

Minutes of the 32nd
Special Meeting of the Board of Studies
Faculty of Engineering Sciences
held on
3rd October 2023
through VLC



Bahria University Islamabad

Minutes of the 32nd FBOS – ES
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**Minutes of the 32nd Special Meeting of Faculty Board of Studies
Engineering Sciences held on 3rd October 2023 through VLC**

Attendance:

BUIC

Prof. Dr. Faisal Bashir Hussain	Dean ES	Chair
Snr. Assoc. Prof. Dr. Said Akbar Khan	HoD(E&ES)	Member
Snr. Assoc. Prof. Dr. Arif ur Rehman	HoD (CS)	Member
Snr. Assoc. Prof. Dr. Awais Majeed	HoD (SE)	Member
Prof. Dr. Shahzad Khalid	HoD (CE)	Member
Assoc. Prof. Dr. Junaid Imtiaz	HoD (EE)	Member

BUKC

Assoc. Prof. Dr. Mukesh Kumar Maheshwari	HoD (EE)	Member
Assoc. Prof. Dr. Salma Hamza	HoD (E&ES)	Member
Assoc. Prof. Dr. Syed Safdar Ali	HoD (CS)	Member
Snr. Assoc. Prof. Dr. Sohaib Ahmad	Associate Dean	Member
Snr. Asst. Prof. Dr. Shoaib Mughal	HoD (CE)	Member
Snr. Assoc. Prof. Dr. Hina Shakir	HoD (SE)	Member

BULC

Snr. Asst. Prof. Dr. Khawaja Qasim Maqbool	HOD (CS)	Member
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Proceedings

Preliminaries

FBoS-ES meeting took place on 3rd October 2023, with the quorum complete, the proceedings commenced at 0930 hours, with recitation from the Holy Quran.

In his opening remarks, the Chair stressed the importance for participation in the proceedings while staying focused on the point under deliberation.

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Item3201: Updated Roadmaps according to HEC UG Policy of BS Environmental Sciences, Geology, Geophysics, RS & GIS.

Sponsor: HOD CS

Referral Authority: FBOS ES

Summary of the Case

- The new HEC UG policy has been launched recently.
- Roadmaps of all UG programs of ES are required to be aligned according to this new policy.
- Capstone and Fieldwork was reduced to 3 credit hours from 6.

Discussion

The sponsor presented the agenda point. The house had a detailed discussion on using unified course codes for interdisciplinary courses. The chair recommended using CS course codes for Computing Courses in ES roadmaps attached at appendage 3201.

Decision 3101

The case to be forwarded for ratification in ACM.

Item3202: Updated Roadmaps according to HEC UG Policy of BS CS, IT, AI, and ADP CS

Sponsor: HOD CS

Referral Authority: FBOS ES

Summary of the Case

- The new HEC UG policy has been launched recently.
- Roadmaps of all UG programs of BS CS, IT, and AI are required to be aligned according to this new policy attached at appendage 3202.
- ADP CS Roadmap should be the same as first four semesters of BSCS for exit strategy of BS CS students to ADP CS and entry for ADP students to CS program in fifth semester.

Discussion

The sponsor presented the agenda point. The chair recommended adding SDGs to the proposed Roadmap of CS, IT and AI at appendage 3202.

Decision 3202

The case to be forwarded for ratification in ACM.

Item3203: Updated Roadmaps according to HEC UG Policy of BEE, and BS R & IS

Sponsor: HOD EE

Referral Authority: FBOS ES

Summary of the Case

- Conformance of new HEC UG Policy with PEC Policy for BEE.
- Roadmaps of BEE and BS Robotics and Intelligent Systems are required to be aligned according to this new policy attached at appendage 3203.

Discussion

The sponsor presented the agenda point. The house had a detailed discussion on changing Functional English from 2 credit hour to 3 credit hour course with the fee adjusted in later semester for the Fall-23 Intake students of BEE.

Decision 3203

The case to be forwarded for ratification in ACM.

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Item3204: Updated Roadmaps according to HEC UG Policy of BCE

Sponsor: HOD Ce

Referral Authority: FBOS ES

Summary of the Case

- Conformance of new HEC UG Policy with PEC Policy for BCE.
- The Roadmap of BCE is required to be aligned according to this new policy attached at appendage 3204.

Discussion

The sponsor presented the agenda point. The chair recommended addition of SDGs to the roadmap.

Decision 3203

The case to be forwarded for ratification in ACM.

Item3205: Updated Roadmaps according to HEC UG Policy of BSE

Sponsor: HOD SE

Referral Authority: FBOS ES

Summary of the Case

- Conformance of new HEC UG Policy with PEC Policy for BSE.
- The Roadmap of BCE is required to be aligned according to this new policy attached at appendage 3205.

Discussion

The sponsor presented the agenda point. The chair recommended the addition of PEC compliance and summary of credit hours to the roadmap.

Decision 3205

The case to be forwarded for ratification in ACM.

Item3206: Updated Roadmaps according to HEC PhD Policy of PhD ES, Geology and Geophysics

Sponsor: HOD E&ES

Referral Authority: FBOS ES

Summary of the Case

- The new HEC UG policy has been launched recently.
- The Roadmaps of PhD Environmental Sciences, Geophysics and Geology are required to be aligned according to this new policy attached at appendage 3206.

Discussion

The sponsor presented the agenda point insisting on that their current roadmap is in compliance with the new HEC Policy. All their courses were already of 800 series. In PhD Geology 1 new course of level 800 series is introduced. The chair recommended addition of SDGs to the roadmap.

Decision 3206

The case to be forwarded for ratification in ACM.

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Item3207: Updated Roadmaps according to HEC PhD Policy of PhD CS

Sponsor: HOD CS

Referral Authority: FBOS ES

Summary of the Case

- The new HEC UG policy has been launched recently.
- The Roadmap of PhD CS to be aligned according to this new policy attached at appendage 3207.
- Level 700 series course codes were updated to level 800.

Discussion

The sponsor presented the agenda point. The house had a detailed discussion on level 800 course codes and the inconsistencies across ES programs. The chair recommended a new course for all Engineering Sciences PhD programs ESC 801 Research Methods in PhD Studies.

Decision 3207

The case to be forwarded for ratification in ACM.

Item3208: Updated Roadmaps according to HEC PhD Policy of PhD Mathematics

Sponsor: Dr. Ramzan

Referral Authority: FBOS ES

Summary of the Case

- The new HEC UG policy has been launched recently.
- The Roadmap of PhD Mathematics to be aligned according to this new policy attached at appendage 3208.
- Level 700 series course codes were updated to level 800.

Discussion

The sponsor presented the agenda point. The chair recommended adopting THS 900 course code for thesis and drop MAT 900.

Decision 3208

The case to be forwarded for ratification in ACM.

Item3209: Updated Roadmaps according to HEC PhD Policy of PhD CE

Sponsor: HOD CE

Referral Authority: FBOS ES

Summary of the Case

- The new HEC UG policy has been launched recently.
- The Roadmap of PhD CE to be aligned according to this new policy attached at appendage 3209.
- Level 700 series course codes were updated to level 800.

Discussion

The sponsor presented the agenda point. The house had a detailed discussion on the nomenclature of the Level 800 series. The chair advised against overusing the word Advanced in course titles.

Decision 3209

The case to be forwarded for ratification in ACM.

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Item3210: Updated Roadmaps according to HEC PhD Policy of PhD EE

Sponsor: HOD E&ES

Referral Authority: FBOS ES

Summary of the Case

- The new HEC UG policy has been launched recently.
- The Roadmap of PhD EE to be aligned according to this new policy attached at appendage 3210.
- Level 700 series course codes were updated to level 800.

Discussion

The sponsor presented the agenda point. The house had detailed discussion on offering admission to interdisciplinary scholars. The chair recommended deficiency courses for interdisciplinary scholars which will be decided by the admission committee.

Decision 3210

The case to be forwarded for ratification in ACM.

Item3211: Updated Roadmaps according to HEC PhD Policy of PhD SE

Sponsor: HOD E&ES

Referral Authority: FBOS ES

Summary of the Case

- The new HEC UG policy has been launched recently.
- The Roadmap of PhD SE to be aligned according to this new policy attached at appendage 3211.
- Level 700 series course codes were updated to level 800.

Discussion

The sponsor presented the agenda point. The chair suggested addition of SDGs to the new and old courses and provide course content for the new courses of level 800 series.

Decision 3211

The case to be forwarded for ratification in ACM.

Closing of the Meeting

There being no further points, the Chair brought the meeting to a close, thanking the participants for their wholehearted participation in both sessions.

Prof. Dr Faisal Bashir Hussain
Dean (ES), Head FBOS
3rd October 2023

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Distribution:

BUHQ:	Rector, Pro-Rector, Registrar DAA
BUKC:	DG BUKC, DKC HOD(EES)

Appendages:**Appendage 3201**

**Roadmap of BS Environmental
Sciences, Geology, Geophysics, RS &
GIS**

**Academic Road Maps of UG Program
Faculty of Engineering Sciences**

Program Title: BS Environmental SciencesDuration: 4 YearsTotal Credit Hours: 132

Endorsement References:

- A: Recommendations of CAC dated 22-Mar-23
- B: Recommendations of DBOS dated 09-Aug-23
- C: Recommendations of FBOS dated 04-Sep-23

Summary of Credit Hours

Sr. No.	Category as per HEC new UG Policy	Credit Hours/Contact Hours	
		Existing Road Map	Proposed New Road Map
1.	General Education (Mandatory)	31	33
2.	Major/Disciplinary (Mandatory)	92	81
3.	Interdisciplinary (Mandatory)	3	12
4.	Electives toward specialization	-	-
5.	Tajweed, Quran and Hadith (Compulsory – non-credit course, only for Muslim Students)	-	8 Contact Hours (non-credited)
6	Field Experience	3	3
7.	Capstone Project (Mandatory)	6	3
8	Double Major (Optional)	-	-
9.	Minor (Optional)	-	-
Total		135	132

Program Educational Objectives (PEOs)

1. **PEO-1:** Function successfully in a professional environment by utilizing and enhancing their problem-solving and communication skills.
2. **PEO-2:** Continued learning through advanced professional education or through certifications whenever possible.
3. **PEO-3:** Promote organizational success with efficient leadership skills, and demonstrate ethical and societal awareness, while practicing and promoting professional behavior towards a sustainable environment.

Program Learning Outcomes (PLOs)

1. **PLO-1 Scientific Knowledge:** Ability to apply fundamental knowledge of environmental sciences to the solution of complex environmental problems.
2. **PLO-2 Problem Analysis:** Ability to identify, formulate, research literature, and analyze complex environmental problems reaching verified conclusions.
3. **PLO-3 Design and Development:** Ability to design solutions for complex environmental problems and design systems, components, or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
4. **PLO-4 Investigation:** Ability to investigate complex environmental problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
5. **PLO-5 Modern Tool Usage:** Ability to create, select and apply appropriate techniques, resources, and modern environmental and IT tools for solutions of environmental problems.
6. **PLO-6 Sustainable Development:** Ability to understand the impact of professional environmental solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
7. **PLO-7 Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of environmental practice.

Mapping of PLOs to PEOs

No	Program Learning Outcomes (PLOs)	PEOs		
		PEO1	PEO-2	PEO-3
1.	Scientific Knowledge	✓	✓	
2.	Problem Analysis:	✓		
3.	Design and Development	✓		
4.	Investigation	✓		
5.	Modern Tool Usage	✓	✓	
6.	Sustainable Development		✓	✓
7.	Ethics		✓	✓
HEC UG Policy		Existing ES Road Map		Proposed ES Road Map

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		CH	Courses	Credit Hours	Courses	Credit Hours	Courses
General Education	Natural Sciences	3	1	6	2	6	2
	Social Sciences	2	1	6	2	2	1
	Arts and Humanities	2	1	0	0	2	1
	Expository Writing	3	1	6	2	3	1
	Functional English	3	1	3	1	3	1
	Quantitative Reasoning	6	2	6	2	6	2
	Ideology and Const. of Pak	2	1	2	1	2	1
	Islamiyat	2	1	2	1	2	1
	Application of ICT	2+1	1	0	0	2+1	1
	Entrepreneurship	2	1	0	0	2	1
	Civics and Comm. Engage	2	1	0	0	2	1
	Total	30	12	31	11	33	13
Major	Diff. Courses	72	As per req.	92	31	81	27
Int. Disciplinary	Diff. Courses	12	4	3	2	12	4
Capstone Project	Thesis	3	NA	6	1	3	1
Field Experience/ Internship	Field Visit	3	NA	3	1	3	1
	Total	120		135		132	

Semester-wise Revised Road map of BS Environmental Sciences

Semester 1

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.	None	PAK 103	Pakistan Studies & Global Perspective	2	General Education Course (Ideology & Constitution of Pakistan)	4, 10, 16
2.	None	ISL 101	Islamic Studies	2	General Education Course (Islamic/Religious Studies)	4, 10, 16
3.	None	ENG 101	Functional English	3	General Education Course (Functional English)	4
4.	None	MAT 105/BIO 105	Mathematics/Biology	0	Zero Credit Course	4/15
5.	None	CSC 102	Introduction to Computers & Programming	2	General Education Course (Quantitative Reasoning)	4, 8,9
		CSL 102	Introduction to Computers & Programming lab	1		
6.	None	PHY 103	Physics	2	General Education Course (Natural Sciences)	4, 9
		PHL 103	Physics Lab	1		
7.	None	ENV 105	Introduction to Environmental Sciences	3	Major (Disciplinary) Requirements	7, 8, 13
8.	None	ISL 107	Tajweed	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				16		

*Only for Muslim students

Semester 2

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs

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						alignment (please mention relevant SDG No.)
	Course Code					
1.	None	GSC 340	Chemistry	2	General Education Course (Natural Sciences)	3, 4, 6, 7
		GSL 340	Chemistry Lab	1		
2.	None	HSS 320	Technical Writing and Presentation Skills	3	General Education Course (Expository Writing)	4
3.	None	ENV 206	Environmental Statistics	3	General Education Course (Quantitative Reasoning)	4, 13
4.	None	GEO 110	Fundamental of Geography & Geomorphology	3	Interdisciplinary/Allied Courses	11,14,15
5.	None	ENV 230	Environmental Issues	3	Major (Disciplinary) Requirements	13, 14,15
6.	None	ENV 110	Environmental Biology	3	Major (Disciplinary) Requirements	3, 14, 15
7.	ISL 107	ISL 108	Understanding Quran – I	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				18		

*Only for Muslim students

Semester 3

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.	None	GEO 201	Museology	2	General Education Course (Arts and Humanities)	4
2.	None	GEO 206	Civics and Community Engagement	2	General Education Course (Civics and Community Engagement)	16,17
3.	None	PSY 102	Introduction to Psychology	2	General Education Course (Social Sciences)	3, 4
4.	CHM 105	ENV 211	Environmental Chemistry	2	Major (Disciplinary) Requirements	3, 4, 6, 7
		ENL 211	Environmental Chemistry Lab	1		
5.	None	ENV 205	Fundamentals of Ecology	3	Major (Disciplinary) Requirements	14,15
6.	None	ENV 215	Social Theory of Environment	3	Major (Disciplinary) Requirements	1, 5, 17
7.	None	ENV 221	Environmental Microbiology	2	Major (Disciplinary) Requirements	4, 11
		ENL 221	Environmental Microbiology Lab	1		
8.	ISL 108	ISL 109	Understanding Quran – II	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				18		

*Only for Muslim students

Semester 4

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment

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	Course Code					(please mention relevant SDG No.)
1.	None	HSS 423	Entrepreneurship	2	General Education Course (Entrepreneurship)	4, 8, 9, 17
2.	None	ENV 306	Environmental Monitoring	2	Major (Disciplinary) Requirements	4, 13, 15
		ENL 306	Environmental Monitoring Lab	1		
3.	None	GEO 207	Application of ICT	2	General Education Course (Application of Information and Communication Technologies (ICT))	4, 10, 11
		GEL 207	Application of ICT Lab	1		
4.	None	ENV 315	Environmental Management System	3	Major (Disciplinary) Requirements	4, 10, 11, 15
5.	ENV 105	ENV 236	Introduction to Climate Change	3	Major (Disciplinary) Requirements	4, 6, 13, 14
6.	None	ENV 310	Environmental Toxicology	3	Major (Disciplinary) Requirements	4, 6, 13, 14
7.	ISL 109	ISL 110	Understanding Quran – III	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				17		

*Only for Muslim students

Semester 5

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.	ENV 220	ENV 320	Environmental Biotechnology	3	Major (Disciplinary) Requirements	4, 10, 14, 15
2.	None	ENV 330	Environmental & Natural Resource Economics	3	Major (Disciplinary) Requirements	4, 8, 13, 14
3.	None	ENV 345	Environmental Hazard & Management	3	Major (Disciplinary) Requirements	4, 8, 13, 14
4.	None	ENV 325	Environmental Engineering	3	Major (Disciplinary) Requirements	3, 4, 8
5.	None	ENV 336	Analytical Techniques in Environmental Sciences	2	Major (Disciplinary) Requirements	4, 6, 12
		ENL 336	Analytical Techniques in Environmental Sciences Lab	1		
6.	None	GEO 305	Environmental Geology	3	Interdisciplinary/Allied Courses	4, 8, 11
7.	ISL 110	ISL 111	Understanding Quran – IV	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				18		

*Only for Muslim students

Semester 6

Sr. No.	Proposed Road map aligned with HEC new UG Policy						17 UN SDGs alignment (please mention relevant SDG No.)
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category		
1.	-	-	Elective-I	3	Major (Disciplinary) Requirements	-	
2.	None	ENV 341	Solid Waste Management	2	Major (Disciplinary) Requirements	8, 11, 12	
		ENL 341	Solid Waste Management Lab	1			
3.	None	ENV 361	Natural Resource Management	3	Major (Disciplinary) Requirements	3, 6, 7, 8, 11	
4.	None	GEO 351	Natural Disaster Management	3	Major (Disciplinary) Requirements	4, 9, 11	
5.	None	ENV 351	Environmental Sciences Field Work	3	Field Experience	13,15	
6.	ISL 111	ISL 112	Understanding Quran – V	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16	
Total Credit Hours				15			

*Only for Muslim students

Semester 7

Sr. No.	Proposed Road map aligned with HEC new UG Policy						17 UN SDGs alignment (please mention relevant SDG No.)
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category		

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1.	None	ENV 410	Environmental Impact Assessment	3	Major (Disciplinary) Requirements	3, 6, 7, 13
2.	-	-	Elective-II	3	Major (Disciplinary) Requirements	-
3.	None	ENV 420	Research Methods in Environmental Sciences	3	Major (Disciplinary) Requirements	4
4.	None	GEO 420	Hydrogeology	3	Interdisciplinary/Allied Courses	8, 11, 12
5.	None	GEO 438	GIS & Remote Sensing	2	Interdisciplinary/Allied Courses	4, 8, 11
		GEL 438	GIS & Remote Sensing Lab	1		
6.	ISL 112	ISL 113	Seerah -I	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours			15			

*Only for Muslim students

Semester 8

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.	-	-	Elective-III	3	Major (Disciplinary) Requirements	-
2.	None	ENV 441	Energy and Environment	2	Major (Disciplinary) Requirements	7, 14, 15
		ENL 441	Energy and Environment Lab	1		
3.	None	ENV 430	Environmental Policies & Laws	3	Major (Disciplinary) Requirements	4, 8, 12, 16
4.		ENV 436	Thesis	3	Thesis / Capstone Project	4, 9
5.		ENV 425	Occupational Health & Safety	3	Major (Disciplinary) Requirements	3, 8, 12, 13, 14

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6.	ISL 113	ISL 114	Seerah -II	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				15		

*Only for Muslim students

List of Elective Courses

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.		ENV 355	Urban Environmental Management	3	Major (Disciplinary) Requirements	3, 8, 11, 12
2.		GEO 365	Biodiversity & Conservation	3	Major (Disciplinary) Requirements	4, 8, 11
3.		ENV 352	Soil and Environment	3	Major (Disciplinary) Requirements	4, 15
4.		GEO 436	Health Safety & Environment	3	Major (Disciplinary) Requirements	3, 8, 12, 13, 14
5.		ENV 405	Pollution Control Technology	3	Major (Disciplinary) Requirements	3, 12, 13, 14
6.	ENV 415	ENV 461	Water Resources Management	3	Major (Disciplinary) Requirements	6, 8, 12, 15
7.		ENV 465	Public health and Environment	3	Major (Disciplinary) Requirements	3, 4, 6, 15
8.		ENV 466	Ecotourism Management	3	Major (Disciplinary) Requirements	3, 11, 15

9.		ENV 467	Air & Noise Pollution	3	Major (Disciplinary) Requirements	3, 13, 15
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Course Description

Course Description of General Education and Foundation Courses for BS Environmental Sciences Program

Course Name: Pakistan Studies & Global Perspective

Credit Hours: 2

Contact Hours: 2+0

Pre-Requisites:

Course Code: PAK 103

Contents:

Historical background of Pakistan: Muslim society in Indo-Pakistan, the movement led by the societies, the downfall of Islamic society, the establishment of British Raj-Causes and consequences. Political evolution of Muslims in the twentieth century: Sir Syed Ahmed Khan; Muslim League; Nehru; Allama Iqbal: Independence Movement; Lahore Resolution; Pakistan culture and society, Constitutional and Administrative issues, Pakistan and its geopolitical dimension, Pakistan and International Affairs, Pakistan and the challenges ahead.

Reference Books:

Ideology of Pakistan by Sharif al-Mujahid

Course Name: Islamic Studies

Credit Hours: 2

Contact Hours: 2+0

Pre-Requisites:

Course Code: ISL 101

Contents:

The course introduces students to the Holy Quran and throws light on its different aspects. Selected verses from the Holy Quran and Hadith have been also included in the course. The course also throws light on the life of Prophet (Peace Be Upon Him).

Reference Books:

Hameed ullah Muhammad, 'Introduction to Islam'.

Hussain Hamid Hassan, "An Introduction to the Study of Islamic Law" leaf Publication Islamabad, Pakistan.

Ahmad Hasan, "Principles of Islamic Jurisprudence" Islamic Research Institute, International Islamic University, Islamabad, 1993.

Mir Waliullah, "Muslim Jrisprudence and the Quranic Law of Crimes"

H.S. Bhatia, "Studies in Islamic Law, Religion and Society" Deep and Deep Publications New Delhi, 1989.

Dr. Muhammad Zia-ul-Haq, "Introduction to Al Sharia Al Islamia" Allama Iqbal Open University, Islamabad, 2001.

Course Name: Functional English

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites:

Course Code: ENG 101

Contents:

Improvement of vocabulary, writing and speaking skills by using various modern language improvement tools. Practicing précis and comprehension exercises. Structural format of scientific reports and papers. Planning for writing scientific reports and papers. Significance of abstracts, introduction, illustration, tables, reference and acknowledgements. Editing techniques and their practice. Presentation, publication.

Reference Books:

“Effective Writing” by Turk & Kirkman

“Secrets of Successful Speakers” by Lilly Walters

“Effective Speaking” by Verderber/Verderber

Course Name: Mathematics/Biology

Credit Hours: 0

Contact Hours: 0+3

Pre-Requisites:

Course Code: MAT 105/BIO 105

Contents:

For Biology - Biology, Introduction to Cell, cell structure, types of cells, cellular organelles, Evolution and theories of Evolution. Biological classification, binomial nomenclature, Structure of DNA and RNA, role of DNA in cell and genetics, DNA replication and Translation, Basics of photosynthesis and autotrophy, basics of human respiratory system, basics of human digestive system.

For Mathematics - Polynomials, Linear Functions, Quadratic Equations and their solution, Algebra of Matrices, Determinants, Inverse of a square matrix, Cramer's Rule, Rational fractions into partial fractions, Partial fractions for non-repeated linear, repeated linear and non-separable roots, Binomial Theorem, Mathematical Induction, Converting logarithmic functions into exponential functions, Sequences and series, Limits, Average and Instantaneous rate of change, Scalars and Vectors, Dot product, Cross Product, Angles of Measurement, Trigonometric Ratios and Trigonometric Identities, Analytical Geometry, Classifications of conics, Differentiation, Integration.

Reference Books:

Concepts of Biology by Samantha Fowler, Rebecca Roush, James Wise

Course Name: Introduction to Computers and Programming

Credit Hours: 2+0

Contact Hours: 2+0

Pre-Requisites:

Course Code: CSC 102

Contents:

History of Computer development; application of Computers; Classification and types of computers; Basic block diagram of computer; Hardware (input, output, memory, CPU and software (system software & Application software); social impact of computer age; Computer in education and Scientific research; Introduction to, and history of Internet; Internet service providers and connections; the World Wide Web. Problem solving and algorithm development. Computer hardware and software. Introduction to programming: machine, assembly and high-level languages. C programming language. Arithmetic and logical statements, data types, input/output, basic control structures (selection, iteration etc).Array data type and usage of character strings.

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Functions: Callby-value and call-by-reference, scopes, recursion. Structures. Pointers. Bit manipulation. File processing.

Reference Books:

Peter Norton, "Introduction to Computers ", 6th Ed

Course Name: Introduction to Computers and Programming Lab

Credit Hours: 1+0

Contact Hours: 2+0

Pre-Requisites:

Course Code: CSL 102

Contents:

Introduction to Microsoft Word, Excel, PowerPoint; Basic operations of Microsoft PowerPoint; Bibliography in MS Word; Graph plotting in MS Excel, Introduction to CorelDraw; Introduction to Adobe Photoshop; Structure of C; Input and output function of C++; Variable and Operators; Decision and Loops.

Reference Books:

Peter Norton, "Introduction to Computers ", 6th Ed

Course Name: Physics

Credit Hours: 2+0

Contact Hours: 2+0

Pre-Requisites:

Course Code: PHY 103

Contents:

Newton's gravitation law; Kepler laws; Electro statistics; Magnetisms; Amperes law; Magnetic flux density B; Reflection and refraction interference and diffraction; Natural and artificial radioactivity; Heat and Conductivity; Pressure and Density; Thermodynamic Principles; Electricity and Magnetism; Semi-Conductor; Transistors; Satellite Communication; Introduction to Meteorology.

Reference Books:

Basic Physics: A Self-Teaching Guide by K. Kuhn

Course Name: Physics Lab

Credit Hours: 1+0

Contact Hours: 2+0

Pre-Requisites:

Course Code: PHY 103

Contents:

Practical lab work on Newton's gravitation law; Kepler laws; Electro statistics; Magnetisms; Amperes law; Magnetic flux density B; Reflection and refraction interference and diffraction; Natural and artificial radioactivity; Heat and Conductivity; Pressure and Density; Thermodynamic Principles; Electricity and Magnetism; Semi-Conductor; Transistors; Satellite Communication and Meteorology.

Reference Books:

The Basics of Physics by Richard L. Myers

Course Name: Introduction to Environmental Sciences

Credit Hours: 3+0

Contact Hours: 3+0

Pre-Requisites:

Course Code: ENV 105

Contents:

Environmental Science introductory class, Introduction to Environmental sciences, Components of Environmental Sciences. Biotic and abiotic factors. Resources and conversation. Abiotic Factors. Detailed study of atmosphere Hydrosphere, Water cycle, Biosphere, Biomes; forest biomes and grassland forest, Aquatic forest, tundra forest, desert forest. Structure of earth and crust. Types of rocks, igneous rocks, sedimentary rocks and metamorphic. Mantle structure Core, Earth is a huge magnet, Distribution of Natural resources Concept of Ecosystem, Types of basic structure of ecosystem Environmental pollution, point sources and non-point sources Environmental hazards, Earthquake, tsunami and landslide. Avalanches etc, Impacts of pollutant on the environment Air pollution, acid rain, Global warming and depletion of ozone layer. Environmental health criteria and standards.

Reference Books:

Environmental Science by GT Miller, S Spoolman 2015

Introduction to Environmental Science by Felicia Armstrong 2019

Course Name: Chemistry

Credit Hours: 2

Contact Hours: 2+0

Pre-Requisites:

Course Code: GSC 340

Contents:

Periodic Table, chemical bonding: ionic, covalent, coordinate covalent bond. Solution chemistry. Surface chemistry. Colloids chemistry. Thermodynamics and chemical kinetics. General chemistry of functional groups of organic compounds (alcohols, carbonyls, esters, carboxylic acids, amines). Aromatic compounds, ions, radicals. Photochemical reactions. Radioactivity. Weak Acids & Bases; Water Hardness; Redox Reactions, Chemical Kinetics; Radioactivity.

Reference Books:

A Comprehensive Treatise on Inorganic and Theoretical Chemistry Vol II By J. W. Mellor

Course Name: Chemistry Lab

Credit Hours: 1

Contact Hours: 2+0

Pre-Requisites:

Course Code: GSL 340

Contents:

Preparation of molar, molal, normal solutions and buffers. Osmosis and Diffusion. Measurement of pH, EC, DO and TDS in waste water. Use of titrimetric and gravimetric analysis. Use of spectrophotometric techniques. Paper Chromatography (one and two dimensional)

Reference Books:

Understanding Basic Chemistry: The Learner's Approach Kim Seng Chan, Jeanne Tan · 2014

Basic Chemistry Concepts and Exercises by John Kenkel · 2018

Course Name: Technical Writing and Presentation Skills

Credit Hours: 3+0

Contact Hours: 3+0

Pre-Requisites:

Course Code: HSS 320

Contents:

The Writing Process, Objectives in Technical Writing, Audience Recognition and Involvement, Criteria for Writing Reports, Summaries, Letters and Proposals, Research Paper Writing, Oral Communication, Writing Technical Descriptions, Instruction and User Manuals, The Job Search. Public Speaking & Presentation Skills, Meeting & Interviewing Skills, Non Verbal Communication, Project Reviewing.

Reference Books:

Collins COBUILD Students' Grammar. London: Longman Eastwood, J. 2004.

Oxford Practice Grammar. New Ed., with tests and answers. O UP Goatly, A. 2000

Critical Reading and Writing: An Introductory Course. London: Taylor & Francis

Course Name: Environmental Statistics

Credit Hours: 3+0

Contact Hours: 3+0

Pre-Requisites:

Course Code: ENV 206

Contents:

Environmental models-deterministic and stochastic; generation of environmental data; types and objectives of environmental studies, stochastic processes in environment; Measurement scales; statistical descriptors of environmental data – numerical and graphical; measurement uncertainty – accuracy, precision and bias estimation of environmental data; variability and errors in environmental pollution data. Probability concepts; probability distribution functions and their applications-discrete and continuous distributions. Probability distribution applications-interpreting environmental standards, flood frequency analysis and air quality data.

Reference Books:

Environmental Statistics: Methods and Applications by Vic Barnett - 2005

Practical Environmental Statistics and Data Analysis by Yue Rong - 2011

Course Name: Fundamental of Geography & Geomorphology

Credit Hours: 3+0

Contact Hours: 3+0

Pre-Requisites:

Course Code: GEO 110

Contents:

This course examines the concepts and processes of physical geography that govern the function of the atmosphere, lithosphere, hydrosphere, and biosphere using an earth-systems approach. Course lectures and lab topics introduce the sciences of cartography, meteorology, climatology, geomorphology, hydrology, biogeography, and soils. A focus on how human activities impact the environment, such as climate change and other real world issues will also be addressed.

Reference Books:

Fundamentals of Geomorphology by Richard Huggett - 2016

Fundamentals of Physical Geography by James Petersen, Dorothy Sack, Robert E. Gabler - 2014

Course Name: Environmental Issues

Credit Hours: 3+0

Contact Hours: 3+0

Pre-Requisites:

Course Code: ENV 230

Contents:

Description of environment and its components: Lithosphere, Atmosphere, Hydrosphere and Biosphere. The hydrologic cycle, Types of Rivers/Stream, Discharge/runoff, Erosion/Transportation, and Groundwater zones, Water table, Aquifers, Natural Springs, Effects of geology on water quality. Key environmental issues such as Ozone layer depletion, Climate Change, Erosion, Deforestation, Waterlogging, Salinity, Drought and Desertification, Issues of environment and sustainable development, issues of the social environment: population, population & resources, population growth, urbanization, migration and poverty, Environment and life style.

Reference Books:

Understanding Environmental Issues by Susan Buckingham, Mike Turner - 2008

Environmental Issues Today by Robert J. Duffy, Susan M. Opp - 2020

Course Name: Environmental Biology

Credit Hours: 3+0

Contact Hours: 3+0

Pre-Requisites:

Course Code: ENV 110

Contents:

Biosphere, Origin of Life, Taxonomy, Biodiversity, Classification, Evolution Of Life, Extinction, Biogeochemical Cycle, Biodiversity, Ecological Factors, Biological Interaction, Layers of Ecosystem, Soil, Pollution, Greenhouse Effect, Soil Erosion, Bio Conversation, Acid Rain.

Reference Books:

Environmental Biology by Allan M. Jones - 2006

Fundamentals of Environmental Biology by Meetu Gupta - 2018

Course Name: Museology

Credit Hours: 2+0

Contact Hours: 2+0

Pre-Requisites:

Course Code: GEO 201

Contents:

Introduction to Museology provides a broad, theory-based introduction to the museum sector and the research field of museology. Focusing on museum ethics, the course also give attention to all museum activities. Excursions to different museums and guest lectures from the museum sector give the students insights into the museum practice and provide present day examples and discussions, which they may study by using museological theories, dilemmas in museum ethics, and knowledge in museum history.

References Books

Dictionary of Museology by François Mairesse - 2023

New Horizons for Asian Museums and Museology Naoko Sonoda - 2016

Course Name: Civics and Community Engagement

Credit Hours: 2

Contact Hours: 2+0

Pre-Requisites: None

Course Code: GEO 206

Contents:

This course aims to bring responsible citizenship and active engagement between Universities/HEIs (through their students) and local communities. The course will provide students with a foundational understanding of the principles, institutions, and processes of civic engagement in a democratic society. Moreover, the course will build the capacity of students as leaders and influencers by gaining fundamental understanding of leadership, citizenship, communication, advocacy, network building as well as having first-hand experience of community development through volunteer works.

Reference Books:

Managing Civic and Community Engagement by David Watson - 2007

Higher Education and Civic Engagement: Comparative Perspectives by L. McIlrath, A. Lyons - 2012

Course Name: Introduction to Psychology

Credit Hours: 2+0

Contact Hours: 2+0

Pre-Requisites:

Course Code: PSY 102

Contents:

The course is designed to introduce students to understand the vocabulary and concept of psychology. Understand how critical thinking is proclaimed to be scientific or based on research. Describe the critical development and led to the present discipline of psychology contrast and compare the three majors, also apply psychology theory in some area of his /her life.

Reference Books:

Introduction to Psychology by Charles Stangor - 2021

Introduction to Psychology: Gateways to Mind and Behavior by Dennis Coon, John O. Mitterer, Tanya S. Martini - 2021

Course Name: Environmental Chemistry

Credit Hours: 2+0

Contact Hours: 2+0

Pre-Requisites: CHM 105

Course Code: ENV 211

Contents:

Theory: Historical background, Introduction to Environmental Science, Technology and Chemistry, Water pollution, Water treatment, Atmosphere and atmospheric chemistry, Particles in the atmosphere, Gaseous inorganic and organic pollutants, Photo-chemical smog, Environmental chemistry of hazardous waste, Chemical analysis of Water and wastewater, Waste and solid, Air and gas.

