerals and to develop a relationship between the structure chemistry and properties of silicates, carbonates, oxides, sulphides, and phosphate.

Course Learning Objectives:

This course will enable the students in learning the mechanisms of mineral nucleation, crystal growth and importance of kinetics in mineral formation as well as by using different computer programs, they will be able to calculate mineralogical parameters.

Course Contents:

1. Physical and chemical properties of mineral
2. Relationship between the structure chemistry and properties of Silicates, carbonates, oxides, sulphides, and Phosphate
3. Physical and chemical properties of minerals
4. Mechanisms of mineral nucleation and crystal growth
5. Importance of kinetics in mineral formation
6. Interpretation of mineral analysis
7. Recalculation of a mineral analysis in terms of fixed number of anions, and, where appropriate, cations
8. Measurement of mineral triple junction angles
9. Description of grain boundaries and their implication for the development of rock textures
10. Use of computer programs, including spreadsheets, to calculate mineralogical parameter
11. Triangular and X-Y plots
12. Related mineralogical information to the assessment and performance of industrial rocks and minerals.

Recommended Texts:

1. Perkins, D. (1998). Mineralogy. In the Beginning, 17(17), 38.
2. Deer, W. A. (2011). Rock-forming minerals. Geological Society of London.

Suggested Readings:

1. Perkins, D., & Henke, K. R. (2004). Minerals in thin section (No. 549.9 PER).
2. Philpotts, A. R. (1989). Petrography of igneous and metamorphic rocks. Pearson College Div.
3. MacKenzie, W. S., & Guilford, C. (2014). Atlas of the Rock-Forming Minerals in Thin Section. Routledge.

GEOL - 6134	Mineral Deposits	3 (3-0)

Course Brief:

As mineral deposits are natural accumulations of minerals in the earth crust, in form of one or several mineral bodies which can be extracted at the present time or in an immediate future. So this course is designed to acquire the knowledge about the formation of various types of economic mineral deposits and their significance. This will help the students to understand the processes which are involved in the genesis of various ores deposits, hydrocarbons, gemstones and other industrial minerals.

Course Learning Objectives:

Studentds will learn to the knowledge about the formation of various types of economic mineral deposits and their significance. They will equipped with understanding of the processes which are involved in the genesis of various ores deposits, hydrocarbons, gemstones and other industrial minerals.

Course Contents:

1. Introduction of minerals and mineral deposits.
2. Classification of mineral deposits.
3. Genesis, occurrence and important features of mineral deposits.
4. Important features of porphyry deposits, Cu-Ni-Fe deposits, volcanic hosted massive sulphide deposits, Mississippi valley type deposits, carbonatites, greisen deposits, skarn deposits and placer deposits.
5. Descrition of few mineral deposits like chromite, platinum group elements, gold and uranium deposits, in detail.
6. Occurrence, distribution and utilization of metallic mineral deposits in Pakistan.

Recommended Texts:

1. Bateman, A. M. (1956). Economic Mineral Deposits. (2nd ed). Jhon Willey & Sons, Inc. New York London.
2. Anthony M. E. (2013). Ore Geology and Industrial Minerals: An Introduction. (3rd Edition). Wiley-Blackwell.
3. Mitchell, A. H. G., & Garson, M. S. (1981). Mineral deposits and global tectonic settings. Academic Press Geology Series.

Suggested Readings:

1. Smirnov, V. I. (1976). Geology of mineral deposits. MIR publishers.
2. Bateman, A. M. (1942). Economic Mineral Deposits. (2nd ed). Jhon Willey & Sons, Inc. New York London.

GEOL - 6135	Igneous Petrogenesis	3 (3-0)

Course Brief:

This course is a graduate level course of Igneous petrogenesis. It is the study of magma and the rocks that solidify from magma. The composition of igneous rocks and minerals can be determined via a variety of methods of varying ease, cost, and complexity. This course also includes the tectonic activities related to magmatic processes and different types of igneous rocks on different tectonic margins.

Course Learning Objectives:

This course will enables students to understand the mechanism and factors affecting the magmatic evolution. They will have the deep understanding of tectonic activities related to magmatic processes and different types of igneous rocks on different tectonic margins.

Course Contents:

1. Mantle-magma systems and source of magma
2. Physico-chemical factors in magmatic evolution.
3. Tectonism-magmatism relationship
4. Igneous activity related to convergent plate boundary and divergent plate boundary environments
5. Intracontinental hot spots
6. Petrogenesis of igneous rocks
7. Ophiolites
8. Physico-chemical factors in magmatic evolution.

Recommended Texts:

1. Winter, J. D. (2014). *Principles of igneous and metamorphic petrology*. London: Pearson Education.
2. McBirney, A. R. (1993). *Igneous petrology*. Burlington: Jones & Bartlett learning.

Suggested Readings:

1. Wilson, B. M. (2007). *Igneous petrogenesis a global tectonic approach*. Springer Science & Business Media.
2. Blatt, H., Tracy, R., & Owens, B. (2006). *Petrology: igneous, sedimentary, and metamorphic.* New York: Macmillan.
3. Winter, J. D. (2000). *An introduction to igneous and metamorphic petrology* . New Jersey: Prentice hall.

GEOL - 6136	Isotope Geochemistry	3 (3-0)

Course Brief:

Isotopes are atoms of the same element that have different numbers of neutrons. The original isotopic compositions of planetary systems are a function of nuclear processes in stars. Over time, isotopic compositions in terrestrial environments change by the processes of radioactive decay, cosmic ray interactions, and such anthropogenic activities as processing of nuclear fuels, reactor accidents, and nuclear-weapons testing. Radioactive (unstable) isotopes are nuclei that spontaneously disintegrate over time to form other isotopes. During the disintegration, radioactive isotopes emit alpha or beta particles and sometimes also gamma rays.

Course Learning Objectives:

Students will learn about isotopes, which are different forms of the same element. Understand how isotopic compositions change on planets due to various processes, like nuclear reactions in stars, radioactive decay, cosmic rays, and human activities like nuclear fuel processing and testing. Explore how unstable isotopes break down, emitting particles during disintegration.

Course Contents:

1. Introduction and the Physics of the Nucleus,
2. Fundamentals of Isotope Geochemistry, Definitions , Terminology, Standards,
3. Basics of Radiogenic Isotope Geochemistry,
4. Radioactive Decay and Nucleosynthesis,
5. Stable Isotope Fractionation.
6. Properties of isotopic molecules.
7. Sampling guidelines and analytical methods
8. U-Pb, Rb-Sr radioisotope systems,
9. Stable Isotope Applications.

Recommended Texts:s:

1. Hoefs, J. (2021). *Stable Isotope geochemistry*, 9th Edition, Springer, Cham.
2. Hoefs, J., & Hoefs, J. (1997). *Stable isotope geochemistry* (Vol. 201). Berlin: Springer.
3. Sharp, Z. (2007). *Principles of stable isotope geochemistry*, 2nd Edition, University of New Mexico.

Suggested Readings:

1. White, W. M. (2014). *Isotope geochemistry*. John Wiley & Sons.
2. Kuleshov, V. (2017). *Isotope Geochemistry: The origin and formation of manganese rocks and ores*. Elsevier.

GEOL - 6137	Industrial Minerals and Rocks of Pakistan	3(3-0)

Course Brief:

Minerals sector has been one of the significant source of economic development of a number of developed countries. Several developed countries have been exploiting their original mineral resources by using as intermediate goods and finished products. Many of the countries are importing minerals from other countries, refining, value addition and then exporting. Although Pakistan has a number of mineral resources in abundance, yet consolidated and aligned with latest economic system, strategy for exploitation does not exist. A number of works in pieces exist on different individual mineral, its small reflection may be domestic demand centered or local production etc. There is a need to analyse the mineral sector potential, its analysis in domestic and international perspective.

Course Learning Objectives:

In this course, Students will learn about the importance of minerals for economic development in various countries. They will understand how some nations use their mineral resources for products and growth. Despite having many minerals, Pakistan lacks a clear plan for using them. They will explore the potential of the mineral sector and analyze it on both local and global scales.

