UNIVERSITY OF SARGODHA
OFFICE OF THE REGISTRAR
(ACAD BRANCH)

NOTIFICATION

On the recommendations of Academic Council made in its 24th (1/2025) meeting held on 26.08.2025, the Syndicate in its 72nd (4/2025) meeting held on 12.09.2025 has approved the revised curriculum of following programs for implementation w.e.f. **Fall 2025**.

I. BS in Geology (Annex-'A')

II. BS in Environmental Sciences (Annex-'B')

(WAQAR AHMAD)
Additional Registrar (General)

No. SU/Acad/25/1160

Dated: 28.10.2025

Distribution:

- Chairman, Department of Earth Sciences
- Controller of Examinations
- Director Academics

C.C:

- Dean, Faculty of Sciences
- Director, QEC
- Secretary to the Vice-Chancellor
- PA to Registrar
- Notification File

Annex – 'B'

Scheme of Studies

BS Environmental Sciences

w.e.f Fall,2025

1. **Title of Degree Program:** BS in Environmental Science
2. **Program Learning Objectives:**
   Environmental science undergraduate degree programme aim to develop human resources with the knowledge and skills necessary to support decisions, mitigate the effects of climate change, or adapt to necessary changes, as well as the attitude to contribute to the development of sustainable lifestyles in society and green economies. Understanding not only scientific ideas but also social interactions between people and the underlying cultural values of behavior is necessary to address environmental challenges. As a result, the learning outcomes from our environmental science programmes involve many different disciplines or ways of knowing. Our more in-depth learning objectives have been arranged into the three traditional academic divisions of social sciences, natural sciences, and humanities.
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 (with combination of atleast any two subject i.e., Math, Physics, Chemistry and Biology) III- DAE (1st & 2nd Year) 5 seats reserved
Degree Completion Requirements:	Students are required to study 137 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	Fables, 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.	2	URCG-5129 URCG-5131	Understanding of Holy Quran-I/Fehm-e-Quran-I/ Ethics-I	1(0-1)	Nil
14.	4	URCG-5130 URCG-5132	Understanding of Holy Quran-II/ Fehm-e-Quran-II/ Ethics-II	1(0-1)	Nil
15.	3	URCG-5127	Seerat of the Holy Prophet (SAW)	1(1-0)	Nil
16.	2	URCG-5128	Pakistan Studies	2(2-0)	Nil
			GE Courses Credit Hours Total	35	

5. **Compulsory Courses:**

Sr. No.	Course Code	Course Title	Credit Hours	Prerequisite
1.	ENVR-5101	Introduction to Environmental Science	3(3-0)	Nil
2.	ENVR-5102	Fundamentals of Ecology	3(3-0)	Nil
3.	ENVR-5103	Environmental Chemistry	3(3-0)	Nil
4.	ENVR-5104	Environmental Physics	3(3-0)	Nil
5.	ENVR-5105	Mineral Resources	3(3-0)	Nil
6.	ENVR-5106	Environmental Toxicology	3(3-0)	Nil
7.	ENVR-5107	Environmental Pollution	3(3-0)	Nil
8.	ENVR-5108	Applied Ecology	3(3-0)	Nil

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9.	ENVR-5109	Environmental Microbiology	3(3-0)	Nil
10.	ENVR-5110	Water & Wastewater Treatment	3(3-0)	Nil
11.	ENVR-5111	Analytical Techniques in Environmental Science	3(3-0)	Nil
12.	ENVR - 5112	Research Methods in Environmental Science	3(3-0)	Nil
13.	ENVR - 6113	Introduction to GIS and Remote Sensing	3(2-1)	Nil
14.	ENVR - 6114	Environmental Governance	3(3-0)	Nil
15.	ENVR-6115	Climate Change	3(3-0)	Nil
16.	ENVR-6116	Disaster Risk Management	3(3-0)	Nil
17.	ENVR -6117	Solid Waste Management	3(3-0)	Nil
18.	ENVR - 6118	Environmental Management System	3(3-0)	Nil
19.	ENVR-6119	Biodiversity and Conservation	3(3-0)	Nil
20.	ENVR-6120	AI & Emerging Technologies in Environmental Science	3(3-0)	Nil
Compulsory Courses Credit Hours Total			**60**	

6. **Mandatory Elective Subjects: Total 21 credit hours**
Seven courses (21 Credit hrs) to be opted from the following list

Sr. No.	Course Code	Course Title	Credit Hours	Prerequisite
1.	ENVR-6130	Environmental Economics	3(3-0)	Nil
2.	ENVR-6131	Environmental Monitoring	3(3-0)	Nil
3.	ENVR-6132	Environmental Impact Assessment	3(3-0)	Nil
4.	ENVR-6133	Hydrology	3(3-0)	Nil
5.	ENVR-6134	Occupational Health and safety	3(3-0)	Nil
6.	ENVR-6135	Ecotourism	3(3-0)	Nil
7.	ENVR-6136	Global Environmental Politics	3(3-0)	Nil
8.	ENVR-6137	Agro-ecology	3(3-0)	Nil
9.	ENVR-6138	Project Management	3(3-0)	Nil
10.	ENVR-6139	Environmental Biotechnology	3(3-0)	Nil
11.	ENVR-6140	Air and Noise Pollution	3(3-0)	Nil
12.	ENVR-6141	Natural Resource Management	3(3-0)	Nil
13.	ENVR-6142	Water Resource Management	3(3-0)	Nil
14.	ENVR-6143	Soil and Environment	3(3-0)	Nil
15.	ENVR-6144	Urban Environmental Management	3(3-0)	Nil
16.	ENVR-6145	Pollutant Movement in Soil	3(3-0)	Nil
17.	ENVR-6146	Energy and Environment	3(3-0)	Nil
18.	ENVR-6147	Environmental Profile of Pakistan	3(3-0)	Nil
19.	ENVR-6148	Environmental Biology	3(3-0)	Nil
20.	ENVR-6149	Climate Change: Mitigation and Adaptation	3(3-0)	Nil
21.	ENVR-6150	Artificial Intelligence (AI) and Climate Change	3(3-0)	Nil

7. **Interdisciplinary/Allied courses: minimum 15 credit hours:**
Interdisciplinary/Allied courses will be offered after 4th semester
Five courses (15 Credit hrs) to be opted from following list

Sr. No.	Semester	Course Code	Course Title	Credit Hours
1.		GEOG-5101	Fundamentals of Geography	3(3-0)	Nil
2.		GEOL-5101	Introduction to Geology	3(3-0)	Nil
3.		URCM-5107	Mathematics I	3(3-0)	Nil
4.		URCM-5108	Mathematics II	3(3-0)	Nil
5.		CHEM-5101	Physical Chemistry	3(3-0)	Nil
6.		CHEM-5102	Inorganic Chemistry	3(3-0)	Nil
7.		PHYS-5101	Mechanics	3(3-0)	Nil
8.		STAT-5123	Introduction to Statistics	3(3-0)	Nil
9.		GEOG-5109	Climatology	3(3-0)	Nil
10.		GEOL-5107	Environmental Geology	3(3-0)	Nil
11.		GEOG-6118	Environmental Geography	3(3-0)	Nil

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12.	MATH-6139	Fluid Mechanics I	3(3-0)	Nil
13.	MATH-6140	Fluid Mechanics II	3(3-0)	Nil
14.	MATH-6134	Heat Transfer	3(3-0)	Nil
15.	GEOL-6192	Introduction to Earth Sciences	3(3-0)	Nil

8. **Internship/Field Experience: 03 credit hours**

1.	ENVR-6185	**Internship/Field Experience**	**3(0-3)**	

9. **Capstone project: Minimum 03 credit hours:**

2.	ENVR-6190	**Capstone Project**	**3(0-3)**	

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Scheme of Studies

BS in Environmental Science

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	ENVR-5101	Introduction to Environmental Science	3(3-0)	Nil
Major-2	ENVR -5102	Fundamentals of Ecology	3(3-0)	Nil
Major-3	ENVR-5103	Environmental Chemistry	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 Literature and EPIC	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-5129 / URCG-5131	Understanding of Holy Quran-I/ Fehm-e-Quran-I/ Ethics-I	1(0-1)	Nil
Major-4	ENVR-5104	Environmental Physics	3(3-0)	Nil
Major-5	ENVR-5105	Mineral Resources	3(3-0)	Nil
Major-6	ENVR-5106	Environmental Toxicology	3(2-1)	Nil
GE-15	URCG-5128	Pakistan Studies	2(2-0)	Nil

Semester Total Credit Hours: 19

Semester-III

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
GE-8	URCG-5127	Seerat of the Holy Prophet (SAW)	1(1-0)	Nil
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	ENVR-5107	Environmental Pollution	3(3-0)	Nil
Major-8	ENVR-5108	Applied Ecology	3(3-0)	Nil
Major-9	ENVR-5109	Environmental Microbiology	3(3-0)	Nil

Semester Total Credit Hours: 18

Semester-IV

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
GE-12	URCG-5130 / URCG-5132	Understanding of Holy Quran-I/ Fehm-e-Quran-I/ Ethics-I	1(0-1)	Nil
GE-13	URCG-5114	Basic Science	3(2-1)	Nil
GE-14	URCG-5121	Entrepreneurship	2(2-0)	Nil
GE-15	URCG-5125	Civics and Community Engagement	2(2-0)	
Major-10	ENVR-5110	Water & Wastewater Treatment	3(3-0)	Nil
Major-11	ENVR-5111	Analytical Techniques in Environmental Science	3(3-0)	Nil
Major-12	ENVR-5112	Research Methods in Environmental Science	3(3-0)	Nil

Semester Total Credit Hours: 17

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Semester-V

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
Major-13	ENVR - 6113	Introduction to GIS and Remote Sensing	3(2-1)	Nil
Major-14	ENVR - 6114	Environmental Governance	3(3-0)	Nil
Major-15	ENVR - 6115	Climate Change	3(3-0)	Nil
Major-16	ENVR - 6116	Disaster Risk Management	3(3-0)	Nil
ID-1	-----	*Interdisciplinary/Allied course-I	3(3-0)	Nil
ID-2	-----	*Interdisciplinary/Allied course-II	3(3-0)	Nil

Semester Total Credit Hours: 18

Semester-VI

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
Major-17	ENVR- 6117	Solid Waste Management	3(3-0)	Nil
Major-18	ENVR- 6118	Environmental Management Systems	3(3-0)	Nil
Major-19	ENVR-6119	Biodiversity and Conservation	3(3-0)	Nil
**ID-3	-----	*Interdisciplinary/Allied course-III	3(3-0)	Nil
**ID-4	-----	*Interdisciplinary/Allied course-IV	3(3-0)	Nil
**ID-5	-----	*Interdisciplinary/Allied course-V	3(3-0)	Nil

Semester Total Credit Hours: 18

Semester-VII

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
Major-20	ENVR- 6120	AI & Emerging Technologies in Environmental Science	3(2-1)	Nil
Major-21	ENVR-61xx	**Elective I	3(3-0)	Nil
Major-22	ENVR-61xx	**Elective II	3 (3-0)	Nil
Major- 23	ENVR-61xx	**Elective III	3(3-0)	Nil
	ENVR-6185	*** Internship/Field Experience	3(0-3)	

Semester Total Credit Hours: 15

Semester-VIII

Category	Course Code	Course Title	Credit Hours	Pre-Requisite
Major-24	ENVR-61xx	Elective IV	3(3-0)	Nil
Major-25	ENVR-61xx	Elective V	3(3-0)	Nil
Major-26	ENVR-61xx	Elective VI	3(3-0)	Nil
Major-27	ENVR-61xx	Elective VII	3(0-3)	Nil
Compulsory	ENVR-6190	***Capstone Project	3(0-3)	Nil

Semester Total Credit Hours: 15

Degree Program Total: 137

Note: Internship/Field Experience: In accordance with Revised Curricula for Environmental Science Degree Programs notified vide letter no. HEC/CD/NCRC/ENV-SCI/2025/7511 dated May 1st, 2025 and Undergraduate Education Policy V.1.1 (2023) "The field experience of six to eight weeks (preferable undertaken during semester or summer break) must be graded by a faculty member in collaboration with the supervisor in the field"

*As notified by the chairman from Interdisciplinary/Allied course List
** To be offered from Mandatory Elective Subjects List
*** Compulsory for degree requirement

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URCG-5118	Functional English	3(3-0)

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. The course will also 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.

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

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

Introductory-compulsory foundation course

Islamic Studies engages in the study of Islam as a textual tradition inscribed in the fundamental sources of Islam: Qur'aan 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 basis of Islam in fields that include Qur'aanic studies, Hadith and Seerah of Prophet Muhammad (PBUH), Islamic philosophy, and Islamic law, culture and theology through the textual study of Qur'aan and Sunnah.

- To make students understand the relevance and praginatic significance of Islam in theirlives.
- To make learners comprehend the true spirit of Islam with reference to modernworld.
- To generate a sense of Islamic principles as a code of living that guarantee the effective solutions to the current challenges ofbeing.
- To provide Basic information about IslamicStudies
- To enhance understanding of the students regarding IslamicCivilization
- To improve Students skill to perform prayers and otherworships
- To enhance the skill of the students for understanding the issues related to faith and religious life.

Contents

1.Introduction to Qur'aanic Studies	تعارف قرآن مجید
1) Basic Concepts of Qur'aan	قرآن مجید کا بنیادی تعارف
2) History of the compilation of Qur'aa	تاریخ جمع وتدوین قرآن مجید
3) Uloom-ul-Qur'aan	علوم القرآن

مطالعہ قرآن (تعارف قرآن مجید، 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 آیت 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

2. Introduction to Hadith	تعارف حدیث
1) Legal Status of Hadith	حدیث کی قانونی حیثیت
2) History of the compilation of Hadith	تاریخ جمع وتدوین حدیث
3) Classifications of Hadith	حدیث کی اقسام

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متن، حدیث: 1 درج ذیل موضوعات پر احادیث کا مطالعہ

1۔ اعمال کا دارومدار نیت پر منحصر ہے۔ 2۔ بہترین انسان قرآن کا طالب علم اور اس کا معلم ہے۔ 3۔ کتاب و سنت گمراہی سے بچنے کا ذریعہ ہیں 4۔ ارکان اسلام 5۔ اسلام، ایمان، احسان اور قیامت کی نشانیاں، 6۔ بچوں کو نماز کی تلقین 7۔ دین کا صحیح فہم اللہ کی خاص عنایت ہے 8۔ حصول علم، تلاوت قرآن اور عمل کی اہمیت و فضیلت، 9۔ روز محشر میں ہونے والا حساب، 10۔ حقوق اللہ کے ساتھ ساتھ حقوق العباد کا خیال رکھنا بھی لازم ہے 11۔ حسن خلق کی عظمت اور فحش و بدگوئی کی مذمت 12۔ دنیا و آخرت کی بھلائی کی ضمانت 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

3. Sirah of the Prophet (PBUH)	سیرت النبی ﷺ
1. Significance of Seerah Studies	مطالعہ سیرت کی ضرورت و اہمیت
2. Prophetic principles of Character building	تعمیر سیرت و شخصیت کا نبوی منہاج

اقامت دین کا نبوی طریق کار، اقامت دین بعہد خلافت راشدہ، میثاق مدینہ، خطبہ حجۃ الوداع، اخلاقی تعلیمات، تحلیل اجتماعیت اور اسوہ حسنہ، قرآن مجید میں سیرت سرور عالم کا بیان، غزوات نبوی ﷺ کے مقاصد و حکمتیں

4. Islamic Culture & Civilization	اسلامی تہذیب و تمدن
1) Basic Concepts of Islamic Civilization	اسلامی تہذیب کا مفہوم
2) Historical evaluation of Islamic Civilization	اسلامی تہذیب کا تاریخی ارتقاء
3) Salient feature of Islamic Civilization	اسلامی تہذیب کی نمایاں خصوصیات
4) Islamic Civilization and ContemporaryIssues	اسلامی تہذیب، تمدن اور معاصر مسائل

اسلامی تہذیب کے عوامل و عناصر، اسلامی تہذیب کے علمی، مداشرتی اور مادی اثرات، تہذیبوں کے تصادم کے نظریے کا تنقیدی جائزہ، تہذیبی تصادم کے اثرات و نتائج، طبی، حیاتیاتی اور معاشرتی علوم میں مسلمانوں کا کردار، نامور مسلمان سائنسدان

Pre-Requisite: Nil

Recommended Books

1) Hameed ullahMuhammad, —Emergence ofIslam ,IRI.Islamabad
2) Hameed ullah Muhammad, —Muslim Conduct ofState
3) Hameed ullah Muhammad, _Introduction tolslam
4) Ahmad Hasan, —Principles of Islamic Jurisprudence, Islamic Research Institute, International Islam 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

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

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. 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.

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; 17th edition.

Suggested Readings:

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

m.F

ENVR-5101	Introduction to Environmental Science	3(3-0)

Course Brief:

This course is aimed to introduce students with basic knowledge of Environment. Environmental science is the study of how human activity affects natural patterns and processes in the globe. We must take into account the physical, biological, and chemical processes that frequently form the basis of today's environmental issues if we are to comprehend them.

Course Learning Objectives:

The objective of this course is to provide orientation on the evolution and scope of this emerging discipline and to motivate them to think beyond basic sciences to decision sciences. After completing this course, the students are expected to learn the importance of Environmental Science in human life, its relationship with various segments of society and sectors of development. The students are also expected to become familiar with current national, regional and global challenges for sustainable development.

Course Contents:

1. Basic principles: about convergence of ecology with economic and sociology to evolve as environmental science.
2. Its nature, history, scope and the contribution to society
3. Environmental aspects: physic-chemical, biological, socio-economic, socio-cultural, moral and ethical, and philosophical thinking.
4. Environmental problems local, regional and global level
5. Environmental challenges
6. Sustainability of resources for development
7. Efficiency of energy and water resources
8. Current and future trends in growth and resultant environmental pollution
9. Poverty and resource depletion
10. Development in industry, agriculture and urbanization

Recommended Texts:

1. Zehnder, C., Manoylov, K., Mutiti, S., Mutiti, C., VandeVoort, A., & Bennett, D. (2015). Introduction to Environmental Science, University System of Georgia.
2. Miller, G. T., & Spoolman, S. (2015). *Environmental science*. Cengage Learning.

Suggested Readings:

1. Botkin, D. B., & Keller, E. A. (1998). *Environmental science: earth as a living planet* (No. Ed. 2). John Wiley & Sons Ltd.
2. McKinney, M. L., & Schoch, R. M. (2003). *Environmental science: systems and solutions*. Jones & Bartlett Learning.

M.F

CHAIRMAN
Department of Earth Sciences

ENVR-5102	Fundamentals of Ecology	3(3-0)

Course Brief:
In this course students learn the organismal diversity and the interactions between organisms and their abiotic and biotic environments is known as fundamental ecology, often known as basic ecology.

Course Learning Objectives:
To develop an understanding about ecology, its fundamental concepts, description of population, community, ecosystem and its types, biogeography and systems' ecology.

Course Contents:
1. Introduction and branches of ecology
2. Levels of ecological organization: species, population, community and ecosystem
3. Abiotic and biotic factors
4. Concepts of limiting factors, habitat and niche
5. Populations: distribution and abundance, population dynamics and distribution limits
6. Community: organization and various concepts community dynamics
7. Ecosystem: structure and function
8. Energy flow and material cycling within ecosystem and carrying capacity
9. Biomes of the world. Ecological production: primary and secondary productivity
10. Productivity of different ecosystems.

Recommended Texts:

1. Molles, M. C., & Tibbets, T. (2002). *Ecology: concepts and applications* (No. Sirsi) i9780070294165). New York: McGraw-Hill.
2. Allen, T. F., & Hoekstra, T. W. (2015). *Toward a unified ecology*. Columbia University Press.