Reference Books:

Environmental Chemistry by Anil K De - 2003

Environmental Chemistry: An Analytical Approach by Kenneth S. Overway - 2017

Course Name: Environmental Chemistry Lab

Credit Hours: 1+0

Contact Hours: 2+0

Pre-Requisites: CHM 105

Course Code: ENL 211

Contents:

The pH and Buffer Capacity of Environmental Waters, Alkalinity of Streams and Lakes, Conductivity of Various Waters (TDS), Hydrophobic/Hydrophilic Character, Kinetics of the Decomposition of Pollutants in the Environment with an Application to Plasticizers, Introduction to Air Sampling: Particulates in Urban Air, Determination of the Concentration of Carbon Dioxide in the Atmosphere.

Reference Books:

Environmental Chemistry by Anil K De · 2003

Environmental Chemistry: An Analytical Approach by Kenneth S. Overway · 2017

Course Name: Fundamentals of Ecology

Credit Hours: 3+0

Contact Hours: 3+0

Pre-Requisites:

Course Code: ENV 205

Contents:

Definition, concepts, history, scope and classification of ecology. Definition, concepts, structure and types of ecosystems. Energy flows in ecosystems. Ecological pyramids. Ecological efficiency and productivity. Definitions and concepts of biogeochemical cycles, habitat and its classification. Biomass with special reference to Pakistan. The biotic community and intra community classification. Ecological dominance. Ecological succession. Evolution of homosapiens, stages of development and impacts of each stage on environment, physiological changes, environmental stress and sociological disorders.

Reference Books:

Fundamentals of Ecosystem Science by Kathleen C. Weathers, David L. Strayer, Gene E. Likens · 2021

Fundamentals of Ecology by Agarwal S. K. · 2008

Course Name: Social Theory of Environment

Credit Hours: 3+0

Contact Hours: 3+0

Pre-Requisites:

Course Code: ENV 215

Contents:

Introduction to Social Theory, Environment and Societies, Contemporary Social Theory, Environmental degradation and politics, Classical Social Theory, Politics, Culture and socialism, Social interactions, Feminism, Population and environment, capitalism, Industrialism and transformation of nature, Globalization, The political ecology of capitalism, Origins of Environmental Movements, The sociology of risk, Social theory, Socialism and Environment, The ecology of unemployment, war and health.

Reference Books:

Environment and Social Theory by John Barry 2007

Social Theory and the Global Environment by PROFESSOR TED. REDCLIFT BENTON (DR MICHAEL.), Michael Redclift 2016

Course Name: Environmental Microbiology

Credit Hours: 2+0

Contact Hours: 2+0

Pre-Requisites:

Course Code: ENV 221

Contents:

Microorganisms and safety: Harmless microorganisms and assumptions, handling clinical and contaminated samples, Bio-safety against risk type microorganisms, Handling of genetically manipulated microorganisms and plant pathogens, Environmental applications: Waste water microbial treatments, solid waste treatment, biogas, sludge from fermentation as fertilizer, bio-deterioration control, bio-mining, and geological applications; Microorganisms and agri-production: bio-pesticides, dinitrogen fixation, virus detection, bacteria and virus elimination in plants, soil biological quality and plant growth, microbial activities, mineralization and immobilization, rhizosphere and degradation, Food technology and microbial aspects, Microbial food spoilage and improvement, sanitation in food industry, value addition, Industrial hygiene.

Reference Books:

Environmental Microbiology by Ian Pepper, Charles P. Gerba, Terry Gentry · 2011

Course Name: Environmental Microbiology Lab

Credit Hours: 1+0

Contact Hours: 2+0

Pre-Requisites:

Course Code: ENL 221

Contents:

Culturing, isolation, and identification of bacteria (culture-based) from environmental or human samples. Isolating the novel bacterial strains, microbial and molecular biological techniques.

Reference Books:

Environmental Microbiology: A Laboratory Manual by Ian Pepper, Charles P. Gerba, Jeffrey W. Brendecke 2011

Course Name: Entrepreneurship

Credit Hours: 2

Contact Hours: 2+0

Pre-Requisites: None

Course Code: HSS 423

Contents:

The Nature and Importance of Entrepreneurship: Nature and Development of Entrepreneurship; Entrepreneurial Decision Process; Role of Entrepreneurs in Economic development; Ethics and Social Responsibility of Entrepreneurship; The Future of Entrepreneurship The Entrepreneur and Entrepreneurial Mind: The Entrepreneurship process; Myths of Entrepreneurs, Managerial VS Entrepreneurial Decision Making; Entrepreneurial Leadership Characteristics The Nature and Importance of SMEs: Nature and Scope of Entrepreneurship; SMEs Definitions / Understanding by various Regulatory Authorities in Pakistan; SMEs contribution to GDP of any country, and of Pakistan; SMEDA's Role in promoting and developing SMEs. The Individual Entrepreneur, and Techniques for Idea Generation Process; Entrepreneur VS Intrapreneur. Inside the Entrepreneurial Mind: From Ideas to reality: Creativity, Innovation and Entrepreneurship; Creativity A necessity for survival; Creative Thinking; Barriers to creativity; How to enhance creativity; The creative Process; Techniques for improving the creative process; Protecting your ideas. The Customer and Product Plan/Feasibility: Understanding of Customer through Demand and Desire, and of Product (Good and/or Service) The Industry and Marketing Plan/Feasibility: Understanding of Marketing Plan, Characteristics of Marketing Plan; and Environment Analysis and Steps in preparing the Marketing Plan The Financial Plan/Feasibility: Operating and Capital Budgets, Break Even Analysis; Cash Flows and Balance Sheets The Organizational Plan/Feasibility: Developing the management team; Building the successful Organization, The Role of BODs. Components, and Classification of Business Plans Financing Options: e.g. Leveraged Buyouts; Preparing for the new Launch; Execution & Growth; Managing early growth of the New ventures. Analysis, and Competitive Environment Analysis. Growth Options: Joint Venture; Franchising; Acquisitions; Synergy; Mergers; Hostile Takeovers; Licencing etc.

Reference Books:

An Introduction to Entrepreneurship Eamonn Butler 2020

Course Name: Introduction to Climate Change

Credit Hours: 3+0

Contact Hours: 3+0

Pre-Requisites: ENV 105

Course Code: ENV 236

Contents:

Introduction to the earth's climate: climate change, and the interactions between climate and the global environment; ; Electromagnetic Radiation and the Global Energy Budget; Energy and Temperature; Climate classifications: Köppen Global Climate; Global Climate Change: Causes & Consequences: Natural & Anthropogenic sources; Human responses to potential climate change; Recent Climate Change Indicators; Predicted changes to the physical world: Predicted changes to the biological world: range shifts, phonological changes, human health, agriculture; Physical, chemical, biological, and social factors contributing to climate and global change; Moisture in the Atmosphere; Precipitation; Patterns in Winds and Pressure; The Measurement of Climate Change; The Causes of Climate Change: Global warming and greenhouse effect; Air Pollution and Acid Rain; Ozone depletion; Regional droughts and cataclysmic climate change; Types & Resources to produce Energy; Role of Energy Production in climate change: Fossil fuels, Hydrocarbons & their byproducts; Future Climates and the Consequences: Ground and Satellite Based Measurements Solutions , Surface and ground water resources, observing the Cryosphere, Consequences of climate change, measurement of climate change, Prediction of climate change.

Reference Books:

A Short Introduction to Climate Change by Tony Eggleton 2012

Introduction to Climate Science by Andreas Schmittner 2018

Course Name: Applications of Information and Communication Technologies

Credit Hours: 2

Contact Hours: 2+0

Pre-Requisites:

Course Code: GEO 207

Contents:

Brief history of Computer, Four Stages of History, Computer Elements, Processor, Memory, Hardware, Software, Application Software its uses and Limitations, System Software its Importance and its Types, Types of Computer (Super, Mainframe, Mini and Micro Computer), Introduction to CBIS (Computer Based Information System), Methods of Input and Processing, Class2. Organizing Computer Facility, Centralized Computing Facility, Distributed Computing Facility, Decentralized Computing Facility, Input Devices. Keyboard and its Types, Terminal (Dump, Smart, Intelligent), Dedicated Data Entry, SDA (Source Data Automation), Pointing Devices, Voice Input, Output Devices. Soft- Hard Copies, Monitors and its Types, Printers and its Types, Plotters, Computer Virus and its Forms, Storage Units, Primary and Secondary Memories, RAM and its Types, Cache, Hard Disks, Working of Hard Disk, Diskettes, RAID, Optical Disk Storages (DVD, CD ROM), Magnetic Types, Backup System, Data Communications, Data Communication Model, Data Transmission, Digital and Analog Transmission, Modems, Asynchronous and Synchronous Transmission, Simplex, Half Duplex, Full Duplex Transmission, Communications, Medias (Cables, Wireless), Protocols, Network Topologies (Star, Bus, Ring), LAN, LAN, Internet, A Brief History, Birthplace of ARPA Net, Web Link, Browser, Internet Services provider and Online Services Providers, Function and Features of Browser, Search Engines, Some Common Services available on Internet.

Reference Books:

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Information Communication Technologies Concepts, Methodologies, Tools and Applications by Craig Van Slyke · 2008

Course Name: Applications of Information and Communication Technologies Lab

Credit Hours: 1

Contact Hours: 2+0

Pre-Requisites:

Course Code: GEL 207

Contents:

Practical exercises will be carried out in lab.

Reference Books:

Information Communication Technologies Concepts, Methodologies, Tools and Applications by Craig Van Slyke · 2008

Course Name: Environmental Management System

Credit Hours: 3+0

Contact Hours: 3+0

Pre-Requisites: ENV 105

Course Code: ENV 315

Contents:

Fundamental concepts and tools of environmental management, Corporate Social Responsibility (CSR), Sustainable development, Ecological footprint, Environmental policy and its management, SWOT analysis, Case study: UNEP-Ecofoam, Environmental marketing, Waste management, Sustainable tourism development, Quality management systems: ISO14000 series of standards, ISO 14001 System, EMS, Environmental auditing, Principles of cleaner production.

Reference Books:

Environmental Management Systems - A Step-by-Step Guide to Implementation and Maintenance by Christopher Sheldon, Mark Yoxon 2012

Course Name: Environmental Monitoring

Credit Hours: 2+0

Contact Hours: 2+0

Pre-Requisites:

Course Code: ENV 306

Contents:

Theory: Conceptual Basis of Environmental Monitoring Systems, Integrated Data Management for Environment Monitoring Programs, Basic Concept and Applications of Environmental Monitoring, Atmospheric Monitoring, Opportunities and Challenges in Surface Water Quality Monitoring, Groundwater Monitoring: Statistical Methods for Testing, Selection of Ecological Indicators for Monitoring, Efficacy of Forest Health Monitoring Indicators, Landscape Monitoring, Monitoring and Assessment of the Fate and Transport, Statistical Methods for Environmental Monitoring and Assessment, Discriminating between the Good and the Bad: Quality Assurance, Monitoring, Assessment and Environmental Policy, Development of Watershed-Based Assessment Tools, Biological Indicators in Environmental Monitoring Programs.

Reference Books:

Fundamentals of Environmental Monitoring by Taras Kazantsev 2016

Course Name: Environmental Monitoring Lab

Credit Hours: 1+0

Contact Hours: 2+0

Pre-Requisites:

Course Code: ENL 306

Contents:

Introduction to sampling techniques and analytical methods to measure environmental contamination in air, water, soils, and food. Emphasis on instrument selection and quality control, including documentation, calibration, and sample management. Wind flow rates. Quantification of noise. Quantification of light intensity. Humidity levels

Reference Books:

Environmental Monitoring and Characterization by Janick F. Artiola, Ian L. Pepper, Mark L. Brusseau 2004

Course Name: Environmental Toxicology

Credit Hours: 3+0

Contact Hours: 3+0

Pre-Requisites:

Course Code: ENV 310

Contents:

Introduction to Toxicology: History, toxins vs. toxicants, Anthropogenic toxicants; Classification of environmental toxicants, toxicological agents and their types, dose and dose response relationship: Threshold limit for chemicals, toxins & toxicants; Toxicity: Types and its measurement; Organs, Organ system and effects of toxicants on Organ system; Bioaccumulation and biomagnifications; Toxicant metabolism and accumulation in body organs and pathways; Response of the body systems to toxicological agents; Immunological considerations in toxicology, toxicity screening using microbial systems; Risks and their characterization: risk assessment and management.

Reference Books:

Basic Environmental Toxicology by Lorris G. Cockerham, Barbara S. Shane 2019

Course Name: Environmental Biotechnology

Credit Hours: 3+0

Contact Hours: 3+0

Pre-Requisites: ENV 220

Course Code: ENV 320

Contents:

Living organisms can be used in industrial and environmental process to obtain desirable products. Environmental biotechnology focuses on use of organisms, specifically microorganisms and plants to resolve environmental problems. This branch of science is fundamentally rooted in waste; hence the course focuses on use of microorganisms and plants to remediate land and water pollution. The course explains what pollution and contamination of land is, types of pollutants, various strategies that can be used to remediate pollution (Bioremediation and Phytoremediation) and various factors affecting bioremediation.

Reference Books:

Environmental Biotechnology by Lawrence K. Wang, Volodymyr Ivanov, Joo-Hwa Tay - 2010

Course Name: Environmental & Natural Resource Economics

Credit Hours: 3+0

Contact Hours: 3+0

Pre-Requisites:

Course Code: ENV 330

Contents:

Basic concepts in environmental economics, The Economy and the Environment, Benefits and Costs, the equilibrium principle, marginal cost and supply, economic efficiency and market, external costs and external benefits, Concept of Externality and internality, Human Development index, economics ways to control pollution, Valuing the environment. Contingent valuation, the travel cost method and the hedonic approach, the value of life, health, risk and safety, Economic Development and Environment.

Reference Books:

Environmental and Natural Resource Economics by Thomas H. Tietenberg, Lynne Lewis 2018

Course Name: Environmental Geology

Credit Hours: 3+0

Contact Hours: 3+0

Pre-Requisites:

Course Code: GEO 305

Contents:

Fundamental concepts of Environmental Geology; Soil; Earth Materials & Processes; Application of Geology to a broad environmental concerns of Society; Evaluation of natural hazards, floods, landslides, subsidence, earthquakes, volcanic activity and coastal erosion; Water resources; Waste disposal management; environmental related health effects; Environmental impacts of mining, petroleum and gas exploitation; Geology in land use and urban planning; Environmental Geology mapping; Preparation of environmental impacts Statements.

Reference Books:

Course Name: Environmental Engineering

Credit Hours: 3+0

Contact Hours: 3+0

Pre-Requisites:

Course Code: ENV 325

Contents:

The course is designed to introduction to environment and factors affecting the environment, global regional and national environmental issues related to human waste, industrial wastewater, solid waste water, air and radiological pollution. Global environmental Issues; acid rain, global warming, and ozone depletion. Further in details study will be done on effects of pollution on human health and environment.

Reference Books:

Introduction to Environmental Engineering by Stefan Fränzle, Bernd Markert, Simone Wünschmann 2012

Course Name: Analytical Techniques in Environmental Sciences

Credit Hours: 2+0

Contact Hours: 2+0

Pre-Requisites:

Course Code: ENV 336

Contents:

Theory: Introduction, Principal of physical, chemical and microbiological analysis of environmental pollutants, Sampling rules, procedure, collection and their preservations for the examination of water, waste water, air, solid waste and soil, Lab technique and field monitoring, Conventional chemical analysis, Analytical Environmental data, assessment and interpretation, Separation Techniques, Electro analytical techniques, Thermal method of analysis, Biological indicators, General principle of spectrometry, Instrumental techniques using atomic absorption, U.V-visible, infrared spectrophotometers, gas chromatography, X-ray defraction, X-ray Florence etc.

Reference Books:

Introduction to Environmental Analysis by Roger N. Reeve 2002

Multidimensional Analytical Techniques in Environmental Research by Regina Duarte, Armando C. Duarte 2020

Course Name: Analytical Techniques in Environmental Sciences Lab

Credit Hours: 1+0

Contact Hours: 2+0

Pre-Requisites:

Course Code: ENL 336

Contents:

Analytical basics (separation versus detection, precision, “accuracy”, common sense, trace analysis (metal and organic), contamination, blanks, protocols, note keeping, sampling), spectrometric theory (atomic absorption, UV, IR, fluorescence, colorimetry: Atomic Absorption for metals, UV for silica and nitrate, IR detection, pH detection), electrodes (function, G, examples of uses in marine chemistry: pH electrodes, microelectrodes; oxygen electrodes), chromatographic theory – LC and GC.

Reference Books:

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Introduction to Environmental Analysis by Roger N. Reeve 2002

Multidimensional Analytical Techniques in Environmental Research by Regina Duarte, Armando C. Duarte 2020

Course Name: Natural Disaster Management

Credit Hours: 3+0

Contact Hours: 3+0

Pre-Requisites:

Course Code: GEO 351

Contents:

Basics Concepts evolving terminologies in Disaster Management, Nature and Scope of Disaster Management, Historical Evolution, Socio-Natural Disasters, Anthropogenic Disasters, Technological Disasters, Disaster Risk, Vulnerability (Types and Causes, Models), Capacity and Types of Capacity, Level of Capacities, Global Disaster Risk Trends, Costs and Frequency, Historical Review of Disasters Trends, Case Studies on Impacts of Disasters.

Reference Books:

Handbook Of Disaster Risk Reduction & Management by Christian N Madu, Chu-hua Kuei · 2017

Disaster Risk Reduction Approaches in Pakistan by Atta-Ur- Rahman, Amir Nawaz Khan, Rajib Shaw · 2015

Course Name: Urban Environmental Management

Credit Hours: 3+0

Contact Hours: 3+0

Pre-Requisites:

Course Code: ENV 355

Contents:

The objective of this course is to provide students with a comprehensive overview of urban planning systems and its application in designing and managing urban built-environment. The course covers the theories and practices of the modern city planning examining several subtopics – such as land use planning, zoning laws, community design and development, and the idea of urban sustainability – in light of some basic dimensions of urban analysis such as historical, economic, political, social, cultural, and spatial issues.

Reference Books:

Urban Environmental Management by Shahab Fazal 2008

Course Name: Solid Waste Management

Credit Hours: 2+0

Contact Hours: 2+0

Pre-Requisites:

Course Code: ENV 341

Contents:

Sources and impacts of waste, Sustainability and the economics of waste management, Integrated Waste Management and Life Cycle Analysis, Quantification of waste, Waste minimisation and reuse, Collection, and sorting systems, Biological treatments, Incineration, Landfill, Recycling and Integrated Waste Management Case Studies, Wastewater emissions and water quality, Waste gas emissions and climate change.

Reference Books:

Solid Waste Management: Principles and Practice by Ramesha Chandrappa, Diganta Bhusan Das 2012

Course Name: Solid Waste Management Lab

Credit Hours: 1+0

Contact Hours: 2+0

Pre-Requisites:

Course Code: ENL 341

Contents:

Introduction, Responsibilities, Waste Minimization, General requirements, Specific Waste Management Requirements, Biological Waste Management, Chemical Waste Management, Radioactive Waste Management, Mixed Waste (mixtures of biological, chemical and/or radioactive), Sharp Waste Management, Laboratory Decommissioning, composting, recycling.

Reference Books:

Solid Waste Management: Principles and Practice by Ramesha Chandrappa, Diganta Bhusan Das 2012

Course Name: Natural Resource Management

Credit Hours: 3+0

Contact Hours: 3+0

Pre-Requisites:

Course Code: ENV 361

Contents:

Introduction to natural resources and their sustainable management, Requirements of a management plan, forest types and Methodologies of watershed management, existing status of Rangeland Management, Existing situation of Wildlife at national level, wildlife census, Threats faced by wildlife, Available water resources and threats to it, Effective management plan., Fisheries Management, Existing situation of Agricultural Sector, Agricultural products and their share in GDP, Problems faced by agricultural sector, Agricultural policy and Management options. Minerals Resources, Oil, methods of oil extraction, primary, secondary and tertiary oil recoveries, and Natural Gas.

Reference Books:

Natural Resource Management: An Introduction by Azmal Hussain 2007

Course Name: Environmental Hazard & Management

Credit Hours: 3+0

Contact Hours: 3+0

Pre-Requisites:

Course Code: ENV 345

Contents:

This course is designed to serve as a bridge between crisis/emergency management and environmental management. The causes and effects of extreme natural and technological hazards will be explored with an emphasis placed on organizational responsibilities, shared governance, management approaches, environmental security, directed technologies, and the social factors related to environmental hazard assessment and risk reduction. An introduction to the various types of natural, technological and social hazards will be provided. Hurricane Katrina, the oil fires in Kuwait, and other recent environmental disasters will be used to illustrate possible

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prevention, response and mitigation tools. Additionally, the course will focus on the cultural, institutional and technical capacities that bear upon environmental disaster management, global adjustment patterns, and national and international risk reduction and mitigation measures. The emerging area of environmental security will be introduced as a response to intentional acts that use the environmental processes to propagate terror, property destruction, and death.

Reference Books:

Environmental Hazards: Assessing Risk and Reducing Disaster by Keith Smith - 2013

Course Name: Environmental Sciences Field Work

Credit Hours: 3+0

Contact Hours: 0+3

Pre-Requisites:

Course Code: ENV 350

Contents:

4 days field work to train the students on the environmental management system of industrial environment or practical applications such as on-site testing/analysis of environmental samples in field. Students on return will write a detailed report on the work carried out in the field.

Reference Books:

Course Name: Environmental Impact Assessment

Credit Hours: 3+0

Contact Hours: 3+0

Pre-Requisites:

Course Code: ENV 410

Contents:

Environmental impacts of human/natural activities. Methods, techniques and format of EIA and EIS. Development plans and projects and detailed studies of their impacts. Environmental impact indicators. Monitoring including Environmental Management Plans and Disaster Management Plans. Auditing in EIA with special reference to Pakistan. National planning of EIA. Case studies of EIAs of industries, wars, infrastructure projects. Environmental quality standards. EIA follow-up. Strategic Environmental Assessments.

Reference Books:

Introduction to Environmental Impact Assessment by John Glasson, Riki Therivel, Andrew Chadwick 2013

Course Name: Water Resources Management

Credit Hours: 3+0

Contact Hours: 3+0

Pre-Requisites: ENV 415

Course Code: ENV 461

Contents:

Surface Water and Groundwater sources (to understand the different types of water sources). The nature and characteristics of groundwater, surface water, river, and wetland water resources (the physical, chemical and biotic nature of water sources). Factors that affect the use of water resources (demand, availability, quality, quantity). Water pollution and impact on water quality and health (point and diffuse pollution sources, natural and anthropogenic pollution, nature of pollution, effects on water sources and water uses). Climate change and water resources (explain the impact of climate change on water resources). Management of the Water Resources (Water catchment management, water conservation, strategic planning of water resources at national, regional and local levels to meet user demand, environmental protection and sustainable management needs). Policies, goals, strategies and Institutional Arrangement for IWRM (National and transboundary considerations). The management of water abstraction, the licensing process, consultation procedures, enforcement. The threats to the quality of water resources, the identification of risk and the measures taken to protect them (water conservation, water treatment and wastewater treatment. Laws, standards and their implementation).

Reference Books:

Water Resource Systems Planning and Management by By Daniel P. Loucks, Eelco van Beek · 2017

Course Name: Research Methods in Environmental Sciences

Credit Hours: 3+0

Contact Hours: 3+0

Pre-Requisites:

Course Code: ENV 420

Contents:

The course is designed to introduce to Research and Research Methods, Meaning of Research, Objectives of Research, Research Steps, Research Characteristics. How Research is Done Research their Process and Criteria for good Research. Types of Research, Research Approaches, Significance of Research, Qualities of a Researcher. Research proposals and writing methods: Introduction, implications of a sample design, steps in sampling design, characteristics of a good sample design Different types of sample design: probability sampling, non – probability sampling, and further types in details. Methods of Data Collection: Collection of Primary Data and secondary data and their various methodology Collection of data through questionnaire and interview and their demerits Research proposal/ thesis format and References discussions.

Reference Books:

Research Methodology: methods and techniques: by C.R. Kothari, Second revised edition 2004. New Age International (P) Ltd., Publishers”

Course Name: Hydrogeology

Credit Hours: 3+0

Contact Hours: 3+0

Pre-Requisites:

Course Code: GEO 420

Contents:

Introduction to hydrology of surface and groundwater supplies, Water bearing properties of the rocks, Hydrodynamics of flow through porous material, Flow nets, Well hydraulics, Analysis and evaluation of pumping wells data, Groundwater quality, Occurrence of groundwater in various rock types and sediments, Introduction to the techniques used in groundwater exploration and survey.

Reference Books:

Applied Hydrogeology by C.W. Fetter

Groundwater Hydrology by Todd

Field hydrogeology by Brasington

Hydrogeology by Kevin Hiscock

Course Name: GIS & Remote Sensing

Credit Hours: 2+0

Contact Hours: 2+0

Pre-Requisites:

Course Code: GEO 438

Contents:

Introduction to Geographical Information System, Data Types (Spatial/Aspatial), Data Models and Structures (Raster/Vector), Data Sources and Capturing Techniques, Displaying and Manipulating spatial information, Vector Data Preparation (Digitization and Spatial Data Editing), GPS Survey, Introduction to the concept of RS, Electromagnetic Spectrum, Atmospheric Interaction, Technology of Remote sensing (Orbits, Satellites, Sensors and Platforms), Applications of Remote Sensing, Satellite Image Processing Cycle, Image Enhancement, Data Fusion and Mosaicing Information Extraction (Classification and Vectorization).

Reference Books:

Textbook of Remote Sensing and Geographical Information Systems by Kali Charan Sahu 2007

Course Name: GIS & Remote Sensing Lab

Credit Hours: 1+0

Contact Hours: 2+0

Pre-Requisites:

Course Code: GEL 438

Contents:

Lab: Introduction to ArcCatalog, Introduction to ArcMap, Project a file from GCS to PCS (coordinate systems), How to Import Coordinate systems, Creation of File geodatabase and shapefile (vectors), Convert a shapefile to Personal Geodatabase (vectors), Finding and Downloading Geospatial Data (shapefiles), Edit A Shapefile, View Satellite Image in ArcMap (rasters), View USGS DEM data, Convert Raster to Vector, Georeferencing and rectify a scanned image, Georeferencing and rectify a scanned image, Perform Image to Map transformation, Make Study area Map, Element of study are map, Use symbology.

Reference Books:

Textbook of Remote Sensing and Geographical Information Systems by Kali Charan Sahu 2007

Course Name: Pollution Control Technology

Credit Hours: 3+0

Contact Hours: 3+0

Pre-Requisites:

Course Code: ENV 405

Contents:

The course has been designed to improve the understanding of the students about different pollution control strategies and the skills of application of remediation techniques to combat pollution in three environmental compartments i.e. air, water and soil. The course will also be dealing about the sources of pollution in air, soil, water, solid-waste and noise and the impacts of these sources on the environment and health. A wide spread of different methods like simplified text, graphics and diagrams overhead and slide-show presentations, case studies, closer looks, weekly quiz,

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monthly papers, assignments , class discussions, and Internet resources would be used.

Reference Books:

Solid Waste Technology and Management, T. Christensen, John Wiley & Sons, 2011.

Water Treatment Technologies, B. Salopek, Akademija tehničkih znanosti Hrvatske, 2007.

Municipal solid waste management: strategies and technologies for sustainable solutions, C. Ludwig, S. Hellweg and S. Stucki, Springer, 2003.

Air Pollution Control Technology Handbook, K.B. Schnelle and C.A. Brown, CRC Press, 2002.

Course Name: Energy and Environment

Credit Hours: 2+0

Contact Hours: 2+0

Pre-Requisites:

Course Code: ENV 441

Contents:

This course explores the scientific foundations of current energy and environmental issues and their implications for public policy. The syllabus is divided into sections, each examining a current environmental theme in depth. The first sections investigate the composition of the atmosphere and the chemical processes that cause air pollution, ozone depletion, and global warming. Moving to the study of water, the course explores the properties of this unique solvent and the effect of various aqueous pollutants. The course also includes an investigation of energy from chemical reactions, our continuing reliance on fossil fuels, and the potential of alternative energy sources. The laboratory experiments are closely integrated with the lecture topics and provide hands-on explorations of central course themes. Throughout the course we also will examine how scientific studies of the environment are intimately connected with political, economic and policy concerns.

Reference Books:

Introduction to Energy the Environment and Sustainability by Paul Gannon 2011

Introduction to Energy Environment and Sustainability by Paul Gannon 2019

Course Name: Energy and Environment Lab

Credit Hours: 1+0

Contact Hours: 2+0

Pre-Requisites:

Course Code: ENL 441

Contents:

Production of biodiesel as biofuel from various renewable sources, determination of calorific values of alternate solid energy sources such as domestic and commercial waste, one day field visit to alternate energy production units (industrial/non industrial).

Reference Books:

Introduction to Energy the Environment and Sustainability by Paul Gannon 2011

Introduction to Energy Environment and Sustainability by Paul Gannon 2019

Course Name: Environmental Policies & Laws

Credit Hours: 3+0

Contact Hours: 3+0

Pre-Requisites:

Course Code: ENV 430

Contents:

An introduction to the concepts and principles which underpin environmental law from the international to the local level. The course will address: principles of international environmental law; environmental legal philosophy; Constitutional responsibilities and roles relating to the environment; environmental planning through environmental impact assessment and land-use law; environmental protection and pollution law; water resources law; the protection of biological diversity; and heritage issues.

Reference Books:

Philippe Sands. Principles of International Environmental Law: Cambridge University Press, 2004.

Steven Ferry. Environmental Law Examples & Explanations. Aspen Publishers.

Stuart Bell and Donald McGillivray. Environmental Law- The law and policy relating to the protection of the environment. Oxford.

Course Name: Occupational Health & Safety

Credit Hours: 3+0

Contact Hours: 3+0

Pre-Requisites:

Course Code: ENV 425

Contents:

Introduction, concepts, importance and principles of OHS,, cost of accidents, hazard and risks at workplace, plants and mine safety and safe work practices, firefighting techniques, emergency response protocols, spill response protocols, risk assessment approaches, OHSAS-18001, OHS in Pakistan. Labor code of Pakistan.

Reference Books:

Fundamental Principles of Occupational Health and Safety by Benjamin O. Alli
Principles of occupational Health and Hygiene by Cherilyn Tillman

Course Name: Ecotourism Management

Credit Hours: 3+0

Contact Hours: 3+0

Pre-Requisites:

Course Code: ENV 466

Contents:

Introduction and general overview, Context and definitions of ecotourism, Types of Ecotourism, Alternative and mass tourism, Principles and philosophies of ecotourism, Ecotourism resources, Protected areas in ecotourism, Identifying and describing ecotourism products, Components of ecotourism, Impacts of ecotourism, Resources required for eco and urban tourism, Ecotourism practices, Environmental and ecological impacts of ecotourism, Ecotourism markets, Clients and motivation, Community based ecotourism, Ecotourism developments, Developing ecotourism products, Ecotourism in the national and global context, Field trip, Report writing.

Reference Books:

Ecotourism: Management and Assessment by Dimitrios Diamantis 2004

Ecotourism Development and Management by B. B. Hosetti 2007

Course Name: Public Health & Environment

Credit Hours: 3+0

Contact Hours: 3+0

Pre-Requisites:

Course Code: ENV 465

Contents:

Concepts and basic requirements for a healthy environment. Environmental Exposure: Measuring environmental quality; Human exposure and health Impact: Impact of environmental factors on health. Nature and types of environmental hazards. Health risk assessment and management. Health and disease concepts. Air, Water and sanitation, Food and agriculture. Human settlement and urbanization, Health and energy use. Health and development, Health indicators, Industrial pollution and health issues; Trans-boundary and global health concerns, Action to protect health and the environment; Classification of diseases, basic concepts of Epidemiology, Immunology, Pathology, Parasitology; Epidemiology of infectious diseases, Communicable diseases, Non-communicable diseases; Personal hygiene and health.

Reference Books:

Basic Environmental Health. Yassi, A., Kjellström, T., de Kok, T. and Guidotti, T. L., 1st Edition. Oxford University Press New York, USA, 2001.

Park's Textbook of Preventive and Social Medicine, Park, K., 2nd Edition. M/s Banarsid. 2002

Course Name: Soil & Environment

Credit Hours: 3+0

Contact Hours: 3+0

Pre-Requisites:

Course Code: ENV 352

Contents:

Introduction, Soil forming minerals, Types and properties of parent materials, Physical and chemical processes of weathering, Factors and processes of soil formation, Physical and chemical properties of soil, Soil morphology and classification Cation and anion exchange, Soil buffering capacity and its importance, Soil degradation, management and green productivity, Environmental implications of fertilizers and agrochemicals, Environmental impact of agricultural and Industrial wastes, Soil as a natural sink for pollutants.

Reference Books:

The Nature and Properties of Soils, Brady, N.C. and Weil, R.R. Prentice- Hall, 14th Edition. Upper Saddle River, NJ, USA, 2007.

Soils in Our Environment, Miller, R.W.,Gardiner, D.T., 11th Edition, Prentice Hall, Upper Saddle River, NJ, USA, 2007.

Course Name: Biodiversity & Conservation

Credit Hours: 3+0

Contact Hours: 3+0

Pre-Requisites:

Course Code: ENV 365

Contents:

Biodiversity: Introduction and levels of biodiversity (Alpha, Beta and Gamma). Biodiversity hotspots (tropical and coral reef ecosystems). Philosophical, ecological, economic, social and ethical values of biodiversity. Plants and animal resources of world and Pakistan. Conservation of biodiversity: Introduction to biological conservation, its history, guiding principles and 43 characteristics. Need and approach

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of biodiversity conservation and prevailing threats. IUCN threatened species categories. Conservation at species and population level: applied population biology, establishing new populations, ex- situ conservation strategies (botanical gardens and arboreta, zoos, seed banks and aquaria). Conservation at community and ecosystem level: protected areas, their categories and objectives, considerations for reserve design, ecotourism. Conservation outside protected areas: conservation in man-made ecosystems, croplands, cities. Legal protection of species and habitats: national and international laws and agreements for species and habitat protection, National Conservation Strategy of Pakistan.

Reference Books:

A Primer of Conservation Biology. 5 th Ed. Sinauer, P.R.B. Associates Inc. Publ. Sunderland. 2012

Essentials of Conservation Biology, 5 thEd., Primack, R. B. Sinauer, P.R.B associates Inc. Publishers, Sunderland MA, USA. 2010.

Course Name: Air & Noise Pollution

Credit Hours: 3+0

Contact Hours: 3+0

Pre-Requisites:

Course Code: ENV 467

Contents:

Air Pollution Essentials; The Risks of Air Pollution; Measurement and Monitoring of Air Pollution; The methodology of Air Pollution; The Regulatory Control of Air Pollution; The Engineering Control of Air Pollution; Introduction to Noise Pollution; Basic concepts of sound and noise; Noise and its effects; approaches to noise problems; Planning to control noise pollution; Noise reduction; Characteristics and impact of surface transportation noise; Traffic noise reduction; Aircraft noise reduction; Preventing airport noise; Control of noise pollution from diesel generator sets; Noise pollution in oil exploring and its control; noise pollution and its control in mining and product industries; Sound control technologies and instrumentation. Electromagnetic waves generated by cellular tower and its potential impact on humans and the environment.