Course Contents:

1. Important industrial minerals of Pakistan
2. The physical and chemical properties of industrial minerals.
3. The geology, origin and occurrence of industrial minerals and rocks.
4. Classification of the chief catagories of industrial minerals and rocks.
5. Existing industries i.e. Glass, ceramics, limestone and lime, cement, gypsum and anhydrite, bentonite, soapstone, marble, graphite, rock salt, rock phosphate, travertine, china clay, Feldspar and common clays.
6. Dimension stone, Slate, Magnesite, Kaolinite, Bentonite, Dunite and serpentinite, Nephline syenite, Natural abrasive materials, Fluorite and Barite.

Recommended Texts:

1. Okrusch, M., & Frimmel, H. E. (2020). *Mineralogy: An introduction to minerals, rocks, and mineral deposits*. Springer Nature.
2. Wenk, H. R., & Bulakh, A. (2016). *Minerals: their constitution and origin*. Cambridge University Press.
3. Anthony M. E. (2013). *Ore Geology and Industrial Minerals: An Introduction.* (3rd Edition). Wiley-Blackwell.

Suggested Readings:

1. Bateman, A. M. (1956). Economic Mineral Deposits. (2nd Ed). Jhon Willey & Sons, Inc. New York London.
2. Simpson, B. (1983). Rock & Minerals. Elsevier.

GEOL – 6140	Rock Mechanics	3(3-0)

Course Brief:

This course is one of the elective advance level courses in the group of specialization in Engineering Geology is Rock Mechanics. The course will enable the students to fully understand the basic knowledge about the stress and strain. The behavior of rocks under different geological stress regimes. The measurement the in-situ stresses around the periphery of underground excavations. The qualities of rock masses are very important to be studied for the overall estimation of rock mass deformation and strength of the rocks. These current and hot topic of rock mechanics is also included in the outline of subject and will enhance the practical knowledge about the mechanics of rocks. For the completion of course, special assignments of testing of uniaxial and triaxial conditions are also included.

Course Learning Objectives:

This course will enable students to understand how rocks behave under different stresses and how to measure them in real situations. Exploring rock qualities is vital for estimating their strength and deformation. The course includes practical topics and assignments, preparing you to conduct independent research for construction site development.

Course Contents:

1. Fabric and mechanical nature of rocks;
2. Determination of rock quality for engineering purposes;
3. Stress strain behaviors of different rocks; rock mass strength. Theories of failure;
4. Types of fracture; rock deformation in compression;
5. Factors controlling mechanical behaviors of rocks; excavation methods in rocks;
6. Distribution of stresses around underground excavations;
7. Use of photo elasticity in rock mechanics.
8. Measurement of stresses in situ; wave propagation in rocks; dynamic models.

Lab. Work

Special Assignments/Projects

Recommended Texts:

1. Brady, B. H., & Brown, E. T. (2013). *Rock mechanics: for underground mining*. Amsterdam: Springer science & business media.
2. Duncan, N. (2000). *Engineering Geology and Rock Mechanics*. London: Leonard Hill

Suggested Readings:

1. Li, D., Hyslip, J., Sussmann, T., & Chrismer, S. (2002). Railway geotechnics. Boca Raton: CRC Press.
2. Franklin, J. A., & Dusseault, M. B. (1989). Rock engineering. Abingdon: Routledge.

GEOL – 6141	Soil Mechanics	3(3-0)

Course Brief:

Soil Mechanics is a sub discipline Engineering geology involving the study of soil, its behaviour and application as an engineering material. Soil Mechanics is the application of laws of mechanics and hydraulics to engineering problems dealing with sediments and other unconsolidated accumulations of solid particles, which are produced by the mechanical and chemical disintegration of rocks, regardless of whether or not they contain an admixture of organic constituents. Soil consists of a multiphase aggregation of solid particles, water, and air. This fundamental composition gives rise to unique engineering properties, and the description of its mechanical behavior requires some of the most classic principles of engineering mechanics.

Course Learning Objectives:

Students will learn about soil behavior and its use in engineering. Soil Mechanics involves applying mechanical and hydraulic laws to engineering problems related to sediments and loose solid particles created by breaking down rocks. Because soil is made up of particles, water, and air, it has special engineering properties that rely on classic engineering principles. By studying this, students will grasp how to work with soil as an engineering material.

Course Contents:

1. Introduction
2. Concept of soil mechanics,
3. Soil formation
4. Classification,
5. survey and sampling with its important engineering properties like soil gradin
6. Moisture contents
7. Void ratios, density, permeability
8. Shearing strength, bearing capacity
9. Consolidation and settlements.

Lab. Work

1. Index properties of soil.
2. Determination of soil density, permeability, unconfined shearing and compressive strength of soil and Attenberg's limits.

Recommended Texts:

1. Nelson, J., & Miller, D. J. (1997). *Expansive soils: problems and practice in foundation and pavement engineering*. New York: John Wiley & Sons. .
2. Attewell, P. B., & Farmer, I. W. (2012). *Principles of engineering geology.* Springer Science & Business Media.

Suggested Readings:

1. Schofield, A., & Wroth, P. (1968). *Critical state soil mechanics*(Vol. 310). London: McGraw-Hill.
2. Atkinson, J. (2017). *The mechanics of soils and foundations*. Boca Raton: CRC Press

GEOL- 6142	Seismotectonics	3(3-0)

Course Brief:

The course in Seismotectonics provides a comprehensive understanding of the field's relevance to geotechnical and civil engineering. It covers the fundamental principles of seismic activity and its relationship to geological structures, along with techniques for assessing seismic hazards and characterizing site-specific conditions.

Course Learning Objectives:

The students will learn the behavior of soils and rocks under seismic loading, the design principles for structures in seismic regions, and the effects of seismic events on infrastructure. They will be able to address seismic risk management strategies and examines case studies to enhance knowledge and practical application. Overall, the course equips students with the necessary skills and knowledge to analyze, evaluate, and mitigate seismic risks in engineering projects.

Course Contents:

1. Enigneering Geology and Seismicity:
2. Geological Factors in Seismotectonics:
3. Soil and Rock Properties
4. Groundwater
5. Construction Material
6. Natural Hazards Investigations
7. Seismicity and Seismic Waves:
8. Seismic Hazard Assessment:
9. Seismic Effects on Dams and Hydro Power Projects
10. Case Studies (Dams Projects in Pakistan)

Recommended Text:

1. Lollino, G., Giordan, D., Thuro, K., Carranza-Torres, C., Wu, F., Marinos, P., & Delgado, C. (Eds.). (2014). Engineering Geology for Society and Territory-Volume 6: Applied Geology for Major Engineering Projects. Springer.
2. Gattinoni, P., Pizzarotti, E. M., & Scesi, L. (2014). Engineering geology for underground works. Springer.
3. Hencher, S. (2013). Practical engineering geology. Taylor & Francis

Suggested Readings:

1. Price, D. G. (2008). Engineering geology: principles and practice. Springer Science & Business Media.
2. Záruba, Q. (2012). Engineering geology (Vol. 10). Elsevier.

GEOL - 6143	Engineering Geology II	3(3-0)

Course Brief:

This course is a graduate course. One of the elective advance level courses in the group of specialization in Engineering Geology is Engineering Geology II. The courses will enable the students to fully understand (1) the rocks and soil mechanics and their role in construction industry, (2) the earthquake related seismicity and intensity, (3) the geological and geophysical surveys, (4) the infrastructure development and (5) the techniques for evaluation of building materials. (6) Hazard Zonation and assessment of rock masses using different techniques of empirical and analytical techniques. (7) Landslides and case studies of landslides. (8) Groundwater and characteristics of ground water. This special course also includes the project and special assignments. After completing these courses, the students will be able to carry out their independent research on the site development for construction.

Course Learning Objectives:

In this course, students will learn advanced concepts in Engineering Geology II, a specialized branch of Engineering Geology. The course covers a range of topics including rocks and soil mechanics for construction, understanding earthquakes and seismicity, geological and geophysical surveys, infrastructure development, building material evaluation techniques, hazard zonation, landslides, groundwater characteristics, and case studies. With special assignments and a project, students will gain practical experience and the ability to conduct independent research for construction site development.