Suggested Readings:

1. Dash, M. C., & Dash, S. P. (2015). Fundamentals of ecology. McGraw Hill Education Private Limited.
2. Coleman, D. C., Callaham, M. A., & Crossley Jr, D. A. (2017). *Fundamentals of soil ecology*. Academic press.

M.F

ENVR-5103	Environmental Chemistry	3(3-0)

Course Brief:

In this course students will get acquainted with the study of how chemicals affect the environment and human health as well as how they affect the air, water, and soil. Because the research they undertake helps to influence decisions that have an impact on all of us, environmental chemists are frequently the scientists who interact with the public the most.

Course Learning Objectives:

This course is designed to provide knowledge about different chemical process occurring in the environment, various physical and chemical methods to minimize pollution and adverse effects of various pollutants on human health and toxicity

Course Contents:

1. Chemistry of atmosphere
2. Major layers in atmosphere, temperature changes in the atmosphere, units to describe atmospheric chemistry
3. Chemical reactions in the atmosphere sources and effects of following pollutant on human health Carbon dioxide, Nitrogen oxides, Sulfur dioxide
4. Volatile organic compounds, automobile pollutants, Industrial smog, Photochemical smog, production of hydroxyl radical, their reaction with hydrocarbons
5. Indoor air pollution various indoor air pollutants, particulates, chemistry of ground level air pollution
6. Production of ozone in the stratosphere catalytic destruction of ozone, Hydroxyl Radical cycle, NO cycle, the chlorine cycle, Null cycles
7. Effects of ozone depletion on human health and environment, Green chemistry, its principles, Water pollution
8. Types of water pollutants oxidation Reduction reactions in aqueous systems. Suspended solids and sediments
9. Dissolved solids. Toxic organic compounds, pesticides, organochlorine insecticides, carbamates. Accumulation in biological systems
10. Bio magnification and Biodegradation. Toxic heavy metals and their Bioaccumulation

Recommended Texts:

1. Manahan, S. E. (2022). *Environmental chemistry*. CRC press.
2. VanLoon, G. W., & Duffy, S. J. (2017). *Environmental chemistry: a global perspective*. Oxford university press.

Suggested Readings:

1. O'neill, P. (2017). *Environmental chemistry*. Routledge.
2. Manahan, S. E. (2017). *Industrial ecology: environmental chemistry and hazardous waste*. Routledge.

M.F

URCG-5112	Fables, Wisdom Literature and EPIC	2(2-0)

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. 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 hikayat 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- Din Sa'di of Shiraz.*
   London: Wm. H. Allen.
2. Chishti, Y.S. (1991). *Sharah-i bang-i dara.* Lahaur: Maktaba-i ta'mir-i insaniyat

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.

M.F

CHAIRMAN
Department of Earth Sciences
UNIVERSITY OF BARGODHA
BARGODHA

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

Course Description:

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.

Learning Outcomes:

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 Outlines:

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.

m.f

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

This is an introductory-level undergraduate course that focuses on the fundamentals related to the quantitative concepts and analysis. The course is designed to familiarize students with the basic concepts of mathematics and statistics and to develop students' abilities to analyze and interpret quantitative information. Through a combination of theoretical concepts and practical exercises, this course will also enable students cultivate their quantitative literacy and problem solving skills while effectively expanding their academic horizon and breadth of knowledge of their specific major / field of study.

Course Learning Outcomes

By the end of this course, students shall have:

1. Fundamental numerical literacy to enable them work with numbers, understand their meaning and present data accurately;
2. Understanding of fundamental mathematical and statistical concepts;
3. Basic ability to interpret data presented in various formats including but not limited to tables, graphs, charts, and equations etc.

Contents

1. Numerical Literacy:

i. Numbers system and basic arithmetic operations;

ii. Units and their conversions, dimensions, area, perimeter and volume;

iii. Rates, ratios, proportions and percentages;

iv. Types and sources of data;

v. Measurement scales;

vi. Tabular and graphical presentation of data;

vii. Quantitative reasoning exercises using number knowledge.

2. Fundamental mathematical concepts:

i. Basics of geometry (lines, angles, circles, polygons etc.);

ii. Sets and their operations;

iii. Relations, functions, and their graphs;

iv. Exponents, factoring and simplifying algebraic expressions;

v. Algebraic and graphical solutions of linear and quadratic equations and inequalities;

vi. Quantitative reasoning exercises using fundamental mathematical concepts.

3. Fundamental Statistical Concepts:

i. Population and sample;

ii. Measures of central tendency, dispersion and data interpretation;

iii. Rules of counting (multiplicative, permutation and combination);

iv. Basic probability theory;

v. Introduction to random variables and their probability distributions;

vi. Quantitative reasoning exercises using fundamental statistical concepts.

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Recommended Texts

1. Sevilla, A., & Somers, K. (2012). *Quantitative reasoning: tools for today's informed citizen*. New Jersey, John Wiley & Sons.

2. Burzynski, D., & Ellis, W. (2008). *Fundamentals of mathematics*. USA, Saunders College Publishing.

Suggested Readings

1. Zaslow, E. (2020). *Quantitative reasoning: thinking in numbers*. Cambridge, Cambridge University Press.

2. de Mesquita, E. B., & Fowler, A. (2021). *Thinking clearly with data: A guide to quantitative reasoning and analysis*. New Jersey, Princeton University Press.

3. Bennett, J., & Briggs, W. (2019). *Using & understanding mathematics: a quantitative reasoning approach*. Pearson.

4. Rosen, K. H., & Krithivasan, K. (2012). *Discrete mathematics and its applications* (Vol. 6). New York: McGraw-Hill.

5. Chatfield, C. (2018). *Statistics for technology: a course in applied statistics*. Routledge.

6. Lock, R. H., Lock, P. F., Morgan, K. L., Lock, E. F., & Lock, D. F. (2020). *Statistics: Unlocking the power of data*. New Jersey, John Wiley & Sons.

M.F

URCG-5129	Understanding of the Holy Quran – I	1(1-0)

Annex-"CXXI"

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URCG-5129

Model Course Outline for the Course Understanding of Quran – I

Course Title: Understanding of Quran – I
Course Book: Muallim ul Quran (Volume 1, 2 & 3) by Dr Ubaid ur Rahman
Credit Hours: 1 (0-1)
Contact Hours: 3 per week
Weeks: 15-16 (45-48 hours)

Course Learning Outcomes:

By the end of this course, students will be able to:

1. Develop the ability to understand basic words of the Quran, phrases and sentences that do not contain verbs (unit 1 to 5 of Muallim ul Quran Book) and then sentences having present tense (first half of unit 6 of Muallim ul Quran Book).
2. Acquire a strong foundation for understanding long verses of the Quran with clarity.
3. Comprehend Quranic vocabulary, particles (operative & non operative particles), compounds (Adjective & Possessive compound), pronouns (singular & plural) and types of plural through hundreds of Quranic sentences.
4. Recognize and understand different styles of Quranic sentences, including nominal sentence, emphatic sentence, double emphatic sentence, negative sentence, interrogative sentence, oath –based sentences.
5. Strengthen understanding of fundamental Quranic linguistic styles, expressions and idioms.
6. Understand at least 30 to 40 % of each page of the holy Quran.

Provision of material, content and books:

- **Paper book:** All volumes are available in printed book form.
- **Tutorial videos:** Teaching video of each lesson available on YouTube.
- **Confirmation Videos:** A complete series of confirmation videos of all lessons is available in which the student can confirm his answers.
- **A flipbook:** A flipbook edition is also accessible.
- **Helping material:** Helping material for the teachers like quizzes, question papers and images available on website.

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Course Outline:

Weeks	Lectures (1.5 hrs)	Units	Lessons	Assignments/Home Task	Linguistic Rules
1.	1.	1	1-8	Writing the meaning of Quranic words Lesson 1-8	Proper Noun Masculine & Feminine
	2.	1	9-14	Writing the meaning of Quranic words 9-14	Two kinds of plural Concept of (و) "And" Common Noun
2.	1.	1	15-17	Writing the meaning of Quranic words, phrases & translation of Sentences 15-17	Demonstrative Noun (This & That for Masculine (هذا- هذه) Demonstrative Noun (This & That for Feminine) (تلك- تلك)
	2.	1	18-19 & Revision (Unit 1)	Writing the meaning of Quranic words , phrases & translation of Sentences 17-19 Quiz	Laam for emphasis (لام التأكيد) Superlative Degree like أكبر Revision of all Quranic Sentences
3.	1.	Unit 2	1-3	Writing the meaning of Quranic words, phrases & translation of Sentences 1-3	Emphatic Particle لن Preposition "For" (اللام) Preposition (في)
		2	4-6	Writing the meaning of Quranic words, phrases & translation of Sentences 4-6	Preposition (على- من- الى)
4.	1.	2	7- 9	Writing the meaning of Quranic words & translation of Sentences 7-9	Preposition (الباء) Absolute Negation Particle Exceptive Particle (لا النافية (إلا) (ما النافية)(للجنس
		2	10-13 & Revision (Unit 2)	Writing the meaning of Quranic words, phrases & translation of Sentences 10-13 Quiz	Subordinating Conjunction(لن), Was (كان), Vocative Particle(حرف النداء)

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5.	1.	Unit 3	1-2	Writing the meaning of Quranic phrases 1-2	Quranic Adjective Compounds (اسم + موصوف)
	2.	3	3-5	Writing the meaning of Quranic phrases & translation of sentences 3-5	Quranic Possessive Construction (مضاف + مضاف إليه)
6.	1	3	6-7	Writing the meaning of Quranic phrase translation of sentences 6-7	Quranic Possessive Construction (مضاف + مضاف إليه)
	2.	3	8-10 & Revision (Unit 3)	Writing the meaning of Quranic phrase & translation of sentences 8-10 Quiz	Active Participle (اسم الفاعل), Passive Participle (اسم المفعول), Dual (مثنى)
7.	1.	Unit 4	1-2	Writing the meaning of Quranic phrase & translation of sentences 1-2	Personal Pronoun He(هو المتصل) Possessive Pronoun His ـه (المتصل)
	2.	4	3-4	Writing the meaning of Quranic phrase & translation of sentences 3-4	Possessive Pronoun with prepositions like في بيته Pronoun "His" with prepositions like له، منه، فيه
8.		4	5-8	Writing the meaning of Quranic sentences 5-8	Personal Pronoun You(أنت المتصل) Possessive Pronoun Your ك (المتصل) Possessive Pronoun with prepositions like في بيتك Pronoun "your" with prepositions like لك، منك، فيك
	2	Mid Term			

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9.	1.	4	9-12	Writing the meaning of Quranic phrases & sentences 9-12	Personal Pronoun She(هي المنفصل) Possessive Pronoun Her ها المتصل) Possessive Pronoun with prepositions like فی بیتها Pronoun "Her" with prepositions like لها
	2.	4	13-16	Writing the meaning of Quranic phrases & sentences 13-16	Personal Pronoun I (أنا المنفصل) Possessive Pronoun Her ي المتصل) Possessive Pronoun with prepositions like فی بیتیPronoun "My" with prepositions like لی
10.	1	4	17 & Revision Unit 4	Revision of all Quranic sentences of Unit 4 Quiz	Adverb (حال)
	2.	Unit 5	1-2	Writing the meaning of Quranic phrases & sentences 1-2	Masculine Plural جمع المذکر السالم و جمع المذکر السالم المضیوق بحرف الجر
11.	1.	5	3-4	Writing the meaning of Quranic phrases & sentences 3-4	Possessive Construction with Plurals جمع المذکر السالم المضیوق بالإضافة
	2.	5	5-6	Writing the meaning of Quranic phrases, sentences & verses 5-6	Personal Pronoun They (هم المنفصل) Possessive Pronoun Their هم المتصل)
12.	1.	5	7-8	Writing the meaning of Quranic phrases, sentences & verses 7-8	Possessive Pronoun with prepositions like فی بیتهمPronoun "Their" with prepositions like لهم
	2.	5	9-11	Writing the meaning of Quranic phrases, sentences & verses 9-11	Personal Pronoun You (أنتم المنفصل) Possessive Pronoun Your كم المتصل) Possessive Pronoun with prepositions

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					like في بيتكم
13.	1.	5	12-14	Writing the meaning of Quranic phrases & sentences & verses 12-14	Pronoun "Your" with prepositions like لكم Personal Pronoun We (نحن المنفصل) Possessive Pronoun Our نا (المتصل)
	2.	5	15-16	Writing the meaning of Quranic sentences & verses 15-16	Possessive Pronoun with prepositions like في بيتنا Pronoun "Our" with prepositions like لنا
14.	1.	5	17-18	Writing the meaning of Quranic sentences & Verses 17-18	Demonstrative Pronoun These, Those (هؤلاء- اولئك)
	2.	5	19-23	Writing the meaning of Quranic sentences & Verses 19-23	ما / إلا، إن / إلا، إنما، ليس، ما ، (أم، ان، بل، كان) (الا، ليس، اليوم، يومئذ، سبحان، سبحانهما، قل، إذن، بئس، نعم، كلا، ما ادراك، حسب، أعلم ب، مصير، مرجع، دينا(تمييز)
15.	1.	5	Revision Unit 5	Quiz	
	2.	5	1-3 (till Page 16)	Writing the meaning of Quranic Verbs &Translation of Quranic Sentences & Verses (1-3)	Introduction of Present Tense(فعل مضارع) & Verbal Sentence (جملة فعلية) Present Tense الفعل المضارع صيغة المفرد يعلم
16.	1.	6	3 (From Page 17) & 4-5	Translation of Quranic Sentences & Verses 3-5	Present Tense الفعل المضارع صيغة المفرد يعلم
	2.	6	6	Translation of Quranic Sentences & Verses	Present Tense الفعل المضارع صيغة الجمع يعلمون

M.F

URCG-5131	Ethics– I	1(1-0)

1-Course Description

The Ethics-I course is designed to provide students with a comprehensive understanding of ethical principles, practices, and theories in various societal contexts. Throughout this degree program, students will explore the complexities of ethical theories of semitic and non-semitic religions along with decision-making and develop critical thinking skills to navigate moral dilemmas. This course will also enable the students to interact with others religious identities with humanistic, inclusive and holistic approach

2- Learning Objectives

This course aims to:

1. Introduce students to the fundamental concepts, scope, and importance of ethics.
2. Explore the relationship between law, morality, and social values.
3. Develop a clear understanding of virtuous and Immoral ethics and their impact on individual and collective life.
4. Study the role of major religious figures in the moral development of human society and enable students to apply ethical principles for personal development, conflict resolution, and social harmony.

3- Learning Outcomes

By the end of the course, students will be able to:

1. Students will be able to identify and analyze major ethical theories, values, and their scope in social and individual life.
2. Differentiate between law and ethics, and analyze their interrelationship.
3. Identify types of virtuous and Immoral ethics and assess their social impacts.
4. Examine the ethical teachings of major religions and their relevance in contemporary society.
5. Apply ethical principles to address modern challenges in personal and professional life.

4-Course Structure

1. Interactive lectures, Group discussions and debates
2. Reflection papers and presentations
3. Assignments and Quiz

Course Contents

Unit 1: Introduction and Fundamentals of Ethics

1. Literal and terminological definition of ethics
2. Literal and terminological definition of values
3. Relationship between law and ethics
4. Need, importance, and scope of ethics

Unit 2: Types of Ethics and Their Impact on Society

- Virtuous ethics: concept, types, benefits, and outcomes
- Immoral ethics: concept, types, and harms
- Role of ethics in social refinement and establishment of peace

Unit 3: Virtuous Ethics (Akhlaq-e-Hasanah)

- Concept, need, and importance of virtuous ethics
- Scope of virtuous ethics in the light of religions
- Major virtues in revealed and non-revealed religions
- Impact of virtuous ethics on individual and collective life

Unit 4: Immoral Ethics (Akhlaq-e-Razilah)

- Concept of immoral ethics
- Social problems caused by immoral ethics
- Practical consequences of immoral ethics
- Major vices in revealed and non-revealed religions

Unit 5: Role of World Religious Figures in Moral Development

- Prophet Moses (AS): Introduction, miracles, and role in moral refinement
- Prophet Jesus (AS): Introduction, miracles, and role in moral refinement
- Prophet Muhammad (ﷺ): Introduction, miracles, and role in moral refinement

Textbook

1. Izutsu, T. (2002). *Ethico-Religious Concepts in the Qur'an*. McGill-Queen's University Press.

Suggested Readings

1. Gert, B. (2005). *Morality: Its Nature and Justification*. Oxford University Press.
2. MacIntyre, A. (2007). *After Virtue: A Study in Moral Theory*. University of Notre Dame Press.
3. Al-Ghazali, Abu Hamid (2001). *The Alchemy of Happiness*. Islamic Texts Society.
4. Nasr, S. H. (1994). *The Heart of Islam: Enduring Values for Humanity*. Harper One.
5. Beauchamp, T. L., & Childress, J. F. (2019). *Principles of Biomedical Ethics*. Oxford University Press.
6. Hasan, Z. (2010). *Ethics in Islam: Key Concepts and Contemporary Challenges*. Islamic Research Institute.

m.f

ENVR-5104	Environmental Physics	3(3-0)

Course Brief:
In this course students will get familiar with the use of physics principles to solve issues in the natural and artificial environments is known as environmental physics, and it is a specialty area within the physics major.

Course Learning Objectives:
The course will provide an introduction to the physical principles that underlie environmental issues and their relationship with different types of interactions with energy and matter.

Course Contents:
1. Introduction to environmental physics
2. Scientific notations and mathematical hints for basic concepts
3. Solar spectrum, interaction of light with matter, Ozone and UV light, Energy, Entropy, Energy conversion.
4. Heat radiation and heat transfer, Nuclear energy, Transport of pollutants
5. Diffusion, Conversion of mass, Solids, Liquids and Gasses, Equations of fluid dynamics
6. Turbulence, Turbulent diffusion, Gaussian plumes in the air
7. Turbulent jets and plumes, Particle physics, Sound and Noise
8. Basic acoustics, Human perceptions and noise criteria
9. Reducing the transmission of sound, Active control of sound, Radioactivity and nuclear physics
10. Isotopes and radioactive decay, Electromagnetic radiation.

Recommended Texts:

1. Monteith, J., & Unsworth, M. (2013). *Principles of environmental physics: plants, animals, and the atmosphere*. Academic Press.
2. Smith, C. (2004). *Environmental physics*. Routledge.

Suggested Readings:

1. Boeker, E., & Van Grondelle, R. (2011). *Environmental physics: sustainable energy and climate change*. John Wiley & Sons.
2. Faraoni, V. (2007). *Exercises in environmental physics*. Springer Science & Business Media.

M.F

ENVR - 5105	Mineral Resources	3(3-0)

Course Brief:

This course presents a comprehensive study of the origin, classification, distribution, and economic significance of mineral resources. The course focuses on the geological processes of mineral deposit formation. It covers methods of mineral exploration and assessment. Environmental and socio-economic effects of mineral mining are also part of this course. This course incorporates case studies and field applications within the mining industry.

Course Learning Objectives:

- Understand the formation and classification of mineral deposits.
- Identify major mineral resources and their global and regional distributions.
- Analyze the techniques used in mineral exploration and resource estimation.
- Evaluate the environmental impacts and sustainability issues in mining.
- Apply theoretical knowledge to real-world mineral resource case studies.

Course Contents:

1. Introduction to Mineral Resources
2. Classification and Economic Importance of Minerals
3. Ore-forming Processes (Magmatic, Hydrothermal, Sedimentary, etc.)
4. Metallic vs. Non-metallic Mineral Deposits
5. Energy Minerals (Coal, Uranium, etc.)
6. Mineral Exploration Techniques
7. Sampling and Resource Estimation
8. Strategic and Critical Minerals
9. Environmental Impacts of Mining
10. Sustainable Mining and Resource Management
11. Case Studies (Pakistan and Global Examples)
12. Laws and Policies Related to Mineral Resources

Recommended Texts:

1. Moon, C., Whateley, M., & Evans, A. (2005). Introduction to mineral exploration. (Wiley-Blackwell.
2. Pohl, W. L. (2011). *Economic geology: principles and practice*. John Wiley & Sons.