Reference Books:

Electromagnetic Surface Waves: A Modern Perspective (Elsevier Insights) by John Polo 2012.

Fundamentals of Air Pollution. Daniel Vallero. 4thEdition. ISBN10: 0-12- 373615-3 (2007).

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Academic Road Map for UG Programs
Faculty of Engineering Sciences

Program Title: **BS Geology**

Duration: **4 Years**

Total Credit Hours: **132**

Endorsement References:

- A: Recommendations of CAC dated 22-Mar-23
- B: Recommendations of DBOS dated 09-August-23
- C: Recommendations of FBOS dated 04-Sep-23

Summary of Credit Hours

Sr. No.	Category as per HEC new UG Policy	Credit Hours/Contact Hours	
		Existing Road Map	Proposed New Road Map
1.	General Education (Mandatory)	28	33
2.	Major/Disciplinary (Mandatory)	83	81
3.	Interdisciplinary (Mandatory)	12	12
4.	Electives toward specialization	-	-
5.	Tajweed, Quran and Hadith (Compulsory – non-credit course, only for Muslim Students)	-	8 Contact Hours (non-credited)
6	Field Experience	6	3
7.	Capstone Project (Mandatory)	6	3
8	Double Major (Optional)	-	-
9.	Minor (Optional)	-	-
Total		135	132

Program Educational Objectives (PEOs)

Following are the sample program educational objectives that are expected to be exhibited by the Geology graduates.

1. **PEO-1:** Demonstrate sound scientific knowledge and skills.
2. **PEO-2:** Work, manage and illustrate effective teamwork, interpersonal skills and professional growth.
3. **PEO-3:** Undertake professional practice considering ethical, societal and geological implications.

Program Learning Outcomes (PLOs)

1. **Academic Education:** Prepare graduates as geological professionals.
2. **Scientific Knowledge:** Ability to acquire a solid base of knowledge and skills in the science of geology.
3. **Problem Analysis:** Analyze/investigate geological materials, features, and processes both qualitatively and quantitatively.
4. **Design and Development:** Apply critical thinking skills to develop solutions for geological problems using the scientific tools/techniques/methods.

- 5. Investigation:** Investigate the complex geological problems/phenomenon in a systematic way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions
- 6. Modern Tool Usage:** Create, select and apply appropriate techniques, resources, and modern geological and IT tools for solutions of geological problems
- 7. Individual and Teamwork:** Function effectively as an individual and as a member or leader in diverse teams and in multi-disciplinary settings
- 8. Ethics:** Understand and commit to professional ethics, responsibilities, and norms of scientific practices.
- 9. Life-long Learning:** Develop the aptitudes and dispositions necessary to help democratize society by obtaining and maintaining employment as a professional geologist.

Mapping of PLOs to PEOs

No.	Program Learning Outcomes (PLOs)	PEOs		
		PEO-1	PEO-2	PEO-3
PLO-1	Academic Education	✓	✓	
PLO-2	Scientific Knowledge	✓		
PLO-3	Problem Analysis	✓		
PLO-4	Design and Development	✓		✓
PLO-5	Investigation	✓		
PLO-6	Modern Tool Usage	✓	✓	
PLO-7	Individual and Teamwork		✓	✓
PLO-8	Ethics		✓	✓
PLO-9	Life-long Learning			✓

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HEC UG Policy				Existing Geology Road Map		Proposed Geology Road Map	
		C H	No. Cours es	Credit Hours	Course s	Credit Hours	Cours es
General Education	Natural Sciences	3	1	6	2	6	2
	Social Sciences	2	1	3	1	2	1
	Arts and Humanities	2	1	0	0	2	1
	Expository Writing	3	1	6	2	3	1
	Functional English	3	1	3	1	3	1
	Quantitative Reasoning	6	2	6	2	6	2
	Ideology and Const. of Pak	2	1	2	1	2	1
	Islamiyat	2	1	2	1	2	1
	Application of ICT	2 + 1	1	0	0	2+1	1
	Entrepreneurship	2	1	0	0	2	1
	Civics and Comm. Engage	2	1	0	0	2	1
	Total	3 0	12	28	10	33	13
Major	Diff. Courses	7 2	As per req.	95	33	81	27
Int. Disciplinary	Diff. Courses	1 2	4	12	4	12	4
Capstone Project	Thesis	3	NA	6	1	3	1
Field Experience / Internship	Field Visit	3	NA	6	2	3	1
	Total	1 2 0		135		132	

Semester-wise Revised Road map of BS Geology

Semester 1

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please

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	Course Code					mention relevant SDG No.
1.		ENG 101	Functional English	3	General Education Course (Functional English)	4
2.		PHY 103	Physics	2	General Education Course (Natural Sciences)	4, 9
		PHL 103	Physics Lab	1		
3.		CSC 102	Introduction to Computers & Programming	2	General Education Course (Quantitative Reasoning)	4, 8, 9
		CSL 102	Introduction to Computers & Programming lab	1		
4.		PAK 103	Pakistan Studies & Global Perspective	2	General Education Course (Ideology & Constitution of Pakistan)	4, 10, 16
5.		GEO 105	Physical & General Geology	3	Major (Disciplinary) Requirements	4, 7, 9
6.		ISL 101	Islamic Studies	2	General Education Course (Islamic/Religious Studies)	4, 10, 16
7.		MAT 105	Mathematics	0	Non-credit Course	4
8.		ISL 107	Tajweed	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours			16			

*Only for Muslim students

Semester 2

Sr. No.	Proposed Road map aligned with HEC new UG Policy					17 UN SDGs alignment (please mention relevant SDG No.)
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	
1.		GSC 340	Chemistry	2	General Education Course (Natural Sciences)	3, 4, 6, 7
		GSL 340	Chemistry Lab	1		

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2.		HSS 320	Technical Writing and Presentation Skills	3	General Education Course (Expository Writing)	4
3.		GEO 115	Introduction to Geophysics	3	Major (Disciplinary) Requirements	4, 9,11
4.		GEO 110	Fundamental of Geography & Geomorphology	3	Major (Disciplinary) Requirements	11, 14, 15
5.	GEO 105	GEO 121	Field Geology	2	Major (Disciplinary) Requirements	4, 9, 11
		GEL 121	Field Geology Lab	1		
6.		MAT 115	Calculus & Analytical Geometry	3	General Education Course (Quantitative Reasoning)	4
7.	ISL 107	ISL 108	Understanding Quran – I	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours			18			

*Only for Muslim students

Semester 3

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.		GEO 201	Museology	2	General Education Course (Arts and Humanities)	4
2.		GEO 206	Civics and Community Engagement	2	General Education Course (Civics and Community Engagement)	16, 17
3.		GEO 208	Structural Geology	2	Major (Disciplinary) Requirements	4, 9, 11
		GEL 208	Structural Geology Lab	1		

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4.		GEO 211	Mineralogy & Crystallography	2	Major (Disciplinary) Requirements	4, 11
		GEL 211	Mineralogy & Crystallography Lab	1		
5.		PSY 102	Introduction to Psychology	2	General Education Course (Social Sciences)	3, 4
6.		GEO 212	Geostatistics	3	Interdisciplinary/ Allied Courses	4, 8
7.	ISL 108	ISL 109	Understanding Quran – II	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours			15			

*Only for Muslim students

Semester 4

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.		GEO 225	Geochemistry	3	Major (Disciplinary) Requirements	4, 10, 11
2.		GEO 215	Sedimentology	3	Major (Disciplinary) Requirements	4, 11
3.		GEO 230	Geotectonics	3	Major (Disciplinary) Requirements	4
4.		GEO 207	Applications of ICT	2	General Education Course (Applications of Information and Communication Technologies (ICT))	4, 9
		GEL 207	Applications of ICT Lab	1		
5.		GEO 221	Optical Mineralogy	3	Major (Disciplinary) Requirements	4, 11
6.		HSS 423	Entrepreneurship	2	General Education Course (Entrepreneurship)	4, 8, 9, 17

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7.	ISL 109	ISL 110	Understanding Quran – III	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours			17			

*Only for Muslim students

Semester 5

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.		GEO 325	Stratigraphy of Pakistan	3	Major (Disciplinary) Requirements	4, 11
2.		GEO 345	Petroleum Geology	3	Major (Disciplinary) Requirements	4, 7, 9
3.		GEO 305	Environmental Geology	3	Major (Disciplinary) Requirements	4, 8, 11
4.		GEO 310	Paleontology	3	Major (Disciplinary) Requirements	4, 11
5.		GEO 315	Igneous & Metamorphic Petrology	3	Major (Disciplinary) Requirements	4, 7, 9
6.		GEO 321	Computing with Matlab	2	Interdisciplinary/allied courses	4, 9, 11
		GEL 321	Computing with Matlab Lab	1		
7.	ISL 110	ISL 111	Understanding Quran – IV	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				18		

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Semester 6

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.		GEO 341	Wireline logging	2	Major (Disciplinary) Requirements	4, 9, 11
		GEL 341	Wireline logging Lab	1		
2.		GEO 331	Micropaleontology & Biostratigraphy	2	Major (Disciplinary) Requirements	4, 11
		GEL 331	Micropaleontology & Biostratigraphy Lab	1		

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3.		GEO 360	Geological Field Work and Report	3	Field Experience	4, 13, 15
4.		GEO 350	Geology of Pakistan	3	Major (Disciplinary) Requirements	4, 11
5.			Elective-I	3	Major (Disciplinary) Requirements	-
6.		GEO 336	Neotectonics	3	Major (Disciplinary) Requirements	4, 11
7.	ISL 111	ISL 112	Understanding Quran – V	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				18		

*Only for Muslim students

Semester 7

Proposed Road map aligned with HEC new UG Policy						
Sr. No.	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.		GEO 425	Research Methodology	3	Interdisciplinary/allied courses	4
2.		GEO 411	Engineering Geology	2	Major (Disciplinary) Requirements	4, 9, 11
		GEL 411	Engineering Geology Lab	1		
3.		GEO 438	GIS & Remote Sensing	2	Interdisciplinary/allied courses	4, 8, 11
		GEL 438	GIS & Remote Sensing Lab	1		
4.		GEO 420	Hydrogeology	3	Major (Disciplinary) Requirements	8, 11, 12
5.			Elective-II	3	Major (Disciplinary) Requirements	-
6.	ISL 112	ISL 113	Seerah -I	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16

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Total Credit Hours	15	
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*Only for Muslim students

Semester 8

Sr. No.	Proposed Road map aligned with HEC new UG Policy					17 UN SDGs alignment (please mention relevant SDG No.)
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	
1.	None	GEO 469	Industrial Mineralogy	3	Major (Disciplinary) Requirements	4, 8, 9
2.	None	GEO 476	Mining Geology	3	Major (Disciplinary) Requirements	4, 8, 9
3.	None		Elective-III	3	Major (Disciplinary) Requirements	-
4.	None	GEO 442	Thesis	3	Capstone Project	4, 9
5.	None	GEO 484	Quaternary Geology	3	Major (Disciplinary) Requirements	4
6.	ISL 113	ISL 114	Seerah -II	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				15		

List of Elective Courses

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.		GEO 320	Marine Geology	3	Major (Disciplinary) Requirements	4, 6, 14
2.		GEO 406	Reservoir Geology	3	Major (Disciplinary) Requirements	8, 12
3.		GEO 407	Clastic Sedimentology	3	Major (Disciplinary) Requirements	4, 9
4.		GEO 408	Carbonate Sedimentology	3	Major (Disciplinary) Requirements	4, 9
5.		GEO 409	Geology and Tectonics of Pakistan	3	Major (Disciplinary) Requirements	4, 11
6.		GEO 415	Economic Geology	3	Major (Disciplinary) Requirements	4, 8, 9
7.		GEO 430	Geochemical Exploration Techniques	3	Major (Disciplinary) Requirements	4, 8, 9
8.		GEO 431	Introduction to Geotechnical Engineering	3	Major (Disciplinary) Requirements	4, 9, 11
9.		GEO 432	Rock Mechanics	3	Major (Disciplinary) Requirements	4, 9, 11
10.		GEO 433	Soil Mechanics	3	Major (Disciplinary) Requirements	4, 9, 11

Course Description**Course Description of General Education and Foundation Courses for**

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BS Geology Program

Course Name: Functional English

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites:

Course Code: ENG 101

Contents:

Improvement of vocabulary, writing and speaking skills by using various modern language improvement tools. Practicing précis and comprehension exercises. Structural format of scientific reports and papers. Planning for writing scientific reports and papers. Significance of abstracts, introduction, illustration, tables, reference and acknowledgements. Editing techniques and their practice. Presentation, publication.

Reference Books:

“Effective Writing” by Turk & Kirkman

“Secrets of Successful Speakers” by Lilly Walters

“Effective Speaking” by Verderber/Verderber

Course Name: Physics

Credit Hours: 2

Contact Hours: 2+0

Pre-Requisites:

Course Code: PHY 103

Contents:

Newton's gravitation law; Kepler laws; Electro statistics; Magnetisms; Amperes law; Magnetic flux density B; Reflection and refraction interference and diffraction; Natural and artificial radioactivity; Heat and Conductivity; Pressure and Density; Thermodynamic Principles; Electricity and Magnetism; Semi-Conductor; Transistors; Satellite Communication; Introduction to Meteorology.

Reference Books:

Physics by Holiday, Resnik and Krane (Latest edition). Mechanics by A. B. Pal (Latest edition).

Physics by A.B. Paul (Latest edition).

Course Name: Physics Lab

Credit Hours: 1

Contact Hours: 2+0

Pre-Requisites:

Course Code: PHL 103

Contents:

Practical lab work on Newton's gravitation law; Kepler laws; Electro statistics; Magnetisms; Amperes law; Magnetic flux density B; Reflection and refraction interference and diffraction; Natural and artificial radioactivity; Heat and Conductivity; Pressure and Density; Thermodynamic Principles; Electricity and Magnetism; Semiconductor; Transistors; Satellite Communication and Meteorology.

Reference Books:

Physics by Holiday, Resnik and Krane (latest edition).

Physics by A. B. Paul (latest edition).

Course Name: Introduction to Computers and Programming

Credit Hours: 2

Contact Hours: 2+0

Pre-Requisites:

Course Code: CSC 102

Contents:

History of Computer development; application of Computers; Classification and types of computers; Basic block diagram of computer; Hardware (input, output, memory, CPU and software (system software & Application software); social impact of computer age; Computer in education and Scientific research; Introduction to, and history of Internet; Internet service providers and connections; the World Wide Web. Problem solving and algorithm development. Computer hardware and software. Introduction to programming: machine, assembly and high level languages. C programming language. Arithmetic and logical statements, data types, input/output, basic control structures(selection, iteration etc).Array data type and usage of character strings. Functions: Callby-value and call-by-reference, scopes, recursion. Structures. Pointers. Bit manipulation. File processing.

Reference Books:

Basic Category Theory for Computer Scientists, C. Benjamin Pierce, 1991.

An Introduction to Computing Infrastructure: Hardware and Operating Systems, John Williams, 1996, Que E and T.

Introduction to Computers, Peter Norton, 2004, Technology Education.

Introduction to Computers, Gary B. Shelly, Steven M. Freund, Misty E. Vermaat, Edition 8, 2010, Technology Education.

Course Name: Introduction to Computers and Programming Lab

Credit Hours: 1

Contact Hours: 2+0

Pre-Requisites:

Course Code: CSL 102

Contents:

Introduction to Microsoft Word, Excel, PowerPoint; Basic operations of Microsoft PowerPoint; Bibliography in MS Word; Graph plotting in MS Excel, Introduction to CorelDraw; Introduction to Adobe Photoshop; Structure of C; Input and output function of C++; Variable and Operators; Decision and Loops.

Reference Books:

An Introduction to Operating Systems-Concepts and Practice, Pramod Chandra P. Bhatt, 2004, PHI Learning Pvt. Ltd.

Introduction to Computers, Rajmohan Joshi, 2009.

Computer Networks, Andrew S. Tanenbaum, 5th Edition, Andrew S. Tanenbaum, 2010.

Course Name: Pakistan Studies & Global Perspective

Credit Hours: 2

Contact Hours: 2+0

Pre-Requisites:

Course Code: PAK 103

Contents:

Historical background of Pakistan: Muslim society in Indo-Pakistan, the movement led by the societies, the downfall of Islamic society, the establishment of British Raj-Causes and consequences. Political evolution of Muslims in the twentieth century: Sir Syed Ahmed Khan; Muslim League; Nehru; Allama Iqbal: Independence Movement; Lahore Resolution; Pakistan culture and society, Constitutional and Administrative issues, Pakistan and its geopolitical dimension, Pakistan and International Affairs, Pakistan and the challenges ahead.

Reference Books

Ideology of Pakistan by Sharif al-Mujahid

Course Name: Physical and General Geology

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites:

Course Code: GEO 105

Contents:

Introduction and scope of geology; importance and relationship with other sciences; history and philosophy of geology; Earth as a member of the solar system; its origin, age, composition and internal structure; introduction to plate tectonics, Isostasy; mountain building processes; earthquakes and volcanoes; weathering and erosion; introduction, identification and classification of rocks; sedimentary, igneous and metamorphic structures; physical properties of mineral; introduction to fossils in sedimentary rocks; introduction to folds, faults, joints, cleavage, foliation, lineation; Geological Time Scale; Concept and techniques of geological dating, relative and absolute dating;; Use of Brunton Compass and GPS, etc.

Reference Books

Physical Geology (15 th Edition) by Charles Plummer, Diane Carlson, Lisa Hammersley, 2015, McGraw-Hill

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Laboratory Manual in Physical Geology (9th Edition), Richard M. Busch, 2011, American Geological Institute, Pearson Education
Physical Geology, By Plummer, (14th Edition), Charles (Carlos) Plummer, Diane Carlson, Lisa Hammersley, 2012 McGraw-Hill
Principles of Physical Geology by Holmes, A., 1978, Nelson.

Course Name: Islamic Studies

Credit Hours: 2

Contact Hours: 2+0

Pre-Requisites:

Course Code: ISL 101

Contents:

The course introduces students to the Holy Quran and throws light on its different aspects. Selected verses from the Holy Quran and Hadith have been also included in the course. The course also throws light on the life of Prophet (Peace Be Upon Him).

Reference Books

Hameed ullah Muhammad, 'Introduction to Islam'.

Hussain Hamid Hassan, "An Introduction to the Study of Islamic Law" leaf Publication Islamabad, Pakistan.

Ahmad Hasan, "Principles of Islamic Jurisprudence" Islamic Research Institute, International Islamic University, Islamabad, 1993.

Mir Waliullah, "Muslim Jrisprudence and the Quranic Law of Crimes"

H.S. Bhatia, "Studies in Islamic Law, Religion and Society" Deep and Deep Publications New Delhi, 1989.

Dr. Muhammad Zia-ul-Haq, "Introduction to Al Sharia Al Islamia" Allama Iqbal Open University, Islamabad, 2001.

Course Name: Mathematics

Credit Hours: 0

Contact Hours: 2+0

Pre-Requisites:

Course Code: MAT 105

Contents:

Polynomials, Linear Functions, Quadratic Equations and their solution, Algebra of Matrices, Determinants, Inverse of a square matrix, Cramer's Rule, Rational fractions into partial fractions, Partial fractions for non-repeated linear, repeated linear and non-separable roots, Binomial Theorem, Mathematical Induction, Converting logarithmic functions into exponential functions, Sequences and series, Limits, Average and Instantaneous rate of change, Scalars and Vectors, Dot product, Cross Product, Angles of Measurement, Trigonometric Ratios and Trigonometric Identities, Analytical Geometry, Classifications of conics, Differentiation, Integration.

Reference Books

Dolciani MP, Wooton W, Beckenback EF, Sharron S, Algebra 2 and Trigonometry, 1978, Houghton and Mifflin,Boston (suggested text).

Kaufmann JE, College Algebra and Trigonometry, 1987, PWS-Kent Company, Boston Swokowski EW, Fundamentals of Algebra and Trigonometry (6th edition), 1986, PWS-Kent Company, Boston.

Course Name: Chemistry

Credit Hours: 2

Contact Hours: 2+0

Pre-Requisites:

Course Code: GSC 340

Contents:

Periodic Table, chemical bonding: ionic, covalent, coordinate covalent bond. Solution chemistry. Surface chemistry. Colloids chemistry. Thermodynamics and chemical kinetics. General chemistry of functional groups of organic compounds (alcohols, carbonyls, esters, carboxylic acids, amines). Aromatic compounds, ions, radicals. Photochemical reactions. Radioactivity. Weak Acids & Bases; Water Hardness; Redox Reactions, Chemical Kinetics; Radioactivity.

Reference Books

A Comprehensive Treatise on Inorganic and Theoretical Chemistry Vol II By J. W. Mellor

Course Name: Chemistry Lab

Credit Hours: 1

Contact Hours: 2+0

Pre-Requisites:

Course Code: GSL 340

Contents:

Preparation of molar, molar, normal solutions and buffers. Osmosis and Diffusion. Measurement of pH, EC, DO and TDS in waste water. Use of titrimetric and gravimetric analysis. Use of spectrophotometric techniques. Paper Chromatography (one and two dimensional)

Reference Books

A Comprehensive Treatise on Inorganic and Theoretical Chemistry Vol II By J. W. Mellor

Course Name: Technical Writing and Presentation Skills

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites:

Course Code: HSS 320

Contents:

The Writing Process, Objectives in Technical Writing, Audience Recognition and Involvement, Criteria for Writing Reports, Summaries, Letters and Proposals, Research Paper Writing, Oral Communication, Writing Technical Descriptions, Instruction and User Manuals, The Job Search. Public Speaking & Presentation Skills, Meeting & Interviewing Skills, Non Verbal Communication, Project Reviewing.

Reference Books

Writing. Advanced by Ron White. Oxford Supplementary Skills. Third Impression 1992.

College Writing Skills by John Langan. McGraw-Hill Higher Education. 2004.

Patterns of College Writing (4th edition) by Laurie G. Kirszner and Stephen R. Mandell. St. Martin's Press.

Collins COBUILD Students' Grammar. London: Longman Eastwood, J. 2004.

Oxford Practice Grammar. New Ed., with tests and answers. O UP Goatly, A. 2000

Critical Reading and Writing: An Introductory Course. London: Taylor & Francis

Course Name: Introduction to Geophysics

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites:

Course Code: GEO 115

Contents:

Introduction to geophysics and geodynamics of earth. Classification and brief description of various methods of geophysics such as seismic; gravity, magnetic; electrical. Geophysical data acquisition, processing, and interpretation; applications of geophysical techniques for exploration of natural resources i.e., oil, gas, metallic minerals, ground water and engineering works.

Reference Books

Whole Earth Geophysics: An Introductory Textbook for Geologists and Geophysicists, Robert J. Lillie, 2008, Prentice Hall.

Gravity and Magnetic Exploration: Principal, Practices, and Application, William J. Hinze, Ralph R. B. von Frese, Afif H. Saad, 2013.

Introduction to Applied Geophysics by Burger R. H., Sheehan, A. and Jones, C. 2000, W. W. Norton.

Course Name: Fundamental of Geography & Geomorphology

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites: None

Course Code: GEO 110

Contents:

This course examines the concepts and processes of physical geography that govern the function of the atmosphere, lithosphere, hydrosphere, and biosphere using an earth-systems approach. Course lectures and lab topics introduce the sciences of cartography, meteorology, climatology, geomorphology, hydrology, biogeography, and soils. A focus on how human activities impact the environment, such as climate change and other real-world issues will also be addressed.

Reference Books

"Key Concepts in Geomorphology" by Paul R. Bierman and David R. Montgomery, published by Freeman & C (2021).

Geomorphology: The Mechanics and Chemistry of Landscapes, Robert S. Anderson, Suzanne P. Anderson, 2010, Cambridge University Press.

Process Geomorphology by Ritter, Kochel and Miller, 2002, the McGrawHill Company.

Fundamentals of Geomorphology by Richard Huggett - 2016

Fundamentals of Physical Geography by James Petersen, Dorothy Sack, Robert E. Gabler - 2014

Course Name: Field Geology

Credit Hours: 2

Contact Hours: 2+0

Pre-Requisites: GEO 105

Course Code: GEO 121

Contents:

Instruments used in field mapping. Introduction to topographic and Geological maps. Methods and techniques of surface and subsurface Geological mapping. Correlation techniques. Field description of igneous, metamorphic and sedimentary rocks. Modes

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of Geological illustration including structural contour, isopach and litho-facies maps, block and fence diagrams. Field mapping, preparation of Geological maps and cross-section. Fieldwork: Each student is required to do Fieldwork and submit a report in the examination. The Fieldwork should cover; observation of physical features and their plotting on topographic sheet. Study of geomorphic feature. Measurement of stratigraphic sections. Recognition of structural features. Fauna observation. Study of primary and secondary structures. Field description of sedimentary, igneous and metamorphic rocks.

Reference Books

Introduction to Field Geology, Bevier, M.L., 2006. McGraw-Hill Ryerson Lecture Series by University of Nairobi; SGL:308.

Course Name: Field Geology Lab

Credit Hours: 1

Contact Hours: 2+0

Pre-Requisites: GEO 105

Course Code: GEL 121

Contents:

Parts of Brunton Compass; Block Diagrams of Anticline and Syncline; activity of measuring true thickness and outcrop thickness and their relationship with strata inclination and land surface; Position finding on base map using GPS values. Activity of taking bearing from waist level, eye level and use of compass as hand level; Contour activity, Area calculation, assigning elevations; Activity of contour drawing through triangulation method; Finding outcrop patterns Profile drawing using base map; Preparation of Lithology; Preparation of pi and beta diagram for fold classification using stereonet; Preparation of Rose diagram

Reference Books

Basic Geological Mapping by John W. Barnes and Richard J. Lisle; John Wiley & Sons, Ltd

Introduction to Geological Mapping

Course Name: Calculus & Analytical Geometry

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites: None

Course Code: MAT 115

Contents:

The main contents are Preliminaries (Real-number line, functions and their graphs, solution of equations involving absolute values, inequalities). Limits and Continuity (Limit of a function, left-hand and right-hand limits, continuity, continuous functions). Derivatives and their Applications (Differentiable functions, differentiation of polynomial, rational and transcendental functions, derivatives). Integration and Definite Integrals (Techniques of evaluating indefinite integrals, integration by substitution, integration by parts, change of variables in indefinite integrals).

Reference Books

Anton H, Bevens I, Davis S, Calculus: A New Horizon (8th edition), 2005, John Wiley, New York.

Stewart J, Calculus (3rd edition), 1995, Brooks/Cole (suggested text).

Swokowski EW, Calculus and Analytic Geometry, 1983, PWS-Kent Company, Boston.

Thomas GB, Finney AR, Calculus (11th edition), 2005, Addison-Wesley, Reading, Ma, USA.

Course Name: Museology

Credit Hours: 2

Contact Hours: 2+0

Pre-Requisites: None

Course Code: GEO 201

Contents:

Introduction to Museology provides a broad, theory-based introduction to the museum sector and the research field of museology. Focusing on museum ethics, the course also give attention to all museum activities. Excursions to different museums and guest lectures from the museum sector give the students insights into the museum practice and provide present day examples and discussions, which they may study by using museological theories, dilemmas in museum ethics, and knowledge in museum history.

Reference Books

The International Handbooks of Museum Studies by Sharon Macdonald et al. (2015).

Manual of Museum Exhibitions by Barry Lord (2014)

Museum Collections Management by Freda Matassa (2011).

Dictionary of Museology by François Mairesse - 2023

New Horizons for Asian Museums and Museology Naoko Sonoda - 2016

Course Name: Civics and Community Engagement

Credit Hours: 2

Contact Hours: 2+0

Pre-Requisites: None

Course Code: GEO 206

Contents:

This course aims to bring responsible citizenship and active engagement between Universities/HEIs (through their students) and local communities. The course will provide students with a foundational understanding of the principles, institutions, and processes of civic engagement in a democratic society. Moreover, the course will build the capacity of students as leaders and influencers by gaining fundamental understanding of leadership, citizenship, communication, advocacy, network building as well as having first-hand experience of community development through volunteer works.

Reference Books

Managing Civic and Community Engagement by David Watson - 2007

Higher Education and Civic Engagement: Comparative Perspectives by L. McIlrath, A. Lyons - 2012

Course Name: Structural Geology

Credit Hours: 2

Contact Hours: 2+0

Pre-Requisites: None

Course Code: GEO 208

Contents:

Dynamics of rock deformation and mechanical properties of rocks; Stress and strain concepts; Factors controlling mechanical behavior of Materials; Folds classification based on morphology, geometry, and vergence; Mechanics of fold formation; Faults classification based on geometry and genesis; Structures in compressional and

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extensional regimes; Classification of Joints, foliations and lineation; Unconformities, their classification and recognition. Laboratory exercises on geologic map interpretation and cross sections; Field trips to area where good Geological structures are exposed.

Reference Books

Physical geology by plummer, Turbak and Marshik

Field geology by Kompton

Structural geology of rocks and regions by Davies

Course Name: Structural Geology Lab

Credit Hours: 1

Contact Hours: 2+0

Pre-Requisites: None

Course Code: GEL 208

Contents:

Map exercises, linear and planar structures, and construction of geological cross-sections; orthographic projections (geometrical exercises); stereographic projections, fault plane solutions, stress and strain analysis using oriented samples and use of structural computer software.

Reference Books

Geological structures and maps by Richard j lisle

Course Name: Mineralogy and Crystallography

Credit Hours: 2

Contact Hours: 2+0

Pre-Requisites: None

Course Code: GEO 211

Contents:

Introduction to Crystallography; elements of symmetry, symmetry operations, crystal notation, crystal systems study of normal classes of crystallographic systems; Classification and system study of minerals with an emphasis on their crystallographic features, physical properties, Chemical composition, occurrences, associations and uses; Introduction to X-ray crystallography.

Reference Books

Dana's textbook of mineralogy

Course Name: Mineralogy and Crystallography Lab

Credit Hours: 1

Contact Hours: 2+0

Pre-Requisites: None

Course Code: GEL 211

Contents:

Study of crystal morphology, preparation of crystal models, orientation of crystallographic axes in different systems, identifying elements of symmetry, symmetry of different crystal systems, crystal forms. Construction and interpretation of unary phase diagrams. Construction and interpretation of binary phase diagrams. Identification and description of different physical properties of the minerals, metallic and non-metallic mineral resources. Hand specimen identification of minerals.

Reference Books

Mineralogy Dexter Perkins, Earth Lab

Course Name: Introduction to Psychology

Credit Hours: 2

Contact Hours: 2+0

Pre-Requisites: None

Course Code: PSY 102

Contents:

The course is designed to introduce to understand the vocabulary and concept of psychology. Understand how critical thinking is proclaimed to be scientific or based on research. Describe the critical development and led to the present discipline of psychology contrast and compare the three majors, also apply psychology theory in some area of his /her life.

Reference Books

Introduction to Psychology by Charles Stangor - 2021

Introduction to Psychology: Gateways to Mind and Behavior by Dennis Coon, John O. Mitterer, Tanya S. Martini - 2021.

Course Name: Geostatistics

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites: None

Course Code: GEO 212

Contents:

Descriptive statistics and exploratory data analysis, random variable; moments; probability distributions; normal and lognormal distributions, random function model,

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modeling spatial continuity; experimental variograms covariance functions; correlograms and madograms; variogram and covariance function models; isotropy and anisotropy, estimation methods: simple kriging.

Reference Books

- Kitanidis, P.K. (1997) Introduction to geostatistics: applications in hydrology.
Goovaerts,Pierre (1999) Geostatistics for Natural Resource Evaluation.
Olea, R. A. (1999) Geostatistics for Engineers and Earth Scientists.
Christakos, G (2000) Modern Spatiotemporal Geostatistics.
Webster, R. and Webster, M (2001) Geostatistics for Environmental Scientists.

Course Name: Geochemistry

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites: None

Course Code: GEO 225

Contents:

Introduction; Nature of geochemical data and methods of analysis; Composition of solar system, meteorites and the earth; Geochemical classification of elements; Factors governing behavior of elements in Geological processes; Eh and pH diagrams; Geochemistry of igneous, sedimentary, and metamorphic rocks; Geochemical cycle; Introduction to exploration, environmental and analytical geochemistry; Laboratory instrumentation and common analytical methods involving rocks, soils, minerals and water.

Reference Books

- Krauskopf & Bird (1995): Introduction to Geochemistry
Albarede: Essentials of Geochemistry
Rollinson: Using Geochemical Data
Petroleum Formation and Occurrence by B.P. Tissot and D.H. Welte
Harry, steven, Maria: Geochemistry
Tulane University, Prof. Stephen A. Nelson notes

Course Name: Sedimentology

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites: None

Course Code: GEO 215

Contents:

Introduction; Sediments, their origin, transportation and deposition; Stratification, diagenesis, lithification and origin of sedimentary rocks; Depositional environments; Sedimentary basins; Sedimentary structures, their morphology and interpretation; Classification, composition and textures of sedimentary rocks and their descriptive study.

Reference Books

Sand and Sandstone by Pettijohn, F. J., Potter, P. E. and Siever, R., 1972, Springer-Verlag.

Principles of Sedimentology by Friedman, G. M. and Sanders, J. E., 1978, John Wiley and Sons.

Depositional Sedimentary Environments by Reineck, H. E. and Singh, I. B., 1980, Springer-Verlag.

Carbonate Sedimentology by Tucker, M. E. and Wright, V. P., 1990, Blackwell.

Course Name: Geotectonics

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites:

Course Code: GEO 230

Contents:

Review of various tectonic theories; Historical development of the plate tectonic theory; Plate Movements, Mantle Plumes, Plate Boundaries, Detail study of plate tectonics; Orogenic belts and evolution of folded mountains; Young folded mountains of the earth with special emphasis on mountain belt in Pakistan; Regional Tectonics of Pakistan.

Reference Books

Global Tectonics (Philip Kearey, Keith A. Klepeis and Frederick J. Vine)

Plate Tectonics & Crustal Evolution (Kent C. Condie)

Other Resources that you may want to refer to:

Plate Tectonics, Continental Drift and Mountain Building - Wolfgang Frisch, Martin Meschede and Ronald C Blakely Springer 2011)

Course Name: Applications of ICT

Credit Hours: 2

Contact Hours: 2+0

Pre-Requisites:

Course Code: GEO 207

Contents:

Learn basic programs (word, excel, illustrator, power point), basic programming and numerical analysis (using MATLAB); basic geographical information systems and visualization; some of the field equipment; basic knowledge related to Computer hardware (CPU, memory, motherboard and bus, power supply, monitor, video card, hard drive, ports (ethernet, parallel, serial, USB), CD, zips, etc. System run programs (drivers, Operating systems like Windows, Unix, Mac and Linux, other software used in industries Geographix, Petrel, Petromod, Kingdom Sweet. Computer encoding

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(Digital, Analogue), various kinds of scripts like MATLAB, ASCII, EBCDIC, and UNICODE; basics of networking. Use of common geological, structural and geophysical computer programs.

Reference Books

- Basic Category Theory for Computer Scientists, C. Benjamin Pierce, 1991.
- An Introduction to Computing Infrastructure: Hardware and Operating Systems, John Williams, 1996, Que E and T.
- Introduction to Computers, Peter Norton, 2004, Technology Education.
- Introduction to Computers, Gary B. Shelly, Steven M. Freund, Misty E. Vermaat, Edition 8, 2010, Technology Education. 49

Course Name: Applications of ICT Lab

Credit Hours: 1

Contact Hours: 2+0

Pre-Requisites:

Course Code: GEL 207

Contents:

Basic exercises on geological, structural and geophysical computer programs.