Course Contents:

1. Rock and soil mechanics and its application in civil engineering;
2. Study of geological factors in relation to the construction of buildings and foundations,
3. Roads, highways, excavation and tunneling, mine openings, dams and bridges;
4. Construction materials; slope stability analysis,
5. Hazard assessment, mass movement, their causes and prevention;
6. Application of geophysical methods for site investigation;
7. Construction in earth-quake zone; dams and their kinds geological investigations for selecting a site for a dam;
8. Landslides, classification, geometry, causes and preventive methods;
9. Ground water and character of ground water;
10. Case histories of important engineering projects (small and mega) in Pakistan.

Lab. Work

Special Assignments/Projects

Recommended Texts:

1. Price, D. G. (2008). Engineering geology: principles and practice. London: Springer Science & Business Media.
2. Steffen, G. S., Candelaria, S. M., Stapledon, D., Bell, G., & Foster, M. (2014). Geotechnical engineering of dams. London: CRC press.

Suggested Readings:

1. Bell, F. G. (2016). Fundamentals of engineering geology. Elsevier.
2. Beavis, F.C. (1985). Engineering Geology. Oxford: Blackwell Scientific.
3. Blyth, F. G. H., & De Freitas, M. (2017). A geology for engineers. London: CRC Press.

GEOL: 6144	Introduction to Geotechnical Engineering	3(3-0)

Course Brief:

The basic aim of the course is to identify the significance of geotechnical engineering to understand the construction material and engineering properties of soil and to evaluate the soil classification and slope stabilization techniques. The course covers topics such as geotechnical investigation, mapping procedures, construction materials, and the mechanics of slope failure. It also introduces students to slope stabilization methods, slope classification, and the application of rock and soil mechanics in civil engineering projects. Additionally, the course focuses on studying geological factors in relation to the construction of buildings, foundations, roads, highways, and excavation and tunneling projects.

Course Learning Objectives:

The primary objectives of this course are to familiarize students with the principles and practices of geotechnical engineering, develop their understanding of site investigation techniques, and equip them with knowledge about the stability and behavior of slopes and the importance of geological considerations in construction projects.

Course Contents:

1. Scope of geotechnical engineering;
2. Engineering significance of geotechnical investigation;
3. Geotechnical investigation at selected sites;
4. Geotechnical mapping procedure; Construction material and uses;
5. Types of concrete; Asphalt;
6. Introduction to slope stabilization methods;
7. Basic mechanics of slope failure;
8. Slope classification. Slope stability;
9. rock and soil mechanics and its application in civil engineering;
10. Study of geological factors in relation to the construction of buildings and foundations, roads, highways, excavation and tunneling.

Labs: Specified assignments/projects.

Recommended Texts:

1. Principles of Engineering Geology by Attewell, P. B. and Farmer, I. W., latest Edition., John Willey and Sons.
2. Engineering Geology by Beavis, F. C., 1985, Blackwell Scientific Publications.
3. Principles of Engineering Geology by Johnson, R. B. and Degraff, J. V., latest Edition., John Willey and Sons.
4. Fundamentals of Engineering Geology by Bell, F. A. G., 1983, Butter Worth.

Suggested Readings:

1. Engineering Geology by Goodman, R. E., 1993, John Wiley and Sons.
2. Foundations of Engineering Geology by Waltham, T, 2002.
3. A Geology for Engineers (7th edition) by F. G. H Blyth PhD 1984.

GEOL-6145	Dam Engineering	3(3-0)

Course Brief:

This focuses on the principles and practices of excavating and constructing tunnels. The course covers a wide range of topics, including the introduction to excavation and tunneling, the tasks of engineering geologists, ground behavior, and geotechnical site investigation. It also delves into exploration techniques during tunnel construction, prediction of rock mass conditions and behavior, mechanical rock excavation methods, sealing/grouting, and the operation and maintenance of underground constructions. Environmental issues related to rock engineering are discussed, along with excavations and tunneling under difficult conditions. The course also addresses tunnel and excavation designs, tunneling through tunnel boring machines (TBM), geological problems, and remedial measures. Important case studies from Pakistan and Kashmir are included to provide practical insights into the subject matter.

Course Learning Objectives:

The primary objectives of this course are to familiarize students with the fundamentals of excavation and tunneling, develop their skills in geotechnical site investigation and prediction of ground behavior, and provide them with knowledge and strategies for efficient and safe construction of underground structures.

Course Contents:

1. History of dam; types of dams by structure, size and use, construction material
2. Construction elements
3. Power generation plant
4. Spillways; dam creation; common purposes
5. Site investigation, location; impact assessment
6. Environmental impact
7. Human and social impact; economics; dam failure
8. Dam design after geological, structural and geotechnical investigations
9. Common problems and remedial measures in dam engineering
10. Case studies of known earth fill and concrete dams of Pakistan

Field Visits: Field visits to Dams of Pakistan

Recommended Texts:

1. Advanced Dam Engineering for Design, Construction, and Rehabilitation, Editor R. B. Jansen, Springer, 1998.
2. Engineering Soundbite: Ethical Issues from the St. Francis Dam Failure, Paul Guyer, Guyer Partners, 2011.

Suggested Readings:

1. Geotechnical Engineering Investigation Handbook, Second Edition, Roy E. Hunt, A. A Balkema Publishers London, 2005
2. Engineering Geology and Construction, Fred G. Bell, London [u.a.]: Spon,

GEOL-6146	Excavation and Tunneling	3(3-0)

Course Brief:

This focuses on the principles and practices of excavating and constructing tunnels. The course covers a wide range of topics, including the introduction to excavation and tunneling, the tasks of engineering geologists, ground behavior, and geotechnical site investigation. It also delves into exploration techniques during tunnel construction, prediction of rock mass conditions and behavior, mechanical rock excavation methods, sealing/grouting, and the operation and maintenance of underground constructions. Environmental issues related to rock engineering are discussed, along with excavations and tunneling under difficult conditions. The course also addresses tunnel and excavation designs, tunneling through tunnel boring machines (TBM), geological problems, and remedial measures. Important case studies from Pakistan and Kashmir are included to provide practical insights into the subject matter.

Course Learning Objectives:

The primary objectives of this course are to familiarize students with the fundamentals of excavation and tunneling, develop their skills in geotechnical site investigation and prediction of ground behavior, and provide them with knowledge and strategies for efficient and safe construction of underground structures.

Course Contents:

1. Introduction to excavation and tunneling
2. Major tasks of engineering geologists
3. Ground behavior
4. Geotechnical site investigation
5. Exploration during tunnel construction
6. Prediction of rock mass conditions and behavior; theory of rock drilling and rock blasting
7. Mechanical rock excavation methods
8. Sealing/grouting, operation and maintenance of underground constructions;
9. Environmental issues of rock engineering
10. Excavations and tunneling under difficult conditions
11. Tunnels and excavation designs; tunneling through TBM
12. Geological problems and remedial measures
13. Important case studies of Pakistan and Kashmir

Field Visits: Visits to excavation and tunneling sites in Pakistan and Kashmir.

Recommended Texts:

1. Civil excavations and tunneling: a practical guide, R. Tatiya, Thomas Telford. 2005.
2. Tunnel Engineering Handbook, by J. O. Bickel, and T. R. Kuesel, Van Nostrand Reinhold Co., 1982.

Suggested Readings:

3. Rock Mechanics Design in Mining and Tunneling by Z. T. Bieniawski, A. A. Balkema, 1984.
4. Engineering Geology: Principles and Practice, David George Price, M. H. De Freitas – 2009.

GEOL-6147	Mining Engineering: Engineering Geological Applications	3(3-0)

Course Brief:

The course "Mining Engineering: Engineering Geological Applications" focuses on the integration of engineering geology principles and practices into mining operations. It provides students with a comprehensive understanding of the geological aspects related to mining, emphasizing the importance of engineering geological investigations, rock mechanics, and geotechnical considerations in mining projects. The course covers both underground and surface mining methods, including mine planning and design. It also addresses geotechnical challenges, such as rock slope stability, ground control, and support systems. Environmental impacts, safety, and risk management in mining operations are also discussed. The course incorporates case studies to provide practical insights into mining engineering applications.