Suggested Readings:

3. Evans, A. M. (2009). Ore geology and industrial minerals: an introduction. John Wiley & Sons.
4. Upadhyay, R. K. (2025). Geology and Mineral Resources. Springer Nature.

M.F

ENVR - 5106	Environmental Toxicology	3(3-0)

Course Brief:

This course provides an in-depth exploration of Environmental Toxicology, focusing on the adverse effects of chemical, biological, and physical agents on living organisms and ecosystems. Students will examine the sources, fate, and transport of toxicants, mechanisms of toxicity, and the impact of pollutants on human health and the environment. The course integrates theoretical knowledge with practical applications, including risk assessment and regulatory frameworks, to equip students with the skills necessary for addressing environmental health challenges

Course Learning Objectives:

By the end of this course, students will be able to:

1. Define key concepts and principles of environmental toxicology.
2. Identify and classify major environmental toxicants and their sources.
3. Understand the processes of absorption, distribution, metabolism, and excretion (ADME) of toxicants.
4. Analyze dose-response relationships and interpret toxicity data.
5. Explain mechanisms of toxicity, including mutagenesis, carcinogenesis, and endocrine disruption.
6. Assess the environmental fate and transport of toxicants.
7. Evaluate human and ecological risk assessments.
8. Apply knowledge of toxicology to real-world environmental health issues, particularly within the Pakistani context.

Course Contents:

Unit I: Introduction to Environmental Toxicology

- Historical development and scope of toxicology
- Fundamental concepts: toxicity, hazard, exposure, risk
- Overview of environmental toxicants: chemical, biological, and physical agents.

Unit II: Principles of Toxicology

- Routes of exposure: inhalation, ingestion, dermal absorption
- ADME processes
- Factors influencing toxicity: dose, duration, frequency, and individual susceptibility

Unit III: Classification of Environmental Toxicants

- Organic pollutants: pesticides, solvents, PCBs
- Inorganic pollutants: heavy metals, metalloids
- Emerging contaminants: pharmaceuticals, personal care products, nanomaterials.

Unit IV: Dose-Response Relationships

- Concepts of threshold, LD_{50}, NOAEL, LOAEL
- Types of dose-response curves
- Synergistic, antagonistic, and additive effects

Unit V: Mechanisms of Toxicity

- Cellular and molecular mechanisms
- Oxidative stress and free radical damage
- Genotoxicity, mutagenesis, and carcinogenesis
- Endocrine disruption and reproductive toxicity

Unit VI: Environmental Fate and Transport of Toxicants

- Chemical properties influencing environmental behavior
- Transport mechanisms: volatilization, leaching, bioaccumulation
- Degradation processes: photolysis, hydrolysis, biodegradation.

Unit VII: Risk Assessment and Management

- Hazard identification and exposure assessment
- Dose-response assessment and risk characterization
- Risk communication and management strategies
- Regulatory frameworks and guidelines

Unit VIII: Case Studies and Applications

- Analysis of environmental toxicology incidents in Pakistan
- Evaluation of remediation and mitigation strategies

Laboratory Work:

- Toxicity testing using bioassays (e.g., Daphnia, algae)
- Determination of LC_{50} and EC_{50} values
- Assessment of heavy metal contamination in water and soil samples
- Evaluation of oxidative stress markers in biological specimens
- Data analysis and interpretation of toxicological studies

Recommended Texts:

1. Yu, M. H., Tsunoda, H., & Tsunoda, M. (2011). *Environmental Toxicology: Biological and Health Effects of Pollutants* (3rd ed.). CRC Press.
2. Klaassen, C. D. (Ed.). (2013). *Casarett & Doull's Essentials of Toxicology* (3rd ed.). McGraw-Hill Education.
3. Gestel, K. van. (2020). *Environmental Toxicology*. Open Textbook Library. Available online
4. LeBlanc, G. A. (2004). Basics of Environmental Toxicology. In E. Hodgson (Ed.), *A Textbook of Modern Toxicology* (3rd ed.). Wiley. DOI: 10.1002/0471646776.ch26

Suggested Readings:

- Walker, C. H., Sibly, R. M., Hopkin, S. P., & Peakall, D. B. (2012). *Principles of Ecotoxicology* (4th ed.). CRC Press.
- Rand, G. M. (Ed.). (1995). *Fundamentals of Aquatic Toxicology: Effects, Environmental Fate, and Risk Assessment*. Taylor & Francis.
- Goyer, R. A., & Klaassen, C. D. (2001). *Toxicology of Metals: Clinical and Biochemical Aspects*. Springer.

M.F

URCG-5128	Pakistan Studies	2(2-0)

This course is designed to provide students with a comprehensive exploration of Pakistan's identity, spanning geographical, historical and cultural dimensions. It delves into the diverse landscape, ancient civilizations, and rich cultural heritage that define Pakistan. Moreover, it examines the socio-cultural and political transformations in Pakistan over time including democratic transitions and military interventions. The aim of this course is to inculcate in students a nuanced understanding of Pakistan's past, present, and potential future trajectories, enabling them to critically evaluate the complex dynamics shaping the nation's development.

Course Learning Outcomes

By the end of this course, student will be able to:

1. Have enhanced knowledge of the geographical, historical and political aspects of Pakistan.
2. Understand the society and cultural of Pakistan.
3. Understand and explain the scio-economics developments in Pakistan.
4. Explore contemporary issues and challenges faced by Pakistan and their implications for the future.

Contents

1. Introduction to Pakistan:

- Geographical location and significance.
- Historical background: Ancient civilizations in the region.
- Factors leading to the creation of Pakistan

2. Political History of Pakistan:

- Formative phase
- Military interventions and democratic transitions.

3. Geography of Pakistan:

- Physiography: Mountains, plains, plateaus, deserts, valleys and coastal areas.
- River system: Indus river and its tributaries;
- Climatic regions of Pakistan.

4. Society and Culture of Pakistan:

- Socio- cultural diversity.
- Language and literature of Pakistan.

5. Economics Development of Pakistan:

- Agriculture and industrial sectors of Pakistan.
- Economic challenges of Pakistan.

6. Contemporary Issues:

- Foreign relations of Pakistan.
- Security challenges: terrorism, extremism, regional conflicts.
- Environmental problems and sustainable development (SDGs).
- Media and social change.

M.F

SUGGESTED READING MATERIALS

1. "Jinnah of Pakistan" by Stanley Wolpert
2. "The sole Spokesman: Jinnah, the Muslim League, and the Demand for Pakistan" by Ayesha Jalal
3. "The struggle for Pakistan" by Ishtiaq Hussain Qureshi
4. "Pakistan, the Formative Phase, 1857-1948" by Khalid B. Sayeed
5. "Pakistan Studies: A Book of Readings" by Sikandar Hayat
6. "Constitutional and Political History of Pakistan" by Hamid Khan
7. "Trek to Pakistan" by Ahmad Saeed and Kh. Mansur Sarwar
8. "Pakistan: A Modern History" by Ian Talbot
9. "Politics in Pakistan: The Nature and Direction of Change" by Khalid B. Sayeed
10. "Physical Geography of Pakistan" by Umar Jahangir
11. "A Geography of Pakistan: Environment, people, and Economy" by Fazle Karim Khan
12. "Pakistan's Foreign Policy: An Historical Analysis" by S.M. Burke
13. "Separatism in East Pakistan" by Rizwan Ullah Kokab
14. "Being Pakistani: Society, Culture and the Arts" by Raza Rumi
15. "Pakistani's Culture Heritage: Socio-Economic and Technological Aspects" edited by Abdul Jabbar Khan
16. "Language and Politics in Pakistan" by Tariq Rahman
17. Sociology" by Horton and Hunt
18. "Pakistan in the Twentieth Century: A Political History" by Lawrence Ziring
19. "Economic Development of Pakistan" by Ishrat Husain
20. "Issues in Pakistan's Economy" by S. Zaidi

URCG-5127	Seerat of the Holy Prophet (SAW)	1(1-0)

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 سیرِ طیبہ کی ضرورت و اہمیت سے آگاہ کرنا ۲۔ تعمیرِ شخصیت میں مطالعہ سیرِ طیبہ کے کردار کو واضح کرنا ۳۔ بعثتِ نبوی کے موقع پر اقوامِ عالم کی عمومی صورتحال سے آگاہ کرنا ۴۔ رسولِ 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 عہدِ 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 و نسب ۲۔ پیدائش اور ابتدائی تربیت ۳۔ لڑکپن اور جوانی کے حالاتِ زندگی
2	بعثتِ نبوی کے وقت دنیا کے حالات (۱)	۱۔ بعثتِ نبوی کے وقت اہم تہذیبیں ۲۔ عرب، مصر، حبشہ، بازنطینی، ساسانی
3	بعثتِ نبوی	۱۔ مکی عہد میں دعوتِ اسلام
4	بعثتِ نبوی	۱۔ مدنی عہد میں دعوتِ اسلام
5	خصائصِ النبیؐ	آپ بطور پیغمبرِ امن
6	خصائصِ النبیؐ	بحیثیت استاد و معلم
7	خصائصِ النبیؐ	بحیثیت تاجر
8	خصائصِ النبیؐ	بحیثیت سربراہِ ریاست
9	خصائصِ النبیؐ	عالمی امن اور عالمگیر اثرات

M.F

ناموس رسالت	خصائص نبوی	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
دشمن 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، سید 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 یٰسین 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 ضیاء العمری	السیرۃ النبویۃ الصحیحۃ
5	مولانا عبدالرؤف داناپوری	اصح السیر

M.F

URCG- 5119	Expository Writing	3(3-0)

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. 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.

M.F

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

This is a sequential undergraduate course that focuses on logical reasoning supported with mathematical and statistical concepts and modeling / analysis techniques to equip students with analytical skills and critical thinking abilities necessary to navigate the complexities of modern world. The course is designed to familiarize students with the quantitative concepts and techniques required to interpret and analyze numerical data and to inculcate ability in students the logical reasoning to construct and evaluate arguments, identify fallacies, and think systematically. Keeping the pre-requisite course of Quantitative reasoning (I) as its base, this course will enable students further their quantitative. Logical and critical reasoning abilities to complement their specific major field of study

Course Learning Outcomes

By the end of the course, student shall have:

1. Understanding of logic and logical reasoning:
2. Understanding the basic quantitative Modeling and Analyses.
3. Logical reasoning skills and abilities to apply them to solve quantitative problems and evaluate arguments;
4. Ability to critically evaluate quantitative information to make evidence based decisions through appropriate computational tools.

Contents

1. Logic, Logical and Critical Reasoning:

i. Introduction and importance of logic,

ii. Introductive, deductive and abductive approaches of reasoning,

iii. Propositions, arguments (valid; invalid), logical connectives, truth tables and propositional equivalences,

iv. Logical fallacies,

v. Venn Diagrams,

vi. Predicates and quantifiers,

vii. Quantitative reasoning exercises using logical reasoning concepts and techniques.

2. Mathematical Modeling and Analyses:

i. Introduction to deterministic models,

ii. Use of linear function for modeling in real-world situations,

iii. Modeling with the system of linear equation and linear solutions,

iv. Elementary introduction to derivatives in mathematical modeling,

v. Linear and exponential growth and decay models,

vi. Quantitative reasoning exercises using mathematical modeling.

3. Statistical Modeling and Analyses:

i. Introduction to probabilistic models,

ii. Bivariate analysis, scatter plots,

iii. Simple linear regression model and correlation analysis,

iv. Basics of estimation and confidence interval,

v. Testing of hypothesis (z-test; t-test),

vi. Statistical inference in decision making,

vii. Quantitative reasoning exercise using statistical modeling.

M.F

Recommended Texts

1. Bennett, J., & Briggs, W. (2019). *Using & understanding mathematics: a quantitative reasoning approach*. Pearson.

2. Rosen, K. H., & Krithivasan, K. (2012). *Discrete mathematics and its applications* (Vol. 6). New York: McGraw-Hill.

Suggested Readings

1. Epp, S. S. (1990). *Discrete mathematics with applications*. Wadsworth Publ. Co..

2. Budnick, F. S., Quinn, S., Bowser, K., & Flaherty, E. H. (1993). *Applied mathematics for business, economics, and the social sciences*. New York: McGraw-Hill.

3. Bluman, A. (2014). *Elementary Statistics: A step by step approach 9e*. McGraw Hill.

4. Mann, P. S. (2007). *Introductory statistics*. John Wiley & Sons.

5. Babones, S. (2013). Applied statistical modeling. *(No Title)*.

6. Green, S. W., Wolf, I.k., Stewrat, B. W. (2022). SAT Study Guide Premium. Barrons

M.F

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

Course Description:

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. It 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

Outline:

- **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**

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Recommended Books:

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

M.F

ENVR-5107	Environmental Pollution	3(3-0)

Course Brief:

Students in this course will become aware of the environmental pollution as the unfavorable modification of our surroundings that occurs as a direct or indirect result of human activity and is caused by changes in energy patterns, radiation levels, the chemical and physical makeup of species, and their abundance.

Course Learning Objectives:

The course is focused on introducing environmental pollution and its sources. It will also cover the existing laws related to pollutants in Pakistan and the conventions ratified internationally

Course Contents:

1. Environmental Pollution, sources, types and causes
2. Types of pollutants: Physical, chemical and biological
3. Characteristics of domestic & industrial effluents
4. Effects of Pollutants on human & other living organisms
5. Industrial and Municipal Solid Waste.
6. Principles of Waste Management & Disposal; Fate of pollutants
7. Factors affecting movement of pollutants in soil, air and water
8. Monitoring of Environmental Pollution
9. Pollution Control Strategies; Environmental Laws
10. Pollutants Guidelines; International Protocols; Case Studies

Recommended Texts:

1. Arnd-Caddigan, M. (2015). Sherry Turkle: Alone Together: Why We Expect More from Technology and Less from Each Other: Basic Books, New York, 2011, 348 pp, ISBN 978-0465031467 (pbk).
2. Vesilind, P. A., Peirce, J. J., & Weiner, R. F. (2013). *Environmental pollution and control*. Elsevier.

Suggested Readings:

1. Environment Pollution: Types, Sources & Management. Ghafoor, A., G. Murtaza, M.Z. Rehman, M. Sabir, H.R. Ahmad and Saifullah. Allied Book Centre, Lahore, Pakistan. 2012.
2. Edwards, C. (Ed.). (2013). *Environmental pollution by pesticides* (Vol. 3). Springer Science & Business Media.

m.f

ENVR - 5108	Applied Ecology	3(3-0)

Course Brief:

Applied Ecology focuses on the practical application of ecological principles to address environmental challenges. This course explores how ecological knowledge can be utilized in the management and conservation of natural resources, restoration of degraded ecosystems, and sustainable development. Emphasis is placed on understanding human impacts on ecosystems and developing strategies for mitigation and adaptation, with particular relevance to Pakistan's environmental context.

Course Learning Objectives:

By the end of this course, students will be able to:

1. Comprehend fundamental ecological concepts and their practical applications.
2. Analyze the effects of human activities on various ecosystems.
3. Evaluate strategies for the conservation and sustainable management of natural resources.
4. Apply ecological principles to real-world environmental problems, including those specific to Pakistan.
5. Develop and propose solutions for ecosystem restoration and biodiversity conservation

Course Contents:

Unit I: Introduction to Applied Ecology

- Definition, scope, and significance of applied ecology
- Relationship between basic and applied ecology
- Role of applied ecology in environmental management

Unit II: Ecosystem Structure and Function

- Components of ecosystems: biotic and abiotic factors
- Energy flow and nutrient cycling
- Ecosystem productivity and trophic dynamics

Unit III: Human Impacts on Ecosystems

- Land-use changes: agriculture, urbanization, deforestation
- Pollution: air, water, soil, and noise
- Climate change and its ecological implications

Unit IV: Conservation and Biodiversity

- Importance of biodiversity and threats to its conservation
- Protected areas and wildlife management
- Community-based conservation approaches

Unit V: Restoration Ecology

- Principles and practices of ecological restoration
- Case studies on habitat restoration

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- Monitoring and evaluating restoration success

Unit VI: Sustainable Resource Management

- Sustainable management of forests, rangelands, and fisheries
- Agroecology and sustainable agriculture practices
- Water resource management in arid and semi-arid regions

Unit VII: Applied Ecology in Pakistan

- Ecosystem services and their valuation in Pakistan
- Case studies: Indus River Basin, mangrove ecosystems, and Himalayan biodiversity
- Policy frameworks and environmental legislation in Pakistan

Laboratory Work:

- Field surveys to assess biodiversity and ecosystem health
- Water and soil quality analysis
- GIS and remote sensing applications in ecological studies
- Data collection and statistical analysis for ecological research

Recommended Texts:

1. McPherson, G. R., & DeStefano, S. (2003). Applied Ecology and Natural Resource Management. Cambridge University Press.
2. **Open Textbook Resource.** *Applied Ecology* (Open University of Hong Kong). Available-online https://www.opentextbooks.org.hk/system/files/export/12/12647/pdf/Applied_Ecology_12647.pdf

Suggested Books:

1. Applied Ecology and Environmental Management. Newman. E.I. 2nd ed. Blackwell Scientific Publications, Oxford. 2000
2. Ecology of Industrial Pollution. 2010. Ed. Lesley C. Batty and Kevin B. Hallberg. Cambridge University Press.

M.F

ENVR - 5109	Environmental Microbiology	3(3-0)

Course Brief:

This course introduces students to the role of microorganisms in the environment, emphasizing their diversity, ecological functions, and applications in environmental processes. It covers microbial interactions in soil, water, and air, and their significance in biogeochemical cycles, pollution control, and environmental sustainability.

Course Learning Objectives:

Upon successful completion of this course, students will be able to:

1. Understand the diversity and classification of environmental microorganisms.
2. Explain microbial roles in natural ecosystems and biogeochemical cycles.
3. Analyze the impact of microorganisms on environmental health and pollution.
4. Apply microbiological techniques to assess environmental samples.
5. Evaluate the applications of microorganisms in wastewater treatment and bioremediation.

Course Contents:

Unit I: Introduction to Environmental Microbiology

- Historical development and scope
- Microbial ecology and environmental significance

Unit II: Microbial Diversity and Classification

- Bacteria, archaea, fungi, protozoa, and viruses
- Methods of classification and identification

Unit III: Microorganisms in Soil and Water

- Soil microbial communities and functions
- Aquatic microbiology: freshwater and marine systems

Unit IV: Microbial Interactions and Biogeochemical Cycles

- Nitrogen, carbon, sulfur, and phosphorus cycles
- Microbial symbiosis and nutrient transformations

Unit V: Environmental Pollution and Microbial Responses

- Microbial degradation of pollutants
- Pathogens in the environment and public health concerns

Unit VI: Wastewater Treatment and Bioremediation

- Microbial processes in sewage treatment
- Bioremediation strategies for contaminated sites

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Unit VII: Air Microbiology and Bioaerosols

- Microorganisms in the atmosphere
- Health implications of airborne microbes

Unit VIII: Microbial Techniques in Environmental Analysis

- Sampling methods for soil, water, and air
- Culture-based and molecular techniques

Laboratory Work:

- Preparation and sterilization of culture media
- Isolation and enumeration of microorganisms from environmental samples
- Biochemical tests for microbial identification
- Assessment of microbial activity in soil and water
- Demonstration of wastewater treatment processes

Recommended Texts:

1. Maier, R. M., Pepper, I. L., & Gerba, C. P. (2015). *Environmental Microbiology* (3rd ed.). Academic Press.
2. Atlas, R. M., & Bartha, R. (1998). *Microbial Ecology: Fundamentals and Applications* (4th ed.). Benjamin/Cummings.
3. Pelczar, M. J., Chan, E. C. S., & Krieg, N. R. (2001). *Microbiology* (5th ed.). McGraw-Hill Education.