Reference Books

- An Introduction to Operating Systems-Concepts and Practice, Pramod Chandra P. Bhatt, 2004, PHI Learning Pvt. Ltd.
- Introduction to Computers, Rajmohan Joshi, 2009.
- Computer Networks, Andrew S. Tanenbaum, 5th Edition, Andrew S. Tanenbaum, 2010.

Course Name: Optical Mineralogy

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites:

Course Code: GEO 221

Contents:

Review of the rock-forming minerals – occurrences and associations, light & its nature, basic principles of polarized light microscopy (PLM) & its applications to mineral identification, optical properties of minerals, types of microscopic samples, refractometry, optics of isotropic minerals, optics of anisotropic minerals, uniaxial optics, biaxial optics, reflected light optics. Practical use of different parts of petrographic microscope. Centering of microscopic stage. Identification and description of common minerals; study of rocks and minerals in thin sections, texture and composition; classification of rocks using different techniques, volume estimates and other elementary petrographic techniques. Use of bertrand lens, use of accessory plates, indicatrices and interference figures.

Reference Books

Optical Mineralogy by William D Nesse

Optical Mineralogy by Paul F Kerr

Course Name: Entrepreneurship

Credit Hours: 2

Contact Hours: 2+0

Pre-Requisites: None

Course Code: HSS 423

Contents:

The Nature and Importance of Entrepreneurship: Nature and Development of Entrepreneurship; Entrepreneurial Decision Process; Role of Entrepreneurs in Economic development; Ethics and Social Responsibility of Entrepreneurship; The Future of Entrepreneurship The Entrepreneur and Entrepreneurial Mind: The Entrepreneurship process; Myths of Entrepreneurs, Managerial VS Entrepreneurial Decision Making; Entrepreneurial Leadership Characteristics The Nature and Importance of SMEs: Nature and Scope of Entrepreneurship; SMEs Definitions / Understanding by various Regulatory Authorities in Pakistan; SMEs contribution to GDP of any country, and of Pakistan; SMEDA's Role in promoting and developing SMEs. The Individual Entrepreneur, and Techniques for Idea Generation Process; Entrepreneur VS Intrapreneur. Inside the Entrepreneurial Mind: From Ideas to reality: Creativity, Innovation and Entrepreneurship; Creativity A necessity for survival; Creative Thinking; Barriers to creativity; How to enhance creativity; The creative Process; Techniques for improving the creative process; Protecting your ideas. The Customer and Product Plan/Feasibility: Understanding of Customer through Demand and Desire, and of Product (Good and/or Service) The Industry and Marketing Plan/Feasibility: Understanding of Marketing Plan, Characteristics of Marketing Plan; and Environment Analysis and Steps in preparing the Marketing Plan The Financial Plan/Feasibility: Operating and Capital Budgets, Break Even Analysis; Cash Flows and Balance Sheets The Organizational Plan/Feasibility: Developing the management team; Building the successful Organization, The Role of BODs. Components, and Classification of Business Plans Financing Options: e.g. Leveraged Buyouts; Preparing for the new Launch; Execution & Growth; Managing early growth of the New ventures. Analysis, and Competitive Environment Analysis. Growth Options: Joint Venture; Franchising; Acquisitions; Synergy; Mergers; Hostile Takeovers; Licensing etc.

Reference Books

An Introduction to Entrepreneurship Eamonn Butler 2020

Course Name: Stratigraphy of Pakistan

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites: None

Course Code: GEO 325

Contents:

Principle of stratigraphy; laws of superposition and faunal succession. Geological time scale with divisions. Classification and nomenclature of strati graphics units: lithostratigraphic units, biostratigraphic units and chronostratigraphic units. Geological time scale with divisions. Stratigraphic Code of Pakistan. Principle of stratigraphic correlation. Outline of stratigraphy of Pakistan. Stratigraphy of Indus Basin and Baluchistan Basin.

Reference Books

Shah, S. I. (2000). Stratigraphy of Pakistan. Quetta: Geological Survey of Pakistan.

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Kazmi, A. H., & Abbasi, I. A. (2008). Stratigraphy & historical geology of Pakistan. Peshawar: Department & National Centre of Excellence in Geology.
Boggs Jr, S. (2014). Principles of sedimentology and stratigraphy.

Course Name: Petroleum Geology

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites: None

Course Code: GEO 345

Contents:

Introduction; Properties of petroleum and natural gas; Origin, migration and accumulation of hydrocarbons; Related source, reservoir and seal rocks; Reservoir properties; Various types of Geological traps for hydrocarbon accumulation; Concept of petroleum province and introduction to basin analysis.

Reference Books

Petroleum Geochemistry and Geology by Hunt J M.

Hydrocarbon Exploration and Production by Jahn F and Graham M.

Geology of Petroleum by Leverson.

Petroleum Geology for Geoscientists by Prof Ifeanacho Paul Orajaka and Dr Johnbosco Azubuike Onyeji.

Course Name: Paleontology

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites: None

Course Code: GEO 310

Contents:

General introduction of paleontology and fossils occurrence; Modes of preservation, limitations and Geological distribution of fossils; Evolutionary trends; Systematic study of the principal phyla of invertebrates; Fossils habitats and time ranges of fossils; Practical include the systematic study of important genera of the main invertebrate fossil phyla; Field trips to fossil bearing localities. Introduction to vertebrate paleontology.

Reference Books

Invertebrate Paleontology & Evolution (E.N.K. Clarkson).

Invertebrate Fossils (Raymond C. Moore, Cecil G. Lalicker, Alfred G. Fisher).

Course Name: Igneous & Metamorphic Petrology

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites: None

Course Code: GEO 315

Contents:

Nature and generation of magma; Magmatic crystallization and differentiation; Mode of occurrence and types of extrusive and intrusive igneous rock bodies; Structure and textures of igneous rocks; Classification and systematic study of igneous rocks; Processes and types of metamorphism and tectonism; Field and Laboratory study of igneous rocks in Hand specimen study of igneous and metamorphic rocks; Field trip to igneous & metamorphic areas.

Reference Books

An Introduction to Igneous and Metamorphic Petrology by John D. Winter

Igneous petrology by Wilson

Physical Geology by Charles C Plummer

Physical Geology by Mark J. Crawford

Metamorphic Petrogenesis by David

Course Name: Computing with Matlab

Credit Hours: 2

Contact Hours: 2+0

Pre-Requisites: None

Course Code: GEO 321

Contents:

Matlab basics (getting mat lab to run, programming, the command prompt, simple expressions, variables and referencing matrix elements), getting mat lab to run, programming, the command prompt, simple expressions, variables, referencing matrix elements, matrices, accessing matrix elements, assigning into sub-matrices, basic tools, matrix concatenations, more expression, plotting, logical constructs, formatting text, flow control, "if" statement, "for" loops. Defining functions, "while" statements, variable scope, functions and logic, multiple input functions, more on logic, basic lab commands, programming structures, bsic graphing routines, advanced matrix operations, file input/output, writing and calling functions, data structures and input assertion, mat lab compiler, practical computer-based exercise.

Reference Books

MATLAB: A Practical Introduction to Programming and Problem Solving, 3rd edition, Stormy Attaway, Elsevier, 2013.

Course Name: Computing with Matlab Lab

Credit Hours: 1

Contact Hours: 2+0

Pre-Requisites: None

Course Code: GEL 321

Contents:

Lab: Introduction to Matlab; MATLAB as Calculator (Artimatic Operations); Elementary Math Functions; Scalar variables, Predefined Variables; Complex numbers; Built-In functions for handling arrays; Writing, saving, and execute MATLAB programs; Fundamental form MATLAB uses to store and manipulate data; Matrices operations: addition and subtraction of arrays Multiplication, division, and exponentiation; element-

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by-element operations; Matrices operations: element-by-element operations; Matrices operations: element-by-element operations; How to input data to a script file; How data are stored in MATLAB; How to exchange data between MATLAB and other applications; Yield 2- and 3-D plots in Matlab; Standard plots with linear axes, logarithmic and semi-logarithmic axes, bar and stairs plots, polar plots, three-dimensional contour surface and mesh plots; Relational operators; Logical operators; Conditional statements; Loops; User-defined functions and function files.

Reference Books

MATLAB: A Practical Introduction to Programming and Problem Solving, 3rd edition, Stormy Attaway, Elsevier, 2013.

Course Name: Wireline Logging

Credit Hours: 2

Contact Hours: 2+0

Pre-Requisites: None

Course Code: GEO 341

Contents:

Introduction; Types of Logs; Methods and principles; Factors influencing Logs; Resistivity logs; SP logs; Gamma Ray logs; Formation density logs; Neutron logs; Sonic logs; Caliper logs. Application of logs; Porosity determination; Lithology and Hydrocarbon Detection; Structural interpretation; Correlation.

Reference Books

AAPG Basic Well Log Analysis by George Asquith and Daniel Krygowski

Schlumberger – Log interpretation Principles/Applications

Course Name: Wireline Logging Lab

Credit Hours: 1

Contact Hours: 2+0

Pre-Requisites: None

Course Code: GEL 341

Contents:

How to read well logs and its presentation, Pattern recognition and correlation of well logs, Estimation of Shale content; Gross Pay vs. Net Pay, Estimation of porosity from a single log, Multiple porosity methods, Water Saturation determination, Gas Sand Interpretation, Identification of lithologies and crossplots, Stock Tank Original Oil In Place (STOOIP) calculation, Image log interpretation

Reference Books

Schlumberger – Log interpretation Principles/Applications

Course Name: Micropaleontology and Biostratigraphy

Credit Hours: 2

Contact Hours: 2+0

Pre-Requisites: None

Course Code: GEO 331

Contents:

Introduction to Foraminifera, Bryozoa, Ostracoda, Conodonts, Algae, Pollen and Spores; Organic walled microplanktons and nano-fossils; Principles of bio-stratigraphy and bio-stratigraphic zones; Biostratigraphic techniques and procedures; Tertiary bio-stratigraphy with special reference to Pakistan. Lab: Basic micro-paleontological and

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bio-stratigraphic techniques. Morphological and taxonomic studies of selected microfossils.

Reference Books

Introduction to Marine Micropaleontology (Bilal U. Haq, Anne Boersma)

Biostratigraphy: microfossils and geological time by McGowan, B., 2005, Cambridge University press, London.

Non marine Permian biostratigraphy and biochronology by Lucas, S.G., Cassinis, G. and Schneider, J.W., 2006, Geological Society of London, London.

Applied micropaleontology by Jenkins, D.J., 1993. Kluwer Academic publishers, Netherlands.

Course Name: Micropaleontology and Biostratigraphy Lab

Credit Hours: 1

Contact Hours: 2+0

Pre-Requisites: None

Course Code: GEL 331

Contents:

Lab: Sampling techniques, labelling and storing, cataloging and shelving, casting and molding, faunal preservation techniques, thin section preparation, microfossils extraction, organization of foraminifera, treatments of planktons, study of micropaleontological samples, as an individual research practice during the second half of each practical session, field excursion to Permian/Tertiary rocks of Salt Range/Kohat Sub-basin.

Reference Books

Recent developments in applied biostratigraphy by Powell, A. J. And Riddig, J. B., 2005. Geological Society of London and British Micropaleontological society, London. Paleozoic vertebrate biostratigraphy and biogeography by Long, J.A., 1994. John JHopkins University Press, MD, USA.

Discover the mysterious world of fossils in close-up their origin, formation and extraordinary variety by Taylor, P.D., 2000. D.K. Eyewitness Books.

Plankton stratigraphy by Bolli, H.M., Saunders, J.B. and Perch-Nielsen, K., 1985. Cambridge University Press.

Course Name: Geological Field Work & Report

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites: None

Course Code: GEO 360

Contents:

One-week fieldwork in geologically important areas to further train the students in geological field techniques; Method of data collection and measurement of stratigraphic section; Identification of complex structures, sample collection techniques. Use of field instruments and Geological mapping procedures; Rock and mineral identification and collection. A written Geological report at the end of semester.

Reference Books

Stratigraphy of Pakistan (2009) by S.M.I. Shah.

Petroleum Geology by George F.K. North.

Petroleum Geosciences by Knut Bjørlykke.

Published research articles on the study area (Hazara Basin) will be used as the Reference material for this field work.

Course Name: Geology of Pakistan

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites: None

Course Code: GEO 350

Contents:

Physiographic and tectonic divisions and their descriptions. Geology and stratigraphy of the Indian plate. Karakoram plate, Afghan block and Arabian plate. Kohistan, Chagai and Ras Koh magmatic arcs, oroclines and sutures zones. Regional metamorphism (Himalayan and Pre-Himalayan). Main episodes of magmatism and their relation to tectonics. Economic mineral and fuel deposits of Pakistan.

Reference Books

Stratigraphy of Pakistan, GSP Memoirs Vol.22 by DR. S. M. Ibrahim Shah

Stratigraphy and Historical Geology of Pakistan by Kazmi and Abbasi

Geodynamics of Pakistan by De Jong

Metallogeny and Mineral Deposits of Pakistan by Kazmi and Abbasi

Course Name: Neotectonics

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites: None

Course Code: GEO 336

Contents:

Active tectonics and neotectonics: definitions, active faults and criteria for identifying active faulting; direct measurements of tectonic movements; direct measurement with geodetic networks; triangulation of sites with reference to satellites; global positioning systems; geology and earthquakes; earthquake seismology; paleoseismology; trenching and seismic trenching; Quaternary dating methods; tectonic geomorphology; offset geological-geomorphological features (paleoseismic indicators, changes in elevations of coast lines, stream offsets, slope retreat, terraces, incised meander); fault scarp morphology; neotectonics behavior of faults and folds; hazards of active tectonics: earthquakes and mass movements; remote sensing and

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satellite imageries applications in neotectonics and related hazards; active tectonics and nuclear waste disposal; neotectonics of Pakistan and Himalayas.

Reference Books

Himalayan Neotectonics and Channel Evolution by Harendra Nath Bhattacharya, Soma Bhattacharya, Balai Chandra Das.

Neotectonics in Earthquake Evaluation by Ellis L. Krinitzsky, D. B. Slemmons.

Neotectonism in the Indian Subcontinent: Landscape Evolution by K S Valdiya, Jaishri Sanwal.

Current Progress in Tectonics by Agnes Nolan.

Course Name: Research Methodology

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites: None

Course Code: GEO 425

Contents:

An Overview of Research Methods and Methodologies; Difference Between “Method” and “Methodology”; Epistemology, Methodology, and Method; An Overview of Empirical Research Methods: Descriptive (Qualitative) & Experimental (Quantitative); Assessing Methods; Ethnographies; Case Studies; Survey Research; Focus Groups; Discourse/Text Analysis; Quantitative Descriptive Studies; Prediction and Classification Studies; Meta-Analysis; Validity in Research; Reliability in Research; Rigor in Research; Key Considerations to Design Your Research Approach; The Importance of Methods and Methodology.

Reference Books

Research Design: Qualitative, Quantitative, and Mixed Methods Approaches, by John W. Creswell

Course Name: Engineering Geology

Credit Hours: 2

Contact Hours: 2+0

Pre-Requisites: None

Course Code: GEO 411

Contents:

Basic concept of Engineering Geology; Mass-wasting, landslide and other rock movements; Introduction to soil mechanics; Classification and characteristics of soil; Engineering properties of soil; Introduction to rock mechanics, stress and strain characteristics in deformation of rocks; rock classification; rock engineering properties; Geology of the engineering structures: dams, tunnels, bridges.

Reference Books

Engineering Geology (F.G.Bell 2nd Edition)

Engineering Geology Principles and Practices (M. H. de Freitas)

Principles of Engineering Geology (P.B. Attewell and I.W. Farmer)

Course Name: Engineering Geology Lab

Credit Hours: 1

Contact Hours: 2+0

Pre-Requisites: None

Course Code: GEL 411

Contents:

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Sieve analysis, moisture content, determination of liquid limit, determination of elastic limit, determination of plasticity limit, void ratios, porosity, angle of repose, compaction of soil and other geotechnical properties.

Reference Books

Engineering Geology Lab Manual Kindle Edition by Anshul Jain.

Engineering Geology Laboratory Manual by Reddy M.T.

Applied Engineering Geology Lab Manual by Vincent S. Cronin

Course Name: GIS & Remote Sensing

Credit Hours: 2

Contact Hours: 2+0

Pre-Requisites: None

Course Code: GEO 438

Contents:

Introduction to Geographical Information System; data types, data models and structures; data sources and capturing techniques; displaying and manipulating spatial information, vector data preparation, GPS Survey; introduction to the concept of RS, electromagnetic spectrum, atmospheric interaction; Technology of Remote Sensing (Orbits, Satellites, Sensors and Platforms); applications of Remote Sensing, satellite image processing cycle, image enhancement, data fusion.

Reference Books

Remote Sensing by Siamak Khorram, Frank H. Koch, Cynthia F. Van der Wiele. 2012. Springer.

Introduction to Geographic Information Systems by Kang-Tsung Chang. 2010. McGraw-Hill Publishers.

GIS: Fundamentals, Applications and Implementations by Elangovan. 2006. McGraw-Hill Publishers.

Remote Sensing of the Environment by John R. Jensen. 2009. Amazon publishers.

Matt Duckham, Michael F. Goodchild, Michael F. Worboys, 2003, Foundations of Geographic Information Science, Tylor and Francis, New York, USA.

Course Name: GIS & Remote Sensing Lab

Credit Hours: 1

Contact Hours: 2+0

Pre-Requisites: None

Course Code: GEL 438

Contents:

Introduction to ArcGIS, Exploring GIS Data set in Arc Catalog, working on vector data in ArcGIS (Scanning, Digitization and Editing), Integrating GPS data in GIS Environment, Applications of GIS, ERDAS Imagine, ENVI - Environment, Noise Corrections, Geometric Corrections, Radiometric Corrections.

Reference Books

Michael N. Demers 2002, Fundamentals of Geographic Information System, John Wiley and Sons, Inc., Singapore.

Kang-Tsung Chang, 2002, Introduction to Geographic Information Systems, McGraw-Hill Company, New York, U.S.A.

W. G. Rees, 2001, Physical Principles of Remote Sensing Cambridge University Press, United Kingdom. ISBN: 0521669480. 38

Asanta Shrestha and Birendra Bajracharya, 2000, GIS for Beginners, By ICIMOD, Kathmandu, Nepal.

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Thomas M. Lilles and Ralph W. Kiefer, 2000, Remote Sensing and Image Interpretation John Wiley and Sons.

Course Name: Hydrogeology

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites: None

Course Code: GEO 420

Contents:

The hydrologic cycle. Aquifer system and types; occurrence and movement of groundwater; hydrologic properties of rocks and their measurements, fluctuation of groundwater levels and causes; recharge and discharge of ground water; groundwater exploration by geological, hydro-geological and geophysical methods and remote sensing techniques; well hydraulics, tube well drilling techniques, designing, development; flow-net analysis and pumping tests; water logging and causes of water table declination; groundwater chemistry, salinity, quality analysis and deterioration of water quality. Groundwater resources of Pakistan.

Reference Books

Hydrogeology: objectives, methods, applications by Ric Gilli, Eric Gilli, Christian Mangan, 2012, CRC Publishers Taylor and Francis Group, USA.

Hydrogeological Conceptual Site Models: Data Analysis and Visulization by Neven Krešić, Alex Mikszewski. 2012. CRC Publishers Taylor and Francis group, USA.

Fundamentals of Hydrology by Tim Davie. 2012. Rourledge for Taylor and Francis Group, USA.

Elementary Hydrogeology by Singh. 2010. Prentice Hall, USA.

Hydrogeology Lab Manual by Lee. 2010. Prentice Hall, USA.

Hydrogeology, Principles and Practice by Geofluids, S. Q. L., 2

Course Name: Industrial Mineralogy

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites: None

Course Code: GEO 469

Contents:

Physical and chemical properties of minerals; relationship between the structure, chemistry and properties of various rocks and minerals. Mechanisms of mineral nucleation and crystal growth; importance of kinetics in mineral formation. Exploration and Exploitation techniques; sands and gravels, hard rock aggregates, dimension stone, slate, limestone and dolomite, magnesite, clays (common clay/shale, kaolin, bentonite, and fuller's earth), silica sand, dunite and serpentinite, feldspars, nepheline syenite; natural abrasive raw materials, gypsum, anhydrite, chromite, barite and gemstones including diamond and their industrial uses. Mineralogy and chemistry of raw materials for cement, glass, agriculture, chemical and refractories; industrial minerals and their environmental impacts; risk assessment and economic evaluation. Economic potential of industrial rocks and minerals in Pakistan.

Reference Books

"Mineralogy" by Perkins

"A Textbook of Mineralogy" by Dana E S and Ford W E

"Introduction to Mineralogy: International Edition" by William D Nesse

Course Name: Mining Geology

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites: None

Course Code: GEO 476

Contents:

Introduction to Mining Geology, Terminology related to mining; mining survey techniques; surface and subsurface mining methods; opening of mines; structural controls in mining; correlation of surface and subsurface data; spatial relationship of seams; surface and underground mapping methods; calculation of ore grade and tonnage; gases in mines and spontaneous combustion; rock pressure and support; collapses in mines and their safety/remedial measures; mine-refuse disposal management; ore grade control in mining; impact of mining on environment and their remedies and rehabilitation; introduction to mining explosives; coring, core logging and data interpretation; the effects of gasses and radioactive isotopes on miners health. Miner's diseases, their monitoring and remedial measures.

Reference Books

Exploration and Mining Geology by William C Peters

Mining Geology by Willard C. Lacy (Editor)

Mining geology in prospect by Grosvenor Rex Davis

"Applied Mineralogy in the Mining Industry" by W Petruk

Course Name: Quaternary Geology

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites: None

Course Code: GEO 484

Contents:

The Quaternary period: Character, duration, development and climatic changes; soil characteristics; soil stratigraphy; morphological evidence and landforms; Quaternary environments; Pleistocene glaciation and sea level changes; lithological evidence of environments; types of sediments; isotopes in deep-sea sediments; biological evidence; plant fossils and animal remains; dating methods; Quaternary stratigraphy and correlation; Quaternary geology, geochronology and neotectonics; Quaternary deposits of Pakistan and its importance (alluvial, fluvial, colluvial, lacustrine, glacial and eolian deposits).

Reference Books

Quaternary Geology by An Zhisheng, Weijian Zhou.

Glacial and Quaternary geology by Richard Foster Flint.

Course Name: Marine Geology

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites: None

Course Code: GEO 320

Contents:

Development of marine geology, contribution of deep sea drilling projects (DSDP) and Oceanic Drilling Program (ODP), Hypsometry, topographic features of the ocean. Plate tectonics and sea floor spreading, major ocean basins, gulfs and seas. Geology of continental margins, estuaries, deltas, barrier islands and coral reefs. Sediment

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types and distributions, shelf sedimentation in marine geology. Worldwide level changes through time.

Reference Books

Marine Geology: A planet Earth Perspective by Anderson, R. N., 1986, New York: John Wiley.

A Work book in Oceanography by Dudley, W. C and Min Lee, 1982, Alpha Editions, A division of Burgess Publishing Co. Minnesota.

Marine Geology by James P. Kennett, 1982, Prentice-Hall, INC, Englewood Cliffs, N.J.
Initial Reports of the Deep Sea Drilling Project, 1975, Vol. 29/ 32/ Washington, D. C.;
U. S. Government Printing Office.

The submerged continental margin by McGregor, B. A., 1984, American Scientist 72 (3): 275-81.

Course Name: Reservoir Geology

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites: None

Course Code: GEO 406

Contents:

Petrophysical evaluation; reservoir rock types: elastic, carbonates and nonmarine reservoirs. Reservoir properties, depositional and diagenetic controls; fluid properties and their saturation; hydrocarbon distributing and fluid contacts; reservoir zonation and thickness mapping, reservoir pore spaces configuration; mapping reservoir heterogeneity; reservoir estimation and calculation of reservoir volumetric, material balance and production, decline curve methods; appraisal and development of reservoir basic concepts.

Reference Books

Introduction to Petroleum Reservoir Analysis by Koederitz I. F. Heaveey., A. H. and Honarpour 1989, Contribution in Petroleum/Geology and Engineering-6 Gulf Publishing Co.

Development and Exploration of Oil and Gas Field by Muravyor, R. et al., latest Edition., Peace publishers.

Petroleum Geology by North F. K. 1985. Allen and Unwin London.

Course Name: Clastic Sedimentology

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites: None

Course Code: GEO 407

Contents:

Texture of clastic sedimentary rocks, Sedimentary structures, their classification and hydrodynamic conditions, Paleocurrent analysis and provenance of clastic rocks, Sedimentary environments and facies Continental environments: Deserts, rivers lakes, glaciers and wind. Transitional environments: Delta, estuary and interdeltaic complexes, Marine environments: Shelf, slope and deep marine. Diagenesis of clastic rocks.

Reference Books

Sedimentary Environments and Facies by Reading, H. G., 1986, Blackwell Scientific Publications

Depositional Sedimentary Environments by Renieck, H. E. and Singh, I. B., 1980, Springer-Verlag.

Petrology of Sedimentary Rocks by Boggs Jr. S., 1992, Merril Publishing Co.

Sedimentary Rocks by Pettijohn, F. J., latest Ed., Harper and Row.

Course Name: Carbonate Sedimentology

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites: None

Course Code: GEO 408

Contents:

Carbonate mineralogy and chemistry: structure of aragonite, calcite and dolomite, trace elements and isotopes, dolomite and dolomitization models: modern and ancient examples. dolomitization reactions, trace element geochemistry of dolomites, dolomite petrography; depositional textures and structures: carbonate constituents, algal stromatolites; classification of carbonates by Folk and Dunham; porosity types; concept of microfacies and microfacies types of Wilson; major controls on carbonate sedimentation; depositional processes and facies in carbonate rocks; carbonate depositional models, platforms, rimmed shelves, ramps, epiceric platforms and isolated platforms; cyclicity in carbonates; modern carbonate environments of Bahamas, Florida and Persian Gulf; carbonate depositional systems; lacustrine, shoreline, peritidal reefs, shallow and deep water; diagenetic processes and sequences and models.

Reference Books

Carbonate Sediments and their Diagenesis by Bathurst, R. G., latest Edition., Elsevier.
Marine Carbonate by Milliman, J. D., 1974, Springer-Verlag.

Carbonate Depositional Environment by Scholle, P. A. Bebout, D. G. and Moore, C. H., AAPG Mem.

Carbonate Sedimentology by Tucker, M. E. and Wright, V. P., 1990, Blackwell Scientific Publications.

Carbonate Depositional Environments by Scholle, P. A., Bebout, D. G. and Moore, C. H., 1993, Mem. Am. Assoc. Petrol. Geol.

Course Name: Geology and Tectonics of Pakistan

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites: None

Course Code: GEO 409

Contents:

Introduction of general geology and tectonics of Pakistan. Physiographic and tectonic divisions; geology and stratigraphy of the accreted terrains such as Karakoram and Kohistan plate, Indian plate, stratigraphy and structure of foreland basins, Chamman fault, Makran convergence zone, and southern Indus basins, oroclines and suture zones. Himalayan and pre-Himalayan orogenic events, magmatism and metamorphism (pre-Himalayan and postHimalayan); Economic mineral and fuel deposits of Pakistan.

Reference Books

Geodynamics of Pakistan by Farah, A. and DeJong, K. A. (eds.), 1979, Geological Survey of Pakistan.

Geology of Himalaya, Karakoram, Hindukush in Pakistan by Tahirkheli, R. A. K., 1982, Geol. Bull., University of Peshawar.

Geology and Tectonics of Pakistan by Kazmi, A. H. and Jan, M. Q., 1997, Graphic Publishers.

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Geology of Pakistan by Bender, F. K. and Raza, H. A. (eds.), 1995, Gebruder Borntraeger.

Metallogeny and Mineral Deposits of Pakistan by Kazmi, A. H., and Abbasi, S. G., 2001, Orient Petroleum Incorporation.

Stratigraphy and Historical Geology of Pakistan by Kazmi, A. H and Abbasi, I. A., 2008, Graphic Publishers, Karachi, Pakistan.

Course Name: Economic Geology

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites: None

Course Code: GEO 415

Contents:

Introduction and historical development of economic Geology; Processes of formation, classification and importance of mineral deposits; Physical and Chemical controls of mineral deposition; Wall rock alteration; Para genesis and zoning; Occurrence, association of ore deposits; Hand specimen studies of common metallic and industrial mineral.

Reference Books

Metals and Society: An Introduction to Economic Geology by Arndt, and C. Ganino – 2012, Springer.

Economic Geology: Principles and Practice by Walter L. Pohl – 2011, John Wiley and Sons.

Introduction to mineral exploration by Charles and Micheal. 2006, Blackwell.

Hand book of mineral and coal exploration in British Colombia by Aime and MABC.2009, Springer.

Directory of Mineral Deposits of Pakistan by Zaki, A., 1969, Geological Survey of Pakistan.

Ore Deposits by Park, C.F. and Mac Diarmid, R.A.,1970, W. H. Freemanand Co.

Course Name: Geochemical Exploration Techniques

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites: None

Course Code: GEO 430

Contents:

Geochemistry application to mineral prospecting; Geochemical analyses; Geochemical anomalies in relation to mineralization; regolith types; path-finding minerals; Geochemical exploration for metallic minerals; Assaying; geochemical exploration technology for petroleum; Macro Seepages; Geochemical Indices of Petroleum; Hydrochemical Indicators of Oil, Classification of Waters; Fluorescence of Bitumens; Microbiological Prospecting Techniques; Surface Geochemical Prospecting; Generation of Biogenic Gas; Application of Carbon Isotopes; Advances in Mud Logging; Applications to Production; Philosophy of Anomaly Selection; Contractor Technology; Future Technology.

Reference Books

Geochemical exploration by Joyee, A. S.,1984, Australian Mineral Foundation. Incorporated.

Geochemical Exploration by Elliott, I. L. and Fletcher, W. K., latest Ed., Elsevier Scientific Publishing Company.

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Petroleum Geochemistry and Basin Evaluation by Gerard Demaison and Relof J. Murris, 1984, AAPG Memoir 35.

Geochemistry Pathways and Processes by McSween, H. Y., jr, Richardson, S. M. and Uhle, M. E., 2003, Columbia University Press, New York.

Course Name: Introduction to Geotechnical Engineering

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites: None

Course Code: GEO 431

Contents:

Scope of geotechnical engineering; Engineering significance of geotechnical investigation; Geotechnical investigation at selected sites; Geotechnical mapping procedure; Construction material and uses; Types of concrete; Asphalt; Introduction to slope stabilization methods; Basic mechanics of slope 79 failure; Slope classification. Slope stability; rock and soil mechanics and its application in civil engineering; study of geological factors in relation to the construction of buildings and foundations, roads, highways, excavation and tunneling.

Reference Books

Principles of Engineering Geology by Attewell, P. B. and Farmer, I. W., latest Edition., John Wiley and Sons.

Engineering Geology by Beavis, F. C., 1985, Blackwell Scientific Publications.

Principles of Engineering Geology by Johnson, R. B. and Degriff, J. V., latest Edition., John Wiley and Sons.

Fundamentals of Engineering Geology by Bell, F. A. G., 1983, Butter Worth.

Engineering Geology by Goodman, R. E., 1993, John Wiley and Sons.

Foundations of Engineering Geology by Waltham, T, 2002. 7. A Geology for Engineers (7th edition) by F. G. H Blyth PhD 1984.

Course Name: Rock Mechanics

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites: None

Course Code: GEO 432

Contents:

Fabric and mechanical nature of rocks; determination of rock quality for engineering purposes; stress strain behaviors of different rocks; rock mass strength. theories of failure; types of fracture; rock deformation in compression; factors controlling mechanical behaviors of rocks; excavation methods in rocks; distribution of stresses around underground excavations; use of photo elasticity in rock mechanics. Measurement of stresses in situ; wave propagation in rocks; dynamic models.

Reference Books

Rock Mechanics for Underground Mining by Brady, B. H. G. and Brown, E.T., 1985, Allen and Unwin.

Engineering Geology by Beavis, F. C., 1985, Blackwell.

Structural and Geotechnical Mechanics by Newark, N. M., latest Edition., Prentice Hall.

Engineering Geology and Rock Mechanics by Duncan, N., 1969, Leonar Hill.

Rock Engineering by Franklin, J. A. and Dusseault, M. B., 1989, McGraw-Hill.

Course Name: Soil Mechanics

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites: None

Course Code: GEO 433

Contents:

Introduction and concept of soil mechanics; soil formation and its classification, survey and sampling with its important engineering properties like soil grading, moisture contents, void ratios, density, permeability, shearing strength, bearing capacity, consolidation and settlements.

Reference Books

Problems in Engineering Soils by Capper, P. L., Cassie W. E. and Geddes, J. D., latest Ed., John Wiley and Sons.

Engineering Geology by Beavis, F. C., 1985, Black well Scientific Publications.

Structural and Geotechnical Mechanics by Newmark, N. M., latest Edition., Prentice Hall.

Engineering Geology and Rock Mechanics by Duncan, N., latest Edition., Leonar Hill.

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Academic Road Map for UG Program
Faculty of Engineering Sciences

Program Title: **BS Geophysics**

Duration: **4 Years**

Total Credit Hours: **132**

Endorsement References:

- A: Recommendations of CAC dated **22-Mar-23**
- B: Recommendations of DBOS dated **09-Aug-23**
- C: Recommendations of FBOS dated **04-Sep-23**

Summary of Credit Hours

Sr. No.	Category as per HEC new UG Policy	Credit Hours/Contact Hours	
		Existing Road Map	Proposed New Road Map
1.	General Education (Mandatory)	28	33
2.	Major/Disciplinary (Mandatory)	83	81
3.	Interdisciplinary (Mandatory)	12	12
4.	Electives toward specialization	-	-
5.	Non-Credit courses (contact hours) – Tajweed, Quran and Hadith (Compulsory)	-	8 Contact Hours (Non-credit)
6	Field Experience (Mandatory)	6	3
7.	Capstone Project (Mandatory)	6	3
8	Double Major (Optional)	-	-
9.	Minor (Optional)	-	-
Total		135	132

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

The educational objectives of Geophysics undergraduate program are for the graduates to attain the following within a few years of graduation:

1. Secure employment in governmental or private sector or engage in entrepreneurship. (PEO 1)
2. Pursue careers by demonstrating leadership and interpersonal skills by teamwork and communication skills. (PEO 2)
3. Advance their professional development through self-learning or pursue advanced degrees. (PEO 3)

PROGRAM LEARNING OUTCOMES (PLOs)

PLO1 Academic Education: A fundamental understanding of the academic field of Geophysics, its different learning areas and application

PLO2 Knowledge: Apply knowledge of geosciences, for the solution of defined problems **PLO3 Problem Analysis:** Demonstrate the ability to use skills in Geophysics and its related areas of technology for formulating and tackling geosciences related problems.

PLO4 Design/ Development of Solutions: Plan and execute Geophysics-related investigations, analyze and interpret data collected using appropriate methods to

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report accurately the findings of the investigations while relating the conclusions to relevant theories in Geophysics.