Course Learning Objectives:

In this course, students will learn how to use geological knowledge in mining through "Mining Engineering: Engineering Geological Applications." They will understand how geology affects mining, especially in areas like rock mechanics and safety. The course covers both underground and surface mining, including planning and dealing with challenges like stability. Environmental impact, safety, and real-world case studies will also be explored, providing practical insights into mining engineering.

Course Contents:

1. Introduction to Mining Engineering
2. Fundamentals of Engineering Geology in Mining
3. Geological Site Investigations for Mining Projects
4. Rock Mechanics and Rock Behavior in Mining
5. Mine Planning and Design
6. Underground Mining and Surface Mining Methods
7. Geotechnical Considerations in Mining Operations
8. Rock Slope Stability Analysis and Design in Mining
9. Ground Control and Support Systems in Mines
10. Environmental Impacts and Remediation in Mining
11. Safety and Risk Management in Mining Operations

Field Visits: Field visits to various mine site of Pakistan

Recommended Texts:

1. Bell, F G (2007) Engineering Geology 2nd edition, Butterworth-Heinemann,
2. Goodman, R.E. (1993) Engineering geology: rock in engineering construction, J. Wiley,
3. Hartley, J S (1994) Drilling: Tools and Programme Management 1st edition, John S Hartley & Associates, Johnson, R B; De Graff, J V (1988) Principles of Engineering Geology 1st edition, John Wiley & Sons,

Suggested Readings:

1. Moon, C J; Whateley, M K G; Evans, A M (2006) Introduction to Mineral Exploration, 2nd edition, Blackwell Publishing, 481 p.
2. Moore, T A; Black, A; Centeno, J A; Harding, J S; Trumm, D A (2005) Metal Contaminants in New Zealand, 1st edition, ResolutionzPress, 490 p.
3. Smith, M R, (Ed) (1999) Stone: building stone, rock fill and armourstone in construction, Geological Society, London, Engineering Geology Special Publication #16.

GEOL - 6150	Petroleum Engineering	3(3-0)

Course Brief:

Petroleum engineering is a field of engineering concerned with the activities related to the production of hydrocarbons, which can be either crude oil or natural gas. Exploration and production are deemed to fall within the upstream sector of the oil and gas industry. Petroleum geologyand geophysics focus on provision of a static description of the hydrocarbon reservoir rock, while petroleum engineering focuses on estimation of the recoverable volume of this resource using a detailed understanding of the physical behavior of oil, water and gas within porous rock at very high pressure. The combined efforts of geologists and petroleum engineers throughout the life of a hydrocarbon accumulation determine the way in which a reservoir is developed and depleted, and usually they have the highest impact on field economics.

Course Learning Objectives:

In this course, students will explore Petroleum Engineering, which deals with producing crude oil and natural gas. They will learn about two main aspects: petroleum geology/geophysics that describe the reservoir rock and petroleum engineering that estimates how much oil and gas can be extracted. This involves understanding how oil, water, and gas behave under high pressure in porous rock. They will understand how geologists and engineers work together to develop and manage reservoirs, impacting their economic success.

Course Contents:

1. Introduction to rig components
2. drilling methods and operations
3. types of bits; drilling fluids
4. composition and function
5. cementation and casing operations
6. coring operations; mud and wireline logging
7. well testing and completion
8. well production operations
9. evaluation and analysis of well data i.e. well cutting, cores, logs and production data
10. secondary and enhanced oil recovery
11. common drilling problems and preventive measures
12. HSE at well site.

Lab. Work

Study of mass properties of rocks, wire line logs, cores, well cuttings, DSTand MDT pressure data.

Recommended Texts:

1. Dobrin, M. B., & Savit, C. H. (2000). *Introduction to geophysical prospecting* (Vol. 4). New York: McGraw-hill.
2. Burger, H. R., Burger, D. C., & Burger, H. R. (1992). *Exploration geophysics of the shallow subsurface* (Vol. 8). Englewood Cliffs: Prentice Hall.

Suggested Readings:

1. Bieniawski, Z. T. (2009). *Engineering rock mass classifications: a complete manual for engineers and geologists in mining, civil, and petroleum engineering*. New York: John Wiley & Sons.
2. Sereda, N.G., & Solvyon, E. M. (1998). *Drilling of Oil and Gas.* Wells Mir Publications.
3. Darling, T. (2005). *Well logging and formation evaluation*. Amsterdam: Elsevier.

GEOL - 6151	Reservoir Geology	3(3-0)

Course Brief:

The main theme of this subject is to trains students to use modern measurement techniques, computational methods and new geological concepts to obtain a quantitative understanding of the processes behind reservoir rocks. These skills are useful not only in the petroleum industry but also in hydrogeology and other related branches and in the search for new energy sources. The Reservoir Geology courses meshes with the courses in petroleum Geology, petroleum engineering and geophysics. It will introduce the fundamental concepts Rock Fluid Interaction, properties of Hydrocarbon and oilfields fluids, reservoir sedimentology, exploration geology, production geology and advance seismic interpretation.

Course Learning Objectives:

The students will learn in detail wire line log interpretation, reservoir characterization and development and its integration engineering. This course leads toward from the Conventional modeling workflow to conceptual geological models. These heterogeneities may be structural, stratigraphic, sedimentologic and/or diagenetic on origin, and often impact flow behavior and hydrocarbon recovery; hence, they must be captured in reservoir models.

Course Contents:

1. Reservoir rock types: clastics, carbonates, and non-marine reservoirs.
2. Reservoir properties, depositional and diagenetic controls.
3. Fluid properties and their saturation.
4. Hydrocarbon distributing and fluid contacts.
5. Reservoir zonation and thickness mapping.
6. Reservoir pore spaces configuration.
7. Mapping reservoir heterogeneity.
8. Reservoir estimation and calculation of reservoir volumetric, material balance and production, decline curve methods.
9. Appraisal and development of reservoir basic concepts.
10. Petrophysical evaluation; Introduction to Reservoir Engineering.
11. Core analysis.
12. Well logs and well testing.

Recommended Texts:

1. Bjorlykke, K. (2010). *Petroleum geoscience: From sedimentary environments to rock physics*. London: Springer Science & Business Media.
2. Asquith, G. B., Krygowski, D., & Gibson, C. R. (2004). *Basic well log analysis* (Vol. 16). Tulsa: American Association of Petroleum Geologists.

Suggested Readings:

1. Ellis, D. V., & Singer, J. M. (2007). *Well logging for earth scientists* (Vol. 692). Dordrecht: Springer.
2. Gluyas, J., & Swarbrick, R. (2013). *Petroleum geoscience*. New York: John Wiley & Sons.
3. Bjorlykke, K. (2010). *Petroleum geoscience: From sedimentary environments to rock physics*. London: Springer Science & Business Media.

GEOL - 6152	Petroleum Geology of Pakistan	3(3-0)

Course Brief:

Pakistan being a developing country is facing significant challenges of energy crises due to a deficit of hydrocarbons. So, it is essential to explore and develop new oil and gas fields with increasing drilling rate to meet energy requirements. So the course is designed to understand the basic knowledge about tectonics, depositional settings and lithostratigraphic divisions of the rocks of various geological periods in Pakistan as well as to learn about the evaluation of petroleum potentials of different basins. This course covers a wide range of earth science subjects and their application to the full spectrum of hydrocarbon exploration and production. It is designed for students with some industrial experience, as well as for recent graduates seeking careers in the petroleum and allied service industries.

Course Learning Objectives:

In this course, students will learn about Petroleum Exploration in Pakistan, addressing the energy crisis. The course focuses on assessing the potential for finding oil and gas in different regions. It covers various earth science topics and their connection to hydrocarbon exploration. Whether you have experience or are a recent graduate, this course prepares you for careers in the petroleum and related industries.