Suggested Books:

- Tortora, G. J., Funke, B. R., & Case, C. L. (2018). *Microbiology: An Introduction* (12th ed.). Pearson.
- Madigan, M. T., Bender, K. S., Buckley, D. H., Sattley, W. M., & Stahl, D. A. (2018). *Brock Biology of Microorganisms* (15th ed.). Pearson.
- Ghafoor, A., Murtaza, G., Rehman, M. Z., Sabir, M., Ahmad, H. R., & Saifullah. (2012). *Environment Pollution: Types, Sources & Management*. Allied Book Centre, Lahore, Pakistan.

M.F

URCG-5130	Understanding of the Holy Quran- II	1 (1-0)

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URCG-5130

Model Course Outline
for the Course Understanding of Quran – II

Course Title: Understanding of Quran – II
Course Book: Muslim ul Quran (Volume 3, 4 & 5) by Dr Ubaid ur Rahman
Credit Hours: 1 (0-1)
Contact Hours: 3 per week
Weeks: 15-16 (45-48 hours)

Course Learning Outcomes:
By the end of this course, students will be able to:

1. Directly comprehend hundreds of Quranic sentences & verses.
2. Understand at least 80 to 85 % of each page of the holy Quran.
3. Understand common verses across different Quranic topics.
4. Achieve proficiency in the basic and advance linguistic aspects of the Arabic language.
5. Understand the difference between Quranic verbs in various forms, such as present, past and imperative.
6. Develop the ability to understand long verses of the holy Quran independently and then expand their interpretation.

Provision of material, content and books:

- **Paper book:** All volumes are available in printed book form.
- **Tutorial videos:** Teaching video of each lesson available on YouTube.
- **Confirmation Videos:** A complete series of confirmation videos of all lessons is available in which the student can confirm his answers.
- **A flipbook:** A flipbook edition is also accessible.
- **Helpful material:** Helping material for the teachers like quizzes, question papers and images is available on website.

Course Outline:

Weeks	Lectures	Units	Lessons	Assignments/Home Task	
1.	1.	6	6	Understanding & Translation of Verses	Present Tense صیغہ جمع مذکر غائب مثل یعبدون
	2.	6	7-8	Understanding & Translation of Verses	Present Tense صیغہ جمع مذکر غائب مثل یعبدون
2.	1	6	9-10	Understanding & Translation of Verses	Present Tense صیغہ مفرد مذکر مخاطب (تعبد) وصیغہ مذکر مخاطب (تعبدون)
	2.	6	11-12	Understanding & Translation of Verses	Present Tense صیغہ جمع مذکر مخاطب (تعبدون)

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					صيغة المتكلم (أعيد)
3.	1.	6	13	Understanding & Translation of Verses	Present Tense صيغة جمع المتكلم (نسد)
		6	14-15	Understanding & Translation of Verses	Negative Imperative صيغة المفرد وصيغة الجمع , لا تمدد، لا تمدوا
4.	1.	6	16-17	Understanding & Translation of Verses	Conditional Sentences & masdar mawsul (مصدر موصول)
	2.	6	18-19	Understanding & Translation of Verses	Laam ottaleel (لام التعليل) & Laam ul jhood(لام الجحود)
5.	1.	6	20-21	Understanding & Translation of Verses	Present with object pronouns & Passive Voice
	2.	6	Revision (Unit 6)	Quiz	
6.	1.	Unit 7	1 (sec 1-3)	Understanding & Translation of Verses	Past Tense صيغة المفرد الغائب
	2.	6	1 (Sec 4-5)	Understanding & Translation of Verses	Past Tense صيغة المفرد للمخاطب
7.	1	6	1 (Sec 5-6)	Understanding & Translation of Verses	Past Tense صيغة المفرد للمخاطب
	2.	6	1 (Sec 7-9)	Understanding & Translation of Verses	Past Tense صيغة المفرد للغائب
8.	1.	7	Revision	Understanding & Translation of Verses QUIZ	Past Tense صيغة المفرد للغائب
		MID TERM			
9.	1.	7	2 (sec 1-2)	Understanding & Translation of Verses	Past Tense صيغة الجمع للغائب عددا
	2.	7	2 (sec 3)	Understanding & Translation of Verses	Past Tense صيغة الجمع للغائب عددا
10.	1.	7	2 (sec 4-5)	Understanding & Translation of Verses	Past Tense صيغة الجمع للغائب عددا
	2.	7	2 (sec 6-7)	Understanding & Translation of Verses	Past Tense صيغة الجمع للغائب عددا
11.	1.	7	3 (sec 1-2)	Understanding & Translation of Verses	Past Tense صيغة الجمع المتكلم عددا

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	2.	7	3 (sec 2-3)	Understanding & Translation of Verses	Past Tense صيغة الجمع للمتكلم صدنا
12.	1.	7	3 (sec 3-4)	Understanding & Translation of Verses	Past Tense صيغة الجمع للمتكلم صدنا
	2.	7	3 (sec 4-5)	Understanding & Translation of Verses	Past Tense صيغة الجمع للمتكلم صدنا
13.	1.	7	4 (sec 1-2-3)	Understanding & Translation of Verses	Past Tense صيغة الجمع للمخاطب صدتم
	2.	7	4 (sec 4-5)	Understanding & Translation of Verses	Past Tense صيغة الجمع للمخاطب صدتم
14.	1.	7	5-6	Understanding & Translation of Verses Quiz	Past Tense صيغة المتكلم و المخاطب صدت ، صدت
	2.	7	7	Understanding & Translation of Verses	Past Tense صيغة المؤنث للغائب صدت
15.	1.	7	8	Understanding & Translation of Verses	Passive Voice (Past Tense) فعل مجهول المفرد
	2.	7	9	Understanding & Translation of Verses	Passive Voice (Past Tense) فعل مجهول الجمع
16.	1	8	1-4	Understanding & Translation of Verses	Imperative Verb for singular فعل الأمر للمفرد
	2.	7	5-8	Understanding & Translation of Verses	Imperative Verb for plural فعل الأمر للجمع

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URCG-5132	Ethics-II	1 (1-0)

Ethics-II

URCG-5132

1 (0-1)

1-Course Description

The course *Ethics-II* is designed to provide students with a deeper understanding of ethical principles and practices from both Semitic and non-Semitic religions, as well as their application in professional and social contexts. Students will engage with Jewish, Christian, Islamic, Hindu, Buddhist, Sikh, Confucius, and Jain ethical traditions. The course emphasizes moral reasoning, decision-making, tolerance, and peacebuilding. It aims to cultivate an inclusive, humanistic, and holistic approach towards ethical living and interfaith engagement.

2- Learning Objectives

The course objectives are to:

1. Understand the fundamental principles and theories of ethics.
2. Introduce the ethical and moral teachings of Judaism, Christianity, Islam, and Hinduism.
3. Explore the ethical teachings of non-Semitic religions such as Buddhism, Sikhism, Confucianism, and Jainism.
4. Develop critical thinking skills to evaluate ethical arguments and theories.
5. Promote ethical leadership and interfaith harmony.

3- Learning Outcomes

By the end of this course, students will be able to:

1. Identify and analyze major ethical theories and teachings from world religions.
2. Understand the role of religions in improving moral values and social behavior.
3. Demonstrate ethical decision-making in various personal and professional contexts.
4. Recognize the impact of ethical decisions on individuals, communities, and society.
5. Apply skills of ethical leadership, including communication, conflict resolution, and inclusive engagement.

4-Course Structure

1. Interactive lectures, Group discussions and debates
2. Reflection papers and presentations
3. Assignments and Quiz

Course Contents

Unit 1: Ethical Teachings of Semitic Religions

- Judaism and its ethical teachings
- Christianity and its ethical teachings
- Islam and its ethical teachings

Unit 2: Ethical Teachings of Non-Semitic Religions

- Hinduism and its ethical teachings
- Sikhism and Buddhism: ethical values and practices
- Confucius and Jain ethical traditions

Unit 3: Professional Ethics

- Ethics for students and teachers
- Ethics in doctor-patient relationships
- Ethics in trader-customer interactions

Unit 4: Concept and Significance of Tolerance

- Definition, need, and importance of tolerance
- Teachings of Semitic religions on tolerance and their contemporary relevance
- Teachings of non-Semitic religions on tolerance and their contemporary relevance

Unit 5: Foundational Values and Ethics for Peacebuilding in Society

- Respect for sacred scriptures, personalities, places of worship, and religious symbols
- Promotion of tolerance and broadmindedness
- Encouragement of dialogue and harmony
- Benevolence towards humanity
- Establishment of justice and fairness
- Patience, forbearance, and forgiveness

Textbook

- Kidder, R. M. (2009). *How Good People Make Tough Choices: Resolving the Dilemmas of Ethical Living*. Harper.

Suggested Readings

1. Barash, D. P., & Webel, C. P. (2014). *Peace and Conflict Studies*. Sage.
2. Smart, N. (1998). *The World's Religions*. Cambridge University Press.
3. Nasr, S. H. (2003). *The Heart of Islam: Enduring Values for Humanity*. HarperOne.
4. Sharma, A. (2006). *Hindu Ethics: Purity, Abortion, and Euthanasia*. SUNY Press.
5. Harvey, P. (2000). *An Introduction to Buddhist Ethics: Foundations, Values and Issues*. Cambridge University Press
6. Cowan, H., & Perkinson, J. (2013). *A Cross-Cultural Dialogue on Ethical Leadership*. Wilfrid Laurier University Press.
7. Confucius. (1998). *The Analects*. Oxford University Press.

URCG-5114	Basic Science	3 (2-1)

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:

1. 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. & Sivakumar, M. (2006). Chemistry of Natural Products. Springer Science
4. De, A.K. (2019). *Environmental Chemistry.* New Age International Press

Suggested Readings:

1. 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

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URCG-5124	Entrepreneurship	2(2-0)

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.

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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). *Small business handbook.* Prentice Hall Press.

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

Course Description:

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.

Learning outcomes:

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

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

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ENVR -5110	Water and Wastewater Treatment	3(3-0)

Course Brief:

This course provides foundational and applied knowledge in water and wastewater treatment processes, focusing on quality assessment, contaminant removal, and sustainable treatment technologies. Students will explore physical, chemical, and biological methods for treating domestic and industrial water sources. Emphasis will be placed on analyzing water quality parameters, understanding treatment system design, evaluating treatment performance, and considering the economic and environmental sustainability of various technologies.

Course Learning Objectives:

By the end of this course, students will be able to:

1. Identify and measure key water quality parameters using standard analytical techniques.
2. Understand the composition and characteristics of water and wastewater from different sources.
3. Explain the scientific principles behind physical, chemical, and biological treatment methods.
4. Compare conventional and emerging treatment technologies in terms of efficiency and applicability.
5. Analyze the environmental and economic aspects of water and wastewater treatment systems.
6. Assess the performance and sustainability of treatment plants in the Pakistani context.

Course Contents:

Unit I: Introduction to Water and Wastewater Treatment

- Importance of clean water and sanitation (SDG 6)
- Water and wastewater sources (municipal, industrial, agricultural)
- Regulatory standards for water quality (NEQS, WHO, EPA)

Unit II: Water Quality Parameters and Characterization

- Physical: turbidity, temperature, color, odor
- Chemical: pH, DO, BOD, COD, TDS, nutrients (N, P)
- Biological: pathogens, indicator organisms
- Sampling techniques and laboratory analysis

Unit III: Physical Treatment Methods

- Screening and grit removal
- Sedimentation and coagulation
- Filtration processes (sand, membrane)
- Disinfection (chlorination, UV, ozonation)

Unit IV: Chemical Treatment Methods

- Coagulation and flocculation
- Precipitation and oxidation-reduction reactions
- Advanced oxidation processes (AOPs)
- Chemical dosing and pH control

Unit V: Biological Treatment Methods

- Microbial metabolism and biodegradation
- Suspended growth systems: activated sludge, aeration tanks
- Attached growth systems: trickling filters, biofilters
- Anaerobic digestion and stabilization ponds

Unit VI: Wastewater Sludge Treatment and Disposal

- Sludge characterization
- Thickening, dewatering, stabilization, and drying
- Safe disposal and resource recovery options (biogas, composting)

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Unit VII: Treatment Plant Design and Operation

- Flow diagrams of typical treatment plants
- Efficiency analysis and troubleshooting
- Cost estimation and affordability considerations
- Operation and maintenance challenges in Pakistan

Unit VIII: Environmental and Sustainability Considerations

- Environmental impacts of treatment plants
- Resource recovery (energy, water reuse, nutrient recovery)
- Green technologies and nature-based solutions
- Case studies: decentralized and community-based systems in Pakistan

Laboratory Work:

- Sampling and field testing of water parameters (pH, turbidity, DO, BOD, etc.)
- Jar test for coagulation efficiency
- Filtration and disinfection demonstration
- Biological oxygen demand (BOD) testing
- Visit to a municipal or industrial wastewater treatment plant

Recommended Texts:

1. Metcalf & Eddy, Inc. (2013). *Wastewater Engineering: Treatment and Resource Recovery* (5th ed.). McGraw-Hill Education.
2. Hammer, M. J., & Hammer, M. J. Jr. (2012). *Water and Wastewater Technology* (7th ed.). Pearson.
3. Droste, R. L. (1997). *Theory and Practice of Water and Wastewater Treatment*. Wiley.

Suggested Books:

1. Tchobanoglous, G., Burton, F. L., & Stensel, H. D. (2003). *Wastewater Engineering: Treatment, Disposal, and Reuse.*
2. Davis, M. L., & Cornwell, D. A. (2012). *Introduction to Environmental Engineering.*
3. Local and international guidelines: Pakistan Environmental Protection Agency (Pak-EPA), WHO, UNEP reports.

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ENVR - 5111	Analytical Techniques in Environmental Science	3(3-0)

Course Brief:

This course introduces students to the important tools and methods used to analyze environmental pollution in air, water, soil, and living organisms. Students will learn how to collect and prepare environmental samples, operate modern instruments, and understand the results. The course also explains how scientists ensure their data is accurate and useful. Focus is placed on understanding techniques like ICP-MS, GC-MS, and HPLC in a way that is clear, practical, and relevant for solving environmental problems in Pakistan.

Course Learning Objectives (CLOs):

By the end of this course, students will be able to:

1. Understand how different analytical tools help in detecting pollution in the environment.
2. Use advanced instruments like ICP-MS, GC-MS, and HPLC to test environmental samples.
3. Learn how to collect, store, and prepare environmental samples properly.
4. Judge how accurate and reliable the results are.
5. Apply these techniques to real-life environmental problems such as water contamination, air pollution, and soil pollution in Pakistan.

Course Contents:

Unit I: Introduction to Environmental Analysis

- Why analysis is important in environmental science
- Basic steps: sampling, testing, and interpreting results
- Concepts: accuracy, precision, sensitivity, detection limits

Unit II: Sample Collection and Preparation

- How to take samples of water, air, and soil
- Ways to store and preserve samples to avoid contamination
- Simple methods for preparing samples for testing

Unit III: Spectroscopy Techniques

- What is spectroscopy and why it's useful
- UV-Vis spectrophotometry: measuring pollutants in water
- Atomic Absorption Spectroscopy (AAS): testing metals in samples
- ICP-MS: advanced method for testing tiny amounts of metals

Unit IV: Chromatography Techniques

- What is chromatography and how it separates pollutants
- Gas Chromatography (GC) for testing gases and volatile chemicals
- GC-MS: used for pesticides and industrial pollutants
- HPLC: used for medicines, dyes, and chemical residues in water

Unit V: Simple Electrochemical Tools

- Measuring pH, conductivity, and dissolved oxygen
- Ion-selective electrodes for testing nitrate and fluoride
- Portable kits and field testing options

Unit VI: Understanding the Results

- How to read data from instruments
- Making calibration curves and comparing with standards
- What makes results trustworthy: repeatability, accuracy, and validation

Unit VII: Practical Applications and Case Studies

- Water testing for metals and pesticides
- Air sample testing for gases and particles
- Soil pollution testing for oil and heavy metals
- Case examples from local Pakistani environments

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Optional Laboratory Work (paired or separate lab course):

- Prepare standard solutions and run basic tests
- Use a spectrophotometer to test water samples
- Simulated GC-MS and HPLC data interpretation exercises
- Visit to a local environmental lab or treatment facility

Recommended Textbooks:

1. Harris, D. C. (2015). *Quantitative Chemical Analysis* (9th ed.). W. H. Freeman.
2. Skoog, D. A., Holler, F. J., & Crouch, S. R. (2017). *Principles of Instrumental Analysis*.
3. Patnaik, P. (2007). *Handbook of Environmental Analysis*. CRC Press.

Suggested Readings:

- WHO and EPA environmental sampling guidelines
- Pakistan NEQS water and air quality standards
- Field and laboratory manuals for environmental testing

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ENVR - 5112	Research Methods in Environmental Science	3(3-0)

Course Brief:

The students will get Information about the techniques used to look into a variety of environmental issues is included in research methodologies. Although not all of these are anticipated to be seen firsthand by students, when they can, it will benefit their learning.

Course Learning Objectives:

At the end of this course, the students should be able to understand some basic concepts of research and its methodologies; identify appropriate research topics; select and define appropriate research problem and parameters. The students will learn how to prepare a project proposal (to undertake a project), organize and conduct research (advanced project) in a more appropriate manner.

Course Contents:

1. Purpose of Research; Research Project Conceptualization.
2. Choice of Methods; Elements of a Research Proposal, Operationalization choices and illustrations
3. Research Design: formulation of research design, pretesting of research instruments and procedures, units of Analysis, time dimension
4. Experimental design and use of indicators in research, Survey Research: Guidelines for asking question and questionnaires construction
5. Self- administered questionnaires, Interview and other survey methods; their strength and weaknesses. Sampling: the logic of sampling
6. Concepts and terminologies
7. Population and sampling frames, types of sampling design
8. Field Studies: Steps in the conducting field study
9. Evaluation Research: How to carry out evaluation research; Analytical tools in research
10. Qualitative and quantitative methods; Statistical Analyses: Univariate, Bivariate and
11. Multivariate analyses

Recommended Texts:

1. Zoeteman, B. C. J. (2015). *Sensory assessment of water quality: Pergamon series on environmental science* (Vol. 2). Elsevier.
2. Reimann, C., & De Caritat, P. (2012). *Chemical elements in the environment: factsheets for the geochemist and environmental scientist*. Springer Science & Business Media.

Suggested Readings:

1. Harrad, S., Batty, L., Diamond, M., & Arhonditsis, G. (2008). *Student projects in environmental science*. John Wiley & Sons.
2. Creswell, J. W. & Plano Clark, V.L. (2007) Designing and Conducting Mixed Methods Research, Thousand Oaks, Sage CA, USA.

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ENVR - 6113	Introduction to GIS and Remote Sensing	3(2-1)

Course Brief:

In this course the students will be learning the science of remote sensing involving high-altitude satellites and aircraft to gather data about the surface of the globe. For mapping, environmental monitoring, and disaster management, data collected through remote sensing offers decision-makers broad and valuable information.

Course Learning Objectives:

To understand the fundamentals of remote sensing. history and data collection, advantages and limitations of process, energy sources, energy matter interaction in the atmosphere, aerial photography, history and platforms.

Course Contents:

1. Fundamental of Geographic Information System (GIS).
2. Integration with other technologies and its importance
3. Data acquisition, analysis and output
4. Types of data used in GIS
5. Cartography, map projection and coordinate systems
6. GIS applications in: Environmental protection and resource conservation
7. Environmental Impact Assessment (EIA),
8. Agriculture, Forestry
9. Fishery and wildlife
10. Introduction to relevant Pakistani Institutions working in GIS

Recommended Texts:

1. Harvey, F. (2015). *A primer of GIS: Fundamental geographic and cartographic concepts*. Guilford Publications.
2. Gupta, R. P. (2017). *Remote sensing geology*. Springer.