PLO5 Modern Tool Usage: Create, select, adapt and apply appropriate techniques, resources, and modern computing tools to complex earth processes, with an understanding of the limitations.

PLO6 Individual and Teamwork: Function effectively as an individual and as a member or leader in diverse teams and in multi-disciplinary settings.

PLO7 Communication: Communicate effectively with the geoscience community and with society at large about activities by being able to comprehend and write effective reports, design documentation, make effective presentations, and give and understand clear instructions.

PLO8 Professionalism and Society: Understand and assess societal, health, safety,

legal, and cultural issues within local and global contexts, and the consequential responsibilities relevant to professional practices

PLO9 Ethics: Understand and commit to professional ethics, responsibilities, and norms of professional geoscience practice.

PLO10 Life-long Learning: Recognize the need, and have the ability, to engage in independent learning for continual development as a computing professional.

Mapping of PLOs and PEOs

S. No	Program Learning Outcomes (PLO's)	PEO's		
		PEO 1	PEO 2	PEO 3
1	Academic Education	✓	✓	
2	Knowledge	✓	✓	
3	Problem Analysis	✓		
4	Design/ Development of Solutions	✓	✓	
5	Modern Tool Usage	✓		✓
6	Individual and Teamwork		✓	✓
7	Communication			✓
8	Professionalism and Society		✓	✓
9	Ethics		✓	✓
10	Life-long Learning			✓

HEC UG Policy			Existing Geophysics Road Map		Proposed Geophysics Road Map	
	C H	No. of Courses	Credit Hours	Course s	Credit Hours	Courses
General Education						
Natural Sciences	3	1	6	2	6	2
Social Sciences	2	1	3	1	2	1
Arts and Humanities	2	1	0	0	2	1
Expository Writing	3	1	6	2	3	1
Functional English	3	1	3	1	3	1
Quantitative Reasoning	6	2	6	2	6	2
Ideology and Const. of Pak	2	1	2	1	2	1
Islamiyat	2	1	2	1	2	1
Application of ICT	2 + 1	1	0	0	2+1	1
Entrepreneurship	2	1	0	0	2	1
Civics and Comm. Engage	2	1	0	0	2	1
Total	30	12	28	10	33	13
Major	Diff. Courses	72	As per req.	95	33	81
						27

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Int. Disciplin ary	Diff. Courses	1 2	4	12	4	12	4
Capstone Project	Thesis	3	NA	6	1	3	1
Field Experience/Internship	Field Visit	3	NA	6	2	3	1
	Total	1 2 0		135		132	

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Semester-wise Revised Road map of BS Geophysics

Semester 1

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment
1		ENG 101	Functional English	3	General Education Course (Functional English)	4
2		PHY 103	Physics	2	General Education Course (Natural Sciences)	4, 9
		PHL 103	Physics Lab	1		
3		CSC 102	Introduction to Computers & Programming	2	General Education Course (Quantitative Reasoning)	4, 8, 9
		CSL 102	Introduction to computers & Programming lab	1		
4		PAK 103	Pakistan Studies & Global Perspective	2	General Education Course (Ideology & Constitution of Pakistan)	4, 10, 16
5		GEO 105	Physical & General Geology	3	Major (Disciplinary) Requirements	4, 7, 9
6		ISL 101	Islamic Studies	2	General Education Course (Islamic/Religious Studies)	4, 10, 16
7		MAT 105	Mathematics	0	Zero Credit Course	4
8		ISL 107	Tajweed	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				16		

*Only for Muslim students

Semester 2

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment

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1		HSS 320	Technical Writing and Presentation Skills	3	General Education Course (Expository Writing)	4
2		GSC 340	Chemistry	2	General Education Course (Natural Sciences)	3, 4, 6, 7
		GSL 340	Chemistry Lab	1		
3		GEO 115	Introduction to Geophysics	3	Major (Disciplinary) Requirements	4, 9, 11
4	GEO 105	GEO 121	Field Geology	2	Major (Disciplinary) Requirements	4, 9, 11
		GEL 121	Field Geology Lab	1		
5		GEO 110	Fundamental of Geography & Geomorphology	3	Major (Disciplinary) Requirements	11, 14, 15
6		MAT 115	Calculus & Analytical Geometry	3	General Education Course (Quantitative Reasoning)	4, 11
7	ISL 107	ISL 108	Understanding Quran-I	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				18		

*Only for Muslim students

Semester 3

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment
1		GEO 201	Museology	2	General Education Course (Arts and Humanities)	4
2		GEO 206	Civics and Community Engagement	2	General Education Course (Civics and Community Engagement)	16, 17

Minutes of the 32nd FBOS – ES

3		GEO 208	Structural Geology	2	Major (Disciplinary) Requirements	4, 9, 11
		GEL 208	Structural Geology Lab	1		
4		GEO 211	Mineralogy & Crystallography	2	Major (Disciplinary) Requirements	4, 11
		GEL 211	Mineralogy & Crystallography Lab	1		
5		PSY 102	Introduction to Psychology	2	General Education Course (Social Sciences)	3, 4
6		GEO 212	Geostatistics	3	Interdisciplinary/Allied courses	4, 8
	ISL 108	ISL 109	Understanding Quran-II	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				15		

*Only for Muslim students

Semester 4

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment
1		HSS 423	Entrepreneurship	2	General Education Course (Entrepreneurship)	4, 8, 9, 17
2		GEO 207	Applications of ICT	2	General Education Course (Applications of Information and Communication Technologies (ICT))	4, 9
		GEL 207	Applications of ICT Lab	1		
3		GEO 240	Gravity and Magnetic Exploration Techniques	3	Major (Disciplinary) Requirement	4, 10, 11

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4		GEO 215	Sedimentology	3	Major (Disciplinary) Requirements	4, 11
		GEO 230	Geotectonics	3	Major (Disciplinary) Requirement	4
5		GEO 335	Earthquake Seismology	3	Major (Disciplinary) Requirement	4, 11
6	ISL 109	ISL 110	Understanding Quran-III	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				17		

*Only for Muslim students

Semester 5

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment
1		GEO 332	Rock Physics	3	Major (Disciplinary) Requirements	4, 7, 9
2		GEO 345	Petroleum Geology	3	Major (Disciplinary) Requirement	4, 7, 9
3		GEO 325	Stratigraphy of Pakistan	3	Major (Disciplinary) Requirement	4, 11
4		GEO 327	Environmental Geophysics	3	Major (Disciplinary) Requirement	4, 8, 11
5		GEO 366	Electrical & Radioactive Exploration Techniques	2	Major (Disciplinary) Requirement	4, 9, 12
		GEL 366	Electrical & Radioactive Exploration Techniques Lab	1		
6		GEO 321	Computing with Matlab	2	Interdisciplinary/Allied courses	9, 11
		GEL 321	Computing with Matlab Lab	1		
7	ISL 110	ISL 111	Understanding Quran-IV	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				18		

*Only for Muslim students

Semester 6

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Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment
1		GEO 341	Wireline Logging	2	Major (Disciplinary) Requirements	4, 9, 11
		GEL 341	Wireline Logging lab	1		
2		GEO 367	Seismic Data Acquisition & Planning	3	Major (Disciplinary) Requirement	4, 8, 7
3		GEO 328	Introduction to Machine Learning	2	Major (Disciplinary) Requirement	4, 9, 11
		GEL 328	Introduction to Machine Learning Lab	1		
4		GEL 361	Geological & Geophysical Field Work and Report	3	Field Experience	13, 15
5		GEO 350	Geology of Pakistan	3	Major (Disciplinary) Requirement	4, 11
6		-	Elective - I	3	Major (Disciplinary) Requirement	-
7	ISL 111	ISL 112	Understanding Quran-V	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				18		

*Only for Muslim students

Semester 7

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment
1		GEO 425	Research Methodology	3	Interdisciplinary/Allied courses	4
2		GEO 470	Seismic Data Processing	3	Major (Disciplinary) Requirement	4, 9, 11
3		-	Elective - II	3	Major (Disciplinary) Requirement	-

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4		GEO 438	GIS & Remote Sensing	2	Interdisciplinary/Allied courses	4, 8, 11
		GEL 438	GIS & Remote Sensing Lab	1		
5		GEO 445	Seismic Stratigraphy	3	Major (Disciplinary) Requirement	4, 9, 11
6	ISL 112	ISL 113	Seerah-I	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				15		

*Only for Muslim students

Semester 8

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment
1		GEO 477	Seismic Data Interpretation	2	Major (Disciplinary) Requirement	4, 9, 11
		GEL 477	Seismic Data Interpretation Lab	1		
2	-		Elective - III	-	Major (Disciplinary) Requirement	-
3		GEO 480	Geophysical Softwares	2	Major (Disciplinary) Requirement	4, 9, 11
		GEL 480	Geophysical Softwares Lab	1		
4		GEO 481	Mining Geophysics	3	Major (Disciplinary) Requirement	4, 9, 11
5		GEO 442	Thesis	3	Capstone Project	4, 9
6	ISL 113	ISL 114	Seerah-II		Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16

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				1 Contact Hour		
		Total Credit Hours	15			

*Only for Muslim students

List of Elective Courses

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre- requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1		GEO 411	Reservoir Geophysics	3	Major (Disciplinary) Requirement	4, 9, 11
2		GEO 413	Sequence Stratigraphy	3	Major (Disciplinary) Requirement	4, 9
3		GEO 390	Borehole Geophysics	3	Major (Disciplinary) Requirement	4, 12
4		GEO 421	Ground Water Investigation	2+1	Major (Disciplinary) Requirement	4, 6, 8
5		GEO 479	Geospatial Techniques	2+1	Major (Disciplinary) Requirement	4, 9, 11
6		GEO 316	Ground water Exploration Techniques	3	Major (Disciplinary) Requirement	4, 6, 8
7		GEO 405	Petroleum Engineering	3	Major (Disciplinary) Requirement	4, 6, 8

Course Description

**Course Description of General Education and Foundation Courses for BS
Geophysics Program**

Course Name: Pakistan Studies & Global Perspective

Credit Hours: 2

Contact Hours: 2+0

Pre-Requisites:

Course Code:

Contents:

Historical background of Pakistan: Muslim society in Indo-Pakistan, the movement led by the societies, the downfall of Islamic society, the establishment of British Raj-Causes and consequences. Political evolution of Muslims in the twentieth century: Sir Syed Ahmed Khan; Muslim League; Nehru; Allama Iqbal: Independence Movement;

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Lahore Resolution; Pakistan culture and society, Constitutional and Administrative issues, Pakistan and its geopolitical dimension, Pakistan and International Affairs, Pakistan and the challenges ahead.

Reference Books

Ideology of Pakistan by Sharif al-Mujahid

Course Name: Islamic Studies

Credit Hours: 2

Contact Hours: 2+0

Pre-Requisites:

Course Code: ISL 102

Contents:

The course introduces students to the Holy Quran and throws light on its different aspects. Selected verses from the Holy Quran and Hadith have been also included in the course. The course also throws light on the life of Prophet (Peace Be Upon Him).

Reference Books:

Islam: its meaning and message by Khurshid Ahmad

Course Name: Functional English

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites:

Course Code: ENG 101

Contents:

Improvement of vocabulary, writing and speaking skills by using various modern language improvement tools. Practicing précis and comprehension exercises. Structural format of scientific reports and papers. Planning for writing scientific reports and papers. Significance of abstracts, introduction, illustration, tables, reference and acknowledgements. Editing techniques and their practice. Presentation, publication.

Reference Books:

“Effective Writing” by Turk & Kirkman

“Secrets of Successful Speakers” by Lilly Walters

“Effective Speaking” by Verderber/Verderber

Course Name: Mathematics

Credit Hours: 0

Contact Hours: 0+3

Pre-Requisites:

Course Code: MAT 105

Contents:

For Biology - Biology, Introduction to Cell, cell structure, types of cells, cellular organelles, Evolution and theories of Evolution. Biological classification, binomial nomenclature, Structure of DNA and RNA, role of DNA in cell and genetics, DNA replication and Translation, Basics of photosynthesis and autotrophy, basics of human respiratory system, basics of human digestive system.

For Mathematics - Polynomials, Linear Functions, Quadratic Equations and their solution, Algebra of Matrices, Determinants, Inverse of a square matrix, Cramer's Rule, Rational fractions into partial fractions, Partial fractions for non-repeated linear, repeated linear and non-separable roots, Binomial Theorem, Mathematical Induction, Converting logarithmic functions into exponential functions, Sequences and series,

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Limits, Average and Instantaneous rate of change, Scalars and Vectors, Dot product, Cross Product, Angles of Measurement, Trigonometric Ratios and Trigonometric Identities, Analytical Geometry, Classifications of conics, Differentiation, Integration.

Reference Books:

Concepts of Biology by Samantha Fowler, Rebecca Roush, James Wise

Course Name: Introduction to Computers and Programming

Credit Hours: 2+0

Contact Hours: 2+0

Pre-Requisites:

Course Code: CSC 102

Contents:

History of Computer development; application of Computers; Classification and types of computers; Basic block diagram of computer; Hardware (input, output, memory, CPU and software (system software & Application software); social impact of computer age; Computer in education and Scientific research; Introduction to, and history of Internet; Internet service providers and connections; the World Wide Web. Problem solving and algorithm development. Computer hardware and software. Introduction to programming: machine, assembly and high level languages. C programming language. Arithmetic and logical statements, data types, input/output, basic control structures(selection, iteration etc).Array data type and usage of character strings. Functions: Callby-value and call-by-reference, scopes, recursion. Structures. Pointers. Bit manipulation. File processing.

Reference Books:

Peter Norton, "Introduction to Computers ", 6th Ed

Course Name: Introduction to Computers and Programming Lab

Credit Hours: 1+0

Contact Hours: 2+0

Pre-Requisites:

Course Code: CSL 102

Contents:

Introduction to Microsoft Word, Excel, PowerPoint; Basic operations of Microsoft PowerPoint; Bibliography in MS Word; Graph plotting in MS Excel, Introduction to CorelDraw; Introduction to Adobe Photoshop; Structure of C; Input and output function of C++; Variable and Operators; Decision and Loops.

Reference Books:

Peter Norton, "Introduction to Computers ", 6th Ed

Course Name: Physics

Credit Hours: 2+0

Contact Hours: 2+0

Pre-Requisites:

Course Code: PHY 103

Contents:

Newton's gravitation law; Kepler laws; Electro statistics; Magnetisms; Amperes law; Magnetic flux density B; Reflection and refraction interference and diffraction; Natural and artificial radioactivity; Heat and Conductivity; Pressure and Density;

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Thermodynamic Principles; Electricity and Magnetism; Semi-Conductor; Transistors; Satellite Communication; Introduction to Meteorology.

Reference Books:

Basic Physics: A Self-Teaching Guide by K. Kuhn

Course Name: Physics Lab

Credit Hours: 1+0

Contact Hours: 2+0

Pre-Requisites:

Course Code: PHY 103

Contents:

Practical lab work on Newton's gravitation law; Kepler laws; Electro statistics; Magnetisms; Amperes law; Magnetic flux density B; Reflection and refraction interference and diffraction; Natural and artificial radioactivity; Heat and Conductivity; Pressure and Density; Thermodynamic Principles; Electricity and Magnetism; Semi-Conductor; Transistors; Satellite Communication and Meteorology.

Reference Books:

The Basics of Physics by Richard L. Myers

Course Name: Physical & General Geology

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites:

Course Code: GEO 105

Contents:

This course introduces basic landforms and geological processes. Topics include rocks, minerals, volcanoes, fluvial processes, geological history, plate tectonics, glaciers, and coastal dynamics. Upon completion, students should be able to describe basic geological processes that shape the earth.

Reference Books:

Physical Geology: Exploring the Earth, 6th Edition 6th Edition by James S. Monroe, Reed Wicander, Richard W. Hazlett

Physical Geology by Charles C. Plummer, Diane H. Carlson, David McGahey

Course Name: Technical Writing and Presentation Skills

Credit Hours: 3+0

Contact Hours: 3+0

Pre-Requisites:

Course Code: HSS 320

Contents:

The Writing Process, Objectives in Technical Writing, Audience Recognition and Involvement, Criteria for Writing Reports, Summaries, Letters and Proposals, Research Paper Writing, Oral Communication, Writing Technical Descriptions, Instruction and User Manuals, The Job Search. Public Speaking & Presentation Skills, Meeting & Interviewing Skills, Non Verbal Communication, Project Reviewing.

Reference Books:

Collins COBUILD Students' Grammar. London: Longman Eastwood, J. 2004.

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Oxford Practice Grammar. New Ed., with tests and answers. O UP Goatly, A. 2000
Critical Reading and Writing: An Introductory Course. London: Taylor & Francis

Course Name: Chemistry

Credit Hours: 2

Contact Hours: 2+0

Pre-Requisites:

Course Code: GSC 340

Contents:

Periodic Table, chemical bonding: ionic, covalent, coordinate covalent bond. Solution chemistry. Surface chemistry. Colloids chemistry. Thermodynamics and chemical kinetics. General chemistry of functional groups of organic compounds (alcohols, carbonyls, esters, carboxylic acids, amines). Aromatic compounds, ions, radicals. Photochemical reactions. Radioactivity. Weak Acids & Bases; Water Hardness; Redox Reactions, Chemical Kinetics; Radioactivity.

Reference Books

A Comprehensive Treatise on Inorganic and Theoretical Chemistry Vol II By J. W. Mellor

Course Name: Chemistry Lab

Credit Hours: 1

Contact Hours: 2+0

Pre-Requisites:

Course Code: GSL 340

Contents:

Preparation of molar, molal, normal solutions and buffers. Osmosis and Diffusion. Measurement of pH, EC, DO and TDS in waste water. Use of titrimetric and gravimetric analysis. Use of spectrophotometric techniques. Paper Chromatography (one and two dimensional)

Reference Books

A Comprehensive Treatise on Inorganic and Theoretical Chemistry Vol II By J. W. Mellor

Course Name: Introduction to Geophysics

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites:

Course Code: GEO 115

Contents:

Elementary study of Gravitational, Seismic, Magnetic, thermal and radioactive properties of the earth, Methods of measurement, interpretation of data and their applications to the specific.

Reference Books

Geophysics: A Very Short Introduction by William Lowrie

Course Name: Field Geology

Credit Hours: 2

Contact Hours: 2+0

Pre-Requisites: GEO 105

Course Code: GEO 121

Contents:

Instruments used in field mapping. Introduction to topographic and Geological maps. Methods and techniques of surface and subsurface Geological mapping. Correlation techniques. Field description of igneous, metamorphic and sedimentary rocks. Modes of Geological illustration including structural contour, isopach and litho-facies maps, block and fence diagrams. Field mapping, preparation of Geological maps and cross-section. Fieldwork: Each student is required to do Fieldwork and submit a report in the examination. The Fieldwork should cover; observation of physical features and their plotting on topographic sheet. Study of geomorphic feature. Measurement of stratigraphic sections. Recognition of structural features. Fauna observation. Study of primary and secondary structures. Field description of sedimentary, igneous and metamorphic rocks.

Reference Books

Introduction to Field Geology, Bevier, M.L., 2006. McGraw-Hill Ryerson Lecture Series by University of Nairobi; SGL:308.

Course Name: Field Geology Lab

Credit Hours: 1

Contact Hours: 2+0

Pre-Requisites: GEO 105

Course Code: GEL 121

Contents:

Parts of Brunton Compass; Block Diagrams of Anticline and Syncline; activity of measuring true thickness and outcrop thickness and their relationship with strata inclination and land surface; Position finding on base map using GPS values. Activity of taking bearing from waist level, eye level and use of compass as hand level; Contour activity, Area calculation, Assigning elevations; Activity of contour drawing through triangulation method; Finding outcrop patterns Profile drawing using base map; Preparation of Litholog; Preparation of pi and beta diagram for fold classification using wulff stereonet; Preparation of Rose diagram

Reference Books

Basic Geological Mapping by John W. Barnes and Richard J. Lisle; John Wiley & Sons, Ltd

Introduction to Geological Mapping

Course Name: Fundamental of Geography & Geomorphology

Credit Hours: 3+0

Contact Hours: 3+0

Pre-Requisites:

Course Code: GEO 110

Contents:

This course examines the concepts and processes of physical geography that govern the function of the atmosphere, lithosphere, hydrosphere, and biosphere using an earth-systems approach. Course lectures and lab topics introduce the sciences of cartography, meteorology, climatology, geomorphology, hydrology, biogeography, and soils. A focus on how human activities impact the environment, such as climate change and other real world issues will also be addressed.

Reference Books:

Fundamentals of Geomorphology by Richard Huggett - 2016

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Fundamentals of Physical Geography by James Petersen, Dorothy Sack, Robert E. Gabler · 2014

Course Name: Calculus and Analytical Geometry

Credit Hours: 3+0

Contact Hours: 3+0

Pre-Requisites:

Course Code: MAT 115

Contents:

Functions and their graphs, Limit of a Function and Theorems on Limits, Chain Rule, Implicit Differentiation, Derivatives of functions, Rules of derivatives, Integration, Integration by Substitution, Integration by Parts, Convergent and Divergent Series

Reference Books:

“Calculus”, By Earl W. Swokowski, (6th Edition).

“Calculus”, By Howard Anton (5th Edition) (CH # 2, 3, 5, 10, 11, 12)

“The Calculus Problem Solver” By Dr. H. Wasbecker

“Algebra and Trigonometry” By Joan Van Glabek

Course Name: Museology

Credit Hours: 2+0

Contact Hours: 2+0

Pre-Requisites:

Course Code: GEO 201

Contents:

Introduction to Museology provides a broad, theory-based introduction to the museum sector and the research field of museology. Focusing on museum ethics, the course also give attention to all museum activities. Excursions to different museums and guest lectures from the museum sector give the students insights into the museum practice and provide present day examples and discussions, which they may study by using museological theories, dilemmas in museum ethics, and knowledge in museum history.

References Books

Dictionary of Museology by François Mairesse · 2023

New Horizons for Asian Museums and Museology Naoko Sonoda · 2016

Course Name: Civics and Community Engagement

Credit Hours: 2

Contact Hours: 2+0

Pre-Requisites: None

Course Code: GEO 206

Contents:

This course aims to bring responsible citizenship and active engagement between Universities/HEIs (through their students) and local communities. The course will

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provide students with a foundational understanding of the principles, institutions, and processes of civic engagement in a democratic society. Moreover, the course will build the capacity of students as leaders and influencers by gaining fundamental understanding of leadership, citizenship, communication, advocacy, network building as well as having first-hand experience of community development through volunteer works.

Reference Books:

Managing Civic and Community Engagement by David Watson - 2007

Higher Education and Civic Engagement: Comparative Perspectives by L. McIlrath, A. Lyons - 2012

Course Name: Structural Geology

Credit Hours: 2

Contact Hours: 2+0

Pre-Requisites: None

Course Code:GEO 208

Contents:

Dynamics of rock deformation and mechanical properties of rocks; Stress and strain concepts; Factors controlling mechanical behavior of Materials; Folds classification based on morphology, geometry, and vergence; Mechanics of fold formation; Faults classification based on geometry and genesis; Structures in compressional and extensional regimes; Classification of Joints, foliations and lineation; Unconformities, their classification and recognition. Laboratory exercises on geologic map interpretation and cross sections; Field trips to area where good Geological structures are exposed.

Reference Books

Physical geology by plummer, Turbak and Marshik

Field geology by Kompton

Structural geology of rocks and regions by Davies

Course Name: Structural Geology Lab

Credit Hours: 1

Contact Hours: 2+0

Pre-Requisites: None

Course Code:GEL 208

Contents:

Map exercises, linear and planar structures, and construction of geological cross-sections; orthographic projections (geometrical exercises); stereographic projections, fault plane solutions, stress and strain analysis using oriented samples and use of structural computer software.

Reference Books

Geological structures and maps by Richard j lisle

Course Name: Mineralogy and Crystallography

Credit Hours: 2

Contact Hours: 2+0

Pre-Requisites: None

Course Code:GEO 211

Contents:

Introduction to Crystallography; elements of symmetry, symmetry operations, crystal notation, crystal systems study of normal classes of crystallographic systems; Classification and system study of minerals with an emphasis on their crystallographic features, physical properties, Chemical composition, occurrences, associations and uses; Introduction to X-ray crystallography

Reference Books

Dana's textbook of mineralogy

Course Name: Mineralogy and Crystallography Lab

Credit Hours: 1

Contact Hours: 2+0

Pre-Requisites: None

Course Code:GEL 211

Contents:

Study of crystal morphology, preparation of crystal models, orientation of crystallographic axes in different systems, identifying elements of symmetry, symmetry of different crystal systems, crystal forms. Construction and interpretation of unary phase diagrams. Construction and interpretation of binary phase diagrams. Identification and description of different physical properties of the minerals, metallic and non-metallic mineral resources. Hand specimen identification of minerals.

Reference Books

Mineralogy Dexter Perkins, Earth Lab

Course Name: Introduction to Psychology

Credit Hours: 2+0

Contact Hours: 2+0

Pre-Requisites:

Course Code: PSY 102

Contents:

The course is designed to introduce to understand the vocabulary and concept of psychology. Understand how critical thinking is proclaimed to be scientific or based on research. Describe the critical development and led to the present discipline of psychology contrast and compare the three major, also apply psychology theory in some area of his /her life.

Reference Books:

Introduction to Psychology by Charles Stangor - 2021

Introduction to Psychology: Gateways to Mind and Behavior by Dennis Coon, John O. Mitterer, Tanya S. Martini - 2021

Course Name: Geostatistics

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites: None

Course Code:GEO 216

Contents:

Descriptive statistics and exploratory data analysis, random variable; moments; probability distributions; normal and lognormal distributions, random function model,

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modeling spatial continuity; experimental variograms covariance functions; correlograms and madograms; variogram and covariance function models; isotropy and anisotropy, estimation methods: simple kriging.

Reference Books

- Kitanidis, P.K. (1997) Introduction to geostatistics: applications in hydrology.
Goovaerts,Pierre (1999) Geostatistics for Natural Resource Evaluation.
Olea, R. A. (1999) Geostatistics for Engineers and Earth Scientists.
Christakos, G (2000) Modern Spatiotemporal Geostatistics.
Webster, R. and Webster, M (2001) Geostatistics for Environmental Scientists.

Course Name: Entrepreneurship

Credit Hours: 2

Contact Hours: 2+0

Pre-Requisites: None

Course Code: HSS 423

Contents:

The Nature and Importance of Entrepreneurship: Nature and Development of Entrepreneurship; Entrepreneurial Decision Process; Role of Entrepreneurs in Economic development; Ethics and Social Responsibility of Entrepreneurship; The Future of Entrepreneurship The Entrepreneur and Entrepreneurial Mind: The Entrepreneurship process; Myths of Entrepreneurs, Managerial VS Entrepreneurial Decision Making; Entrepreneurial Leadership Characteristics The Nature and Importance of SMEs: Nature and Scope of Entrepreneurship; SMEs Definitions / Understanding by various Regulatory Authorities in Pakistan; SMEs contribution to GDP of any country, and of Pakistan; SMEDA's Role in promoting and developing SMEs. The Individual Entrepreneur, and Techniques for Idea Generation Process; Entrepreneur VS Intrapreneur. Inside the Entrepreneurial Mind: From Ideas to reality: Creativity, Innovation and Entrepreneurship; Creativity A necessity for survival; Creative Thinking; Barriers to creativity; How to enhance creativity; The creative Process; Techniques for improving the creative process; Protecting your ideas. The Customer and Product Plan/Feasibility: Understanding of Customer through Demand and Desire, and of Product (Good and/or Service) The Industry and Marketing Plan/Feasibility: Understanding of Marketing Plan, Characteristics of Marketing Plan; and Environment Analysis and Steps in preparing the Marketing Plan The Financial Plan/Feasibility: Operating and Capital Budgets, Break Even Analysis; Cash Flows and Balance Sheets The Organizational Plan/Feasibility: Developing the management team; Building the successful Organization, The Role of BODs. Components, and Classification of Business Plans Financing Options: e.g. Leveraged Buyouts; Preparing for the new Launch; Execution & Growth; Managing early growth of the New ventures. Analysis, and Competitive Environment Analysis. Growth Options: Joint Venture; Franchising; Acquisitions; Synergy; Mergers; Hostile Takeovers; Licencing etc.

Reference Books:

An Introduction to Entrepreneurship Eamonn Butler 2020

Course Name: Applications of Information and Communication Technologies

Credit Hours: 2

Contact Hours: 2+0

Pre-Requisites:

Course Code: GEO 207

Contents:

Brief history of Computer, Four Stages of History, Computer Elements, Processor, Memory, Hardware, Software, Application Software its uses and Limitations, System Software its Importance and its Types, Types of Computer (Super, Mainframe, Mini and Micro Computer), Introduction to CBIS (Computer Based Information System), Methods of Input and Processing, Class2. Organizing Computer Facility, Centralized Computing Facility, Distributed Computing Facility, Decentralized Computing Facility, Input Devices. Keyboard and its Types, Terminal (Dump, Smart, Intelligent), Dedicated Data Entry, SDA (Source Data Automation), Pointing Devices, Voice Input, Output Devices. Soft- Hard Copies, Monitors and its Types, Printers and its Types, Plotters, Computer Virus and its Forms, Storage Units, Primary and Secondary Memories, RAM and its Types, Cache, Hard Disks, Working of Hard Disk, Diskettes, RAID, Optical Disk Storages (DVD, CD ROM), Magnetic Types, Backup System, Data Communications, Data Communication Model, Data Transmission, Digital and Analog Transmission, Modems, Asynchronous and Synchronous Transmission, Simplex, Half Duplex, Full Duplex Transmission, Communications, Medias (Cables, Wireless), Protocols, Network Topologies (Star, Bus, Ring), LAN, LAN, Internet, A Brief History, Birthplace of ARPA Net, Web Link, Browser, Internet Services provider and Online Services Providers, Function and Features of Browser, Search Engines, Some Common Services available on Internet.

Reference Books:

Information Communication Technologies Concepts, Methodologies, Tools and Applications by Craig Van Slyke · 2008

Course Name: Applications of Information and Communication Technologies

Lab

Credit Hours: 1

Contact Hours: 2+0

Pre-Requisites:

Course Code: GEL 207

Contents:

Practical exercises will be carried out in lab.

Reference Books:

Information Communication Technologies Concepts, Methodologies, Tools and Applications by Craig Van Slyke · 2008

Course Name: Gravity & Magnetic Exploration Techniques

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites:

Course Code: GEO 240

Contents:

This course is a core course which introduces the students' to Gravity & Magnetic Methods. Theory of attraction and potential with applications to simple mass distributions. Green and Gauss theorems. Green's formulae and Equivalent surface layers, Instrumentation and data acquisition. Gravity data reduction; Regional, residual anomaly separation. Interpretation of gravity anomalies; Dead and total mass estimates. Application of gravity method in ocean floor and deep-sea explorations. Fundamentals of magnetic dipole interactions with applications to simple mass distributions, Gauss Theorem. Instrumentation and data acquisition procedures. Reduction of magnetic data. Anomaly separation and interpretation. Air-borne and sea-borne magnetic surveys. Data acquisition and Interpretation. Application of magnetic methods in ocean floor and deep-sea explorations.

Reference Books:

Dobrin M. B. And Savit C. H. (1988), Introduction to Geophysical Prospecting 4th Edition. MacGraw-Hill Book Coy, New York, 867pp

Lowrie, W. (2004) Fundamentals of Geophysics, Cambridge University Press, 354pp

Parasnis, D. S. (1982), Principles of Applied Geophysics. Chapman and Hall New York, 275pp

Reynolds, J. M., (1997), An Introduction to Applied and Environmental Geophysics, John Wiley and Sons Ltd, 796pp

Telford, W.M., Geldart, L.P., Sheriff, R.E. and Keys, D.A. (1982). Applied Geophysics Cambridge University Press 860p.

Peter Dehlinger (1978) Marine Gravity, Elsevier Science. 314pp 5

Richard A. Geyer and Margaret Ashwell (1991) Handbook of Geophysical Exploration at Sea, CRC Press; 2nd edition. 496pp

William J. Hinze, Ralph R. B. von Frese, Afif H. Saad (2013) Gravity and Magnetic Exploration: Principles, Practices and Applications, Cambridge University Press. 525pp

Jones J. W. (1999) Marine Geophysics. Wiley Publishers, 474pp

Course Name: Sedimentology

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites: None

Course Code: GEO 215

Contents:

Introduction; Sediments, their origin, transportation and deposition; Stratification, diagenesis, lithification and origin of sedimentary rocks; Depositional environments; Sedimentary basins; Sedimentary structures, their morphology and interpretation; Classification, composition and textures of sedimentary rocks and their descriptive study.

Reference Books:

Sand and Sandstone by Pettijohn, F. J., Potter, P. E. and Siever, R., 1972, Springer-Verlag.

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Principles of Sedimentology by Friedman, G. M. and Sanders, J. E., 1978, John Wiley and Sons.

Depositional Sedimentary Environments by Reineck, H. E. and Singh, I. B., 1980, Springer-Verlag.

Carbonate Sedimentology by Tucker, M. E. and Wright, V. P., 1990, Blackwell.

Course Name: Geotectonics

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites:

Course Code: GEO 230

Contents:

Review of various tectonic theories; Historical development of the plate tectonic theory; Plate Movements, Mantle Plumes, Plate Boundaries, Detail study of plate tectonics; Orogenic belts and evolution of folded mountains; Young folded mountains of the earth with special emphasis on mountain belt in Pakistan; Regional Tectonics of Pakistan.

Reference Books:

Global Tectonics (Philip Kearey, Keith A. Klepeis and Frederick J. Vine)

Plate Tectonics & Crustal Evolution (Kent C. Condie)

Other Resources that you may want to refer to:

Plate Tectonics, Continental Drift and Mountain Building - Wolfgang Frisch, Martin Meschede and Ronald C Blakely Springer 2011)

Course Name: Earthquake Seismology

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites:

Course Code: GEO 335

Contents:

Causes and effects of earthquakes; Methods to locate and to assign magnitudes to earthquakes; Types of seismic waves, their propagation; Estimation of Omori's coefficient and its role towards earthquake location, Computation of dynamic ranges and memory size; Seismic phases at the rock boundaries; man-made earthquakes; Seismometry. Seismic waves and their analysis in earthquake seismology. Frequency, magnitude of earthquake and their relationship. Seismic source parameters. Composite fault plane solutions of earthquakes and their interpretation. Geographical distribution of important earthquakes. Teleseismic waves and interior of the earth, Earthquakes and their implication on the tectonics of the area.

Reference Books:

Micro-Earthquake Seismology and Seismotectonics of South-Asia by J.R. Kayal

Introduction to Seismology by Peter M. Shearer

Anatomy of Seismograms by Ota Kulhanek

Handouts for the lectures.