Course Contents:

1. History of petroleum exploration
2. New trends for petroleum exploration
3. Tectonic framework
4. Sedimentary basins and their evolution and distribution
5. Sectonics, depositional settings and lithostratigraphic divisions of the rocks of various geological periods
6. Facies development and their association in depositional basins such as Indus, Baluchistan and offshore regions
7. Evaluation of petroleum potentials of different basins
8. Structural styles and petroleum play in the basins of Pakistan
9. Geothermal gradients and their maturity
10. Productive and potential oil and gas reservoirs and source rocks and their distribution in the basins
11. Play Fairways and Petroleum System in basins; case studies.

Lab. Work : Case histories of oil and gas fields of Pakistan.

Recommended Texts:

1. Kadri, I. B. (1995). *Petroleum geology of Pakistan*. Karachi: Pakistan Petroleum Limited.
2. Kazmi, A. H., & Abbasi, I. A. (2008). *Stratigraphy & historical geology of Pakistan*. Peshawar: Department & National Centre of Excellence in Geology.

Suggested Readings:

1. Bender, F., & Raza, H. A. (1995). *Geology of Pakistan.* Karachi: Oxford Press.
2. Haq, B. U., & Milliman, J. D. (1985). *Marine geology and oceanography of Arabian Sea and coastal Pakistan*. Karachi: Oxford University Press.

GEOL- 6153	Geological and Geophysical Software Application	3(3-0)

Course Brief:

Exploration for natural resources (ores, industrial minerals, hydrocarbons), as well as other geological and exploration activities, uses geophysical mapping and interpretation techniques. Understanding conceptual and geological model in context of geophysical software are the main topics of the course. Description of geological and geophysical software from the small to regional scale, requires the use of various scales. We concentrate on the modelling and analysis of geological data empowered by geophysical techniques.

Course Learning Objectives:

This course will contribute to Petroleum Geosciences specialization and specifically by providing a multidisciplinary learning area with a variety of applications with close collaboration with industrial partners of Saudi Aramco and Pakistan Petroleum Limited, for example.

Course Contents:

1. Graphics for geological and geophysical sections, maps, digitization.
2. CorelDraw suite for lithological logs
3. Adobe Illustrator Suite for creating geological maps
4. Introduction to Easy Core Suite
   This introductory course provides an overview of the key concepts and core philosophy in digitizing cores from sub-surfaces.
5. Understanding of study the fundamentals of 3D visualisation and exploratory data analysis through practical activities that teach you how to open a project,
6. Navigate the interface, input multi-disciplinary data, and more.
7. Introduction to Move Suite
8. Learn how to create a 3D geological and structural model that is integrated and how to identify potential exploration targets.
9. Introduction to Paleoscan Suite
10. Acquire to identify possible exploration targets using seismic sections and how to build an integrated 3D geological model using geophysical data
11. Introduction to Opendtect Suite
12. OpendTect for seismic interpretation system for visualizing, analyzing and interpreting 2D, 3D and 4D seismic data.

Recommended Texts:

1. Eppelbaum, L. (2019). Geophysical potential fields: geological and environmental applications. Elsevier.
2. Houlding, S. (1987). 3D computer modelling of geology and mine geometry. Min. Mag.; (United Kingdom), 156(3).

Suggested Readings:

1. OpendTect (2021) User Documentation and Manual - Version 6.6, dGB Earth Sciences Publications.
2. Petrel Manual (2017) Schlumberger Publications.

GEOL- 6154	Basin Modeling	3(3-0)

Course Brief:

This is an integrated course containing modules focusing on Petroleum Systems and Basin Evaluation, covering both conventional and unconventional hydrocarbon resources. This course covers a range of topics related to the various basins formation at plate margins and the key potential of elements and processes of the petroleum system, including hydrocarbon generation, migration, accumulation and alteration. Techniques for source rock evaluation and assessing organic maturation are reviewed, and the mechanisms and efficiencies of migration are reconstructed. It focuses on thermal history modelling and basin analysis, which provides the basis for predicting the timing and extent of petroleum generation in sedimentary basins.

Course Learning Objectives:

In this course, Students will explore Petroleum Systems and Basin Evaluation, looking at both regular and unconventional energy sources. Students will study how basins form, the elements of petroleum systems, and processes like generation and movement. Techniques for studying source rocks and maturation are covered, along with migration mechanisms. The course emphasizes thermal history modeling and basin analysis to predict when and where petroleum is generated in sedimentary basins.

Course Contents:

1. The Foundation of Sedimentary Basins,
2. Compositional and Rheological Zoning of Earth and Plate Motion, Classification Scheme for Sedimentary Basins,
3. Types of Sedimentary Basins, Physical State of the Lithosphere, Stress and Strain, Heat Flow, Conduction, Convection, Gravity and Isostacy,
4. Mechanism of Sedimentary Basin Formation Basin due to Lithospheric Stretching, Basins due to Flexure, Geometry of Deflection,
5. Flexural Rigidity of Oceanic and Continental lithosphere, Basins associated with Strike slip Deformation, The Structural Pattern of Strike slip Fault system and Basin in Strike slip zones, Long term Eustacy and Epierogeny,
6. Mantle Processes, Dynamics, Supercontinent Cycles, Dynamic Topography and Eperiogeny, Accommodation and Shoreline Shifts,
7. Allogenic Controls on Sedimentation, Sediment supply, Energy Flux, Sediment Accommodation, The Sedimentary Basin Fill and The Sediment Routing System,
8. The Basin Stratigraphy, Process Stratigraphy, Driving Mechanism and Numerical Simulation, Subsidence and Thermal History, Geohistory Analysis, Paleo temperatures in Basins, Application to Petroleum Play Assesment,
9. Petroleum System Charge, The Reservoir, The Regional Topseal and Trap, Petroleum System Modeling An Exploration Tool,
10. Introduction to Basin Modeling, Geological Processes, Structure of a Model, Modeling Workflow, Structural Restoration, Heat Flow Analysis, ID,
11. Thermal Conductivity, Specific Heat Capacity, Radiogenic Heat, SWI Temperatures,
12. Risk Analysis in Basin Modeling.

Labs: Stratigraphy columns and their correlation; textural data interpretation; paleocurrent data interpretation; basin mapping methods; clastic petro facies analysis; interpretation of depositional basins and source area.

Recommended Texts:s

1. Allen, P.A. and Allen, J.R. 1990 Allen, P.A. and Homewood. P and William G.D., 1986, Basin analysis: Principles and Applications Blackwell Scientific Publications
2. Einsle, G., 1992, Sedimentary Basin Evolution, Facies and Sediment Budget.

Suggested Readings

1. Tucker, M.E., 1991, Sedimentary Petrology Blackwell Publications.
2. Kazmi, A.H and Abbasi, I.A., 2008, Stratigraphy and Historical Geology of Pakistan Graphic Publishers, Karachi, Pakistan.

GEOL- 6155	Petroleum Geology and Subsurface Methods	3(3-0)

Course Brief:

The exploration, development, and production of petroleum resources are normally covered in a course on petroleum geology and subsurface methods, with an emphasis on the geological processes involved and the techniques used to analyze and interpret subsurface data. It also gives an overview of the principles of petroleum geochemistry with a focus on how they apply to exploration and production. Following discussions of various elements of hydrocarbon generation and accumulation, lectures on geochemical techniques, markers, modelling, coal-bed methane, and case studies are given. Understand various oil and gas recovery techniques and how they are used in field development. It will help to put student's critical thinking and problem-solving abilities to use by tackling actual petroleum geology problems, communicate clearly and convey technical data about petroleum geology.

Course Learning Objectives:

Students will learn about the geological processes and tools for analyzing subsurface data. The course also covers principles of petroleum geochemistry as they relate to exploration and production. They will explore hydrocarbon generation, accumulation, and various recovery techniques. Through case studies, They will be able to tackle real geology problems, enhance critical thinking, and improve communication skills for conveying technical data effectively.