Suggested Readings:

1. Lulla, K. P., & Dessinov, L. V. (Eds.). (2000). *Dynamic Earth Environments: remote sensing observations from shuttle-Mir missions*. John Wiley & Sons.
2. Chang, K. T. (2008). *Introduction to geographic information systems* (Vol. 4). Boston: Mcgraw-hill.

M.F

ENVR- 6114	Environmental Governance	3(3-0)

Course Brief:
This course deals with environmental policy, as it is any action taken by the government, a company, or any public or private organization to address how human activity affects the environment. Especially to prevent or lessen adverse consequences on ecosystems.

Course Learning Objectives:
The objective of this course is to provide direction on national environmental policy of Pakistan and its implementation, conservation strategies and action plans; environmental provisions in the constitution of Pakistan.

Course Contents:
1. The concept of governance and its relevance to environment
2. The role of government in a state
3. Derivation of environmental legislation from constitution of Pakistan
4. Environmental Policies in Pakistan
5. Federal, provincial and local legislation in Pakistan
6. Environmental Rules and regulations
7. Pakistan Environmental Protection Act of 1997 and the rules regulations made there under environmental provisions in the Local Government Ordinance, 2001 and The rules of business made there under

Recommended Texts:

1. Lazarus, R. J. (2023). *The making of environmental law*. University of Chicago Press.
2. Bell, S., McGillivray, D., & Pedersen, O. (2013). *Environmental law*. Oxford University Press, USA.

Suggested Readings:

1. Acton, Q. A. (2012). *Issues in Environmental Law, Policy, and Planning: 2011 Edition*. Scholarly Editions.
2. SNBP Local Government Ordinance, 2001.

M.F

ENVR - 6115	Climate Change	3(3-0)

Course Brief:

This course offers students a complete understanding of the science, causes, impacts, and responses to climate change. It introduces key greenhouse gases, human activities behind emissions, and international efforts such as the Paris Agreement. The course uses examples from both global and Pakistani contexts to explore how climate change affects societies and ecosystems, and how we can respond through adaptation, mitigation, and policy measures.

Course Learning Objectives (CLOs):

By the end of this course, students will be able to:
a) Explain scientific mechanisms and key drivers of climate change including greenhouse gas emissions and deforestation.
b) Evaluate the impacts of climate change on ecosystems, biodiversity, human societies, and global economies.
c) Identify and assess adaptation and mitigation strategies to address climate change at local, regional, and global levels.
d) Understand the role of international climate agreements and evaluate their effectiveness.

Course Contents:

Unit I: Course Orientation and Introduction

- Overview of course structure, goals, and assessment
- Introduction to climate change as a global issue
- Understanding how to succeed in this course

Unit II: Scientific Foundations of Climate Change

- Greenhouse effect: natural vs. enhanced
- Key greenhouse gases: CO_2, CH_4, N_2O
- Causes and effects of climate change
- Feedback loops and climate tipping points
- Environmental impacts on agriculture, oceans, and weather

Unit III: Human Causes and Historical Emissions

- The Industrial Revolution and fossil fuel use
- Greenhouse gas emissions from agriculture, livestock, and deforestation
- How humans learned about climate change
- Early scientific awareness and recent policy milestones
- Timeline of climate action and resistance

Unit IV: Climate Responsibility and Global Governance

- Country-wise emission comparisons
- Carbon footprints, per capita vs. national emissions
- Emission tracking and reporting

- Paris Agreement and Nationally Determined Contributions (NDCs)
- Climate justice and equity in global agreements

Unit V: Climate Change Impacts on Society and Environment

- Human health, migration, and vulnerability
- Biodiversity shifts and species extinction
- Agriculture and food security
- Case Study: 2022 Pakistan floods and GLOFs
- Regional vulnerability assessments

Unit VI: Adaptation and Mitigation Strategies

- Climate adaptation: infrastructure, community resilience
- Mitigation: renewable energy, afforestation, carbon pricing
- Local strategies: solar villages, water harvesting, agroforestry
- Sustainable urban planning and disaster risk reduction

Unit VII: International Agreements and Climate Policy

- UNFCCC, Kyoto Protocol, and the Paris Agreement
- Role of COP (Conference of the Parties)
- Green Climate Fund and climate finance
- Role of Pakistan's Ministry of Climate Change
- Policy tools and national adaptation frameworks

Unit VIII: Course Review and Future Learning Paths

- Summary of course content
- Supplementary reading and future action
- Overview of career paths and research in climate science
- Final Assessment: Multiple-choice and reflective short-answer exam

Recommended Textbooks:

- Dessler, A. (2021). *Introduction to Modern Climate Change.*
- UNDP. (2017). Climate Box: An Educational Toolkit on Climate Change for Schoolchildren. United Nations Development Programme.
  Available online
  www.undp.org/sites/g/files/zskgke326/files/migration/eurasia/Climatebox_textbook_EN.pdf

Suggested Readings:

- IPCC Synthesis Report (Latest Edition)
- Ministry of Climate Change, Pakistan. *National Climate Change Policy (Revised)*
- UNEP. *Adaptation Gap Report* and *Emissions Gap Report*

M.F

ENVR- 6116	Disaster Risk Management	3(3-0)

Course Brief:

In this course the students will be acquainted with the natural disasters. Disasters are defined as floods, hurricanes, tornadoes, earthquakes, volcanic eruptions, fires, wildfires, and blizzards that are caused by natural causes. Disaster management is the continuous and integrated process of planning, organising, coordinating, and implementing measures that are necessary or expedient for these events.

Course Learning Objectives:

The students will learn about natural hazards and disasters: the need for hazard and disaster studies, historical background, disaster and its types. Also it will help to understand the natural vs man-made, flooding, earthquake and landslide.

Course Contents:

1. Natural cycles and their role, Prediction; Hazards, Risk and Vulnerability
2. Definitions and characterization, Different approaches and Indicators; Factors of
3. Vulnerability:
4. Demographic factors, Socio-economic factors, Cultural factors, Political factors,
5. Physical factors; the impact of natural disasters
6. Direct and short-term impact of disasters, Indirect and long-term consequences of
7. Catastrophes,
8. Disaster as an opportunity for development; Disaster Management: Components of
9. Management, International phenomenon
10. Hazard and vulnerability reduction and Mitigation: hard and soft measures;
11. Earthquake Management
12. Flood Management: Organizational Role; Role of Government and Non-Governmental
13. Organizations (NGOs
14. Role of Media in Disaster Management
15. Techniques and methods to assess hazard
16. Qualitative and Quantitative approaches; Disaster Management Trainings and Policies.

Recommended Texts:

1. Hallegatte, S. (2016). *Natural disasters and climate change*. Springer International Pu.
2. Madu, C. N. (2017). *Handbook of disaster risk reduction & management: Climate change and natural disasters*. World Scientific Publishing Company.

Suggested Readings:

1. Cheval, S. (Ed.). (2012). *Natural disasters*. BoD–Books on Demand.
2. Pelling, M. (2012). *The vulnerability of cities: natural disasters and social resilience*. Routledge.

M.F

ENVR - 6117	Solid Waste Management	3(3-0)

Course Brief:

This course deals with the full process of gathering, treating, and discarding solid wastes as it is referred to as "solid waste management." The trash are gathered from various sources and disposed of during the waste management process. The collection, transportation, treatment, analysis, and disposal of waste are all part of this process.

Course Learning Objectives:

The students will learn the types, handling and management systems of solid wastes. To describe the trash and put legal knowledge of biological waste management, municipal solid waste management, and plastic waste management to use. To use engineering, physics, and math expertise to design efficient solid waste collection systems, optimise trash collection routes, and process solid waste. Create composting systems, keep them up to date, and manage the anaerobic and aerobic composting processes to efficiently recycle organic waste. To oversee the development and maintenance of landfill facilities, energy recovery systems, and leachate system management

Course Contents:

1. Introduction to solid waste management
2. Solid waste characterization
3. Sources, quantities, quality
4. Waste collection and transport; Treatment technologies
5. Bioremediation strategies
6. Composting: Types and methods
7. Environmental requirements, incineration, reuse and recycling
8. Landfills: Site design and management
9. Pollution and risk assessment of landfills; Biogas 58 generation
10. Use of biogas digest; Recent technologies used for solid waste management

Recommended Texts:

1. Manzoor, M., Gul, I., Iqrar, I., & Arshad, M. (2020). Solid waste management practices in Pakistan. In *Sustainable Waste Management Challenges in Developing Countries* (pp. 248-269). IGI Global.
2. Serge Kubanza, N., & Simatele, M. D. (2020). Sustainable solid waste management in developing countries: a study of institutional strengthening for solid waste management in Johannesburg, South Africa. *Journal of Environmental Planning and Management*, *63*(2), 175-188.

Suggested Readings:

1. Pariatamby, A., Tanaka, M., Islam, A., Rasul, G., Manandhar, P., Parveen, J. A., & Ahmed, N. (2014). Municipal solid waste management in Asia and the Pacific Islands. *Environmental Science, Springer, Singapore*, *201*.
2. Polprasert, C. (2007). *Organic waste recycling: technology and management*. IWA publishing.

M. F

ENVR - 6118	Environmental Management Systems	3(3-0)

Course Brief:
In this course the students will be exposed to the effects of various organizations on the environments. The organizations can lessen its negative effects on the environment and improve operational effectiveness by implementing an Environmental Management System (EMS), which is a collection of procedures and methods.

Course Learning Objectives:
The course will cover Introduction to Environmental Management Systems (EMS) along with Introduction of International Standards. To comprehend the definitions, ideas, rules, and specifications of the ISO 14001 standard as they pertain to environmental management systems (EMS). Recognize the phases of EMS implementation, acquire best practice methods, and apply environmental management concepts to promote ongoing organizational progress. To give a fundamental grasp of numerous methods and techniques, including environmental audits, life cycle assessments, and environmental performance evaluation for environmental decision-making

Course Contents:
1. Organization (ISO) 14000 series of standards and their role in environmental management,
2. Environmental Management Systems Principles
3. Certification of EMS, Environmental Management tools
4. Environmental Economy, Environmental/social
5. Auditing procedures and reporting processes
6. Environmental aspects and impacts
7. Environment and sustainable development
8. Methods of environmental protection
9. Related Environmental legislation, standards and guidelines
10. Principles of Cleaner production, tools of sustainable consumption and production (eco Label, eco-design, cleaner technologies, etc.)

Recommended Texts:

1. Thi, N. B. D., Kumar, G., & Lin, C. Y. (2015). An overview of food waste management in developing countries: Current status and future perspective. *Journal of environmental management*, *157*, 220-229.
2. Ramos, T. B., Caeiro, S., Van Hoof, B., Lozano, R., Huisingh, D., & Ceulemans, K. (2015). Experiences from the implementation of sustainable development in higher education institutions: Environmental Management for Sustainable Universities. *Journal of Cleaner Production*, *106*, 3-10.

Suggested Readings:

1. Sheldon, C., & Yoxon, M. (2012). *Environmental management systems: a step-by-step guide to implementation and maintenance*. Routledge.
2. ISO. (1996). *Environmental Management Systems: General Guidelines on Principles, Systems and Supporting Techniques*. ISO.

M.F

ENVR - 6119	Biodiversity and Conservation	3(3-0)

Course Brief:

As part of this course the students will develop an understanding of human health, wealth, food, fuel, and other essential services, biodiversity conservation. The practice of safeguarding and preserving the riches and variety of species, habitats, ecosystems, and genetic diversity on the planet is crucial.

Course Learning Objectives:

It will include Introduction to the course along with types of biodiversity, alpha and beta diversity, philosophical, ecological, economic, social and ethical values of biodiversity. Moreover, it will also provide details on the plant, animal and microbial resources of world and Pakistan, threats to biodiversity, hot spots of biodiversity.

Course Contents:

1. Conservation of biodiversity, need and approach
2. Conservation at species, population, community and ecosystem level
3. Conservation strategies, in-situ and ex-situ conservation
4. Conservation of wildlife, plants, forests; conservation in man-made ecosystems
5. Croplands, cities, role of protected areas and ecological corridors in conservation
6. Legal protection of species, habitats, national and international laws and regulations,
7. International agreements, protected areas, their categories
8. Management, ecotourism, conservation and livelihood
9. National Conservation Strategy of Pakistan
10. Role of traditional knowledge in conservation.

Recommended Texts:

1. Rotherham, I. D. (2015). Bio-cultural heritage and biodiversity: emerging paradigms in conservation and planning. *Biodiversity and conservation*, *24*, 3405-3429.
2. Milne, S., & Mahanty, S. (Eds.). (2015). *Conservation and development in Cambodia: Exploring frontiers of change in nature, state and society*. Routledge.

Suggested Readings:

1. Bennett, B., & Kruger, F. (2015). *Forestry and water conservation in South Africa*. ANU Press.
2. Muller, M. R. (2015). *Genetic resources as natural information: implications for the Convention on Biological Diversity and Nagoya Protocol*. Routledge.

m.f

CHAIRMAN
DEPARTMENT OF ENVIRONMENTAL SCIENCES
UNIVERSITY OF SARGODHA

ENVR-6120	AI & Emerging technologies in Environmental Science	3(2-1)

Course Brief:

This course explores the applications of Artificial Intelligence (AI) in environmental science and geology, focusing on how AI enhances environmental monitoring, resource management, hazard prediction, and sustainability efforts. Students will learn how AI technologies, including machine learning, remote sensing, GIS, and predictive modeling, are used to analyze climate change, pollution control, water resource management, and geological hazards. The course integrates real-world case studies, hands-on data analysis, and AI tools to equip students with skills for solving complex environmental and geological challenges.

Course Learning Outcomes:

This course will teach students how AI technologies like remote sensing, GIS, and machine learning are used in environmental and geological management. They will learn to analyze climate change, pollution, water resources, and geological hazards using AI-driven tools. Through case studies and hands-on applications, students will develop skills in data analysis, risk assessment, and sustainable resource management while understanding the ethical and practical implications of AI in environmental science.

Course Contents:

1. Introduction to AI in Environmental and Geological Sciences
2. AI in Climate Change and Pollution Monitoring
3. Remote Sensing and GIS in Environmental and Geological Management
4. AI in Water Resource Management
5. AI in Mineral Exploration and Geological Hazard Prediction
6. AI and Sustainable Land Management
7. AI for Disaster Management and Early Warning Systems
8. Future of AI in Environmental and Geological Sciences

Recommended Texts:

1. Camps-Valls, G., Tuia, D., Zhu, X. X., & Reichstein, M. (Eds.). (2021). *Deep learning for the Earth Sciences: A comprehensive approach to remote sensing, climate science and geosciences*. John Wiley & Sons.
2. Haupt, S. E., Pasini, A., & Marzban, C. (Eds.). (2008). *Artificial intelligence methods in the environmental sciences*. Springer Science & Business Media.
3. Hassanien, A. E., Darwish, A., & Elghamrawy, S. M. (Eds.). (2024). *Artificial Intelligence for Environmental Sustainability and Green Initiatives*. Springer Nature Switzerland, Imprint: Springer.

Suggested Readings:

1. Ertel, W. (2024). *Introduction to artificial intelligence*. Springer Nature.
2. Oktavia Suhyani, N. (2025). Machine learning for Earth sciences: using Python to solve geological problems: by Maurizio Petrelli, Switzerland AG, Springer Nature. ISBN: 9783031351136.

M.F

List of Elective Subjects

ENVR-6130	Environmental Economics	3(3-0)

Course Brief:

This course discusses the environmental and natural resource economics. It is a subfield of scientific subject that examines how environmental and natural resource development and management are studied. To make its environmental regulations more effective, EPA (Pakistan Environmental Protection Agency) conducts economic evaluations.

Course Learning Objectives:

The objective of this course is to provide the students the application of natural laws and principles in economics to develop their understanding of internalization of externalities

Course Contents:

1. Basic concepts in environmental economics
2. The Economy and the Environment, Benefits and Costs, the equilibrium principle
3. Marginal cost and supply, economic efficiency and market, markets and Social Efficiency
4. External costs and external benefits
5. Pollution Control-a general model, pollution damages and abatement costs
6. Valuing the environment
7. Measuring environmental benefits
8. Contingent valuation
9. The travel cost method and the hedonic approach
10. The value of life, health, risk and safety
11. Economic Development and Environment. Natural resource economics

Recommended Texts:

1. Sandmo, A. (2015). The early history of environmental economics. *Review of Environmental Economics and Policy*.
2. O'Neill, J., & Uebel, T. (2015). Analytical philosophy and ecological economics. *Handbook of ecological economics*, 48-73.

Suggested Readings:

1. Bleys, B., & Whitby, A. (2015). Barriers and opportunities for alternative measures of economic welfare. *Ecological Economics*, *117*, 162-172.
2. Bertram, C., Luderer, G., Pietzcker, R. C., Schmid, E., Kriegler, E., & Edenhofer, O. (2015). Complementing carbon prices with technology policies to keep climate targets within reach. *Nature climate change*, *5*(3), 235-239.

M.F

ENVR - 6131	Environmental Monitoring	3(3-0)

Course Brief:
In this course the students will learn about the environmental monitoring, about policymakers, and international organisations. The general public can be informed on environmental trends and conditions as well as to promote policy development.

Course Learning Objectives:
This course aims to provide information of techniques used in environmental monitoring and evaluation of different standards of environmental factors i.e. air, water, soil and living organisms. The goal of the course is to help students develop the sampling and analytical abilities necessary for environmental monitoring. The students will learn about several industry standards for environmental monitoring.

Course Contents:
1. Introduction, objectives of sampling and monitoring programme
2. Design and types of samples, pre-sampling requirements/information
3. Sampling and design purposes, application of national and international methods of sampling
4. Regulatory purposes for NEQS compliance, EIA requirement, NOC for plant operation
5. Determination of concentration and distribution of a specific pollutant environment sampling techniques.
6. Quality assurance and quality control, Planning analytic protocols
7. Quality assurance programmes, quality control sampling
8. Considerations, quality assessment, field custody, laboratory custody
9. Preservation methods including pH control, chemical addition, refrigeration and freezing methods.
10. Biological indicators for environmental monitoring, role of biomarkers in environmental assessment.

Recommended Texts:

1. O'Higgins, T. (2015). *Systems Approach to Environmental Management: It's not easy being Green*. Dunedin Academic Press Ltd.
2. Ramos, T. B., Caeiro, S., Van Hoof, B., Lozano, R., Huisingh, D., & Ceulemans, K. (2015). Experiences from the implementation of sustainable development in higher education institutions: Environmental Management for Sustainable Universities. *Journal of Cleaner Production, 106*, 3-10.

Suggested Readings:

1. Cartlidge, D. (2015). *Construction project manager's pocket book*. Routledge.
2. Berkes, F. (2015). *Coasts for people: Interdisciplinary approaches to coastal and marine resource management*. Routledge.

ENVR - 6132	Environmental Impact Assessment	3(3-0)

Course Brief:

The students will learn about the Environmental Impact Assessment. An instrument used to evaluate the significant environmental impacts of a project or development proposal is the environmental impact assessment (EIA). EIAs ensure that project decision-makers consider the environment's likely effects as early as feasible and work to avoid, mitigate, or counteract those effects.

Course Learning Objectives:

The aim of this course is to enable the participants to build their capacity to integrate environmental concerns in project proposals. The specific objectives of the course are to help students to: learn the principles, skills, procedures and practices of integrating environment in development through EIA; become aware of the legal and regulatory obligations of integrating environment in development projects familiarize themselves with the techniques of getting public participation and integrate socio-economic aspects in development projects; and enable the participants to conduct an EIA study for a development project.