Course Name: Rock Physics

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites: None

Course Code:GEO 332

Contents:

The purpose of the course is to give an overview of rock physics observations and models relating reservoir properties such as saturation, lithology, clay content, and pore pressure and their seismic signatures. Understanding this relation can help to improve quantitative seismic interpretation. The course covers fundamentals of Rock Physics ranging from basic laboratory and theoretical results to practical “recipes” that can be immediately applied in the field. Application of quantitative tools for understanding and predicting the effects of lithology, pore fluid types and saturation, saturation scales, stress, pore pressure and temperature, and fractures on seismic velocity. Use of rock physics models requires understanding the assumptions and pitfalls of each model and the uncertainties associated with the interpretations using these models. Analysis of case studies and strategies for quantitative seismic interpretation using statistical rock physics work flows, and suggestions for more effectively employing seismic-to-rock properties transforms in Bayesian machine learning for reservoir characterization and monitoring, with emphasis on seismic interpretation and uncertainty quantification for lithology and subsurface fluid detection

Reference Books

The Rock Physics Handbook 3rd Edition by Gary Mavko, Tapan Mukerji, Jack Dvorkin

Course Name: Petroleum Geology

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites: None

Course Code: GEO 345

Contents:

Introduction; Properties of petroleum and natural gas; Origin, migration and accumulation of hydrocarbons; Related source, reservoir and seal rocks; Reservoir properties; Various types of Geological traps for hydrocarbon accumulation; Concept of petroleum province and introduction to basin analysis.

Reference Books

Petroleum Geochemistry and Geology by Hunt J M.

Hydrocarbon Exploration and Production by Jahn F and Graham M.

Geology of Petroleum by Leverson.

Petroleum Geology for Geoscientists by Prof Ifeanacho Paul Orajaka and Dr Johnbosco Azubuike Onyeji.

Course Name: Stratigraphy of Pakistan

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites: None

Course Code: GEO 325

Contents:

Principle of stratigraphy; laws of superposition and faunal succession. Geological time scale with divisions. Classification and nomenclature of strati graphics units: lithostratigraphic units, biostratigraphic units and chronostratigraphic units. Geological time scale with divisions. Stratigraphic Code of Pakistan. Principle of stratigraphic correlation. Outline of stratigraphy of Pakistan. Stratigraphy of Indus Basin and Baluchistan Basin.

Reference Books

Shah, S. I. (2000). Stratigraphy of Pakistan. Quetta: Geological Survey of Pakistan.

Kazmi, A. H., & Abbasi, I. A. (2008). Stratigraphy & historical geology of Pakistan.

Peshawar: Department & National Centre of Excellence in Geology.

Boggs Jr, S. (2014). Principles of sedimentology and stratigraphy.

Course Name: Environmental Geophysics

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites: None

Course Code:GEO 327

Contents:

This course aims to provide skills required in research and consulting environments in hydrology, hydrogeology, climatology and environment sciences. Lectures on the theory behind various environmental geophysical methods used in the analysis of air, water, soil, vegetation or the subsurface. Field measurements to enable everyone to get hands-on experience of geophysical techniques. Methods covered will include a selection of the following environmental geophysical techniques: weather station design and hydrology measurements using geophysical techniques; infra-red measurements of soil and atmospheric carbon dioxide concentrations; x-ray fluorescence analysis of soil mineral properties; optical geophysics, using fluorescence and absorbance, to measure river organic matter water quality; cavity-ringdown and off-axis mass spectrometry measurements for mapping methane and carbon dioxide processes in the landscape.

Reference Books

An Introduction to Applied and Environmental Geophysics 2nd Edition by John M. Reynolds

Course Name: Electrical and Radioactive Techniques

Credit Hours: 2

Contact Hours: 2+0

Pre-Requisites: None

Course Code:GEO 366

Contents:

Electrical methods Basic Theory; Electrical properties of rock and minerals; self-potential method Basic; self-potential methods field and interpretation; self-Induce polarization methods principles and theory; IP methods field survey and interpretation study of a Case history; resistivity methods basic theory; Electrical resistivity relation and measurements; Resistivity and properties of materials; Acquisition and Processing of Data interpretation; Radioactive methods Basic theory Radioactive minerals and survey interpretation.

Reference Books

Introduction Of Geophysics by Dr. El-Arabi H. Shendi

Course Name: Electrical and Radioactive Techniques Lab

Credit Hours: 1

Contact Hours: 2+0

Pre-Requisites: None

Course Code:GEL 366

Contents:

Practical data acquisition on field and practical exercises of interpretation of Electrical and Radioactive methods

Reference Books

Introduction Of Geophysics by Dr. El Arabi H. Shendi

Course Name: Computing with Matlab

Credit Hours: 2

Contact Hours: 2+0

Pre-Requisites: None

Course Code: GEO 321

Contents:

Matlab basics (getting mat lab to run, programming, the command prompt, simple expressions, variables and referencing matrix elements), getting mat lab to run, programming, the command prompt, simple expressions, variables, referencing matrix elements, matrices, accessing matrix elements, assigning into sub-matrices, basic tools, matrix concatenations, more expression, plotting, logical constructs, formatting text, flow control, "if" statement, "for" loops. Defining functions, "while" statements, variable scope, functions and logic, multiple input functions, more on logic, basic lab commands, programming structures, bsic graphing routines, advanced matrix operations, file input/output, writing and calling functions, data structures and input assertion, mat lab compiler, practical computer-based exercise.

Reference Books

MATLAB: A Practical Introduction to Programming and Problem Solving, 3rd edition, Stormy Attaway, Elsevier, 2013.

Course Name: Computing with Matlab Lab

Credit Hours: 1

Contact Hours: 2+0

Pre-Requisites: None

Course Code: GEL 321

Contents:

Lab: Introduction to Matlab; MATLAB as Calculator (Arithmetic Operations); Elementary Math Functions; Scalar variables, Predefined Variables; Complex numbers; Built-In functions for handling arrays; Writing, saving, and execute MATLAB programs; Fundamental form MATLAB uses to store and manipulate data; Matrices operations: addition and subtraction of arrays Multiplication, division, and exponentiation; element-by-element operations; Matrices operations: element-by-element operations; Matrices operations: element-by-element operations; How to input data to a script file; How data are stored in MATLAB; How to exchange data between MATLAB and other applications; Yield 2- and 3-D plots in Matlab; Standard plots with linear axes, logarithmic and semi-logarithmic axes, bar and stairs plots, polar plots, three-dimensional contour surface and mesh plots; Relational operators; Logical operators; Conditional statements; Loops; User-defined functions and function files.

Reference Books

MATLAB: A Practical Introduction to Programming and Problem Solving, 3rd edition, Stormy Attaway, Elsevier, 2013.

Course Name: Wireline Logging

Credit Hours: 2

Contact Hours: 2+0

Pre-Requisites: None

Course Code: GEO 341

Contents:

Introduction; Types of Logs; Methods and principles; Factors influencing Logs; Resistivity logs; SP logs; Gamma Ray logs; Formation density logs; Neutron logs; Sonic logs; Caliper logs. Application of logs; Porosity determination; Lithology and Hydrocarbon Detection; Structural interpretation; Correlation.

Reference Books

AAPG Basic Well Log Analysis by George Asquith and Daniel Krygowski
Schlumberger – Log interpretation Principles/Applications

Course Name: Wireline Logging Lab

Credit Hours: 1

Contact Hours: 2+0

Pre-Requisites: None

Course Code: GEL 341

Contents:

How to read well logs and its presentation, Pattern recognition and correlation of well logs, Estimation of Shale content; Gross Pay vs. Net Pay, Estimation of porosity from a single log, Multiple porosity methods, Water Saturation determination, Gas Sand Interpretation, Identification of lithologies and crossplots, Stock Tank Original Oil In Place (STOOIP) calculation, Image log interpretation

Reference Books

Schlumberger – Log interpretation Principles/Applications

Course Name: Seismic Data Acquisition & Planning

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites: None

Course Code:GEO 325

Contents:

It will include Overview of the Course, Books recommendation, Evaluation Criteria, Concept of Hook's Law, Bulk, Shear & Young's Modulus, Poisson's Ratio, Stress and Strain, Types of Strain, Elasticity, Stiffness, Deformation, Attenuation, Refraction, Reflection and Diffraction of Elastic Waves, Wave Convergence, Snell's Law, Huygens's Principle, Fermets Principal, Ray path & wave front, Head Waves, Critical refraction, Travel time of direct, reflected and refracted waves in a layered earth, Seismic Refraction Method, Seismic Reflection Method, Spherical Divergence, Ray parameters, Geometrical Spreading & absorption, Acoustic Impedance, Offset, Seismic Sources, minimum & zero phase data, Recording Instruments and their requirements. Principle of geophone, Acquiring Seismic Reflection data on Land, Geometry, String, Group Channel & Array designing, CMP & CDP shooting, Advantages of CDP shooting, Borehole geophysics including Sonic Log, VSP and Checkshot Analysis.

Reference Books

Introduction to Geophysical Prospecting by Milton B. Dobrin and Carl H. Savit, 4th Edition

Applied Geophysics by W. M. Telford, L. P. Geldart, R. E. Sheriff Paperback Edition

Basic Exploration Geophysics by Edwin S. Robinson, Cahit Coruh **Paperback** Edition

An Introduction to Geophysical Exploration by P. Kearey, et al Paperback Edition

Course Name: Introduction to Machine Learning

Credit Hours: 2

Contact Hours: 2+0

Pre-Requisites: None

Course Code:GEO 328

Contents:

This course provides a thorough introduction to the theoretical foundations and practical applications of ML. We will learn fundamental algorithms in supervised learning and unsupervised learning. We will not only learn how to use ML methods and algorithms but will explain the underlying theory building on mathematical foundations. While reviewing the several problems and algorithms to carry out classification, regression, clustering, dimensionality reduction, core fundamentals will be focused which unify all the algorithms

Reference Books

Introduction to Machine Learning by Alex Smola and S.V.N. Vishwanathan

Course Name: Introduction to Machine Learning Lab

Credit Hours: 1

Contact Hours: 2+0

Pre-Requisites: None

Course Code:GEL 328

Contents:

Students will gain an introductory-level understanding of both supervised and unsupervised machine learning (ML), including deeper knowledge of a number of algorithms of each type. Students will learn how to evaluate and quantify predictive

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performance of ML systems. Students will also become familiar with one or more ML development environments with practical assignments and demonstrations.

Reference Books

Introduction to Machine Learning by Alex Smola and S.V.N. Vishwanathan

Course Name: Geological Field Work & Report

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites: None

Course Code: GEO 361

Contents:

One-week fieldwork in geologically important areas to further train the students in geological field techniques; Method of data collection and measurement of stratigraphic section; Identification of complex structures, sample collection techniques. Use of field instruments and Geological mapping procedures; Rock and mineral identification and collection. A written Geological report at the end of semester.

Reference Books

Stratigraphy of Pakistan (2009) by S.M.I. Shah.

Petroleum Geology by George F.K. North.

Petroleum Geosciences by Knut Bjørlykke.

Published research articles on the study area (Hazara Basin) will be used as the Reference material for this field work.

Course Name: Geology of Pakistan

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites: None

Course Code: GEO 350

Contents:

Physiographic and tectonic divisions and their descriptions. Geology and stratigraphy of the Indian plate. Karakoram plate, Afghan block and Arabian plate. Kohistan, Chagai and Ras Koh magmatic arcs, oroclines and sutures zones. Regional metamorphism (Himalayan and Pre-Himalayan). Main episodes of magmatism and their relation to tectonics. Economic mineral and fuel deposits of Pakistan.

Reference Books

Stratigraphy of Pakistan, GSP Memoirs Vol.22 by DR. S. M. Ibrahim Shah

Stratigraphy and Historical Geology of Pakistan by Kazmi and Abbasi

Geodynamics of Pakistan by De Jong

Metallogeny and Mineral Deposits of Pakistan by Kazmi and Abbasi

Course Name: Reservoir Geophysics

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites: None

Course Code:GEO 326

Contents:

This course provides an introduction to reservoir geophysics/seismic with special emphasis on an integrated and multi-disciplinary approach. The topics are central to those planning to work as geologists/geophysicists within the petroleum industry.

Reference Books

Methods And Applications In Reservoir Geophysics by David H. Johnston

Course Name: Research Methodology

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites: None

Course Code: GEO 425

Contents:

An Overview of Research Methods and Methodologies; Difference Between “Method” and “Methodology”; Epistemology, Methodology, and Method; An Overview of Empirical Research Methods: Descriptive (Qualitative) & Experimental (Quantitative); Assessing Methods; Ethnographies; Case Studies; Survey Research; Focus Groups; Discourse/Text Analysis; Quantitative Descriptive Studies; Prediction and Classification Studies; Meta-Analysis; Validity in Research; Reliability in Research; Rigor in Research; Key Considerations to Design Your Research Approach; The Importance of Methods and Methodology.

Reference Books

Research Design: Qualitative, Quantitative, and Mixed Methods Approaches, by John W. Creswell

Course Name: Seismic Data Processing

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites: None

Course Code: GEO 470

Contents:

Introduction: Basic Principles with emphasis on mathematical analysis; Review of Fourier transforms and matrices; Basic Field procedure; Computational Fundamentals of interpretation techniques, and application of the geophysical methods: Development of theories of the discrete Fourier and z-transform; Wavelets; Design of digital filters (recursive, inverse); Convolution; Auto-correlation and cross-correlation theorem; Deconvolution; transfer function; Maximum, minimum and mixed delay wavelets; Application to geophysical data.

Reference Books

Yilmaz, Ozdogan. (1987). Seismic data processing. Investigations in geophysics.

Course Name: Ground Water Investigation

Credit Hours: 2

Contact Hours: 2+0

Pre-Requisites: None

Course Code: GEO 421

Contents:

This course cover the details and criteria employed in groundwater investigations. Basic concepts and methods used to determine subsurface conditions pertaining to groundwater levels, pore water pressures and the permeability of subsurface materials are considered. Installation methods for observation wells and devices commonly used for sensing and measuring water levels in boreholes and observation wells are covered. Permeability is measured in the field by a variety of tests, which include seepage, pressure or packer, pumping, slug and the piezocone dissipation tests. Quality assurance for testing, obtaining measurements and logging subsurface data are considered. The AASHTO and ASTM designations for the commonly used tests are provided.

Reference Books

Investigating Groundwater By Ian Acworth

Course Name: Ground Water Investigation Lab

Credit Hours: 1

Contact Hours: 2+0

Pre-Requisites: None

Course Code:GEL 421

Contents:

Discussion of aquifer properties. These might include: a review of key diagrams to explain porosity, grain size and sorting, and tortuosity; and some examples of rock specimens that serve as aquifers or aquitards—for example, hand specimens of sandstones, shales, and other rocks that the students can inspect with hand lenses or pour water onto. Students will generate plots and interpret them. Interpretation of potentiometric surface maps, further developing the analogy to topographic maps, tracing flow lines, and the effects of pumping wells would help to solidify key concepts. Drawing upon current events for discussion of the link between well hydrographs and climatic conditions would also be valuable in both illustrating the connection between surface processes and groundwater resources, and in making the relevance of the material clearer. Physical groundwater simulators (so called "ant farms"), and demonstrations to help students visualize groundwater flow and the concept of hydraulic head.

Reference Books

Laboratory Manual for Groundwater, Wells, and Pumps By Rohitashw Kumar, Vijay P. Singh, Munjid Maryam

Course Name: GIS & Remote Sensing

Credit Hours: 2

Contact Hours: 2+0

Pre-Requisites: None

Course Code: GEO 438

Contents:

Introduction to Geographical Information System; data types, data models and structures; data sources and capturing techniques; displaying and manipulating spatial information, vector data preparation, GPS Survey; introduction to the concept of RS, electromagnetic spectrum, atmospheric interaction; Technology of Remote Sensing (Orbits, Satellites, Sensors and Platforms); applications of Remote Sensing, satellite image processing cycle, image enhancement, data fusion.

Reference Books

Remote Sensing by Siamak Khorram, Frank H. Koch, Cynthia F. Van der Wiele. 2012. Springer.

Introduction to Geographic Information Systems by Kang-Tsung Chang. 2010. McGraw-Hill Publishers.

GIS: Fundamentals, Applications and Implementations by Elangovan. 2006. McGraw-Hill Publishers.

Remote Sensing of the Environment by John R. Jensen. 2009. Amazon publishers.
Matt Duckham, Michael F. Goodchild, Michael F. Worboys, 2003, Foundations of Geographic Information Science, Tylor and Francis, New York, USA.

Course Name: GIS & Remote Sensing Lab

Credit Hours: 1

Contact Hours: 2+0

Pre-Requisites: None

Course Code: GEL 438

Contents:

Introduction to ArcGIS, Exploring GIS Data set in Arc Catalog, working on vector data in ArcGIS (Scanning, Digitization and Editing), Integrating GPS data in GIS Environment, Applications of GIS, ERDAS Imagine, ENVI - Environment, Noise Corrections, Geometric Corrections, Radiometric Corrections.

Reference Books

Michael N. Demers 2002, Fundamentals of Geographic Information System, John Wiley and Sons, Inc., Singapore.

Kang-Tsung Chang, 2002, Introduction to Geographic Information Systems, McGraw-Hill Company, New York, U.S.A.

W. G. Rees, 2001, Physical Principles of Remote Sensing Cambridge University Press, United Kingdom. ISBN: 0521669480. 38

Asanta Shrestha and Birendra Bajracharya, 2000, GIS for Beginners, By ICIMOD, Kathmandu, Nepal.

Thomas M. Lilles and Ralph W. Kiefer, 2000, Remote Sensing and Image Interpretation John Wiley and Sons.

Course Name: Seismic Stratigraphy

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites: None

Course Code: GEO 445

Contents:

Introduction , Seismic Stratigraphic approach, Recognition and discrimination of depositional sequence, Boundaries of depositional sequence , Stratigraphic interpretation of seismic facies, Principal types of seismic facies, Recognizing and evaluating unconfirmities; Factors controlling deposition of cyclic sequences; Origin of cyclic sequence; Application of seismic stratigraphy in hydrocarbon exploration; Basin classification; Classification and structural styles related to strike-slip, Thrust tectonic; Source rocks and its types. Interpretation of logs and other relevant data to identify areas favorable for hydrocarbon exploration.

Reference Books

“Principal of sequence Stratigraphy” by O.Catuneanu

Holland, S.M., 1999. An Online Guide to Sequence Stratigraphy.

Kendall, C., 2002. USC Sequence Stratigraphy Web. <http://strata.geol.sc.edu/>

Posamentier, H.W., Jersey, M.T., and Vail, P.R., 1988. Eustatic Controls on Clastic Deposition I - Conceptual Framework. In C.K. Wilgus, B.S. Hastings, C.G.St.C. Kendall, H.W. Posamentier, C.A.

Ross, J.C. Van Wagoner, eds., Sea-level changes: an integrated approach. Society of Economic Paleontologists and Mineralogists Special Publication No. 42, p. 109-124.

Posamentier, H.W., and Vail, P.R., 1988. Eustatic Controls on Clastic Deposition II - Sequence and Systems Tract Models. In C.K. Wilgus, B.S. Hastings, C.G.St.C. Kendall, H.W. Posamentier, C.A

Course Name: Seismic Data Interpretation

Credit Hours: 2

Contact Hours: 2+0

Pre-Requisites: None

Course Code: GEO 477

Contents:

Seismic data analysis techniques, Geological constraints regarding seismic data interpretation, Importance of seismic data quality, QC of data, Geological implementation in the seismic data, Seismic to well tie, Tying methods, Seismic correlation techniques, e.g Jump tie, loop tie, Interpretation ways, Mapping, 3 D surfaces, Practical implementation of different Software like Surfer, Open Tect, Kingdom, Geographix.

Reference Books

Seismic Data Interpretation and Evaluation for Hydrocarbon Exploration and Production by Niranjan C. Nanda

Course Name: Seismic Data Interpretation Lab

Credit Hours: 1

Contact Hours: 2+0

Pre-Requisites: None

Course Code: GEL 477

Contents:

Practical implementation of different Software like Surfer, Open Tect, Kingdom, Geographix.

Reference Books

Seismic Data Interpretation and Evaluation for Hydrocarbon Exploration and Production by Niranjan C. Nanda

Course Name: Geospatial Techniques

Credit Hours: 2

Contact Hours: 2+0

Pre-Requisites: None

Course Code: GEO 479

Contents:

Study of geospatial technology, including Geographic Information Systems (GIS), Global Positioning Systems (GPS), cartography, remote sensing, and spatial analysis. Application of Geographic Information Systems (GIS) science to spatial data management. Assessment of vector and raster systems, scale, resolution, map projection, coordinate systems and georeferencing. Identification and acquisition of spatial data.

Reference Books

Geospatial Data Science Techniques and Applications By Hassan A. Karimi, Bobak Karimi

Course Name: Geospatial Techniques Lab

Credit Hours: 1

Contact Hours: 2+0

Pre-Requisites: None

Course Code: GEL 479

Contents:

This course introduces students to computer-based GIS, Geographic Information Systems, and its applications to spatial data management as a tool to understand the world by describing and explaining the human relationship to the physical environment. Topics include assessment of vector and raster systems, scale, resolution, map projection, coordinate systems, georeferencing and Global Positioning Systems (GPS). Hands-on exposure to spatial analysis and modeling with GIS through the use of computers

Reference Books

Geospatial Data Science Techniques and Applications By Hassan A. Karimi, Bobak Karimi

Course Name: Geophysical Softwares Lab

Credit Hours: 1

Contact Hours: 2+0

Pre-Requisites: None

Course Code: GEL 480

Contents:

Introduction to software used in different industry. How to create and manage a project including establishing project boundaries, choosing an X/Y projection. the use of authors, CRS and its types. Culture (geographic layer) input: creating and entering culture data on the base map including formatted and unformatted data entry and the importing of ESRI shape files. Well data input: using file sources such as HIS Energy and ascii formatted data; loading of well locations, deviation surveys, formation tops, log curves, and local and shared Time-Depth information. Using the SEG-Y Viewer to examine 2D and 3D trace header data.

Reference Books

Lab Manuals

Course Name: Geophysical Softwares Lab

Credit Hours: 1

Contact Hours: 2+0

Pre-Requisites: None

Course Code: GEL 480

Contents:

How to create and manage a project including establishing project boundaries, choosing an X/Y projection. the use of authors, CRS and its types. Culture (geographic layer) input: creating and entering culture data on the base map including formatted and unformatted data entry and the importing of ESRI shape files. Well data input: using file sources such as HIS Energy and ascii formatted data; loading of well locations, deviation surveys, formation tops, log curves, and local and shared Time-Depth information. Using the SEG-Y Viewer to examine 2D and 3D trace header data.

Reference Books

Lab Manuals

Course Name: Mining Geophysics

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites: None

Course Code: GEO 481

Contents:

Role of Geophysical prospecting in Mining techniques like; Electromagnetic, Resistivity, Induced Polarization, Self-Potential, Radiometric, Gravity and Magnetic methods applied for metallic mineral deposits; Airborne, electromagnetic surveys; site design; theoretical basis for each technique, the instrumentation used; Working Conditions, data collection, processing and interpretation procedures; Deposition of coal; Seismic methods for identifying coal, iron and copper sulphides; Review of geophysical research conducted in Pakistan; Specified assignments/projects

Reference Books

Mining Geophysics by D Parasnath

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Academic Road Map for UG Program
Faculty of Engineering Sciences

Program Title: **BS Remote Sensing & GIS**

Duration: **4 Years**

Total Credit Hours: **132**

Endorsement References:

- A: Recommendations of CAC dated 22-Mar-23
- B: Recommendations of DBOS dated 09-Aug-23
- C: Recommendations of FBOS dated 04-Sep-23

Summary of Credit Hours

Sr. No.	Category as per HEC new UG Policy	Credit Hours/Contact Hours	
		Existing Road Map	Proposed New Road Map
1.	General Education (Mandatory)	31	33
2.	Major/Disciplinary (Mandatory)	92	81
3.	Interdisciplinary (Mandatory)	3	12
4.	Electives toward specialization	-	-
5.	Tajweed, Quran and Hadith (Compulsory, non-credit course, only for Muslim Students)		8 Contact Hours
6	Field Experience	3	3
7.	Capstone Project (Mandatory)	6	3
8	Double Major (Optional)	-	-
9.	Minor (Optional)	-	-
Total		135	132

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Following are the sample program educational objectives that are expected to be exhibited by the Geology graduates.

1. Demonstrate sound knowledge and skills (PEO 1)
2. Work, manage and illustrate effective teamwork, interpersonal skills and professional growth (PEO 2)
3. Undertake professional practice considering ethical, societal and environmental implications. Note: Institutions are expected to customize their own PEOs for their program requirements (PEO 3)

PROGRAM LEARNING OUTCOMES (PLOs)

Minutes of the 32nd FBOS – ES

PLO1 Academic Education: A fundamental understanding of the academic field of Remote Sensing, different learning areas and its applications

PLO2 Knowledge: Apply knowledge of remote sensing & GIS, for the solution of defined problems

PLO3 Problem Analysis: Demonstrate the ability to use skills in remote sensing & GIS and its related areas of technology for formulating and tackling remote sensing related problems.

PLO4 Design/ Development of Solutions: Plan and execute remote sensing related investigations, analyze and interpret data collected using appropriate methods to report accurately the findings of the investigations

PLO5 Modern Tool Usage: Create, select, adapt and apply appropriate techniques, resources, and modern remote sensing tools to complex processes, with an understanding of the limitations.

PLO6 Individual and Teamwork: Function effectively as an individual and as a member or leader in diverse teams and in multi-disciplinary settings.

PLO7 Communication: Communicate effectively with the GIS community and with society at large about activities by being able to comprehend and write effective reports, design documentation, make effective presentations, and give and understand clear instructions.

PLO8 Professionalism and Society: Understand and assess societal, health, safety, legal, and cultural issues within local and global contexts, and the consequential responsibilities relevant to professional practices

PLO9 Ethics: Understand and commit to professional ethics, responsibilities, and norms of professional practice.

PLO10 Life-long Learning: Recognize the need, and have the ability, to engage in independent learning for continual development as a GIS professional.

Mapping of PLO and PEO

T. No	Program Learning Outcomes (PLOs)	PEOs		
		PEO 1	PEO 2	PEO 3
1	Academic Education	✓	✓	
2	Knowledge	✓	✓	
3	Problem Analysis	✓		
4	Design/ Development of Solutions	✓	✓	
5	Modern Tool Usage	✓		✓
6	Individual and Teamwork		✓	✓
7	Communication			✓
8	Professionalism and Society		✓	✓
9	Ethics		✓	✓
10	Life-long Learning			✓

HEC UG Policy	Existing (RS&GIS) Road Map	Proposed (RS&GIS) Road Map

Minutes of the 32nd FBOS – ES

		CH	No. of Courses	Credit Hours	Courses	Credit Hours
General Education	Natural Sciences	3	1	6	2	6
	Social Sciences	2	1	3	1	2
	Arts and Humanities	2	1	6	2	2
	Expository Writing	3	1	6	2	3
	Functional English	3	1	3	1	3
	Quantitative Reasoning	6	2	6	2	6
	Ideology and Const. of Pak	2	1	3	1	2
	Islamiyat	2	1	3	1	2
	Application of ICT	2+1	1	3	1	2+1
	Entrepreneurship	2	1	0	0	2
	Civics and Comm. Engage	2	1	0	0	2
	Total	30	12	36	12	30
Major	Diff. Courses	72	As per req.	75	25	84
Int. Disciplinary	Diff. Courses	12	4	12	4	12
Capstone Project	Thesis	3	NA	6	1	3
Field Experience/Internship	Field Visit	3	NA	6	2	3
	Total	120		135		132

Minutes of the 32nd FBOS – ES
Semester-wise Revised Road map of BS RSGIS

Semester 1

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.		PAK 103	Pakistan Studies & Global Perspective	2	General Education	4, 10, 16
2.		ISL 101	Islamic Studies	2	General Education	4, 10, 16
3.		ENG 101	Functional English	3	General Education	4
4.		MAT 105	Mathematics	0	Zero Credit Course (1 zero credit course for	4
5.		CSC 102	Introduction to Computers & Programming	2	Major (Disciplinary)	4, 8, 9
		CSL 102	Introduction to computers & Programming lab	1		
6.		PHY 103	Physics	2	General Education	4, 9
		PHL 103	Physics Lab	1		
7.		RGS 103	Fundamental of GIS	2	Major (Disciplinary)	4, 8 ,11
		RGL 103	Fundamental of GIS Lab	1		
8.	None	ISL 107	Tajweed	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				16		

*Only for Muslim students

Semester 2

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention

Minutes of the 32nd FBOS – ES

						relevant SDG No.
1.		GSC 340	Chemistry	2	General Education	4, 6, 7
		GSL 340	Chemistry Lab	1		
2.		HSS 320	Technical Writing and Presentation Skills	3	General Education	4, 8, 10
3.		MAT 115	Calculus & Analytic Geometry	3	General Education	4
4.		RGS 104	Physical Geography	2	Major (Disciplinary)	4, 11, 14, 15
		RGL 104	Physical Geography Lab	1		
5.		RGS 105	Fundamental of Earth Sciences	2	Major (Disciplinary)	4, 6, 7, 15
		RGL 105	Fundamental of Earth Sciences Lab	1		
6.	RGS 103	RGS 106	Introduction to Remote Sensing	2	Major (Disciplinary)	3, 4, 14, 15
		RGL 106	Introduction to Remote Sensing Lab	1		
7.	ISL 107	ISL 108	Understanding Quran – I	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				18		

*Only for Muslim students

Semester 3

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)

Minutes of the 32nd FBOS – ES

1.		GEO 201	Museology	2	General Education	4
2.		GEO 206	Civics and Community Engagement	2	General Education	4, 13, 16, 17
3.		HSS 107	Introduction to Psychology	2	General Education	3, 4
4.		RGS 201	Introduction to Cartography	2	Major (Disciplinary)	4, 8, 9, 11, 12
		RGL 201	Introduction to Cartography Lab	1		
5.		RGS 202	GPS & Surveying	2	Major (Disciplinary)	4, 8, 9, 11
		RGL 202	GPS & Surveying Lab	1		
6.		RGS 315	Human Geography	3	Major (Disciplinary)	1-17
7.	RGS 106	RGS 204	Introduction to Photogrammetry	2	Major (Disciplinary)	4, 8, 9, 11
	RGL 106	RGL 204	Introduction to Photogrammetry Lab	1		
8.	ISL 108	ISL 109	Understanding Quran – II	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				18		

*Only for Muslim students

Semester 4

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.		HSS 423	Entrepreneurship	2	General Education	4, 8, 9, 17
2.		RGS 319	Multidisciplinary Applications of GIS & RS	2	Major (Disciplinary)	4, 8, 9, 14, 15
		RGL 319	Multidisciplinary Applications of GIS & RS Lab	1		
3.		GEO 207	Application of Information and Communication Technologies	2	General Education	4, 8, 9
		GEL 207	Application of Information and Communication Technologies Lab	1		
4.		GEO 212	Geostatistics	3	Major (Disciplinary)	4, 8
5.		RGS 206	Database Management System	2	Major (Disciplinary)	4, 8, 9
		RGS 20L	Database Management System Lab	1		
6.		RGS 207	Active Remote Sensing & Space Law	3	Major (Disciplinary)	4, 9, 11
7.	ISL 109	ISL 110	Understanding Quran – III	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				17		

*Only for Muslim students

Semester 5

Minutes of the 32nd FBOS – ES

*Only for Muslim students

Sr. No.	Proposed Road map aligned with HEC new UG Policy					17 UN SDGs alignment (please mention relevant SDG No.)
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	
1.	RGS 206	RGS 317	Spatial Decision Support Systems	3	Major (Disciplinary)	4, 12, 15, 16
2.	RGS 207	RGS 316	Microwave & Hyper Spectral RS	3	Major (Disciplinary)	4, 11
		RGL 316	Microwave & Hyper Spectral RS Lab			
3.		GEO 321	Computing with MATLAB	2	Interdisciplinary	9, 11
		GEL 321	Computing with MATLAB Lab	1		
4.	RGS 106	RGS 331	Digital Image Processing	2	Major (Disciplinary)	4, 9, 11
	RGL 106	RGL 331	Digital Image Processing	1		
5.	RGS 202	RGS 318	Spatial Data Infrastructure & Visualization	2	Major (Disciplinary)	4, 9, 11
	RGL 202	RGL 318	Spatial Data Infrastructure & Visualization Lab	1		
6.		RGS 361	Integrated Geospatial Technologies	2	Major (Disciplinary)	4, 8, 9
		RGL 361	Integrated Geospatial Technologies Lab	1		
7.	ISL 110	ISL 111	Understanding Quran – IV	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				18		

Semester 6

Proposed Road map aligned with HEC new UG Policy	

Minutes of the 32nd FBOS – ES

Sr. No.	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.			Elective-I	3	Major (Disciplinary)	-
2.		RGS 330	Web GIS	2	Major (Disciplinary)	4, 8, 9
		RGL 330	Web GIS Lab	1		
3.		RGS 350	Geodesy	2	Major (Disciplinary)	4, 11
		RGL 350	Geodesy Lab	1		
4.		RGS 332	Satellite Navigation System	3	Major (Disciplinary)	4, 9
5.		RGS 360	Spatial Data Analysis	2	Major (Disciplinary)	4, 8, 9
		RGL 360	Spatial Data Analysis Lab	1		
1.		RGL 251	Geospatial Field Work and Report-I	3	Internship (Mandatory)/Field Experience	4, 8, 14, 15
2.	ISL 111	ISL 112	Understanding Quran – V	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				18		

*Only for Muslim students

Semester 7

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)

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9.		-	Elective-II	3	Major (Disciplinary)	-
1.		RGS 453	GIS for Disaster Management	3	Major (Disciplinary)	4,9,11
2.		RGS 458	Geospatial Techniques	2	Major (Disciplinary)	4, 8, 9
		RGL 458	Geospatial Techniques Lab	1		
3.		EES 424	Research Methods	3	Interdisciplinary	4
4.		ENV 425	Occupational Health & Safety	3	Interdisciplinary	3, 4, 6, 13
5.	ISL 112	ISL 113	Seerah -I	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				15		

*Only for Muslim students

Semester 8

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.		-	Elective-III	3	Major (Disciplinary)	-
2.		RGS 451	Computer Aided Drafting/Drawing	2	Major (Disciplinary)	4, 9, 11
		RGL 451	Computer Aided Drafting/Drawing Lab	1		
3.		RGS 471	Legal and Social Issues in Geospatial Sciences	3	Major (Disciplinary)	4, 16

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4.		RGS 490	Thesis	3	Thesis / Capstone Project	4
5.		RGS 456	GIS Programming & Python	2	Major (Disciplinary)	4, 8
		RGL 456	GIS Programming & Python Lab	1		
6.	ISL 113	ISL 114	Seerah -II	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours			15			

*Only for Muslim students

List of Elective Courses

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.		RGS 320	Geospatial Project Management	3	Major (Disciplinary) Requirements	4, 13, 15
2.		RGS 454	Spatial Data Modelling	2	Major (Disciplinary) Requirements	4, 13, 15
		RGL 454	Spatial Data Modelling Lab	1		
3.		RGS 455	Land & Water Information System	2	Major (Disciplinary) Requirements	4, 14, 15
		RGL 455	Land & Water Information System Lab	1		
4.		RGS 452	Data Structures and Algorithms	2	Major (Disciplinary) Requirements	4
		RGL 452	Data Structures and	1		

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			Algorithms Lab			
5.		CSC 102	Machine Learning	2	Major (Disciplinary) Requirements	3, 4, 9
		CSL 102	Machine Learning Lab	1		
6.		AIC 201	Artificial Intelligence	2	Major (Disciplinary) Requirements	4, 9
		AIL 201	Artificial Intelligence Lab	1		

Course Outlines

Course Name: Geostatistics

Credit Hours: 3

Contact Hours: 3+0

Pre-Requisites: None

Course Code: GEO 216

Course Learning Outcomes:

1. Apply the concepts of spatial variability to geological, geomechanical and/or environmental variables,
2. Calculate variograms for simple one- and two-dimensional data sets
3. Assemble models to experimental variograms and interpret model parameters

Contents:

Descriptive statistics and exploratory data analysis, random variable; moments; probability distributions; normal and lognormal distributions, random function model, modeling spatial continuity; experimental variograms covariance functions; correlograms and madograms; variogram and covariance function models; isotropy and anisotropy, estimation methods: simple kriging.