Course Contents:

1. Source rocks and petroleum's place of origin
2. Fluid migration concepts; reservoir rocks and traps.
3. Employing subsurface methods for hydrocarbon play exploration and development.
4. Introduction to the production of hydrocarbons and reservoir evaluation.
5. Core analysis and laboratory techniques
6. Reservoir modeling and simulation
7. Introduction and review of fundamentals Geochemical methods
8. Geological and geochemical constraints on hydrocarbon generation and accumulation
9. Geochemistry in exploitation and development (reservoir geochemistry)
10. Introduction to coal-bed methane
11. Enhanced oil recovery (EOR) methods
12. Field development planning and optimization
13. Case studies

Recommended Texts:s

1. Tearpock, D. J., Bischke, R. E., Metzner, D., & Brenneke, J. (2020). Applied three dimensional subsurface geological mapping: with structural methods.
2. Bjorlykke, K. (2010). Petroleum geoscience: From sedimentary environments to rock physics. Springer Science & Business Media.

Suggested Readings:

1. Gluyas, J. G., & Swarbrick, R. E. (2021). Petroleum geoscience. John Wiley & Sons.
2. Morton-Thompson, D., & Woods, A. M. (Eds.). (1993). Development geology reference manual: AAPG methods in exploration series, no. 10 (No. 10). AAPG.

GEOL-6156	Advance Structural Geology	3(3-0)

Course Brief:

Structural features of complexly folded strata; advanced fold and fault analysis; simple statistical analysis of data; structural analysis; applications to exploration and exploitation; cross-sections and balancing; advanced map interpretation; tectonics; neotectonics. Analyze and integrate structural data within a tectonic framework or general stress field. Comprehend the aspects of structural style, what factors control the style and incorporate the style into an interpretation Describe the general strain path of an observed structure from the incipient state to present day Produce a balanced cross-section, a section that is kinematically viable and admissible Evaluate the quality and limitations of a structural geology interpretation. For example – Practice qualitative evaluations of existing geologic cross-sections and maps Gather structural data from a variety of data sources and evaluate the veracity and limitations of the data.

Course Learning Objectives:

In this course, students will learn how to analyze the complexly folded layers, advanced fold and fault analysis, structural features, statistical techniques for data and their application to exploration and exploitation. Students should be able to evaluate and interpret various structural styles, create balanced cross-sections, and assess the quality and limits of structural interpretations. This involves practical tasks like evaluating existing cross-sections, gathering and evaluating data from multiple sources.

Course Contents:

1. Stress and strain, types of stress/strain, measures of strain
2. Controlling factor of mechanical behavior of rocks
3. Brittle and ductile deformation
4. Mechanism of fold formation
5. Fold geometry
6. Mechanism of faults
7. Types of fault
8. Fractures
9. Tectonics
10. Foliation and lineation
11. Structural Trapes

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Recommended Texts:

1. Twiss, R. J., & Moores, E. M. (1992). *Structural geology*. Macmillan.
2. Davis, G. H., Reynolds, S. J., & Kluth, C. F. (2011). *Structural geology of rocks and regions*.
   John Wiley & Sons.

Suggested Readings:

1. Ramsay, J. G., Huber, M. I., & Lisle, R. J. (1983). *The techniques of modern structural geology: Folds and fractures* (Vol. 2). Academic press.
2. Fossen, H. (2016). *Structural geology*. Cambridge university press.

GEOL-6157	Applied Sedimentology	3(3-0)

Course Brief:

Depositional and diagenetic facies models applied to main depositional settings for siliciclastic sedimentary rocks, based on both modern and ancient examples. Describe structures and textures of siliciclastic sediment and sedimentary rocks at multiple scales. Apply concepts of facies and facies successions/associations to characterize depositional settings. Investigation of the linkages between provenance, deposition, stratigraphic stacking and diagenesis of siliciclastic rocks, and how these factors affect the quality of subsurface fluid reservoirs. Petrography of carbonate sediments and their biotic and abiotic constituents. Ocean chemistry of carbonate systems and ocean acidification. Sedimentological, biological and climatic significance of modern and ancient carbonates. Warm- and cool-water carbonate factories. Lacustrine, peritidal, neritic, reef, slope, and pelagic environments. Diagenesis, dolomitization and carbonate reservoirs.

Course Learning Objectives:

Students will be able evaluate sedimentary rocks and how they're formed and changed over time. Describe different environments, like oceans and lakes, influence their characteristics. This includes examining both current and ancient examples. Additionally, analyze carbonate sediments, their components, and the impact of ocean conditions. Discuss about different types of carbonate environments, from reefs to deep ocean settings. The course also covers how these rocks change over time (diagenesis), including dolomitization, and how they can become important reservoirs for fluids underground.

Course Contents:

1. Introduction; discussion on Intended Learning Outcomes
2. Textures of the sedimentary rocks
3. What physical sedimentary structures do you know? What do they indicate about processes
4. Conditions for erosion and deposition processes
5. Facies & facies successions/associations
6. Eolian depositional processes and facies, Shallow marine (SM) depositional processes and facies Siliciclastic and carbonate Rocks Constituents: Framework Grains
7. Provenance of siliciclastic and carbonate rocks
8. Diagenetic processes
9. Geochemical Methods

Recommended Texts:

1. Boggs, S. (2012). Principles of sedimentology and stratigraphy
2. Nichols, G. (2009). *Sedimentology and stratigraphy*. John Wiley & Sons.

Suggested Readings:

1. Bjørlykke, K. (1989). *Sedimentology and petroleum geology* (p. 363). Berlin: Springer-Verlag.
2. Tucker, M. E., & Wright, V. P. (2009). *Carbonate sedimentology*. John Wiley & Sons.

GEOL - 6160	Earthquake Seismology	3(3-0)

Course Brief:

The course explores the processes that cause earthquakes, as well as the methodologies used by seismologists to analyze seismograms, to measure source parameters, and to simulate the seismic wave impact at the Earth's surface. The main goals are to provide an overview of earthquake seismology for non-seismologists, to introduce undergraduate geoscience students to earthquake seismology. The course is designed to deliver basic knowledge of earthquake phenomena. Describe the main scales for measuring the size of an earthquake.

Course Learning Objectives:

This course will enable undergraduate students to develop understanding for the occurrence of earthquakes according to elastic rebound theory and distribution of different types of earthquakes with reference to Plate Tectonic. Explain the relationship between earthquakes and faults and fault plan solutions. Learn basic techniques to locate earthquake epicenters using P and S waves.

Course Contents:

1. Mathematical analysis of seismological processes on the basis of elastic wave theory
2. Seismic waves and their analysis in earthquake seismology
3. Frequency, magnitude, energy of an earthquake and their relationship
4. Source parameters and their determination
5. Composite fault plane solutions of earthquakes and their determination
6. Geographical distribution of important earthquakes
7. Earthquakes and their relationship to the tectonics of the area.

Lab. Work

Specified problems on data processing, analysis, fault solutions and interpretation.

Recommended Texts:

1. Shearer, P. M. (2019). *Introduction to seismology*. Cambridge: Cambridge university press.
2. James, D. E. (Ed.). (1989). *Encyclopedia of solid Earth geophysics*. London: Springer Science & Business Media.

Suggested Readings:

1. Borr, M. H. P. (1982). *The Interior of the Earth: its Structure, Constitution and Evolution.* London: Edward Arnold.
2. Shearer, P. M. (2019). Introduction to seismology. Cambridge: Cambridge University Press.
3. Bullen, K. E., Bullen, K. E., & Bolt, B. A. (1985). *An introduction to the theory of seismology*. Cambridge: Cambridge university press.

GEOL – 6161	Electrical and Radiometric Exploration Methods	3(3-0)

Course Brief:

The major objective of this course is to skill undergraduate students with basic principles of the electrical and radiometric exploration methods used in mineral exploration and energy resources. Describe the different electrical and electromagnetic methods and how they relate to electrical conductivity and dielectric permittivity the importance of optimal processing and display of these data and the strengths and limitations of the various methods. Students shall learn how to extract the maximum amount of geological information from the data, recognizing noise-related artifacts in interpretation products and how to deal with the ambiguity when interpreting electrical and radiometric data sets.