Course Contents:

1. Introduction: principles
2. Concepts and purposes of IEE and EIA and its significance for the society
3. Cost and benefits of EIA
4. Main stages in EIA process
5. Public consultation and participation in EIA process
6. Methods and techniques for impact prediction and evaluation
7. Integration during project life cycle
8. EIA review and post project analysis
9. EIA process management
10. EIA Regulations and guidelines in Pakistan

Recommended Texts:

1. Loza, A. R. A., & Fidélis, T. (2021). Literature review on the analysis of climate change risks in the environmental impact assessment of dams. *Impact Assessment and Project Appraisal, 39*(4), 277-289.
2. Rozema, J. G., & Bond, A. J. (2015). Framing effectiveness in impact assessment: Discourse accommodation in controversial infrastructure development. *Environmental Impact Assessment Review, 50*, 66-73.

Suggested Readings:

1. Glasson, J., & Therivel, R. (2013). *Introduction to environmental impact assessment*. Routledge.
2. Fischer, T.S. (2014). Environmental Impact Assessment Handbook for Pakistan, Liverpool University Press, UK.

M. F

ENVR - 6133	Hydrology	3(3-0)

Course Brief:

The course is designed to highlight the hydrologic cycle, its dynamics, and its component portions are all studied in this course. Measurement techniques and the interpretation of hydrologic data will be used in field and lab activities.

Course Learning Objectives:

Understanding of surface and groundwater, as well as its systems and uses, in environmental science

Course Contents:

1. Principles of Hydrology,
2. Surface water origin, Occurrence,
3. Distribution and movement,
4. Hydrologic Cycle,
5. Hydrographs, Precipitation, Evaporation,
6. Infiltration, Run-off and its types,
7. Basic equations, Stream flow measurements.
8. Groundwater Balance,
9. Ground water exploitation and management,
10. Surface- Groundwater interaction and Ecosystem dependence
11. Water Balance, Rainfall recharge.
12. Erosion and Silting,
13. Water logging and Salinity problems in Pakistan

Recommended Texts:

1. Todd, D. K., & Mays, L. W. (2004). *Groundwater hydrology*. John Wiley & Sons.
2. Bedient, P., B. E. Vieux, W. C. Huber (2018). Hydrology and Floodplain Analysis (POD File). Pearson; 5th edition.

Suggested Readings:

1. Reddy, P. J. R. (2005). *A text book of hydrology*. Firewall Media.
2. Jain, S. K., & Singh, V. P. (2019). Engineering hydrology: an introduction to processes, analysis, and modeling. McGraw-Hill Education.

M.F

ENVR - 6134	Occupational Health and Safety	3(3-0)

Course Brief:

This course deals with the occupational safety, occupational health, and industrial hygiene. Understanding the reasons why accidents happen at work and finding strategies to stop risky behavior and harmful working circumstances are all part of occupational safety.

Course Learning Objectives:

The students will be trained with the concept of environment related human health problems, public health concept, communicable and non-communicable diseases water borne, air borne, food borne and sanitation related diseases and control measures. This course also includes occupational health problems and issues, prevention and control.

Course Contents:

1. Continuum of Exposure to Disease, Industrial Hygiene, Biologic Monitoring, Medical
2. Surveillance, Occupational Safety and Health Administration
3. Accident prevention and safety plans
4. Safety techniques, Ergonomic and Safety
5. Primary health care services; principles and practices
6. Government Policies and Programs
7. Importance and principles of occupational health and safety, Historical Aspects of
8. Occupational Health,
9. Occupational health and safety legislation
10. Physical environmental stresses, Biological environmental stresses
11. Psychological environmental stresses, Significance of exposure limits in occupational
12. hygiene Cost of accidents
13. Hazards and risks at work place and causes, Plant, Emergency response protocols, Spill
14. response protocols, Risk assessment approaches

Recommended Texts:

1. Quinlan, M. (2015). *The effects of non-standard forms of employment on worker health and safety*. Geneva: ILO.
2. Alli, B. O. (2008). *Fudamental Principles of Occupational Health and Safety*.

Suggested Readings:

1. Boyd, C. (2004). *Human resource management and occupational health and safety*. Routledge.
2. Lingard, H., & Rowlinson, S. (2004). *Occupational health and safety in construction project management*. Routledge.

M.F

ENVR - 6135	Ecotourism	3(3-0)

Course Brief:

The students will learn about the tourism associated with travelling. As ecotourism itinerary often entails visiting places where the local flora, animals, cultural history, geoheritage and geoconservation are the main draws. The goal of ecotourism is to increase tourists' understanding of how humans affect the environment and their appreciation for our natural surroundings.

Course Learning Objectives:

The course has been designed for the students to enable them meet the existing global challenges for achieving a sustainable growth in a competitive environment of tourism industry.

Course Contents:

1. Introduction and general overview,
2. Context and definitions of ecotourism,
3. Types of Ecotourism,
4. Alternative and mass tourism,
5. Principles and philosophies of ecotourism,
6. Ecotourism resources, Protected areas in ecotourism,
7. Identifying and describing ecotourism products,
8. Components of ecotourism, Impacts of ecotourism,
9. Resources required for eco and urban tourism, Ecotourism practices,
10. Environmental and ecological impacts of ecotourism,
11. Ecotourism markets, Clients and motivation, Community based ecotourism,
12. Ecotourism developments, Developing ecotourism products,
13. Ecotourism in the national and global context,
14. Field trip, Report writing.

Recommended Texts:

1. Weaver, D., Milton Qld (2008). *Ecotourism*. John Wiley & Sons.
2. Fennell, D.A. (1999). *Ecotourism: An introduction*. Taylor and Francis.

Suggested Readings:

1. Honey, M., (1999). *Ecotourism and sustainable development*, Elsevier.
2. Satsuka, S., (2011). *Japanese Tourism Encounters the Canadian Rockies*, Duke University Press.

M.F

CHAIRMAN

ENVR - 6136	Global Environmental Politics	3(3-0)

Course Brief:
This course deals with the ecological problems that affect an environment or system's health and are frequently influenced by human actions. Especially related to the increase of CO_2 levels and subsequent rise of sea level. Examine the various concerns and related accords intended to reduce pollution, combat climate change, and promote sustainable development.

Course Learning Objectives:
The students will learn about climate change relationship with overpopulation, ozone depletion, pollution, air pollution, consumerism, toxins waste land degradation, conservation of species energy and nuclear issues.

Course Contents:
1. Burial, Water crisis, Overpopulation in companion animals, Tragedy of the commons
2. Causes, effects and control measures for Chloro-floro carbons (CFC).
3. Light pollution, Noise pollution, Visual pollution, Nonpoint source pollution, Point source pollution.
4. Smog, Tropospheric ozone, Indoor air quality, Volatile organic compound, Particulate matter, Sulphur oxide. Resource depletion: Exploitation of natural resources, over drafting
5. Consumer capitalism, Planned obsolescence, Over-consumption
6. Chlorofluorocarbons, DDT, Endocrine disruptors, Dioxin, Toxic heavy metals, Herbicides, Pesticides, Toxic waste, Polychlorinated bienyl (PCB), Bioaccumulation, Biomagnifications, Toxins, Bioaccumulation of POPs.
7. Accumulation of Waste/Garbage, E-waste, Litter, Waste disposal incidents, Marine debris, Medical waste, Landfill, Leachate, Recycling, Incineration, Great Pacific Garbage Patch.
8. Over Fishing/hunting/deforestation, Genetic Degradation Ocean Salinity, Shutdown of thermohaline circulation, Persistence of Plastic in Environment.
9. Global warming, Global dimming, Fossil fuels, Sea level rise, Greenhouse gas, Ocean acidification, Shutdown of thermohaline circulation
10. Extinct Animals and birds in The Last 100 Years, Species extinction, Pollinator decline, Coral bleaching

Recommended Texts:
1. United Nations Environment Programme. Division of Early Warning. (2011). *UNEP year book 2011: emerging issues in our global environment*. UNEP/Earthprint.
2. Bulkeley, H. (2013). *Cities and climate change*. Routledge.

Suggested Readings:
1. Berner, E. K., & Berner, R. A. (2012). *Global environment: water, air, and geochemical cycles*. Princeton University Press.
2. Daniel B. Botkin, Adward A. Keller, (2010). Environmental Science- Earth as a living planet. 7th Edition. John Wiley & Sons (Asia) Pte. Ltd.

M.F

CHAIRMAN

ENVR-6137	Agro-Ecology	3(3-0)

Course Brief:

This course trains students to compare agro-ecosystems and attempt to integrate knowledge of natural ecosystems into agricultural practice. Students will learn to link ecology, socioeconomics, and culture to sustain agricultural production, farming communities, and environmental health.

Course Learning Objectives:

The course will provide insight into applying ecological principles to modern farming systems with the goal of long-term food production without depleting Earth's resources. It will explore the on-farm and off-farm ecological implications of agricultural and livestock practices for crop biodiversity, riparian and wetland systems, agroforestry, soil fertility, and pasture.

Course Contents:

1. Application of ecological principles in agro-ecosystems.
2. Enhancing recycling of biomass and optimizing nutrient availability.
3. Balancing nutrient flow and securing favorable soil conditions for plant growth.
4. Managing organic matter and enhancing soil biotic activity.
5. Minimizing losses due to flows of solar radiation, air, and water through microclimate management.
6. Water harvesting and soil management through increased soil cover.
7. Species and genetic diversification of agro-ecosystems in time and space.

Recommended Books:

1. Gliessman, S. R. (2007). Agroecology: *The Ecology of Sustainable Food Systems*. Taylor & Francis Group, CRC Press, N.W. Corporate Blvd., Boca Raton, FL 33431. ISBN 0-8493-2845-4
2. Gliessman, S. R. (Ed.), & Edwards, C. A. (2000). *Agroecosystem Sustainability: Developing Practical Strategies*. CRC Press, 224 pages.
3. Wojtkowski, P. A. (2000). *Introduction to Agroecology: Principles and Practices*. Routledge.

Suggested Books:

1. Altieri, M. A. (2018). *Agroecology: The Science of Sustainable Agriculture* (3rd ed.). CRC Press.
2. Wezel, A. (Ed.). (2017). *Agroecological Practices for Sustainable Agriculture: Principles, Applications, and Research*. World Scientific.
3. Francis, C., Lieblein, G., Breland, T. A., & Salomonsson, L. (2008). *Agroecology: The Ecology of Food Systems*. CRC Press.

m.f

ENVR-6138	Project Management	3(3-0)

Course Brief:

The course aims at provide understanding of Project Management that is a practice focused course that is diverse and vibrant in an inspirational learning environment that embeds internationalisation, employability and professionalism you'll need to succeed as a project manager. It provides essential skills for planning, executing, and managing projects effectively, covering topics like project planning, risk management, budgeting, and team management, ultimately equipping individuals to lead projects to successful completion

Course Learning Objectives:

The course will provide insight to convey the knowledge and ideas after studying this course, Students should be able to: define what a project that is being studied; understand the importance of risk; define the questions a decision maker needs to ask; list the main activities and tasks of a project manager and consider phased development, prototype approaches or agile methods.

Course Contents:

1. Project Management Fundamentals
2. Project Management Methodologies
3. Projects in Global Environments
4. Leadership
5. Project Management in Context
6. Sustainable Development: Principles and Practice
7. Dissertation (Masters

Recommended Texts:

1. Kerzner, H. (2025). *Project management: a systems approach to planning, scheduling, and controlling*. John Wiley & Sons.
2. Harold, K. (2009). *Project management: a systems approach to planning, scheduling, and conrolling/Harold Kerzner.—10th ed.* John Wiley & Sons, Inc..
3. Schwalbe, K. (2009). *Introduction to project management*. Boston: Course Technology Cengage Learning.

Suggested Readings:

1. Meredith, J. R., Shafer, S. M., & Mantel Jr, S. J. (2017). *Project management: a strategic managerial approach*. John Wiley & Sons.
2. Igbenese, D. A. (2022). *Introduction to project management: A source book for traditional PM basics*. Routledge.

M.F

ENVR-6139	Environmental Biotechnology	3(3-0)

Course Brief:

The course aims at provide understanding of fundamental concepts, applications, and emerging technologies in areas like bioremediation, waste treatment, and sustainable resource management, often incorporating microbiology, biochemistry, and environmental engineering principles. This course covers the application of biological treatment of wastewater and (to a lesser degree) drinking water treatment. This includes the different types of aerobic, anoxic and anaerobic biological processes that are used in wastewater treatments plants (WWTPs), and expands upon the underlying bacterial energetics and reactor kinetics are considered when designing a wastewater treatment plant. Biological nutrient removal and recovery are covered, as is energy and waste conversion.

Course Learning Objectives:

The course will provide insight to convey the knowledge and explain the underlying of microbial physiology for water treatment and incorporate this into bioreactor design; describe the major wastewater treatment process configurations for the removal of carbon, nitrogen and phosphorous from sewage; identify and describe the potential of wastewater as a source of resources and energy, and evaluate the sustainability of current approaches; describe the use of biological processes for drinking water treatment. Through the delivery of a group report demonstrate an in-depth understanding of an emerging biotechnology and evaluate its sustainability

Course Contents:

1. An introduction to environmental biotechnology
2. Utilization of microbial processes in waste and water treatment
3. Bioremediation
4. Microbial energy metabolism
5. Microbial growth kinetics and elementary chemostat theory, relevant microbiological processes
6. Microbial ecology, approaches for studying microbial communities
7. Basic principles in bioremediation and biological water and waste treatment.

Recommended Texts:

1. Wang, L. K., Ivanov, V., Tay, J. H., & Hung, Y. T. (Eds.). (2010). *Environmental biotechnology* (Vol. 10). Springer Science & Business Media.
2. Singh, P. K. (2017). *Principles and applications of environmental biotechnology for a sustainable future* (pp. 13-41). R. L. Singh (Ed.). Springer Singapore.
3. Fulekar, M. H. (2010). *Environmental biotechnology*. CRC Press.

Suggested Readings:

1. Evans, G. M., & Furlong, J. C. (2003). *Environmental biotechnology: theory and application*. John Wiley & Sons.
2. Singh, A. (2013). *Biotechnology for environmental management and resource recovery* (pp. 191-218). R. C. Kuhad (Ed.). New Delhi, India:: Springer.

M.F

CHAIRMAN
Department of Environmental Sciences
UNIVERSITY OF SARGODHA

ENVR-6140	Air and Noise Pollution	3(3-0)

Course Brief:

With increasing noise and air pollution nationally and globally, it is necessary to be familiar with basic information regarding air and noise pollution to allow proper assessment of impacts arising from the various projects or activities and devising appropriate mitigation or control measures. In this respect, the Air and Noise Pollution course is subdivided into three sections: the general introductory, air pollution and noise pollution sections. The general introductory section covers information on national standards and regulations governing air and noise levels; definitions of air pollution and noise pollution. The air pollution section includes aspects on: sources, types and effects of air pollutants, air pollution sources; ambient air/ or and emission measurement and monitoring including sampling procedures; minimization and control of emissions; indoor air pollution and control.

Course Learning Objectives:

To give the students an overview of air and noise pollution including methods for prevention, control, measures and management of the pollution. The purpose of this course is to give the students an overview of air and noise pollution including methods for prevention, control, measures and management of the pollution.

Course Contents:

1. Air Pollution Control
2. Introduction to Air Pollution
3. Fabric Filtration
4. Cyclones
5. Electrostatic Precipitation
6. Wet Scrubbing
7. Atmospheric Dilution
8. Ventilation and Air Conditioning
9. Other Air Pollution Control Techniques
10. . Introduction to Noise Pollution and Noise Pollution Control
11. Noise Control.

Recommended Texts:

1. Wang, L. K. (2005). *Advanced air and noise pollution control*. American.
2. Boubel, R. W., Vallero, D., Fox, D. L., Turner, B., & Stern, A. C. (2013). *Fundamentals of air pollution*. Elsevier.
3. Stansfeld, S., Haines, M., & Brown, B. (2000). Noise and health in the urban environment. *Reviews on environmental health*, *15*(1-2), 43-82.

Suggested Readings:

1. Stansfeld, S. A., & Matheson, M. P. (2003). Noise pollution: non-auditory effects on health. *British medical bulletin*, *68*(1), 243-257.
2. Wang, L. K., & Pereira, N. C. (Eds.). (2012). *Air and Noise Pollution Control: Volume 1* (Vol. 1). Springer Science & Business Media.

M.F

ENVR-6141	Natural Resources Management	3(3-0)

Course Brief:

This course introduces students to the management, conservation, and sustainable use of natural resources, focusing on their geological and environmental aspects. It explores the formation, distribution, and extraction of resources such as minerals, fossil fuels, groundwater, and soils and their impact on the environment. The course emphasizes sustainable resource use, land management, and environmental protection while addressing challenges such as climate change, resource depletion, and pollution. Through real-world case studies, students will gain insights into the role of geology in resource management, legal frameworks, and emerging solutions for responsible resource utilization.

Course Learning Outcomes:

By the end of this course, students will develop a clear understanding of how natural resources form, their economic importance, and the environmental impact of their extraction and use. They will be able to analyze and evaluate different resource management strategies and explore solutions for reducing environmental damage and promoting sustainability. Students will also learn about geological hazards, groundwater conservation, land-use planning, and environmental policies. This course will equip them with the knowledge needed to apply scientific principles to real-world environmental issues and contribute to responsible natural resource management.

Course Contents:

1. Introduction to Natural Resource Management
2. Geological Resources: Formation and Distribution
3. Transition to renewable energy sources
4. Water Resources and Hydrogeology
5. Water pollution and sustainable water management strategies
6. Soil Resources and Land Use
7. Impact of deforestation and urbanization on soil health
8. Geological Hazards and Risk Management
9. Human-induced hazards: Mining-induced subsidence, groundwater depletion
10. Disaster preparedness and mitigation strategies
11. Environmental Impact of Resource Extraction
12. Legal and Policy Frameworks in Resource Management
13. Future of Resource Management: Challenges and Innovations
14. Case studies on successful sustainable resource management practices.

Recommended Texts:

1. Chiras, D. D., & Reganold, J. P. (2010). *Natural resource conservation: management for a sustainable future*. Benjamin Cummings.
2. Information Resources Management Association (Ed.). (2019). *Natural Resources Management: Concepts, Methodologies, Tools, and Applications*. Information Science Reference..
3. Jhariya, M. K., Meena, R. S., Banerjee, A., & Meena, S. N. (Eds.). (2021). *Natural resources conservation and advances for sustainability*. Elsevier.

Suggested Readings:

1. Anderson, D. A. (2019). *Environmental economics and natural resource management*. Routledge.
2. Cubbage, F. (2021). *Natural resource leadership and management: a practical guide for professionals*. Routledge.

M-F

ENVR-6142	Water Resources Management	3(3-0)

Course Brief:

This course explores the availability, distribution, and management of water resources, emphasizing geological and environmental aspects. It covers surface water and groundwater systems, aquifers, hydrological cycles, and water-related geological hazards. Students will learn about sustainable water use, groundwater recharge, watershed management, and the impact of human activities on water resources. The course also examines water scarcity, pollution, climate change impacts, and legal frameworks for water conservation. Through case studies and practical applications, students will develop skills for analyzing water-related issues and proposing sustainable management solutions.

Course Learning Outcomes:

This course will equip students with a geological and environmental perspective on water resource management, covering the hydrological cycle, groundwater systems, and watershed dynamics. Students will explore water scarcity, pollution, and geological hazards like floods and droughts while assessing the impact of human activities and climate change on water resources. They will also learn about sustainable management strategies, legal frameworks, and policy approaches to ensure water conservation and responsible usage. By applying scientific principles to real-world challenges, students will develop the skills needed for effective water resource management.