Reference Books:

- Kitanidis, P.K. (1997) Introduction to geostatistics: applications in hydrology.
- Goovaerts,Pierre (1999) Geostatistics for Natural Resource Evaluation.
- Olea, R. A. (1999) Geostatistics for Engineers and Earth Scientists.
- Christakos, G (2000) Modern Spatiotemporal Geostatistics.
- Webster, R. and Webster, M (2001) Geostatistics for Environmental Scientists.

Course Name: Museology

Credit Hours: 2+0

Contact Hours: 2+0

Pre-Requisites:

Course Code: GEO 201

CLOs:

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1. Show an understanding of professional procedures in museum display, collections, care and preservation.
2. Exhibit an understanding of the use of materials, techniques, and media as they relate to museums.

Contents:

Introduction to Museology provides a broad, theory-based introduction to the museum sector and the research field of museology. Focusing on museum ethics, the course also give attention to all museum activities. Excursions to different museums and guest lectures from the museum sector give the students insights into the museum practice and provide present day examples and discussions, which they may study by using museological theories, dilemmas in museum ethics, and knowledge in museum history.

References Books

- Dictionary of Museology by François Mairesse - 2023
- New Horizons for Asian Museums and Museology Naoko Sonoda - 2016

Course Name: Geospatial Techniques

Credit Hours: 2

Contact Hours: 2+0

Pre-Requisites: None

Course Code: GEO 479

Course Learning Outcomes

1. Demonstrate advanced knowledge of theory of remote sensing and GIS including sensor systems, basic radiative transfer, cartographic projections and display, and spatial databases, and of fundamental concepts in geospatial analysis and modeling techniques.
2. Quantitatively analyze data to evaluate scientific hypotheses and arguments in remote sensing and geographic information science.
3. Communicate effectively, both verbally and in writing, advanced concepts in remote sensing and geographic information systems.

Contents:

Study of geospatial technology, including Geographic Information Systems (GIS), Global Positioning Systems (GPS), cartography, remote sensing, and spatial analysis. Application of Geographic Information Systems (GIS) science to spatial data management. Assessment of vector and raster systems, scale, resolution, map projection, coordinate systems and georeferencing. Identification and acquisition of spatial data.

Reference Books

- Geospatial Data Science Techniques and Applications By Hassan A. Karimi, Bobak Karimi

Appendage 3202**Roadmap of BS CS, IT, AI and ADP CS****Academic Road Maps of UG Program
Faculty of Engineering Sciences**Program Title: BS Computer ScienceDuration: 4 YearsTotal Credit Hours: 133

Endorsement References:

A: Recommendations of CAC dated 7-Jul-23B: Recommendations of DBOS dated 23-Aug-23C: Recommendations of FBOS dated 04-Sep-23**Summary of Credit Hours**

Sr. No.	Category as per HEC new UG Policy	Credit Hours/Contact Hours	
		Existing Road Map	Proposed New Road Map
1.	General Education (Mandatory)	30	30
2.	Major/Disciplinary (Mandatory)	43 (Computing Core) 18 (Domain Core)	43 (Computing Core) 18 (Domain Core)
3.	Interdisciplinary (Mandatory)	12 (mathematics and supporting courses) 3(Elective Supporting)	12 (mathematics and supporting courses) 3(Elective Supporting)
4.	Electives toward specialization	21	21
5.	Tajweed, Quran and Hadith (Compulsory, non-credit course, only for Muslim Students)	-	8 Contact Hours (non-credited)
6	Internship (Mandatory)/Field Experience	non-credited	6-8 Weeks non-credited (mandatory)
7.	Capstone Project (Mandatory)	6	6
8	Double Major (Optional)	-	-
9.	Minor (Optional)	-	-
		Total	133
			133

Semester-wise Revised Roadmap of BSCS**Semester 1**

Sr. No	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment
.						

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	Cour se Code					t (please mention relevant SDG No.
1.	None	GSC 114	Applied Physics	2	Gen Edu (Natural Science)	4, 9
2.	None	GSL 113	Applied Physics Lab	1	Gen Edu (Natural Science)	4, 9
3.	None	CSC 114	Introduction to Information & Communication Technology	2	Gen Edu (ICT)	4, 9
4.	None	CSL 114	Introduction to Information & Communication Technology Lab	1	Gen Edu (ICT)	4, 9
5.	None	CSC 113	Computer Programming	3	Major/Disciplinary (Computing Core)	4, 8, 9
6.	None	CSL 113	Computer Programming Lab	1	Major/Disciplinary (Computing Core)	4, 8, 9
7.	None	GSC 221	Discrete Mathematics	3	Gen Edu (Quantitative Reasoning)	4
8.	None	ISL 101	Islamic Studies/Ethics	2	Gen Edu (Religious Education/Ethics)	4, 10, 16
9.	None	CSC 308	Professional Practices & Ethics	2	Gen Edu (Arts & Humanities)	4, 8, 10
10.	None	ISL 107	Tajweed	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				17		

*Only for Muslim students

Semester 2

Sr. No	Proposed Road map aligned with HEC new UG Policy					
	Pre- requisit e Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignmen t (please mention

Minutes of the 32nd FBOS – ES

						relevant SDG No.
1.	None	GSC 122	Probability and Statistics	3	Interdisciplinary (Mathematics & Supporting Courses)	4, 8
2.	CSC 113	CSC 210	Object Oriented Programming	3	Major/Disciplinary (Computing Core)	4, 9
3.	CSC 113	CSL 210	Object Oriented Programming Lab	1	Major/Disciplinary (Computing Core)	4, 9
4.	GSC 114	CEN 122	Digital Design	2	Major/Disciplinary (Computing Core)	4,8,9
5.	GSC 114	CEL 122	Digital Design Lab	1	Major/Disciplinary (Computing Core)	4,8,9
6.	None	GSC 110	Applied Calculus and Analytical Geometry	3	Gen Edu (Quantitative Reasoning)	4
7.	None	ENG 101	Functional English	3	Gen Edu (Functional English)	4
8.	None	PAK 103	Pakistan Studies & Global Perspective	2	Gen Edu (Ideology & Constitution of Pakistan)	4, 10, 16
9.	ISL 107	ISL 108	Understanding Quran-I	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				18		

*Only for Muslim students

Semester 3

Sr. No	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.	None	HSS 219	Civic and Community Engagement	2	Gen Edu (Civics & Community Engagement)	4, 5, 16
2.	None	GSC 121	Linear Algebra	3	Interdisciplinary (Mathematics & Supporting Courses)	4

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3.	GSC 110	GSC 211	Multivariable Calculus	3	Interdisciplinary (Mathematics & Supporting Courses)	4
4.	None	CEN 223	Computer Communication & Networks	3	Major/Disciplinary (Computing Core)	4, 9
5.	None	CEL 223	Computer Communication & Networks Lab	1	Major/Disciplinary (Computing Core)	4, 9
6.	CSC 113	CSC 221	Data Structure & Algorithm	3	Major/Disciplinary (Computing Core)	4
7.	CSC 113	CSL 221	Data Structure & Algorithm Lab	1	Major/Disciplinary (Computing Core)	4
8.	None	ENG 134	Communication Skills	2	Gen Edu (Arts & Humanities)	4
9.	ISL 108	ISL 109	Understanding Quran-II	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				18		

*Only for Muslim students

Semester 4

Sr. No	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.	None	-	Social Sciences Elective	3	Gen Edu (Social Sciences)	4, 5, 16
2.	CEN 122	CEN 323	Computer Organization and Assembly Language	2	Major/Disciplinary (Computing Core)	4, 9
3.	CEN 122	CEL 323	Computer Organization & Assembly Language Lab	1	Major/Disciplinary (Computing Core)	4, 9

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4.	None	ENG 123	Expository Writing	3	Interdisciplinary (Mathematics & Supporting Courses)	4
5.	None	CSC 220	Database Management Systems	3	Major/Disciplinary (Computing Core)	4, 8
6.	None	CSL 220	Database Management Systems Lab	1	Major/Disciplinary (Computing Core)	4, 8
7.	None	HSS 423	Entrepreneurship	2	Gen Edu (Entrepreneurship)	4, 8, 9, 17
8.	None	SEN 220	Software Engineering	3	Major/Disciplinary (Computing Core)	4, 8, 9
9.	ISL 109	ISL 110	Understanding Quran – III	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours			18			

*Only for Muslim students

Semester 5

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.	CSC 221	CSC 320	Operating Systems	3	Major/Disciplinary (Computing Core)	4, 8
2.	CSC 221	CSL 320	Operating Systems Lab	1	Major/Disciplinary (Computing Core)	4, 8
3.	None	CSC 315	Theory of Automata	3	Major/Disciplinary (Domain Core)	4
4.	CSC 221	CSC 321	Design and Analysis of Algorithms	3	Major/Disciplinary (Computing Core)	4
5.	CEN 323	CSC 327	Computer Architecture	2	Major/Disciplinary (Domain Core)	4, 9
6.	CEN 323	CSL 327	Computer Architecture Lab	1	Major/Disciplinary (Domain Core)	4, 9
7.	None	CSC 412	Artificial Intelligence	3	Major/Disciplinary (Computing Core)	4, 9
8.	None	CSL 411	Artificial Intelligence Lab	1	Major/Disciplinary (Computing Core)	4, 9

Minutes of the 32nd FBOS – ES

9.	ISL 110	ISL 111	Understanding Quran – IV	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4,10,16
Total Credit Hours				18		

*Only for Muslim students

Semester 6

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
3.	CSC 315	CSC 323	Compiler Construction	2	Major/Disciplinary (Domain Core)	4
4.	CSC 315	CSL 323	Compiler Construction Lab	1	Major/Disciplinary (Domain Core)	4
5.			Elective 1 (2+1)	2	Domain Elective	4, 8, 9
6.			Elective 1 Lab	1	Domain Elective	4, 8, 9
7.			Elective 2 (2+1)	2	Domain Elective	4, 8, 9
8.			Elective 2 Lab	1	Domain Elective	4, 8, 9
9.			Elective 3 (3+0 or 2+1)	3	Domain Elective	4, 8, 9
10.	SEN 220	SEN 321	Human Computer Interaction	2	Major/Disciplinary (Domain Core)	4, 9
11.	SEN 220	SEN 320	Human Computer Interaction Lab	1	Major/Disciplinary (Domain Core)	4, 9
12.	ISL 111	ISL 112	Understanding Quran – V	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4,10,16
Total Credit Hours				15		

*Only for Muslim students

Semester 7

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)

Minutes of the 32nd FBOS – ES

6.	None	FYP 400	Final Year Project	3	Capstone Project	1 to 17
7.	CSC 220	CSC 470	Advanced Databases	2	Major/Disciplinary (Domain Core)	4, 9
8.	CSC 220	CSL 470	Advanced Databases Lab	1	Major/Disciplinary(Domain Core)	4, 9
9.			Elective Supporting Course	3	Interdisciplinary (Elective Supporting Courses)	4, 8, 16, 17
10.			Elective 4 (2+1)	2	Domain Elective	4, 8, 9
11.			Elective 4 Lab	1	Domain Elective	4, 8, 9
12.			Elective 5 (2+1)	2	Domain Elective	4, 8, 9
13.			Elective 5 Lab	1	Domain Elective	4, 8, 9
14.	ISL 112	ISL 113	Seerah-I	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4,10,16
Total Credit Hours				15		

*Only for Muslim students

Semester 8

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
7.	None	FYP 400	Final Year Project	3	Capstone Project	1 to 17
8.	None	CSC 407	Information Security	3	Major/Disciplinary (Computing Core)	4, 8, 9
9.	CSC 320	AIC 302	Parallel & Distributed Computing	2	Major/Disciplinary (Domain Core)	4, 9
10.	CSC 320	AIL 302	Parallel & Distributed Computing Lab	1	Major/Disciplinary (Domain Core)	4, 9
11.			Elective 6	2	Domain Elective	4, 8, 9
12.			Elective 6 Lab	1	Domain Elective	4, 8, 9

Minutes of the 32nd FBOS – ES

13.			Elective 7 (3+0 or 2+1)	3/2	Domain Elective	4, 8, 9
14.	ISL 113	ISL 114	Seerah –II	0	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4,10,16
Total Credit Hours			15			

*Only for Muslim students

List of Elective Courses (21 credit hours)

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre- requisit e Course Code	Course Code	Course Title	Credi t Hour s	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.	CSC 321	CSC 521	Advanced Design and Analysis of Algorithm	3	Domain Elective	4, 9
2.	CEN 223	CEN 451	Data Encryption and Security	3	Domain Elective	4, 9, 11
3.	CSC 220	CSC 452	Data Mining	3	Domain Elective	3, 4, 9
4.	CSC 220	CSC 454	Data Warehousing	3	Domain Elective	4, 9
5.	CSC 220	CSC 490	Introduction to Cloud Computing	3	Domain Elective	4, 9, 11
6.	CSC 325	SEN 455	Knowledge Based Management System	3	Domain Elective	4, 9
7.	SEN 220	CSC 458	Management Information System	3	Domain Elective	4, 8, 9, 11
8.	CSC 325	CSC 441	Natural Language Processing	3	Domain Elective	4, 9
9.	CSC 325	CSC 449	Neural Networks & Fuzzy Logic	3	Domain Elective	3, 4, 9
10.	CSC 113	SEN 422	Semantic Computing	3	Domain Elective	4, 9, 11

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11.	SEN 220	SEN 458	Software Requirement Engineering	3	Domain Elective	4, 9, 11
12.	CSC 323	CSC 451	Theory of Programming Languages	3	Domain Elective	4, 9
13.	SEN 220	SEN 456	Usability Engineering	3	Domain Elective	4, 9
14.	CEN 223	CSC 489	Ubiquitous Computing	3	Domain Elective	4, 9, 11
15.	SEN 220	SEN 410	Software Project Management	3	Domain Elective	4, 8, 9
16.	SEN 220	SEN 420	Software Quality Assurance	3	Domain Elective	4, 9
17.	SEN 220	SEN 447	Software Testing	3	Domain Elective	4, 8, 9
18.	CEN 223	ITC 411	Cyber Security	3	Domain Elective	4, 8, 9, 11
19.	CSC 325	CSC 464	Computer Vision	3	Domain Elective	3, 4, 9
20.	CSC 221	CSC 404	Blockchain Technologies	3	Domain Elective	4, 9, 11
21.	CSC 325	CSC 448	Introduction to Bioinformatics	3	Domain Elective	3, 4, 9, 15
22.	CEN 223	CEN 449	Internet of Things	3	Domain Elective	4, 9, 11
23.	CSC 220	CSC 488	Big Data Analytics	2	Domain Elective	3, 4, 9
24.	CSC 220	CSL 488	Big Data Analytics Lab	1	Domain Elective	3, 4, 9
25.	CSC 210	CSC 444	Computer Graphics	2	Domain Elective	4, 9
26.	CSC 210	CSL 444	Computer Graphics Lab	1	Domain Elective	4, 9
27.	None	CSC 484	Content Management	2	Domain Elective	4, 9
28.	None	CSL 484	Content Management Lab	1	Domain Elective	4, 9

Minutes of the 32nd FBOS – ES

29.	CSC 210	CEN 444	Digital Image Processing	2	Domain Elective	3, 4, 9
30.	CSC 210	CEL 444	Digital Image Processing Lab	1	Domain Elective	3, 4, 9
31.	CSC 210	CSC 319	Game Development and Design	2	Domain Elective	4, 9
32.	CSC 210	CSL 319	Game Development and Design Lab	1	Domain Elective	4, 9
33.	CSC 325	CSC 466	Introduction to Biometrics	2	Domain Elective	4, 8, 9
34.	CSC 325	CSL 466	Introduction to Biometrics Lab	1	Domain Elective	4, 8, 9
35.	CSC 220	CSC 487	Introduction to Data Science	2	Domain Elective	4, 8, 9
36.	CSC 220	CSL 487	Introduction to Data Science Lab	1	Domain Elective	4, 8, 9
37.	CSC 210	CSC 341	Mobile Application Development	2	Domain Elective	4, 8, 9
38.	CSC 210	CSL 341	Mobile Application Development Lab	1	Domain Elective	4, 8, 9
39.	None	SEN 493	Multimedia Systems	2	Domain Elective	4, 9
40.	None	SEL 493	Multimedia Systems Lab	1	Domain Elective	4, 9
41.	CSC 325	CEN 458	Robotics	2	Domain Elective	4, 9, 11
42.	CSC 325	CEL 458	Robotics Lab	1	Domain Elective	4, 9, 11
43.	CSC 210	SEN 448	Software Application for Mobile Device	2	Domain Elective	4, 8, 9
44.	CSC 210	SEL 448	Software Application for Mobile Device Lab	1	Domain Elective	4, 8, 9

Minutes of the 32nd FBOS – ES

45.	SEN 220	SEN 457	Software Design and Architecture	2	Domain Elective	4, 9
46.	SEN 220	SEL 457	Software Design and Architecture Lab	1	Domain Elective	4, 9
47.	CSC 210	CSC 313	Visual Programming	2	Domain Elective	4, 9
48.	CSC 210	CSL 313	Visual Programming Lab	1	Domain Elective	4, 9
49.	CSC 113	SEN 310	Web Engineering	2	Domain Elective	4, 8, 9
50.	CSC 113	SEL 310	Web Engineering Lab	1	Domain Elective	4, 8, 9
51.	CSC 325	AIC 301	Machine Learning	2	Domain Elective	3, 4, 9
52.	CSC 325	AIL 301	Machine Learning Lab	1	Domain Elective	3, 4, 9
53.	CSC 325	AIC 401	Deep Learning	2	Domain Elective	3, 4, 9
54.	CSC 325	AIL 401	Deep Learning Lab	1	Domain Elective	3, 4, 9
55.	None	CSC 400	Quantum Computing	2	Domain Elective	4, 8, 9
56.	None	CSL 400	Quantum Computing Lab	1	Domain Elective	4, 8, 9

List of Social Sciences Courses

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.	None	HSS 107	Introduction to Psychology	3	General Education (Social Sciences)	3, 4

Minutes of the 32nd FBOS – ES

2.	None	HSS 115	Introduction to Media studies	3	General Education (Social Sciences)	4
3.	None	BES 103	Critical Thinking	3	General Education (Social Sciences)	3, 4

List of Elective Supporting Courses (3 credit hours)

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.	None	MKT 110	Principles of Marketing	3	Interdisciplinary (Elective Supporting)	4, 8
2.	None	FIN 201	Fundamentals of Finance	3	Interdisciplinary (Elective Supporting)	4, 8
3.	None	MGT 111	Principles of Management	3	Interdisciplinary (Elective Supporting)	4, 8
4.	None	MGT 242	Organizational Theory and Behavior	3	Interdisciplinary (Elective Supporting)	4, 8

BSCS Program - Deficiency Courses for Pre-Medical Students

Students with F.Sc./A level Pre-medical group should preferably study the Fundamental of Mathematics-I and Fundamental of Mathematics-II courses in the first two semesters of their BS program. They are also allowed to enroll these two courses in summer semesters, as well as in any semester before the completion of their maximum degree program, as per BU rules.

Minutes of the 32nd FBOS – ES
Academic Road Map for UG Program
Faculty of Engineering Sciences

Program Title: BS Information Technology

Duration: 4 Years

Total Credit Hours: 133

Endorsement References:

- A: Recommendations of CAC dated 07-Jul-2023
- B: Recommendations of DBOS dated 23-Aug-2023
- C: Recommendations of FBOS dated 04-Sep-2023

Summary of Credit Hours

Sr. No.	Category as per HEC new UG Policy	Credit Hours/Contact Hours	
		Existing Road Map	Proposed New Road Map
1.	General Education (Mandatory)	30	30
2.	Major/Disciplinary (Mandatory)	42(Computing Core) 19(Domain Core)	42(Computing Core) 19(Domain Core)
3.	Interdisciplinary (Mandatory)	12 (mathematics and supporting courses) 3(Elective Supporting)	12 (mathematics and supporting courses) 3 (Elective Supporting)
4.	Electives toward specialization	21	21
5.	Tajweed, Quran and Hadith (Compulsory, non-credit course, only for Muslim Students)	-	08 Contact Hours (non-credited)
6	Internship (Mandatory)	non-credited	6-8 Weeks non-credited (mandatory)
7.	Capstone Project (Mandatory)	6	6
8	Double Major (Optional)	-	-
9.	Minor (Optional)	-	-
Total		133	133

Semester-wise Revised Roadmap of BSIT

Semester 1

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)

Minutes of the 32nd FBOS – ES

1.	None	CSC 114	Introduction to Information & Communication Technology	2	General Education	4, 9
2.	None	CSL 114	Introduction to Information & Communication Technology Lab	1	General Education	4, 9
3.	None	CSC 113	Computer Programming	3	Major/Disciplinar (Computing Core)	4, 8, 9
4.	None	CSL 113	Computer Programming Lab	1	Major/Disciplinar (Computing Core)	4, 8, 9
5.	None	GSC 114	Applied Physics	2	General Education	4, 9
6.	None	GSL 113	Applied Physics Lab	1	General Education	4,9
7.	None	ISL 101	Islamic Studies / Ethics	2	General Education	4, 10, 16
8.	None	GSC 221	Discrete Mathematics	3	General Education	4
9.	None	CSC 308	Professional Practices and Ethics	2	General Education	4, 8, 10
10.	None	ISL 107	Tajweed	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 16
Total Credit Hours				17		

*Compulsory for Muslim students only

Semester 2

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.	CSC 113	CSC 210	Object Oriented Programming	3	Major/Disciplinary (Computing Core)	4, 9

Minutes of the 32nd FBOS – ES

2.	CSC 113	CSL 210	Object Oriented Programming Lab	1	Major/Disciplinary (Computing Core)	4, 9
3.	GSC 114	CEN 122	Digital Design	2	Major/Disciplinary (Computing Core)	4, 8, 9
4.	GSC 114	CEL 122	Digital Design Lab	1	Major/Disciplinary (Computing Core)	4, 8, 9
5.	None	GSC 110	Applied Calculus and Analytical Geometry	3	General Education	4
6.	None	GSC 122	Probability and Statistics	3	Interdisciplinary (Mathematics & Supporting Courses)	4, 8
7.	None	PAK 103	Pakistan Studies and Global Perspective	2	General Education	4, 10, 16
8.	None	ENG 101	Functional English	3	General Education	4
9.	ISL 107	ISL 108	Understanding Quran-I	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4,10,16
Total Credit Hours				18		

*Compulsory for Muslim students only

Semester 3

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.	CSC 113	CSC 221	Data Structure & Algorithm	3	Major/Disciplinary (Computing Core)	4

Minutes of the 32nd FBOS – ES

2.	CSC 113	CSL 221	Data Structure & Algorithm Lab	1	Major/Disciplinary (Computing Core)	4
3.	None	SEN 220	Software Engineering	3	Major/Disciplinary (Computing Core)	4, 8, 9
4.	None	CEN 223	Computer Communication & Networks	3	Major/Disciplinary (Computing Core)	4, 9
5.	None	CEL 223	Computer Communication & Networks Lab	1	Major/Disciplinary (Computing Core)	4, 9
6.	None	GSC 121	Linear Algebra	3	Interdisciplinary (Mathematics & Supporting Courses)	4
7.	None	HSS 219	Civic and Community Engagement	2	General Education	4, 5, 16
8.	None	ENG 134	Communication Skills	2	General Education	4
9.	ISL 108	ISL 109	Understanding Quran-II	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				18		

*Compulsory for Muslim students only

Semester 4

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.	CSC 210	ITC 226	Web Systems and Technologies	2	Major/Disciplinary (Computing Core)	4, 8, 9

Minutes of the 32nd FBOS – ES

2.	CSC 210	ITL 226	Web Systems and Technologies Lab	1	Major/Disciplinary (Computing Core)	4, 8, 9
3.	CSC 221	CSC 321	Design and Analysis of Algorithms	3	Major/Disciplinary (Computing Core)	4
4.	None	HSS 423	Entrepreneurship	2	General Education	4, 8, 9, 17
5.	HSS 118	ENG 123	Expository Writing	3	Interdisciplinary (Mathematics & Supporting Courses)	4, 9
6.	GSC 110	GSC 211	Multivariable Calculus	3	Interdisciplinary (Mathematics & Supporting Courses)	4, 9
7.	None		Social Sciences Elective	3	General Education	4, 9
8.	ISL 109	ISL 110	Understanding Quran-III	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 8
Total Credit Hours				17		

*Compulsory for Muslim students only

Semester 5

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.	None	CSC 220	Database Management System	3	Major/Disciplinary (Computing Core)	4, 8
2.	None	CSL 220	Database Management System Lab	1	Major/Disciplinary(Computing Core)	4, 8

Minutes of the 32nd FBOS – ES

3.	CSC 221	CSC 320	Operating Systems	3	Major/Disciplinary (Computing Core)	4, 8
4.	CSC 221	CSL 320	Operating Systems Lab	1	Major/Disciplinary (Computing Core)	4, 8
5.	CEN 223	ITC 312	System and Network Administration	3	Major/Disciplinary (Computing Core)	4, 9, 11
6.	CEN 223	ITL 312	System and Network Administration Lab	1	Major/Disciplinary (Computing Core)	4, 9, 11
7.			Elective 1 (3+0 or 2+1)	3	Domain Elective	4, 9
8.	CEN 223	CSC 407	Information Security	3	Major/Disciplinary (Computing Core)	4, 8, 9
9.	ISL 110	ISL 111	Understanding Quran-IV	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				18		

*Compulsory for Muslim students only

Semester 6

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.	CEN 122	CEN 323	Computer Organization and Assembly Language	2	Major/Disciplinary (Computing Core)	4, 9
2.	CEN 122	CEL 323	Computer Organization and Assembly Language Lab	1	Major/Disciplinary (Computing Core)	4, 9

Minutes of the 32nd FBOS – ES

3.	CSC 210	CSC 411	Artificial Intelligence	2	Major/Disciplinary (Computing Core)	4, 9
4.	CSC 210	CSL 411	Artificial Intelligence Lab	1	Major/Disciplinary (Computing Core)	4,9
5.	ITC 312	ITC 324	Information Technology Infrastructure	3	Major/Disciplinary (Computing Core)	4, 8, 11
6.			Elective 2 (2+1)	3	Domain Elective	
7.			Elective 3 (2+1)	3	Domain Elective	
8.	ISL 111	ISL 112	Understanding Quran-V	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				15		

*Compulsory for Muslim students only

Semester 7

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.	CSC 220	ITC 327	Database Administration and Management	2	Major/Disciplinary (Computing Core)	9
2.	CSC 220	ITL 327	Database Administration and Management Lab	1	Major/Disciplinary (Computing Core)	4, 8
3.	None	FYP 400	Final Year Project	3	Capstone Project	4
4.	CEN 223	ITC 411	Cyber Security	3	Major/Disciplinary (Computing Core)	4, 8, 9, 11

Minutes of the 32nd FBOS – ES

5.			Elective 4 (2+1)	3	Domain Elective	-
6.			Elective 5 (3+0 or 2+1)	3	Domain Elective	-
7.	ISL 112	ISL 113	Seerah-I	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours			15			

* Compulsory for Muslim students only

Semester 8

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.	None	FYP 400	Final Year Project	3	Capstone Project	4
2.	CSC320	AIC 302	Parallel and Distributed Computing	2	Major/Disciplinary (Computing Core)	4, 9, 11
3.	CSC320	AIL 302	Parallel and Distributed Computing Lab	1	Major/Disciplinary (Computing Core)	4, 9, 11
4.			Elective Supporting	3	Interdisciplinary (Elective Supporting Courses)	
5.			Elective 6 (3+0 or 2+1)	3	Domain Elective	
6.			Elective 7 (3+0 or 2+1)	3	Domain Elective	
7.	ISL 113	ISL 114	Seerah-II	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours			15			

* Compulsory for Muslim students only

List of Domain Elective Courses

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.	ITC 226	ITB 471	E Commerce	3	Major	4, 8, 9
2.	None	ITC 425	Business Processing Re-engineering	3	Major	4, 8
3.	None	ITC 457	Knowledge Management System & Technologies	3	Major	4, 9
4.	CSC 220	CSC 452	Data Mining	3	Major	3, 4, 9
5.	CSC 220	CSC 454	Data Warehousing	3	Major	4, 9
6.	ITC 226	SEN 421	Semantic Web	3	Major	4, 9
7.	SEN 220	SEN 411	Software Testing	3	Major	4, 9
8.	SEN 220	SEN 456	Usability Engineering	3	Major	4, 9
9.	CSC 220	CSC 426	Business Intelligence and Analytic	3	Major	4, 8, 9
10.	None	SEN 427	Information Systems Auditing and Assurance	3	Major	4, 8
11.	SEN 220	SEN 428	Service Oriented Architecture	3	Major	4, 8
12.	SEN 220	SEN 420	Software Quality Assurance	3	Major	4, 9

Minutes of the 32nd FBOS – ES

13.	CEN 223	EET 455	Wireless Communication	3	Major	4, 9, 11
14.	None	SEN 320	Human Computer Interaction	3	Major	4,9
15.	CSC 221	CSC 404	Blockchain Technologies	3	Major	4, 9, 11
16.	CSC 221	CSC 448	Introduction to Bioinformatics	3	Major	3, 4, 9, 15
17.	CEN 223	CSC 450	Internet of Things	3	Major	4, 9, 11
18.	CEN 223	SEN 459	Software Defined Network	3	Major	4, 9
19.	SEN 220	CSC 489	Ubiquitous Computing	3	Major	4, 9
20.	GSC 221	GSC 445	Operation Research	3	Major	4
21.	None	CSC 458	Management Information System	3	Major	4, 8, 9, 11
22.	SEN 220	SEN 410	Software Project Management	3	Major	4, 8, 9
23.	CSC 210	CSC 313	Visual Programming	2	Major	4
24.	CSC 210	CSL 313	Visual Programming Lab	1	Major	4
25.	CSC 220	CSC 487	Introduction to Data Science	2	Major	4, 8, 9
26.	CSC 220	CSL 487	Introduction to Data Science Lab	1	Major	4, 8, 9
27.	CSC 210	CEN 444	Digital Image Processing	2	Major	4,9

Minutes of the 32nd FBOS – ES

28.	CSC 210	CEL 444	Digital Image Processing Lab	1	Major	4,9
29.	CSC 210	CSC 444	Computer Graphics	2	Major	4,9
30.	CSC 210	CSL 444	Computer Graphics Lab	1	Major	4,9
31.	CSC 220	CSC 468	Advanced Databases	2	Major	4,9
32.	CSC 220	CSL 468	Advanced Databases Lab	1	Major	4,9
33.	CSC 210	CSC 341	Mobile Application Development	2	Major	4,9
34.	CSC 210	CSL 341	Mobile Application Development Lab	1	Major	4,9
35.	None	SEN 493	Multimedia Systems	2	Major	4,9
36.	None	SEL 493	Multimedia Systems Lab	1	Major	4,9
37.	SEN 220	SEN 457	Software Design and Architecture	2	Major	4,9
38.	SEN 220	SEL 457	Software Design and Architecture Lab	1	Major	4,9
39.	CSC 113	SEN 310	Web Engineering	2	Major	4,9
40.	CSC 113	SEL 310	Web Engineering Lab	1	Major	4,9
41.	CSC 220	CSC 488	Big Data Analytics	2	Major	4,9
42.	CSC 220	CSL 488	Big Data Analytics Lab	1	Major	4,9
43.	None	CSC 484	Content Management	2	Major	4,9

Minutes of the 32nd FBOS – ES

44.	None	CSL 484	Content Management Lab	1	Major	4,9
45.	CSC 411	CSC 413	Introduction to Machine Learning	2	Major	4,9
46.	CSC 411	CSL 413	Introduction to Machine Learning Lab	1	Major	4,9
Total Credit Hrs.			21			

List of Social Sciences Courses

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.	None	HSS 107	Introduction to Psychology	3	General Education (Social Sciences)	4
2.	None	HSS 115	Introduction to Media studies	3	General Education (Social Sciences)	4
3.	None	BES 103	Critical Thinking	3	General Education (Social Sciences)	4

List of Elective Supporting Courses

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)

Minutes of the 32nd FBOS – ES

1.	None	MKT 110	Principles of Marketing	3	Interdisciplinary (Elective Supporting)	4
2.	None	FIN 201	Fundamentals of Finance	3	Interdisciplinary (Elective Supporting)	4
3.	None	MGT 111	Principles of Management	3	Interdisciplinary (Elective Supporting)	4
4.	None	MGT 242	Organizational Theory and Behavior	3	Interdisciplinary (Elective Supporting)	4

BSIT Program - Deficiency Courses for Pre-Medical Students

Students with F.Sc/A level Pre-medical group should preferably study the Fundamental of Mathematics-I and Fundamental of Mathematics-II courses in the first two semesters of their BS program. They are also allowed to enroll these two courses in summer semesters, as well as, in any semester before the completion of their maximum degree program, as per BU rules.