Course Learning Objectives:

The core learning in this course include the basic principles of the main geophysical exploration methods used in mineral exploration including the importance of optimal processing and display of these data and the strengths and limitations of the various methods. Particular attention will be paid to extracting the maximum amount of geological information from the data, recognizing noise-related artifacts in interpretation products and how to deal with the ambiguity when interpreting geophysical datasets.

Course Contents:

1. Fundamentals of current flow in the earth
2. Electrode arrangements and field procedures
3. Instruments; processing and interpretation of resistivity data
4. Field procedure, data acquisition and interpretation of self-potential
5. Induced polarization and electromagnetic methods;
6. Study of case histories.
7. Physical principles and basic theory of Radioactivity
8. Radioactivity of rocks
9. Radioactive dating methods
10. Field surveys and instruments for radiometric methods
11. Data processing and interpretation of radiometric surveys
12. Application of radiometric methods in exploration of minerals and energy resources

Recommended Texts:

1. Dobrin, M. B., & Savit, C. H. (2000). *Introduction to geophysical prospecting* (Vol. 4). New York: McGraw-hill.
2. Nabighian, M. N. (Ed.). (1991). Electromagnetic Methods in Applied Geophysics. Volume 2, Application, Parts A and B. Amsterdam: Society of Exploration Geophysicists.

Suggested Readings:

1. Kearey, P., Brooks, M., & Hill, I. (2013). *An introduction to geophysical exploration.* New York: John Wiley & Sons.
2. Robinson, E. S. and Coruh, C. (1988) *Basic Exploration Geophysics.* New York: John Wiley & Sons.

GEOL- 6162	Borehole Geophysics	3(3-0)

Course Brief:

The course on Borehole Geophysics provides a comprehensive understanding of the theory, techniques, and applications of geophysical methods specifically applied to boreholes. Students will learn the basic principles of geophysical methods and their relevance in petrophysics and formation evaluation. They will become familiar with various logging techniques, instrumentation, and their practical field application. The course emphasizes log analysis and interpretation for lithological analysis, environmental studies, water resource assessment, geotechnical investigations, mineral exploration, and hydrocarbon studies. Through case histories, students will gain insights into the real-world application of borehole geophysics.

Course Learning Objectives:

The objective is to equip students with the knowledge and skills to effectively utilize borehole geophysics in various disciplines and interpret valuable information from borehole logs for decision-making in geotechnical and geological projects.

Course Contents:

1. Introduction
2. Basic theory of geophysical methods
3. Borehole logging
4. Different types of logging techniques, instrumentation and their field application
5. Log analysis and interpretation
6. Petrophysics and formation evaluation
7. Application of borehole geophysics for lithological environmental, water resources,
8. geotechnical, mineral and hydrocarbon studies.
9. VSP
10. Case histories

Labs: Specified assignments on data acquisition/processing and interpretation.

Recommended Texts:

1. Kearey, P., Brooks, M., and Hill, I., 2002, An Introduction to Geophysical Exploration 3rd Ed., Blackwell Scientific Publications, London.
2. Lowe, C., Thomas, M.D., and Morris, W.A., (Eds) 1999, Geophysics in Mineral Exploration: Fundamentals and Case Histories Geology Association of Canada, Short Course Notes Volume 14, Sudbury.
3. Reynolds, J.M. 1997, An Introduction to Applied and Environmental Geophysics Wiley, New York.
4. Sharma, P.V., 1997, Environmental and Engineering Geophysics, Cambridge University Press.

Suggested Readings:

1. Telford, W.M. Geldart, L.P. and Sherriff, R.E., (1990), Applied Geophysics, 2nd Ed. Cambridge University Press, Cambridge.
2. Ward, S.H. , (1990), Geotechnical and Environmental Geophysics, Vol. I-III Society of Exploration Geophysicists, Tulsa, Okla.
3. Moone, P.L., (1986), Drilling Practices, Manual Pen Well.

GEOL - 6163	Seismic Prospecting	3(3-0)

Course Brief:

The overall objective of this course is to introduce undergraduate students to seismic data acquisition, technical processing concepts and interpretation principles that form the basis for value added seismic applications in exploration of hydrocarbon and reservoir management. This course will provide practical understanding of seismic acquisition, processing and interpretation skill. Data examples and practical exercises will illustrate key concepts, practical issues, and pitfalls of acquisition and processing as they affect the interpretation of seismic data.

Course Learning Objectives:

The students will be introduced to seismic data interpretation to generate structural and stratigraphic sections using seismic and well data. The participant learns to answer these and related questions by gaining an understanding of the seismic system, its limitations and pitfalls, and by interpreting 2D and 3D seismic examples of structural and stratigraphic features associated with actively producing hydrocarbon areas.

Course Contents:

1. Planning for 2D and 3D seismic surveys and concepts of recording parameters
2. Types of seismic surveys
3. Onshore and offshore seismic surveys
4. Methodology of seismic data acquisition
5. Seismic equipment
6. Types of seismic energy sources and recording equipment
7. Acquisition methods,
8. Quality control of data during acquisition and processing
9. Field processing,
10. Work flow for various basic and advanced processing techniques
11. Seismic mapping and interpretation of 2D and 3D seismic data
12. Well seismic (VSP)
13. Forward seismic Modeling
14. Ray tracing
15. Synthetic seismograms generation
16. AVO for lithology and DHI
17. Applications in Exploration and Production.

Recommended Texts:

1. Burger, H. R., Burger, D. C., & Burger, H. R. (1992). *Exploration geophysics of the shallow subsurface* (Vol. 8). Englewood Cliffs: Prentice Hall.
2. Mares, S., & Tvrdý, M. (1984). *Introduction to applied geophysics*. London: Springer Science & Business Media.

Suggested Readings:

1. Pal, S. K. (1998). *Statistics for Geoscientists Techniques and Applications*. Delhi: Concept Publishing Company.
2. Davis, J. C., & Sampson, R. J. (1986). *Statistics and data analysis in geology* (Vol. 646). New York: John Wiley & Sons.
3. Freeden, W., Nashed, M. Z., & Sonar, T. (Eds.). (2010). *Handbook of geomathematics*. London: Springer Science & Business Media.

GEOL- 6164	Gravity and Magnetic Methods	3(3-0)

Course Brief:

The aim of the course is to introduce various aspects of gravity and magnetic method and familiarize the student with them. The course is emphasizing the physical concepts of each method. A conceptual review of the governing laws gravity and magnetic methods will be provided. The course is intended to be a practical, hands-on, field-oriented course on the applications of gravity and magnetic methods to these problems. For each topic, the development will proceed from basic principles (theory) through methodology and applications, to case histories. Applications will be emphasized; theory will be kept to essentials. The basic principles and operational procedures of each method will be presented, along with discussions of where the method is and is not applicable. Case histories will be included to illustrate applications.

Course Learning Objectives:

The learning objectives of this course is to teach students about gravity and magnetic methods. It focuses on the physical concepts behind these methods and provides a review of the laws that govern them. The course is practical and field-oriented, aiming to apply gravity and magnetic methods to real-world problems. You'll start with the basics and move on to methodology, applications, and case studies. The goal is to emphasize how these methods are used in various situations, with practical examples illustrating their applications.

Course Contents:

1. Physical principles and basic theory of Gravity Method
2. Gravity Instrumentation and planning of the gravity survey and evaluation of errors
3. Rock densities and their measurements and Isostasy
4. Gravity data acquisition and processing;
5. Data interpretation and mapping to identify gravity anomalies
6. Gravity ; regional fields, residual anomalies and derivatives
7. Continuation of the gravity field and two and three-dimensional modeling;
8. Applications in petroleum industry and case histories
9. Physical principles and basic theory of Magnetic Method
10. Magnetic Instrumentation and planning of the magnetic survey and evaluation of errors
11. Rock susceptibilities and their measurements
12. Magnetic data acquisition and processing;
13. Data interpretation and mapping to identify magnetic anomalies
14. Magnetic ; regional fields, residual anomalies and derivatives
15. Continuation of the magnetic field and two and three-dimensional modeling;
16. Applications in petroleum industry and case histories

Recommended Texts:

1. Telford, W. M., Telford, W. M., Geldart, L. P., Sheriff, R. E., & Sheriff, R. E. (2012). *Applied geophysics*. Cambridge university press.
2. Reynolds, J. M. (2011). *An introduction to applied and environmental geophysics*. John Wiley & Sons.