Course Contents:

9. Introduction to Water Resource Management
10. The Hydrological Cycle and Water Movement
11. Groundwater Resources and Aquifers
12. Surface Water and Watershed Management
13. Water Scarcity and Management Challenges
14. Water Pollution and Contamination
15. Water-Related Geological Hazards
16. Climate Change and Water Resources
17. Legal and Policy Frameworks in Water Management
18. Future of Water Resource Management.

Recommended Texts:

1. Fetter, C. W., & Kreamer, D. (2021). Applied hydrogeology. Waveland Press.
2. Karamouz, M., Ahmadi, A., & Akhbari, M. (2020). Groundwater hydrology: Engineering, planning, and management. CRC press.
3. Grigg, N. S. (2023). Water Resources Management: Principles, Methods, and Tools. John Wiley & Sons.

Suggested Readings:

1. Weight, W. D. (2019). *Practical Hydrogeology: Principles and Field Applications*. McGraw Hill Professional.
2. Hornberger, G. M., & Perrone, D. (2019). *Water resources: Science and society*. Johns Hopkins University Press.

M.F

ENVR-6143	Soil and Environment	3(3-0)

Course Brief:

This course provides an in-depth understanding of soil as a critical component of the environment, focusing on its formation, properties, functions, and interactions with geological and environmental systems. It explores soil genesis, classification, and degradation while emphasizing the role of geology in soil development. Students will learn how soils influence water resources, ecosystems, agriculture, and land-use planning. The course also examines human-induced soil degradation, erosion, pollution, and conservation strategies, providing practical knowledge on sustainable soil management in the context of environmental geology.

Course Learning Outcomes:

On completion of this course, students will have a comprehensive understanding of soil formation, classification, and its relationship with geology and environmental systems. They will be able to analyze soil properties, assess soil degradation causes, and explore sustainable management strategies for soil conservation. Students will also gain practical skills in soil mapping, erosion control, and land-use planning while understanding the impacts of climate change, deforestation, and urbanization on soil health. This course will equip students with scientific and applied knowledge to address soil-related environmental challenges and promote sustainable land-use practices.

Course Contents:

1. Introduction to Soil and Its Environmental Importance
2. Soil Formation and Classification
3. Soil Properties and Processes
4. Soil and Water Interactions
5. Soil Degradation and Conservation
6. Soil Pollution and Remediation
7. Soil and Climate Change
8. Soil and Land-Use Planning
9. Applied Soil Science and Environmental Geology.

Recommended Texts:

1. Hakeem, K. R., Akhtar, J., & Sabir, M. (Eds.). (2016). Soil science: agricultural and environmental prospectives. Springer.
2. Wild, A. (2010). Soils and the Environment. Cambridge university press.
3. Goss, M. J., & Oliver, M. A. (Eds.). (2023). Encyclopedia of Soils in the Environment. Elsevier.

Suggested Readings:

1. Sparks, D. L., Singh, B., & Siebecker, M. G. (2022). Environmental soil chemistry. Elsevier.
2. Gardiner, D. T., & Miller, R. W. (2004). Soils in our environment (pp. 126-165). NJ.

M.F

ENVR -6144	Urban Environmental Management	3(3-0)

Course Brief:

This course provides an overview of urban environmental challenges and the management strategies required to create sustainable and resilient cities. It focuses on pollution control, waste management, urban planning, climate resilience, and green infrastructure. The course equips students with the knowledge and tools to address environmental issues in urban settings through policy-making, planning, and sustainable practices.

Course Learning Objectives:

By the end of this course, students will gain a comprehensive understanding of key environmental challenges in urban areas and explore sustainable planning and management techniques. They will analyze policies and strategies for waste management, air quality control, and water resource management while examining real-world case studies of successful urban environmental initiatives. Additionally, students will develop critical skills to assess environmental impacts and propose sustainable solutions for urban development.

Course Contents:

1. Introduction to Urban Environmental Management
2. Urbanization and Environmental Challenges
3. Sustainable Urban Planning
4. Air and Water Pollution Management in Cities
5. Waste Management Strategies
6. Green Infrastructure and Smart Cities
7. Climate Change and Urban Resilience
8. Public Policy and Governance in Urban Environmental Management

Recommended Texts:

1. Alberti, M. (2008). *Advances in Urban Ecology: Integrating Humans and Ecological Processes in Urban Ecosystems*. Springer.
2. White, R., & Whitney, J. (1992). *Environmental Planning and Management*. Routledge.
3. UN-Habitat (2016). *Urbanization and Development: Emerging Futures*. United Nations.

Suggested Readings:

1. Newman, P., & Kenworthy, J. (2015). *The End of Automobile Dependence: How Cities are Moving Beyond Car-Based Planning*. Island Press.
2. Pelling, M. (2011). *Adaptation to Climate Change: From Resilience to Transformation*. Routledge.
3. Satterthwaite, D. (2009). *The Earthscan Reader in Sustainable Cities*. Earthscan.

ENVR-6145	Pollutant Movement in Soil	3(3-0)

Course Brief:

Understanding how pollutants move within water systems is crucial for environmental science. Pollutants originate from point sources, like industrial discharges, and nonpoint sources, such as agricultural runoff. Once introduced, these substances are transported through processes like advection, diffusion, and sorption. Factors such as chemical properties, environmental conditions, and hydrological features influence their behavior. The movement of pollutants can lead to ecosystem damage and pose risks to human health.

Course Learning Objectives:

This course explores the processes influencing pollutant movement in soil, including adsorption, leaching, and biodegradation. Students will analyze soil properties, groundwater interactions, and contamination risks while developing remediation strategies for sustainable land management.

Course Contents:

1. Sources, classification and characteristics of pollutants;
2. Water movement in soil: Saturated and unsaturated flow;
3. Convection, dispersion, and hydrodynamic diffusion of pollutants;
4. Solute transport parameters;
5. Movement of volatile pollutants; Movement of adsorbing and inert pollutants;
6. Adsorption isotherms; Pollutant breakthrough curves and their application;
7. Movements of NO3, pesticides and heavy metals in soil and groundwater.
8. First order decay and pollutant movement;
9. Half-life of various

Recommended Texts:

1. Jury, W.A. and R. Horton. 2004. *Soil Physics*. Academic Press, Boca Raton, FL, USA.
2. Young, R.N., A.M.O. Mohammed and B.F. Warkentin. 1992. *Principles of Contaminant Transport in Soils*. Elsevier Publishers, Tokyo, Japan.

Suggested Readings:

1. Kennish, M.J. 1992. *Ecology of Estuaries: Anthropogenic Effects*. CRC Press, Boca Raton, FL, USA.
2. Spellman, F.R. 2021. *The Science of Environmental Pollution*. CRC Press, Boca Raton, FL, USA.

ENVR-6146	Energy and Environment	3(3-0)

Course Brief:

The course aims to provide the physical principles behind energy, its generation, sources, uses, and effects on our environment. It highlights the environmental impact of energy production and use and discusses viable alternatives.

Course Learning Objectives:

The course will provide an understanding of various energy resources and their environmental implications. Furthermore, it will enhance students' knowledge of alternative and renewable energy sources and their role in sustainable development.

Course Contents:

1. Introduction: Energy Units, forms, and types of energy, energy resources, energy use and growth patterns, energy conversion, energy use in developing countries and losses.
2. Energy Mix: Coal Characteristics; Problems associated with Mining, Transportation, and use.
3. Petroleum: History and Processing; Problems associated with petroleum production, transportation, and storage.
4. Energy Conversion: Electric Power Generation.
5. Hydroelectricity: Environmental Issues during Survey, Population Displacement, and Construction.
6. Nuclear Energy: Nuclear Fission; Electromagnetic Spectrum, Solar Spectrum, Light Intensity at Earth.
7. Problems with Energy Resources: Wood, Coal, and Fossil fuels; Local and Global issues.
8. Ecological Effects of Large Dams; Spent Nuclear Fuel Disposal Issues; Nuclear Accidents (Three-Mile Island, Chernobyl, Fukushima, etc.).
9. Renewable Energy Sources: Microhydel, Wind, Solar Thermal, Photovoltaic, Biogas, etc.
10. Novel Energy Sources: Biofuels, Geothermal, Wave, Tidal.
11. Hydrogen as an Energy Carrier, Fuel Cells, Hybrid Vehicles.

Recommended Texts:

1. Hinrichs, R., & Kleinbach, M. H. (2002). *Energy: Its use and the environment.* 5th Edition.
2. Quaschning, V. (2010) *Renewable Energy and Climate Change*, Wiley-IEEE,

Suggested Readings:

1. Coley, D. (2010) *Energy and Climate change*, 2nd Edition, John Wiley, 2008 4. R. Ristinen and J.K. Kraushaar, Energy and Environment, John Wiley,
2. Boyle, G. (2004). *Renewable Energy*. Oxford University Press.

M.F

ENVR-6147	Environmental Profile of Pakistan	3(3-0)

Course Brief:
Students in this course will become familiar with the Environmental Issues in Pakistan. As a result of Pakistan's economic expansion, its natural resources have been degrading and becoming more polluted. The macro environmental effects of water logging, land degradation, and desertification are all on the rise, as is air pollution and water toxicity.

Course Learning Objectives:
To provide students with a comprehensive knowledge about the environmental resource base of Pakistan in order to learn its efficient utilization for sustainable development.

Course Contents:
1. Introduction to history of the region
2. Features: land, geography, people
3. Culture, health, education
4. Ecological: ecological zones
5. Major ecosystems
6. Topographic zones
7. Economic: agriculture
8. Industry
9. Water resources
10. Urbanization and pollution

Recommended Texts:

1. Almusaed, A., Almssad, A., Homod, R. Z., & Yitmen, I. (2020). Environmental profile on building material passports for hot climates. *Sustainability*, *12*(9), 3720.
2. State of the Environment-Pakistan (2005) Government of Pakistan.

Suggested Readings:

1. Khan, A. N., & Shaw, R. (Eds.). (2015). *Disaster risk reduction approaches in Pakistan*. Springer Japan, 281-94.
2. Hussain, M. (1999). Environmental Legislation in Pakistan. In *Australasian Environmental Engineering Conference (1999: Wellington, NZ)* (pp. 119-123). Wellington, New Zealand: Institution of Professional Engineers New Zealand.

M.F

ENVR-6148	Environmental Biology	3(2-1)

Course Brief:

In this course students will get familiar with an overview of the biological and ecological principles required to comprehend environmental concerns, as well as an introduction to environmental biology. Perspectives from around the world, the country, and the neighbourhood on contemporary problems like resource consumption, pollution, biodiversity loss, and the effects of population increase.

Course Learning Objectives:

The objective of this course is to provide knowledge the molecular basis of life to give a foundation for understanding the biochemical principles of structure and function of a living system as unity of life.

Course Contents:

1. Introduction: definition and concept of life,
2. Chemical basis of structure and function of cell,
3. Chemical diversity of functional groups.
4. Molecular basis of life: carbohydrates,
5. Lipids,
6. Proteins,
7. Phospholipids in membrane systems,
8. Polypeptides in protein diversity,
9. Enzymes as molecular tools in chemical transformations nucleic acids the molecule of genetic information,
10. Replication and protein synthesis.
11. Overview of structure
12. Function of cell organelles
13. Cell cycle.

Practical Work:

Identification of chemical nature of different animal and plant materials. Cytochemical demonstration of DNA and RNA in Avian blood and Protozoa. Biochemical tests for carbohydrates, proteins and lipids. Protein digestion by enzyme pepsin. Study of mitosis in onion root tips. Study of meiosis in Grasshopper's testis.

Recommended Texts:

1. Fisher, M. R. (2017). Environmental Biology. Open Oregon Educational Resources.
2. Hilleman, T. B. (2009). Environmental Biology. CRC Press.

Suggested Readings:

1. Jones, A. M. (2006). Environmental biology. Routledge.
2. Bhatia, A. L. (2010). Textbook of environmental biology. IK International.

M.F

ENVR - 6149	Climate Change: Mitigation and Adaptation	3(3-0)

Course Brief:

This course equips students with an advanced understanding of how climate change is affecting societies and ecosystems globally. Students will analyze mitigation strategies to reduce greenhouse gas emissions, explore practical adaptation techniques for living in a warming world, and evaluate emerging technological solutions such as artificial intelligence and geoengineering. The course uses real-world examples, particularly from energy, agriculture, infrastructure, and health sectors, to help students connect theory with global and local responses to climate challenges.

Course Learning Objectives (CLOs):

By the end of this course, students will be able to:

1. Analyze the environmental, societal, and economic impacts of climate change globally and in Pakistan.
2. Evaluate key mitigation strategies in different sectors, including energy, industry, buildings, transport, and agriculture.
3. Identify and assess adaptation strategies to manage the risks of climate-related extreme events, water scarcity, health threats, and displacement.
4. Explore the role of emerging technologies, such as artificial intelligence and geoengineering, in climate change mitigation and adaptation.
5. Discuss global and local energy transition pathways toward low-carbon futures.
6. Critically examine ethical and equity considerations in global climate response efforts.

Course Contents:

Unit I: Course Orientation & Foundations

- Course structure, expectations, and assessment methods
- Climate change: definitions and framing as a global challenge
- Introduction to mitigation and adaptation
- Getting to know climate change learners and perspectives

Unit II: Mitigation – Reducing Emissions Across Key Sectors

- What is mitigation and why it matters
- Sectoral GHG emissions: an overview
  - **Energy sector**: renewable energy options and barriers
  - **Industry**: decarbonization, circular economy
  - **Agriculture and land use**: soil carbon, reforestation
  - **Transportation**: electrification, mass transit
  - **Buildings**: insulation, energy efficiency
- Barriers to action and global cooperation

Unit III: Adaptation – Living in a Warming World

- Understanding climate risks: extreme weather, sea-level rise
- Health impacts: diseases, heat stress, health systems adaptation
- Food and water security

M.F

- Infrastructure and economic adaptation
- Displacement, migration, and social equity
- National and local adaptation planning (e.g., NDMA, GLOF II)

Unit IV: Energy Transition and Decarbonization

- Energy basics and GHG emissions
- Decarbonizing electricity: wind, solar, hydro
- Clean electrification of other sectors (e.g., transport)
- National energy plans (Pakistan's NDCs, CPEC's green transition)
- Policy tools for decarbonization (carbon pricing, subsidies, regulation)

Unit V: Emerging Climate Technologies

- History of climate-related technologies
- Artificial intelligence for mitigation and adaptation
- Risks and potentials of AI in climate models and management
- Geoengineering: solar radiation management, carbon dioxide removal

Unit VI: Final Review and Future Engagement *(Based on Module 6)*

- Summary of mitigation and adaptation strategies
- Individual reflections on learning
- Continuing education and advocacy in climate change
- Final assessment: comprehensive exam and/or project (e.g., climate policy brief)

Recommended Textbooks:

- **UNDP (2017).** *Climate Box: An Educational Toolkit on Climate Change.*
- IPCC. *Synthesis Report on Climate Change* (Latest Edition)
- Dessler, A. E. (2021). *Introduction to Modern Climate Change*. Cambridge University Pres

Suggested Readings:

- Ministry of Climate Change, Pakistan. *Updated NDC (2021)* and *Climate Change Act (2017)*

M.F

ENVR - 6150	Artificial Intelligence (AI) and Climate Change	3(3-0)

Course Brief:

This course explores the intersection of Artificial Intelligence (AI) and Climate Change by introducing students to key concepts in climate science, mitigation, and adaptation, and demonstrating how AI technologies such as machine learning, time series analysis, and computer vision can support climate action. Students will work with real-world datasets, forecast renewable energy outputs, and apply image classification techniques to monitor biodiversity. Practical lab components will allow students to build basic AI models relevant to climate-related problems.

Course Learning Objectives (CLOs):

By the end of this course, students will be able to:

1. Explain the mechanisms and consequences of anthropogenic climate change.
2. Analyze the potential of AI to support climate change mitigation (e.g., forecasting renewable energy) and adaptation (e.g., biodiversity monitoring).
3. Apply machine learning techniques such as time series modeling and transfer learning in climate-related case studies.
4. Work with datasets in Jupyter Notebooks to visualize, process, and interpret environmental data.
5. Understand the ethical considerations, limitations, and governance of AI applications in the climate context.

Course Contents:

Unit I: Introduction to AI and Climate Change

- Overview of AI applications in climate action
- What is climate change? Causes and global temperature trends
- Impacts of climate change on ecosystems and weather
- Introduction to Jupyter Notebooks for lab work
- Lab: Visualizing global temperature change using historical data

Unit II: Case Study – AI for Wind Power Forecasting

- The challenge of integrating wind power into energy grids
- AI for Good Framework
- Data exploration and visualization of wind energy datasets
- Building baseline models and training neural networks
- Sequence modeling and 24-hour forecast accuracy
- Lab: Forecasting wind energy using time series models

Unit III: Case Study – Biodiversity Monitoring using Computer Vision

- Climate change and biodiversity loss
- Role of biodiversity in ecosystem resilience
- Image data analysis and visual pattern recognition
- Lab: Exploring and visualizing Karoo biodiversity dataset

M.F

Unit IV: Deep Learning for Climate Applications

- Convolutional Neural Networks (CNNs) and pre-training
- Transfer learning for low-data environments
- MegaDetector and object detection pipelines
- Ethical and practical concerns in AI deployment for conservation
- Guest insights (e.g., Priya Donti) on ML for climate action
- Lab: Fine-tuning a biodiversity classification model

Laboratory Component (Practical Sessions):

Each unit includes hands-on lab sessions using Python in Jupyter Notebooks. Students will:

- Access and clean environmental datasets
- Visualize time series and image data
- Build and evaluate simple AI models
- Work in small groups to implement climate-tech solutions

Recommended Textbooks:

1. Mohanty, S. N., Satpathy, S., Agarwal, N., & Mahapatra, S. S. (2024). *AI for Climate Change and Environmental Sustainability*. In Artificial Intelligence Applications in Environmental and Climate Change Management. Springer.

Suggested Readings:

1. Agarwal, N., Satpathy, S., Mahapatra, S. S., & Mohanty, S. N. (2024). *AI for Climate Change and Environmental Sustainability*. CRC Press

M.F

CHAIRMAN
Department of Earth

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.

M.F

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.

M.F

CHAIRMAN
Department of Earth

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

URCM – 5108	Mathematics II	3(3-0)

Course Brief:

Calculus is the mathematical study of continuous change. It has two major branches, differential calculus and integral calculus. Both branches make use of the fundamental notions of convergence of infinite sequences and infinite series to a well-defined limit. Modern calculus is considered to have been developed in 17th century .

Course Learning Objectives:

This course in calculus is a gateway to other, more advanced courses in mathematics devoted to the study of functions and limits, broadly called mathematical analysis. Calculus is used in every branch of the physical sciences, actuarial science, computer science, medicine, demography, and in other fields. It allows one to go from rates of change to the total change or vice versa, and many times in studying a problem we know one and are trying to find the other. This course aims to provide students with the essential concepts of mathematics and how these can be employed for analyzing real data.

Course Contents:

1. Preliminaries
2. Real-number line
3. Functions and their graphs
4. Solution of equations involving absolute values, inequalities.
5. Limits and Continuity
6. Limit of a function
7. Left-hand and right-hand limits
8. Continuity
9. Continuous functions.
10. Derivatives and their Applications
11. Differentiable functions
12. Differentiation of polynomial
13. Rational and transcendental functions, derivatives.
14. Integration and Definite Integrals
15. Techniques of evaluating indefinite integrals
16. Integration by substitution, integration by parts
17. Change of variables in indefinite integrals.

Recommended Texts:

1. Thomas, G. B., & Finney, A. R. *(2005). Calculus.* Reading: Addison-Wesley.
2. Anton, H., Bevens. L, & 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.

M.F

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.* (11th 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.

M.F

CHEM-5102	Inorganic Chemistry	3 (3-0)

Course Brief:

This course covers a range of general topics of inorganic chemistry. It will provide a useful supplement to the advanced courses specified in the department. This course aims to enable the students to achieve the advance knowledge about the key introductory concepts of chemical bonding, acid-base chemistry, and properties of the representative and transition elements, as well as using this knowledge for qualitative and quantitative analysis of inorganic compounds during laboratory work. Learning objectives emphasized in CHEM 5102 involve developing an understanding of basic principles of inorganic chemistry.

Course Learning Objectives:

It develop critical thinking skills enabling students to solve chemistry problems that incorporate their cumulative knowledge. Students learned in class to modern chemistry techniques which give them opportunities to upgrade their knowledge about advanced inorganic concepts. The essence of this course is to develop study skills that students need to succeed in university-level chemistry courses and preparation of students for professional positions in chemistry.

Course Contents:

1. Periodic Table and Periodicity of Properties
2. Redox potential, electrochemical series and its applications. Corrosion and electroplating.
3. Acid Base Equilibria: Acids and bases, relative strengths of acids, pH, pKa, pKb.
4. Hard and soft acid and Bases. SHAB Principle and its application.
5. Buffers, types buffer, Preparation, Buffer capacity and applications of buffers.
6. Chemical Bonding, VBT, MOT, VSEPR. Special types of bonds
7. Chemistry of p-Block Elements
8. Production of pure silicon chips for solar energy cells.
9. Chemistry of d-Block Elements Werner's theory, VBT, MOT and CFT
10. Isomerism in coordination compounds.
11. Chelates, Classification and applications
12. Separation Techniques: General introduction and Applications
13. Principle, brief instrumentation(Flame emission, Atomic Absorption, IR and UV/Vis).
14. Metallurgy of Al, Cr and U, fertilizers (Urea and Phosphate fertilizers) Cement and Sugar.

Recommended Texts:

1. Iqbal, M. Z. (2015). *Text book of inorganic chemistry.* Lahore: Ilmi Kitab Khana
2. Lee, J. D. (1996). *Concise inorganic chemistry.* (5th ed.). UK: Chapman and Hall

Suggested Readings:

1. Graham, H., & Man, H. (2000). *Chemistry in context.* (5th ed.). UK: Thomas Nelson Ltd.
2. Philp, M. (1996). Advance chemistry. UK: Cambridge Publishing.

M.F

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* (10th ed.). New York: Wiley.
2. Halliday, D., Resnick, R. & Krane, K. S. (2003). *Physics* (5th ed.). New York: Wiley.

Suggested Readings:

1. Young, H. D., Freedman, R. A. & Ford, A. L. (2019). *University physics* (15th ed.). New York: Pearson.
2. Serway, R. A. & Jewelt, J. W. (2014). *Physics for scientist and engineers* (9th ed.). New York: Brooks/Cole.
3. Melissinos, A.C. (2003). *Experiments in modern physics*. New York: Academic press.

M.F

STAT-5121	Introduction to Statistics	3(3-0)

Course Brief:

This course is designed for under-graduate level. Statistical analysis is a basic requirement in order toanalyze the phenomenon related to all sectors.

Course Learning Objectives:

This course aims to produce skills related to descriptiveas well as inferential statistical analysis. Use of descriptive, inferential, regression, sampling statisticshas vital importance to analyze and decision making theories related to agriculture, economics andbusiness statistics etc.

Course Contents:

1. Introduction to Statistics: Descriptive and Inferential Statistics,
2. Limitations of Statistics
3. Scope of Statistics
4. Variable, Data, Types of Variable and Data, Scales of Measurements.
5. Display of Data: Tabulation of Data, Graphical Display, Histogram, Bar Charts, Pie Chart,
6. Stem and Leaf Plots.
7. Measures of Central Tendency: Mean Median, Mode, Box Plot, and Application in Real Life.
8. Measures of Dispersion: Range, Quartile Deviation, Mean Deviation, Variance and Standard
9. Deviation, Coefficient of Variation, Z-score and their Application.
10. Normal Distribution: Normal Distribution and its Application,
11. Sampling and Sampling Distribution.
12. Estimation:
13. Hypothesis Testing
14. Regression and Regression Analysis: Simple Linear Regression, Multiple Regression, Fitness
15. Model.
16. All the observational analysis will be carried out using MS Excel and SPSS.

Recommended Texts:

1. Chaudhry, S.M. &Kamal,S.(2010). *Introduction to statistical theory.* (Parts I &II). Lahore: IlmiKitabKhana.
2. Walpole,R.E.,Mysters,R.H. & Myers,S.L.(1998). *Probability and statistics for engineers andscientists.* New York: Prentice Hall.

Suggested Readings

1. Mclave, J.T., Benson, P.G.& Snitch.(2005).*Statistics for business & economics.*New Jersey: Prentice Hall.
2. Spiegel, M.R., Schiller, J.L. &Srinivasan, R.L. (2000) Probability and statistics. New York: McGraw Hill
3. Clark, G. M.,& Cooke, D. (1998). Basic course in statistics. London: Arnold.

M.F

CHAIRMAN

GEOG – 5109	Climatology	3(3-0)

Course Brief:

The course provides an overview of the physical processes responsible for determining global and regional climate. This course gives a general introduction to meteorology and climatology. Meteorology topics include energy balance, moisture and cloud development in the atmosphere, atmospheric dynamics, small and large scale circulations, storms and cyclones, and weather forecasting. Climatology topics include the interaction between the atmosphere and oceans over long time periods, climate classification, and the potential for climatic change. It brings together information from rural communities, indigenous peoples and research workers on how they use agro- biodiversity to cope with climate change.

Course Learning Objectives:

It stimulates communication between agro-biodiversity researchers, users and maintainers. It identifies tools and practices relevant to using agro-biodiversity for coping with climate change and making these widely available. It also promotes awareness of the vital role of agro-biodiversity in adapting to climate change among key audiences, including donors, development agents and the global biodiversity community.

Course Contents:

1. Introduction.
2. Key concepts in climatology and meteorology.
3. Structure and composition of atmosphere.
4. Elements and factors of climate.
5. Insolation and Terrestrial heat budget.
6. Temperature distribution.
7. Humidity and its types; Condensation and their forms, Precipitation, formation and their types.
8. Atmospheric Pressure and global pressure belts.
9. Atmospheric Circulation: (Upper and Lower) air stability and instability, storms; Cyclones (hurricanes, typhoons) and tornadoes
10. Air masses and fronts.
11. Classification of climates; critical study of the Koppen, Miller and Thornthwaite classifications of major climates.
12. Climate variability and climate change: Natural and anthropogenic; Greenhouse gasses; global warming; acid rain, ozone layer depletion El-Niño and La-Niña, impact on precipitation distribution.
13. Climatic regions of Pakistan and their characteristics
14. Climatic data: sources, collection, analysis and presentation. Problems associated with data quality (spatial, temporal).

Recommended Texts:

1. Miller A. (2001). *Climatology*. Haryana: Shubhi Publications.
2. Barry. R. (1998). *Atmosphere, weather and climate*. London: Routledge.

Suggested Readings:

1. Shamshad, K.M. (1988). *The meteorology of Pakistan*. Karachi: Royal Book Co.
2. Strahler, A. N. (1998). *Elements of physical geography*. New York: John Wiley.
3. Diwan A. P. &Arora. D. K. (1995). *Origin of ocean*. New York: John Wiley.

M.F

GEOL - 5107	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 will help 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:

13. Introduction to environmental geology, management of natural resources, climatic changes.
14. Environmental controls for erosion, desertification and coastal degradation.
15. Introduction to environmental impact assessment and initial environmental examination.
16. Environmental impact of mining, dams, reservoirs.
17. Environmental impact of Highways, their assessment and controls.
18. Geological hazards such as floods, landslides.
19. Earthquakes, tsunamis, volcanoes.
20. Glaciers and shoreline processes and their remedial measures
21. Industrial pollution, solid and liquid waste disposal.
22. Groundwater contaminations.
23. River lake and marine pollution and their impact on human health.
24. 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:

5. Armand, N. A., & Polyakov, V. M. (2004). Radio propagation and remote sensing of the environment. New York: CRC Press.
6. Pipkin, B. W., Trent, D. D., Hazlett, R., & Bierman, P. (2013). Geology and the Environment. Boston: Cengage Learning.

M.F

GEOG-6118	Environmental Geography	3(3-0)

Course Brief:

In this subject of Geography, students will learn about the natural science, social science, and humanistic understandings of the Earth's environment. Environmental Geographers study the complex relationships between humans and the natural environment over time and through space. This course will provide a historical, geographical, and humanistic foundation for understanding the environment and the plethora of environmental issues that confront us at the beginning of this century.

Course Learning Objectives:

Major aim of this course is to produce environmentally aware students and to equip them with skills to enable them to become future decision-makers on environmental matters in whatever field they wish to pursue in the future. By studying this course students will be able to recognize what the issues are, and to view them from a geographic perspective. They will recognize the responsibilities they have in relation to other people, the environment, and sustainability, and there will be opportunities to initiate personal action.

Course Contents:

1. Evolution of Environmental Studies in Geography
2. Comparative Advantage of Geography
3. Concept of environmental management
4. Environment and Man interaction, Ecosystem, natural resources
5. Important Cycles
6. Population explosion, The human impact on the environment
7. Environmental hazards, Types of Hazards
8. Major Environmental hazards and Problems in Pakistan: Floods, Earthquake, Tsunami, Cyclones, Landslides, Droughts, Deforestation and Desertification
9. Water-logging and Salinity
10. Soil Erosion
11. Global Warming and ozone depletion
12. Environmental Pollution, Waste Management, Control and Mitigation Measures, Technology, awareness, Legislation, Ethics
13. Pakistan Environmental Act
14. National Conservation Strategy
15. National Environmental Quality Standard

Recommended Texts:

1. Arms, K. (2001). Environmental science. Philadelphia: Asunders College Publishing.
2. Basak, A. (2009). Environmental studies. New Delhi: Pearson.

Suggested Readings:

1. Botkin, D. B. & Edward A. K. (2012). Environmental science. Hoboken: John Wiley & Sons
2. Burton, I. R., W. Kates & Gilbert. F. W. (2000). The environment as hazard. Karachi. Oxford University Press.

MATH-6139	Fluid Mechanics-I	3(3-0)

This course is the first part of the core level course on fluid mechanics. Fluid mechanics is the branch of physics concerned with the mechanics of fluids (liquids, gases, & plasmas) & the forces on them. It has applications in a wide range of disciplines, including mechanical, civil, chemical & biomedical engineering, geophysics, oceanography, meteorology, astrophysics, & biology. The course of fluid mechanics is introducing fundamental aspects of fluid flow behavior. Students will learn properties of Newtonian fluids; apply concepts of mass, momentum & energy conservation to flows.

Contents

1 Introduction: Definition of Fluid, basics equations
2 Methods of analysis, dimensions & units. Fundamental concepts
3 Fluid as a continuum, velocity field, stress field, viscosity, surface tension, description & classification of fluid motions
4 Fluid Statics: The basic equation of fluid static
5 The standard atmosphere
6 Pressure variation in a static fluid
7 Fluid in rigid body motion. Basic equation in integral form for a control volume
8 Basic laws for a system
9 Relation of derivatives to the control volume formulation
10 Conservation of mass
11 Momentum equation for inertial control volume
12 Momentum equation for control volume with rectilinear acceleration
13 Momentum equation for control volume with arbitrary acceleration
14 The angular momentum principle
15 The first law of thermodynamics
16 The second law of thermodynamics
17 Introduction to differential analysis of fluid motion
18 Conservation of mass
19 Stream function for two-dimensional incompressible flow
20 Motion of a fluid element (kinematics), momentum equation

Recommended Texts

1. Fox, R. W.,& McDonald, A. T. (2004). *Introduction to fluid mechanics* (6th ed.). New York: John Wiley & Sons.
2. White, F. M. (2006). *Fluid mechanics* (5th ed.). New York: Mc. Graw Hill.

Suggested Readings

1. Granger, R. A. (1985). *Fluid mechanics* (1st ed.). Montana: Winston Publisher.
2. Bruce, R., Rothmayer, A. P., Theodore, H. O.,& Wade, W. H. (2013). *Fundamental of fluid mechanics* (7th ed.). New York: Wiley Son Publisher.
3. Nakayama, Y. (2018). *Introduction to fluid mechanics* (2nd ed.). Oxford: Butterworth Heinemann Publisher.

M.F

MATH-6140	Fluid Mechanics-II	3(3-0)

This course is the second part of the core level course on fluid mechanics. Fluid mechanics is concerned with the mechanics of fluids (liquids, gases, & plasmas) & the forces on them. This course covers properties of fluids, laws of fluid mechanics & energy relationships for incompressible fluids Studies flow in closed conduits, including pressure loss, flow measurement, pipe sizing & pump Selection, momentum equation for frictionless flow, Euler's equations, Bernoulli equation- Integration of Euler's equation, laminar flow & Boundary layers.

Contents

1 Incompressible inviscid flow
2 Momentum equation for frictionless flow
3 Euler's equations
4 Euler's equations in streamline coordinates
5 Bernoulli equation- Integration of Euler's equation along a streamline for steady flow
6 Relation between first law of thermodynamics & the Bernoulli equation
7 Unsteady Bernoulli equation-Integration of Euler's equation along a streamline
8 Irrotational flow, internal incompressible viscous flow
9 Fully developed laminar flow
10 Fully developed laminar flow between infinite parallel plates
11 Fully developed laminar flow in a pipe
12 Part-B Flow in pipes & ducts
13 Shear stress distribution in fully developed pipe flow
14 Turbulent velocity profiles in fully developed pipe flow
15 Energy consideration in pipe flow
16 External incompressible viscous flow
17 Boundary layers, the boundary concept, boundary thickness, laminar flat plate
18 Boundary layer: exact solution, momentum, integral equation,
19 Use of momentum integral equation for flow with zero pressure gradient
20 Pressure gradient in boundary-layer flow

Pre-requisite: Fluid Mechanics-I

Recommended Texts

1. Fox, R. W., & McDonald, A. T. (2004). *Introduction to fluid mechanics* (6th ed.). New York: John Wiley & Sons.
2. White, F. M. (2006). *Fluid mechanics* (5th ed.). New York: Mc. Graw Hill.

Suggested Readings

1. Bruce, R., Rothmayer, A. P., Theodore, H. O.,& Wade, W. H. (2013). *Fundamental of fluid mechanics* (7th ed.). New York: Willey Son Publisher.
2. Nakayama, Y. (2018). *Introduction to fluid mechanics* (2nd ed.). Oxford: Butterworth Heinemann Publisher.
3. Granger, R. A. (1985). *Fluid mechanics* (1st ed.). Montana: Winston Publisher.

M.F

CHAIRMAN

MATH-6134	Heat Transfer	3(3-0)

Heat transfer is a discipline of thermal engineering that concerns the generation, use, conversion, & exchange of thermal energy (heat) between physical systems. Heat transfer is classified into various mechanisms, such as thermal conduction, thermal convection, thermal radiation, & transfer of energy by phase changes. The objectives of heat transfer include the following: Insulation, wherein across a finite temperature difference between the system & its surrounding, the engineer seeks to reduce the heat transfer as much as possible. The learning outcomes of this course are: to explain the basics of heat transfer, to explain the importance of heat transfer, to define the concept of boiling & condensation, to define the concept of heat exchangers, to explain heat transfer by conduction, to explain the Fourier heat conduction law, to define thermal conductivity coefficient & diffusion coefficient, to explain heat transfer with convection, to explain Newton's law, to explain free transport phenomenon, to explain the forced convection, to explain heat transfer by radiation.

Contents

1 First law of thermodynamics
2 Second law of thermodynamics
3 Fourier's law of heat conduction
4 Newton's law of cooling
5 Energy equation
6 Steady-State Conduction-One Dimension
7 Steady-State Conduction-Multiples Dimensions
8 Unsteady-State Conduction,
9 Principles of Convection
10 Empirical & practical Relations
11 Forced –Convection Heat Transfer
12 Natural Convection Systems
13 Radiation Heat Transfer
14 Laminar forced flow over a flat plate
15 Thermal boundary layer on an isothermal flat plate
16 Thermal boundary layer on a flat plate with constant surface heat flux

Recommended Texts

1. Holman, J. P. (1996). *Heat transfer* (8th ed.). New York: McGraw Hill.
2. Kays, W. M.,& Crawford, M. E. (1993). *Convective heat & mass transfer* (3rd ed.). New York: McGraw Hill.
3. Sadik Kakac, and Yamman Yener. (1995). Convective heat transfer (2nd ed.). CRC Press United States of America

Suggested Readings

1. Incropera, F. P., & Dewitt, D. P. (1985). *Fundamentals of heat & mass transfer* (2nded). New York: Wiley.
2. Cenegel, Y., & Ghajar, A. J. (2015). *Heat & mass transfer: Fundamentals & applications*(5th ed.). New York: Mc-Graw Hill.
3. Lienhar IV, J. H., & Lienhar V, J. H. (2019). *A heat transfer textbook*(5th ed.). New York: Dover Publications.
4. Incropera, F. P. (2006). *Fundamentals of heat & mass transfer* (6th ed.). New York: John Wiley & Sons.

M.F

GEOL-6192	Introduction to Earth Sciences	3(3-0)

Course Brief:

In this course students will get familiar with physical Earth, its oceans, and the air that surrounds it is the subject of earth sciences. With the overarching goal of comprehending Earth's current features and historical evolution and applying this knowledge to benefit humanity, they comprise the geology, hydrologic, and atmospheric sciences.

Course Learning Objectives:

This course aims to provide knowledge about the basic concepts of geology and geography. This will help the student to get the knowledge about different types of rocks and minerals, the processes of their formation, different earth processes like mountain buildings, earthquakes, weathering and erosion. The students will also be introduced to work with different type of maps and GPS system.

Course Contents:

1. Major components of Earth Systems: earth systems and their characteristics, Geologic Time and processes, Geology as an historical science, scientific methods and study of Earth's evolving systems.
2. Earth Systems: Processes and Interactions-Earth Solid System: components and processes, Rock cycle: Igneous rocks, Sedimentary rocks and Metamorphic rocks.
3. The Hydrosphere–hydrologic cycle, Ocean circulations, the Biosphere–Biogeography, Energy relationships, biogeochemical cycles.
4. Sedimentary rocks and fossils, processes of weathering, Biogenic sedimentary rocks, Chemical sedimentary rocks, Marine environments, Coral Reefs, Continental Shelves.
5. Terrestrial Environments: Forests, Deserts, Glaciers and Lakes. Time and Stratigraphy:
6. Introduction, Relative ages, Absolute ages, Evolution of Geologic time scale, why sea level is so important.
7. Plate tectonics, structure of earth, hypothesis of continental drift, continental margins and plate boundaries types, features and behaviours, tectonic cycles.
8. The Dynamic Earth and Natural Hazards: Earth Quake and Volcanoes
9. Land instability, Weather Hazards, Fires and Costal Hazards, Humans and the Environment
10. Introduction to Holocene, sea level rise, Rapid climate change: at Millennial time scale, at Continental time scale and at Multidecadal time scales.

Recommended Texts:

1. Martin, R. (2013). *Earth's evolving systems: the history of planet Earth*. Jones & Bartlett Publishers.
2. Worden, S. (2015). The Earth sciences and creative practice: Entering the Anthropocene. In *Handbook of Research on Digital Media and Creative Technologies* (pp. 110-140). IGI Global.

Suggested Readings:

1. Wicander, R., and Monroe, J. (2007) Historical geology: Evolution of Earth and Life Through Time, 5thEdition, Brooks/Cole.
2. Trauth, M. H., Gebbers, R., Marwan, N., & Sillmann, E. (2007). *MATLAB recipes for earth sciences* (Vol. 34). Berlin: Springer.

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