Suggested Readings:

1. Parasnis, D. S. (2012). *Principles of applied geophysics*. Springer Science & Business Media.
2. Griffiths, D. H., & King, R. F. (2013). *Applied geophysics for geologists and engineers: the elements of geophysical prospecting*. Elsevier.

GEOL-6165	Marine Geophysics	3(3-0)

Course Brief:

Marine geophysics is a multidisciplinary field that focuses on studying the Earth's oceans and seas using geophysical methods. It involves investigating the origin of continents and oceans, the physiography of the seafloor, processes like seafloor spreading and heat flow, and the use of geophysical instruments for surveys and research. The objectives of marine geophysical studies include mapping and understanding the seafloor's geological structures, dating the ocean floor using magnetic anomalies, exploring marine resources, and conducting engineering investigations for offshore structures and seabed infrastructure. By applying geophysical techniques, marine geophysics aims to enhance our understanding of the dynamic processes and resources within the oceans and contribute to various scientific and practical applications.

Course Learning Objectives:

This course is about marine geophysics, a field that studies Earth's oceans using geophysical methods. Students will learn about the origin of oceans, the seafloor's features, and processes like seafloor spreading and heat flow. The course covers using geophysical tools for research, including mapping the seafloor, exploring resources, and studying engineering for offshore structures. By applying these techniques, marine geophysics helps us understand ocean processes and resources, contributing to both science and practical uses.

Course Contents:

1. Oceans, Seas and Origin of continents and oceans
2. Physiography and divisions of the sea floor
3. Sea floor spreading and The Vine-Mathews hypothesis
4. Geomagnetic time scale and dating the ocean floor
5. Oceanic magnetic anomalies
6. Heat flow: Earth's internal sources of heat and transfer of heat within the earth
7. Geophysical Instrumentation and Surveys
8. Objectives of marine geophysical surveys
9. Adaptation of Geophysical Instruments for Marine Surveys
10. Measurements at the Sea surface and Under water
11. Geophysical Equipment Currently in use and board research vessels
12. Complement of equipment on board the survey ship and layout of equipment
13. Marine geophysical surveys for sea bed resources and engineering investigations

Recommended Texts:

1. Turekian, K. K. (2010) Marine geology & geophysics: a derivative of Encyclopedia of ocean sciences. Academic Press.
2. Harff, J., Meschede, M., Petersen, S., & Thiede, J. (Eds.). (2016). Encyclopedia of marine geosciences. Springer Netherlands.
3. Cazenave, A., & Royer, J. Y. (2001). Applications to marine geophysics. In International Geophysics; Vol. 69,. Academic Press.
4. Board, O. S., & National Research Council. (2000). Achievements in Marine Geology and Geophysics. In 50 Years of Ocean Discovery: National Science Foundation 1950—2000. National Academies Press (US).

Suggested Readings:

1. SWART, P. K. (2012). Marine Geology and Geophysics. Black Sea Oceanography, 351, 75.
2. Seibold, E., & Berger, W. (2017). The sea floor: an introduction to marine geology. Springer.

GEOL-6166	Environmental and Engineering Geophysics	3(3-0)

Course Brief:

This undergraduate course provides students with a comprehensive understanding of the principles and practical applications of geophysical techniques in the fields of environmental and engineering geophysics. Through a combination of theoretical knowledge, hands-on fieldwork, and data analysis, students will learn how to assess subsurface conditions, investigate environmental challenges, and solve engineering problems using geophysical methods. The course emphasizes the integration of theory and practice, enabling students to develop essential skills in data collection, interpretation, and problem-solving. By exploring real-world case studies and emerging trends, students will gain insights into the limitations and challenges of near-surface geophysics, ultimately preparing them to apply these techniques effectively in environmental and engineering projects.

Course Learning Objectives:

In this undergraduate course, students will gain a solid grasp of geophysical techniques for environmental and engineering purposes. Through theory, hands-on fieldwork, and data analysis, They will learn how to evaluate what's beneath the surface, address environmental issues, and tackle engineering challenges using geophysics. The course combines theory with practical skills, helping you learn data collection, interpretation, and solutions. By studying real cases and new developments, They will understand the limitations and complexities of near-surface geophysics, preparing you to use these methods effectively in environmental and engineering projects.

Course Contents:

1. Introduction to Environmental and Engineering Geophysics
2. Definition and scope of Environmental and Engineering Geophysics
3. Geophysical Methods
4. Data Acquisition and Instrumentation
5. Survey planning and design
6. Field instrumentation and data collection techniques
7. Quality control and data validation
8. Data Processing, Inversion, modeling and Interpretation
9. Integration of geophysical data with other subsurface information
10. Applications in Engineering Geophysics
11. Applications in Environmental Geophysics
12. Practical considerations in field surveys
13. Limitations, Challenges ,Emerging Trends and Future Directions

Recommended Texts:

1. Medhus, A. B., & Klinkby, L. (Eds.). (2022). *Engineering Geophysics*. CRC Press.
2. Reynolds, J. M. (2011). *An Introduction to Applied and Environmental Geophysics*. John Wiley & Sons.
3. Yilmaz, Ö. (2015). *Engineering Seismology with Applications to Geotechnical Engineering.* Society of Exploration Geophysicists.

Suggested Readings:

1. Griffiths, D. H., & King, R. F. (2013). *Applied Geophysics for Geologists and Engineers: the Elements of Geophysical Prospecting*. Elsevier.
2. Kearey, P., Brooks, M., & Hill, I. (2002). *An Introduction to Geophysical Exploration*. John Wiley & Sons.

GEOL-6167	Hydrogreophysics	3(3-0)

Course Brief:

The course on Hydrogeophysics is designed to provide students with a comprehensive understanding of the theory, methods, and practical applications of geophysical techniques in the field of groundwater investigations. Students will be introduced to the fundamental principles of hydrogeophysics and learn how geophysical methods can be used to measure and characterize subsurface properties relevant to groundwater flow and aquifer characterization. The course will cover topics such as water content/porosity, hydraulic conductivity, hydrostratigraphy, and the integration of airborne and remote sensing techniques for hydrogeophysical studies. Through a combination of lectures, laboratory exercises, and fieldwork, students will gain hands-on experience in data collection, interpretation, and analysis using a variety of geophysical instruments and software tools.

Course Learning Objectives:

This course focuses on Hydrogeophysics and teaches students about using geophysical techniques to study groundwater. They learn the theory, methods, and real-world applications of these tools. The course covers how to measure and understand underground properties that relate to groundwater movement and aquifers. They will study topics like water content, conductivity, and hydrostratigraphy, and also explore how airborne and remote sensing techniques can be integrated for groundwater studies. Through lectures, labs, and fieldwork, will gain practical experience in collecting, interpreting, and analyzing data using different geophysical instruments and software.

Course Contents:

1. Introduction to Hydrogeophysics
2. Theory and methods in hydrogeophysics
3. Measuring properties of the subsurface
4. Water content/porosity
5. Hydraulic conductivity
6. Field measurements of properties
7. Hydrostratigraphy
8. Geophysical Techniques for groundwater investigations
9. Airborne & remote sensing hydrogeophysics

Recommended Texts:

1. Burger, H.R., (2012), Exploration Geophysics of the Shallow Subsurface: Prentice-Hall, Englewood Cliffs, NJ..
2. Dobrin, M.B., (2012),introduction to geophysical prospecting (2nd ed.): McGraw-Hill Book Co., New York.

Suggested Readings:

1. Kirsch, R. (2018) ,Groundwater Geophysics – A Tool for Hydrogeology (2nd ed.): Springer- Verlag, Berlin.
2. Rubin, Y., and Hubbard, S.S., (2012), Hydrogeophysics: Water Science and Technology Library, Springer, Berlin, .
3. Sharma, P.V., (2014), Environmental and Engineering Geophysics: Cambridge University Press, Cambridge, UK.