Minutes of the 32nd FBOS – ES
Academic Road Map for UG Program
Faculty of Engineering Sciences

Program Title: **BS Artificial Intelligence**

Duration: **4 Years**

Total Credit Hours: **133**

Endorsement References:

- A: Recommendations of CAC dated **07-Jul-23**
- B: Recommendations of DBOS dated **23-Aug-23**
- C: Recommendations of FBOS dated **04-Sep-23**

Summary of Credit Hours

Sr. No.	Category as per HEC new UG Policy	Credit Hours/Contact Hours	
		Existing Road Map	Proposed New Road Map
1.	General Education (Mandatory)	30	30
2.	Major/Disciplinary (Mandatory)	43(Computing Core) 18(Domain Core)	43(Computing Core) 18(Domain Core)
3.	Interdisciplinary (Mandatory)	12 (mathematics and supporting courses) 3(Elective Supporting)	12 (mathematics and supporting courses) 3(Elective Supporting)
4.	Electives toward specialization	21	21
5.	Tajweed, Quran and Hadith (Compulsory – non-credit course, only for Muslim Students)	-	8 Contact Hours (non-credited)
6	Internship (Mandatory)	non-credited	6-8 Weeks non-credited (mandatory)
7.	Capstone Project (Mandatory)	6	6
8	Double Major (Optional)	-	-
9.	Minor (Optional)	-	-
Total		133	133

Semester-wise Revised Roadmap of BSAI

Semester 1

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention)

Minutes of the 32nd FBOS – ES

						relevant SDG No.
1.	None	GSC 114	Applied Physics	2	General Education	4, 9
2.	None	GSL 113	Applied Physics Lab	1	General Education	4, 9
3.	None	CSC 114	Introduction to Information & Communication Technology	2	General Education	4, 9
4.	None	CSL 114	Introduction to Information & Communication Technology Lab	1	General Education	4, 9
5.	None	CSC 113	Computer Programming	3	Major/Disciplinary (Computing Core)	4, 8, 9
6.	None	CSL 113	Computer Programming Lab	1	Major/Disciplinary (Computing Core)	4, 8, 9
7.	None	GSC 221	Discrete Mathematics	3	General Education	4
8.	None	ISL 101	Islamic Studies	2	General Education	4
9.	None	CSC 308	Professional Practices and Ethics	2	General Education	4, 8, 9
10	None	ISL 107	Tajweed	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	
Total Credit Hours				17		

*Only for Muslim students

Semester 2

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.	None	CEN 122	Digital Design	2	Major/Disciplinary (Computing Core)	4, 8, 9
2.	None	CEL 122	Digital Design Lab	1	Major/Disciplinary (Computing Core)	4, 8, 9

Minutes of the 32nd FBOS – ES

3.	CSC 113	CSC 210	Object Oriented Programming	3	Major/Disciplinary (Computing Core)	4, 9
4.	CSC 113	CSL 210	Object Oriented Programming Lab	1	Major/Disciplinary (Computing Core)	4, 9
5.	None	GSC 122	Probability and Statistics	3	Interdisciplinary (Mathematics & Supporting Courses)	4
6.	None	GSC 110	Applied Calculus and Analytical Geometry	3	General Education	4
7.	None	ENG 101	Functional English	3	General Education	4
8.	None	PAK 103	Pakistan Studies & Global Perspective	2	General Education	4, 10, 16
9.	ISL 107	ISL 108	Understanding Quran-I	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				18		

*Only for Muslim students

Semester 3

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.	CEN 120	CEN 323	Computer Organization& Assembly Language	2	Major/Disciplinary (Computing Core)	4, 9

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2.	CEN 120	CEL 323	Computer Organization& Assembly Language Lab	1	Major/Disciplinary (Computing Core)	4, 9
3.	CSC 113	CSC 221	Data Structures and Algorithms	3	Major/Disciplinary (Computing Core)	4
4.	CSC 113	CSL 221	Data Structures and Algorithms Lab	1	Major/Disciplinary (Computing Core)	4
5.	AIC 201	AIC 202	Programming for Artificial Intelligence	2	Major/Disciplinary (Domain Core)	4, 9
6.	AIC 201	AIL 202	Programming for Artificial Intelligence Lab	1	Major/Disciplinary (Domain Core)	4, 9
7.	None	GSC 121	Linear Algebra	3	Interdisciplinary (Mathematics & Supporting Courses)	4
8.	None	ENG134	Communication Skills	2	General Education	4
9.	None	HSS 219	Civic and Community Engagement	2	General Education	4, 5, 16
10.	ISL 108	ISL 109	Understanding Quran-II	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				17		

*Only for Muslim students

Semester 4

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.	None	CEN 222	Data Communication and Networking	3	Major/Disciplinary (Computing Core)	4, 9

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2.	None	CEL 222	Data Communication and Networking Lab	1	Major/Disciplinary (Computing Core)	4, 9
3.	CSC 210	AIC 201	Artificial Intelligence	3	Major/Disciplinary (Computing Core)	4, 9
4.	CSC 210	AIL 201	Artificial Intelligence Lab	1	Major/Disciplinary (Computing Core)	4, 9
5.	None	CSC 220	Database Management Systems	3	Major/Disciplinary (Computing Core)	4, 8
6.	None	CSL 220	Database Management Systems Lab	1	Major/Disciplinary (Computing Core)	4, 8
7.	None	HSS 423	Entrepreneurship	2	General Education	4, 8, 9, 17
8.			Social Sciences Elective	3	General Education	
9.	ISL 109	ISL 110	Understanding Quran-III	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				17		

*Only for Muslim students

Semester 5

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.	AIC 201	AIC 203	Knowledge Representation & Reasoning	3	Major/Disciplinary (Domain Core)	4, 9
2.	AIC 201	AIC 301	Machine Learning	2	Major/Disciplinary (Domain Core)	3, 4, 9
3.	AIC 201	AIL 301	Machine Learning Lab	1	Major/Disciplinary (Domain Core)	3, 4, 9

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4.	GSC 110	GSC 211	Multivariable Calculus	3	Interdisciplinary (Mathematics & Supporting Courses)	4
5.	CSC 221	CSC 321	Design and Analysis of Algorithms	3	Major/Disciplinary (Computing Core)	4, 9
6.			Domain Elective 1	(2+1)	Domain Elective	
7.			Domain Elective 2	(3+0 or 2+1)	Domain Elective	
8.	ISL 110	ISL 111	Understanding Quran-IV	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours			18			

*Only for Muslim students

Semester 6

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.	AIC 301	AIC 401	Deep Learning	2	Major/Disciplinary (Domain Core)	3, 4, 9
2.	AIC 301	AIL 401	Deep Learning Lab	1	Major/Disciplinary (Domain Core)	3, 4, 9
3.	CSC 221	CSC 320	Operating Systems	3	Major/Disciplinary (Computing Core)	4, 8
4.	CSC 221	CSL 320	Operating Systems Lab	1	Major/Disciplinary (Computing Core)	4, 8
5.	CSC 320	AIC 302	Parallel & Distributed Computing	2	Major/Disciplinary (Domain Core)	4, 9

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6.	CSC 320	AIL 302	Parallel & Distributed Computing Lab	1	Major/Disciplinary (Domain Core)	4, 9
7.			Domain Elective 3	(2+1)	Domain Elective	
8.			Elective 4	(3+0 or 2+1)	Domain Elective	
9.	ISL 111	ISL 112	Understanding Quran-V	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				16		

*Only for Muslim students

Semester 7

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.	None	FYP 400	Final Year Project	3	Capstone Project	4
2.	None	SEN 220	Software Engineering	3	Major/Disciplinary (Computing Core)	4, 8, 9
3.	None	AIC 304	Computer Vision	2	Major/Disciplinary (Domain Core)	3, 4, 9
4.	None	AIL 304	Computer Vision Lab	1	Major/Disciplinary (Domain Core)	3, 4, 9
5.	HSS 120	ENG 123	Expository Writing	3	Interdisciplinary (Mathematics & Supporting Courses)	4
6.			Elective 5	(2+1)	Domain Elective	

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7.	ISL 112	ISL 113	Seerah-I	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				15		

*Only for Muslim students

Semester 8

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.	None	FYP 400	Final Year Project	3	Capstone Project	9
2.	CEN 222	CSC 407	Information Security	3	Major/Disciplinary (Computing Core)	4, 8, 9
3.			Elective Supporting	3	Interdisciplinary (Elective Supporting Courses)	
4.			Domain Elective 6	(2+1)	Domain Elective	
5.			Domain Elective 7	(3+0 or 2+1)	Domain Elective	
6.	ISL 113	ISL 114	Seerah-II	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				15		

*Only for Muslim students

List of Elective Courses

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention

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						relevant SDG No.
57.	GSC 122	AIC 305	Advance Statistics	3	Domain Elective	4
58.	None	CSC 315	Theory of Automata	3	Domain Elective	4
59.	None	CSC 452	Data Mining	3	Domain Elective	3, 4, 9
60.	None	AIC 306	Speech Processing	3	Domain Elective	4, 9
61.	None	AIC 402	Reinforcement Learning	3	Domain Elective	4, 9, 11
62.	None	AIC 403	Fuzzy Systems	2	Domain Elective	4, 9, 11
63.	None	AIC 307	Evolutionary Computing	3	Domain Elective	4, 9
64.	None	AIC 308	Agent-Based Modeling	3	Domain Elective	4, 9
65.	None	CEN 459	Robotics	2+1	Domain Elective	4, 9, 11
66.	None	ITC 412	Introduction to Cyber Security	2+1	Domain Elective	4, 8, 9
67.	None	AIC 442	Natural Language Processing	2+1	Domain Elective	4, 9
68.	None	AIC 410	Virtual and Augmented Reality	2+1	Domain Elective	4, 9
69.	None	AIC 411	HCI & Computer Graphics	2+1	Domain Elective	4, 9
70.	None	AIC 310	Swarm Intelligence	2+1	Domain Elective	4, 9, 11
71.	None	CSC 400	Quantum Computing	2+1	Domain Elective	4, 8, 9
72.	None	AIC 377	Game Artificial Intelligence	2+1	Domain Elective	4, 9

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List of Social Sciences Courses

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.	None	HSS 107	Introduction to Psychology	3	General Education (Social Sciences)	3, 4
2.	None	HSS 115	Introduction to Media studies	3	General Education (Social Sciences)	4
3.	None	BES 103	Critical Thinking	3	General Education (Social Sciences)	3, 4

List of Elective Supporting Courses

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.	None	MKT 110	Principles of Marketing	3	Interdisciplinary (Elective Supporting)	4, 8
2.	None	FIN 201	Fundamentals of Finance	3	Interdisciplinary (Elective Supporting)	4, 8
3.	None	MGT 111	Principles of Management	3	Interdisciplinary (Elective Supporting)	4, 8
4.	None	MGT 242	Organizational Theory and Behavior	3	Interdisciplinary (Elective Supporting)	4, 8

BSAI Program - Deficiency Courses for Pre-Medical Students

Students with F.Sc/A level Pre-medical group should preferably study the Fundamental of Mathematics-I and Fundamental of Mathematics-II courses in the first two semesters of their BS program. They are also allowed to enroll these two courses in summer semesters, as well as, in any semester before the completion of their maximum degree program, as per BU rules.

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Academic Road Maps of UG Program
Faculty of Engineering Sciences

Program Title: Associate Degree in Computer Science

Duration: 4 Years

Total Credit Hours: 71

Endorsement References:

- A: Recommendations of CAC dated 7-Jul-23
- B: Recommendations of DBOS dated 23-Aug-23
- C: Recommendations of FBOS dated 04-Sep-23

Generic Structure for Computing Disciplines:

Sr. No.	Category as per HEC new UG Policy	Credit Hours/Contact Hours	
		Existing Road Map	Proposed New Road Map
1.	General Education (Mandatory)	18	30
2.	Major/Disciplinary (Mandatory)	34	29
3.	Interdisciplinary (Mandatory)	6	12
4.	Electives toward specialization	14	-
5.	Tajweed, Quran and Hadith (Compulsory, non-credit course, only for Muslim Students)	-	8 Contact Hours (non-credited)
6	Internship (Mandatory)/Field Experience	-	-
7.	Capstone Project (Mandatory)	-	-
8	Double Major (Optional)	-	-
9.	Minor (Optional)	-	-
Total		72	71

Semester-wise Revised Roadmap of AD(CS)

Semester 1

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.	None	GSC 114	Applied Physics	2	Gen Edu (Natural Science)	4, 9
2.	None	GSL 113	Applied Physics Lab	1	Gen Edu (Natural Science)	4, 9
3.	None	CSC	Introduction to	2	Gen Edu (ICT)	4, 9

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		114	Information & Communication Technology			
4.	None	CSL 114	Introduction to Information & Communication Technology Lab	1	Gen Edu (ICT)	4, 9
5.	None	CSC 113	Computer Programming	3	Major/Disciplinary (Computing Core)	4, 8, 9
6.	None	CSL 113	Computer Programming Lab	1	Major/Disciplinary (Computing Core)	4, 8, 9
7.	None	GSC 221	Discrete Mathematics	3	Gen Edu (Quantitative Reasoning)	4
8.	None	ISL 101	Islamic Studies/Ethics	2	Gen Edu (Religious Education/Ethics)	4, 10, 16
9.	None	CSC 308	Professional Practices & Ethics	2	Gen Edu (Arts & Humanities)	4, 8, 10
10.	None	ISL 107	Tajweed	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16

*Only for Muslim students

Semester 2

Sr. No	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.	None	GSC 122	Probability and Statistics	3	Interdisciplinary (Mathematics & Supporting Courses)	4, 8
2.	CSC 113	CSC 210	Object Oriented Programming	3	Major/Disciplinary (Computing Core)	4, 9
3.	CSC 113	CSL 210	Object Oriented Programming Lab	1	Major/Disciplinary (Computing Core)	4, 9
4.	GSC 114	CEN 122	Digital Design	2	Major/Disciplinary (Computing Core)	4,8,9
5.	GSC 114	CEL 122	Digital Design Lab	1	Major/Disciplinary (Computing Core)	4,8,9

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6.	None	GSC 110	Applied Calculus and Analytical Geometry	3	Gen Edu (Quantitative Reasoning)	4
7.	None	ENG 101	Functional English	3	Gen Edu (Functional English)	4
8.	None	PAK 103	Pakistan Studies & Global Perspective	2	Gen Edu (Ideology & Constitution of Pakistan)	4, 10, 16
9.	ISL 107	ISL 108	Understanding Quran-I	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				18		

*Only for Muslim students

Semester 3

Sr. No	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.	None	HSS 219	Civic and Community Engagement	2	Gen Edu (Civics & Community Engagement)	4, 5, 16
2.	None	GSC 121	Linear Algebra	3	Interdisciplinary (Mathematics & Supporting Courses)	4
3.	GSC 110	GSC 211	Multivariable Calculus	3	Interdisciplinary (Mathematics & Supporting Courses)	4
4.	None	CEN 223	Computer Communication & Networks	3	Major/Disciplinary (Computing Core)	4, 9
5.	None	CEL 223	Computer Communication & Networks Lab	1	Major/Disciplinary (Computing Core)	4, 9
6.	CSC 113	CSC 221	Data Structure & Algorithm	3	Major/Disciplinary (Computing Core)	4
7.	CSC 113	CSL 221	Data Structure & Algorithm Lab	1	Major/Disciplinary (Computing Core)	4
8.	None	ENG 134	Communication Skills	2	Gen Edu (Arts & Humanities)	4

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9.	ISL 108	ISL 109	Understanding Quran-II	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
			Total Credit Hours	18		

*Only for Muslim students

Semester 4

Sr. No	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1.	None		Social Sciences Elective	3	Gen Edu (Social Sciences)	4, 5, 16
2.	CEN 122	CEN 323	Computer Organization and Assembly Language	2	Major/Disciplinary (Computing Core)	4, 9
3.	CEN 122	CEL 323	Computer Organization & Assembly Language Lab	1	Major/Disciplinary (Computing Core)	4, 9
4.	None	ENG 123	Expository Writing	3	Interdisciplinary (Mathematics & Supporting Courses)	4
5.	None	CSC 220	Database Management Systems	3	Major/Disciplinary (Computing Core)	4, 8
6.	None	CSL 220	Database Management Systems Lab	1	Major/Disciplinary (Computing Core)	4, 8
7.	None	HSS 423	Entrepreneurship	2	Gen Edu (Entrepreneurship)	4, 8, 9, 17
8.	None	SEN 220	Software Engineering	3	Major/Disciplinary (Computing Core)	4, 8, 9
9.	ISL 109	ISL 110	Understanding Quran – III	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
			Total Credit Hours	18		

*Only for Muslim students

AD(CS) Program - Deficiency Courses for Pre-Medical Students

Minutes of the 32nd FBOS – ES

Students with F.Sc/A level Pre-medical group should preferably study the Fundamental of Mathematics-I and Fundamental of Mathematics-II courses in the first two semesters of their BS program. They are also allowed to enroll these two courses in summer semesters, as well as, in any semester before the completion of their maximum degree program, as per BU rules.

Appendage 3203**Roadmap of BEE and BS R & IS****Academic Road Map for UG Program
Faculty of Engineering Sciences**Program Title: Bachelor of Electrical Engineering (BEE)Duration: 4 YearsTotal Credit Hours: 136

Endorsement References:

A: Recommendations of FBOS dated 06-Oct-23**Summary of Credit Hours (PEC Alignment)**

Sr. No.	Category as per PEC Revised Guidelines	Credit Hours/Contact Hours	
		PEC Revised Guidelines	BEE Roadmap - BU
1.	General Education	Min 38	43
2.	Engineering	Min 72	81
3.	Multidisciplinary	Min 06	06
4.	FYDP Capstone Project	06	06
5.	Flexible Engineering/ Non-Engineering Courses (may be adjusted as per the requirements)	8-14	-
	Total:	130-136	136

	Description/ Attributes	HEC Policy	Revised PEC Guidelines for Fall-2023 & onwards	BU Compliance

Minutes of the 32nd FBOS – ES

1 .	Nomenclature	<ul style="list-style-type: none"> Bachelor of Science or Bachelor of Studies (BS) Professional Councils will follow their own approved nomenclature to remain synchronize with their service rules. 	<ul style="list-style-type: none"> B.E, B.S Engineering and B.Sc. Engineering. 	Bachelor of Electrical Engineering (Electronics/Telecommunication/Power)
2.	Program Credits	<ul style="list-style-type: none"> Total-120-144 Credit Hours General Education: Min 30 (Arts & humanities, Social Natural Quantitative Reasoning, Expository Writing, Computer Courses, Entrepreneurship, Pak Studies, Islamic Studies/Ethics) Major Courses: Min 72 Minor Courses: Min 12 Inter-Disc/ Distribution: Min 12 	<ul style="list-style-type: none"> Total-130-136 Credit Hours General Education for Engineering Disciplines = Min 38 (After readjusting non-engineering courses) Engineering = Min 72 (Including Computer Courses, foundation, breadth depth/ Major) FYDP/ Capstone Project= 06 Multi-Disciplinary Engineering Courses= Min 06 08-14 Credit Hours (Flexible Engineering/ Non-Engineering Courses) may be adjusted as 	Total Credit Hours: 136 General Education: 43 Engineering: 81 FYDP: 6 Multi-Disciplinary Engineering Courses: 6

Minutes of the 32nd FBOS – ES

			per the requirements	
3.	Admission	In the Department (In the 1 st semester)	In the program/department (In the First Semester) As per PEC Regulations for Engineering Education in Pakistan	Already in Compliance with PEC Guidelines
4.	General Education Courses	HEI may offer during first 4 semesters	Spread over 8 semesters/program	Already in Compliance with PEC Guidelines
5.	Academic Advisory	Proposed by HEC	Already included in PEC Policies	Already in Compliance with PEC Guidelines
6.	Guidance on General Education	To be provided by the Curriculum Division, HEC for degrees	To be provided by PEC Curriculum Section	Response Awaited Currently as per previous Compliance
7.	Field Experience (Mandatory)	At-least 06-08 weeks, (preferably undertaken during semester or summer break of 03 Credit Hours (Graded)	Mandatory and qualifying Industrial Internship of 06-08 Weeks as per PEC Accreditation Manual-2019	Already in Compliance with PEC Guidelines
8.	Capstone Project (Mandatory)	Till completion of the BS program (03 Credit Hours)	FYDP/ Capstone (06 Credit Hours)/ Spread over Final Year (7th & 8th Semester) The FYDP shall include complex engineering problems and design of systems, components or processes integrating core areas and meeting specified needs with appropriate consideration for public health and safety along	Already in Compliance with PEC Guidelines

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			with cultural, societal, and environmental considerations encompassing the UN-SDGs. A project of this nature should invariably lead to an integration of the knowledge and practical skills as mandated in the GAS.	
9.	Admission in 5th Semester	Allowed (Councils will decide to allow or not)	Not Allowed (as concept of Associate Degree in Engineering Discipline is not approved by PEC)	Already in Compliance with PEC Guidelines
10.	Exit after 4th Semester	Allowed with Associate Degree (Councils will decide to allow or not)	Not Allowed (as concept of Associate Degree in Engineering Discipline is not approved by PEC)	Already in Compliance with PEC Guidelines

Knowledge Profile (WK-1 to WK-8)	Knowledge Area	Sub-Area	Courses		Credit Hours	Courses	C
			PEC Revised			BEE Alignment	
Non-Engineering Domain							
WK2	Natural Science	Math	Quantitative Reasoning-I /Equivalent	3	Applied Calculus and Analytical Geometry		
			Quantitative Reasoning-II /Equivalent	3	Probability Methods in Engineering		
WK-1			Advanced/Applied Math Courses	6-9	Linear Algebra & Differential Equations		

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					Complex Variables & Transforms	
		Natural Science (Physics, Chemistry, Math)	Applied Physics	3-9	Applied Physics	
			Applied Chemistry		Chemistry	
			Math Elective		Math Elective	
WK-7	Humanities	English	Functional English	3	Functional English	
			Expository Writing	3	Technical Writing & Present. Skills	
		Culture	Islamic Studies/ Ethics	2	Culture Elective-I	
					Tajweed	
					Understanding Quran-I	
					Understanding Quran-II	
					Understanding Quran-III	
					Understanding Quran-IV	
					Understanding Quran-V	
					Seerah-I	
		Social Science	Ideology and Constitution of Pakistan	2	Culture Elective-II	
			Arts & Humanities (Languages etc.)	2	Culture Elective-III	
			Social Science	2	Social Science Elective-I	
		Management Science	Applications of ICT	5	Introduction to Computing	
			Civics and Community Engagement		Engineering AutoCAD	
			Project Management		Social Science Elective-II	
					Community Support Program (40 Hours)	
					Professional Practice Elective-I	

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			Entrepreneurship	2	Professional Practice Elective-II	
Total (Non-Engineering Domain)				Min 38		
Knowledge Profile (WK-1 to WK-8)	Knowledge Area	Sub-Area	Courses	Credit Hours	Courses	
			PEC Revised		BEE Alignment -	
Engineering Domain						
WK-2/ WK-4/ WK-5/ WK-6	Computer and Information Sciences	AI/ Data Science / Cyber Security	Specific to Program	6-9	CIS Elective-I	
WK-2/ WK-3	Foundation Engineering Courses				CIS Elective II	
			Specific to Program	22-24	Workshop Practice	
					Linear Circuit Analysis	
					Digital Logic Design	
					Electronic Devices and Circuits	
					Electrical Network Analysis	
					Signals and Systems	
					Electromagnetic Field Theory	
WK-4/ WK-2/ WK-1	Core Breadth of Engineering Discipline	Specific to Program	22-24	Communication Systems		
				Embedded System design		
				Electrical Machines		
				Electronic Circuit Design		
				Breadth Core I		
				Breadth Core II		
WK-5/ WK-6	Core Depth of Engineering Discipline					
				22-24	Linear Control Systems	
					Depth Elective I	
					Depth Elective II	
					Depth Elective III	

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					Depth Elective IV							
					Depth Elective V							
Min 72												
WK-1/ WK-2/ WK-3/ WK-4	Multi-Disciplinary Engineering Courses		Specific to Program Objectives and outcome	6	MDEE-I							
			Occupational Health and Safety (mandatory – 01 CH)		MDEE-II							
WK-6/ WK-7/ WK-8	Final Year Design Project (FYDP)/ Capstone	Final Year Design Project (FYDP)/ Capstone		6	Occupational Health and Safety							
WK-6/WK-7	Qualifying	Internship (06-08 Weeks)			Project-I							
WK-6/WK-7	Qualifying	Internship (06-08 Weeks)		Mandatory & Qualifying	Project-II							
WK-2 / WK-4 / WK-5 / WK-6 / WK-7 / WK-8	Innovative & Critical Thinking (under relevant courses) - Complex Problem Solving - Complex Engineering Activities - Semester Project - Case Studies - Open-Ended Labs - Problem-Based Learning (PBL)				Internship (06-08 Weeks) Mandatory & Qualifying							
Total (Engineering Domain)					Min 84							
Flexible Engineering / Non-Engineering Courses may be adjusted as per requirement					8-14	Programming Fundamentals						
Total (Credit Hours)					130-136	Total (Credit Hours)						

Summary of Credit Hours (HEC-UG Alignment)

Sr. No.	Category as per HEC new UG Policy	Credit Hours/Contact Hours	
		Existing Road Map	Proposed New Road Map
1.	General Education (Mandatory)	41	43
2.	Major/Disciplinary (Mandatory)	84	81
3.	Interdisciplinary (Mandatory)	5	6

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4.	Electives toward specialization	-	-
5.	Tajweed, Quran and Hadith (Compulsory, non-credit course, only for Muslim Students)		<ul style="list-style-type: none"> • Tajweed, Quran, and Hadith 8 Contact Hrs (Non-credited, for Muslim students only) • Chemistry: 2 Contact Hours in 1st semester (Non-credited, for ICS students only)
6	Internship (Mandatory)	Non-credited	Non-credited 6-8 Weeks
7.	Capstone Project (Mandatory)	6	6
8	Double Major (Optional)	-	N/A aa per PEC
9.	Minor (Optional)	-	N/A aa per PEC
Total		136	136

Semester-wise Revised Roadmap of BEE**Semester 1**

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1	None	GSC 110	Applied Calculus and Analytical Geometry	3	Quantitative Reasoning (Gen. Education)	4, 9
2	None	CSC 111	Introduction to Computing	1	Applications of Information & Communication Technologies (ICT) (Gen. Education)	4, 9
3	None	CSL 111	Introduction to Computing Lab	1	Applications of Information & Communication Technologies (ICT) (Gen. Education)	4, 9
4	None	ENG 101	Functional English	3	Functional English (Gen. Education)	4
5	None		Culture Elective-I	2	Islamic Studies or Ethics (Gen. Education)	4, 5, 10, 16
6	None		MDEE-I	2	Interdisciplinary	-
	None	GSC 113	Applied Physics	3	Natural Sciences (Gen. Education)	7, 9
7	None	GSL 113	Applied Physics Lab	1	Natural Sciences (Gen. Education)	7, 9
8	None	EEL 112	Workshop Practice Lab	1	Major/Disciplinary	9

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9	None	ISL 107	Tajweed	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
10	None	GSC 340	Chemistry	2 Contact Hours	Non-Credit course** Natural Sciences (Gen. Education)	4, 6
Total Credit Hours			17			

*Only for Muslim students

** Only for ICS students

Semester 2

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre- requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1	None	EEL 121	Engineering Drawing & CAD	1	ICT (Gen. Education)	9
2	None	GSC 123	Linear Algebra & Differential Equations	3	Natural Science (Gen. Education)	4, 9
3	CSC 111	CSC 112	Programming Fundamentals	2	Interdisciplinary	4, 9
4	CSC 111	CSL 112	Programming Fundamentals Lab	1	Interdisciplinary	4, 9
5	None	EEN 110	Linear Circuit Analysis	3	Major/Disciplinary	7, 9
6	None	EEL 110	Linear Circuit Analysis Lab	1	Major/Disciplinary	7, 9
7	None	CEN 120	Digital Logic Design	3	Major/Disciplinary	9
8	None	CEL 120	Digital Logic Design Lab	1	Major/Disciplinary	9
9	None	PAK XXX	Culture Elective II	2	Ideology and Constitution of Pakistan (Gen. Education)	4, 16

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10	None	ENV 101	Occupational Health and Safety	1	Interdisciplinary	3,11,15
11	None	ISL 108	Understanding Quran -I	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours			18			

*Only for Muslim students

Semester 3

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1	None		Culture Elective-III	2	Arts & Humanities (Gen. Education)	4, 8
2	EEN 110	EEN 224	Electronic Devices and Circuits	3	Major/Disciplinary	9
3	EEN 110	EEL 224	Electronic Devices and Circuits Lab	1	Major/Disciplinary	9
4	EEN 110	EEN 211	Electrical Network Analysis	3	Major/Disciplinary	7, 9
5	EEN 110	EEL 211	Electrical Network Analysis Lab	1	Major/Disciplinary	7, 9
6	None		CIS Elective-I	3	Interdisciplinary	9
7	None		CIS Elective-I Lab	1	Interdisciplinary	9
8	GSC 110	GSC 220	Complex Variables and Transforms	3	Natural Science (Gen. Education)	4, 9

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9	ISL 108	ISL 109	Understanding Quran-II	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours			17			

*Only for Muslim students

Semester 4

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1	CEN 120	CEN 440	Embedded Systems Design	3	Major/Disciplinary	4, 8
2	CEN 120	CEL 440	Embedded Systems Design Lab	1	Major/Disciplinary	4, 8
3	None		Social Science Elective -I	2	Humanities/ Social Sciences (Gen. Education)	-
4	GSC 220	EEN 313	Signals and Systems	3	Major/Disciplinary	9
5	GSC 220	EEL 313	Signals and Systems Lab	1	Major/Disciplinary	9
6	EEN 224	EEN 225	Electronic Circuit Design	3	Major/Disciplinary	9
7	EEN 224	EEL 225	Electronic Circuit Design Lab	1	Major/Disciplinary	9
8	GSC 110	EEN 226	Probability Methods in Engineering	3	Major/Disciplinary	4
9	ISL 109	ISL 110	Understanding Quran-III	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16

Total Credit Hours	17	
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*Only for Muslim students

Semester 5

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1	GSC 110	EEN 311	Electromagnetic Field Theory	3	Major/Disciplinary	9
2	None		CIS Elective-II	3	Major/Disciplinary	9
3	None		Math Elective	3	Natural Sciences (Gen. Education)	-
4	EEN 313	EET 321	Communication Systems	3	Major/Disciplinary	9
5	EEN 313	EEL 321	Communication Systems Lab	1	Major/Disciplinary	9
6	EEN 211	EEN 312	Electrical Machines	3	Major/Disciplinary	7, 9
7	EEN 211	EEL 312	Electrical Machines Lab	1	Major/Disciplinary	7, 9
8	ISL 110	ISL 111	Understanding Quran-IV	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				17		

*Only for Muslim students

Semester 6

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Proposed Road map aligned with HEC new UG Policy						
Sr. No.	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1	XXXX	EEXXX	Breadth Core-I	3	Major/Disciplinary	-
2	XXXX	EEXXX	Breadth Core-I Lab	1	Major/Disciplinary	-
3	EEN 313	EEN 412	Linear Control Systems	3	Major/Disciplinary	9
4	EEN 313	EEL 412	Linear Control Systems Lab	1	Major/Disciplinary	9
5	XXXX	XXXX	Management Sciences Elective-I	2	General Education	-
6	XXXX	EEXXXX	Depth Elective I	3	Major/Disciplinary	-
7	XXXX	EEXXXX	Breadth Core II	3	Major/Disciplinary	-
8	XXXX	EEXXXX	Breadth Core II Lab	1	Major/Disciplinary	-
9	ISL 111	ISL 112	Understanding Quran-V	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 5, 10, 16
Total Credit Hours				17		

*Only for Muslim students

Semester 7

Sr. No.	Proposed Road map aligned with HEC new UG Policy
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	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1	None	ESC 498	Project – I	3	Capstone Project	3, 6, 7, 9, 11, 12, 13
2	None	ENG 321	Technical Writing & Presentation Skills	3	Expository Writing (Gen. Education)	4, 17
3	XXXX	EEXXX	Depth Elective II	3	Major/Disciplinary	-
4	XXXX	EEXXX	Depth Elective II Lab	1	Major/Disciplinary	-
5	XXXX	EEXXX	Depth Elective III	3	Major/Disciplinary	-
4	XXXX	EEXXX	Depth Elective III Lab	1	Major/Disciplinary	-
5	XXXX	XXXX	MDEE-II	3	Interdisciplinary	-
6	ISL 112	ISL 113	Seerah-I	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				17		

*Only for Muslim students

Semester 8

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1	XXXX	ESC 499	Project-II	3	Capstone Project	3, 6, 7, 9, 11, 12, 13

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2	None	HSSXXX	Social Science Elective II	2	Humanities & Social Sciences (Gen. Education)	-
3	None	XXXX	Management Sciences Elective II	3	General Education	-
4	XXXX	EEXXXX	Depth Elective IV	3	Major/Disciplinary	-
5	XXXX	EEXXXX	Depth Elective IV Lab	1	Major/Disciplinary	-
6	XXXX	EEXXXX	Depth Elective V	3	Major/Disciplinary	-
7	XXXX	EEXXXX	Depth Elective V Lab	1	Major/Disciplinary	-
8	ISL 113	ISL 114	Seerah-II	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				16		

*Only for Muslim students

List of Natural Science (Math) Electives

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1	GSC 110	GSC 211	Multivariable Calculus	3	Natural Sciences (Gen. Education)	4, 12
2	GSC 210	GSC 320	Numerical Analysis	3	Natural Sciences (Gen. Education)	4, 9
3	None	GSC 221	Discrete Mathematics	3	Natural Sciences (Gen. Education)	4, 12

List of Humanities and Social Science Electives

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
Humanities (Culture)						
1	None	ISL 101	Islamic Studies	2	Islamic Studies (Gen. Education)	4, 5, 10, 16
2	None	HSS 116	Ethics (For non-Muslims only)	2	Ethics (Gen. Education)	4, 5, 10, 16
3	None	PAK 103	Pakistan Studies & Global Perspective	2	Ideology and Constitution of Pakistan (Gen. Education)	4, 16

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4	None	PAK 105	Pakistan Studies	2	Ideology and Constitution of Pakistan (Gen. Education)	4, 16
5	None	ENG 134	Communication Skills	2	Arts & Humanities (Gen. Education)	4, 8
6	None	HSS 462	Foreign Language	2	Arts & Humanities (Gen. Education)	4, 8

Social Science

1	None	HSS 413	Sociology for Engineers	2	Social Sciences (Gen. Education)	10
2	None	SOC 112	Critical Reasoning & Logic	2	Social Sciences (Gen. Education)	4
3	None	HSS 119	Introduction to International Relations	2	Social Sciences (Gen. Education)	16
4	None	HSS 107	Introduction to Psychology	2	Social Sciences (Gen. Education)	3
5	None	HSS 424	Engineering Ethics	2	Civics and Community Engagement (Gen. Education)	16
6	None	MGT 421	Leadership	2	Civics and Community Engagement (Gen. Education)	4, 8
7	None	MGT 422	Personal Grooming	2	Civics and Community Engagement (Gen. Education)	8

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8	None	HSS 456	Organizational Behavior	2	Civics and Community Engagement (Gen. Education)	8
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List of Management Science Electives

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1	None	HSS 412	Engineering Economics	2	Entrepreneurship (Gen. Education)	8
2	None	HSS 423	Entrepreneurship	2	Entrepreneurship (Gen. Education)	12
3	None	MGT 426	Sales and Marketing Strategies for Engineers	2	Entrepreneurship (Gen. Education)	8, 9
4	None	MGT 111	Principles of Management	3	General Education	8, 9
5	None	MGT 423	Engineering Management	3	General Education	8, 9
6	None	MGT 425	Project Management in Engineering	3	General Education	8, 9

Engineering Domain Electives

List of Computing and Information Science Elective Courses

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)

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1	CSC 112	CSC 210	Object Oriented Programming	3+1	Interdisciplinary	4, 9
2	CSC 112	CSC 221	Data structure and Algorithm	3+1	Interdisciplinary	4, 9
3	None	CSC 320	Operating Systems	3+1	Interdisciplinary	4, 9
4	None	EET 462	Cryptography and Network Security	3+0	Interdisciplinary	9, 16
5	None	ITC 411	Cyber Security	3+0	Interdisciplinary	9, 16
6	None	CEN 409	Artificial Intelligence & Machine Learning	3+0	Interdisciplinary	4, 9

List of MDEE Elective Courses

Proposed Road map aligned with HEC new UG Policy						
Sr. No.	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1	None	ESC 111	Basic Mechanical Engineering	2	Interdisciplinary	7, 9
2	None	GSC 104	Surveying and Leveling	2	Interdisciplinary	9
3	None	GSC 486	Geographical Information System	2	Interdisciplinary	11, 15
4	None	ENV 440	Energy and Environment	2	Interdisciplinary	7, 13
5	None	MTE 101	Maritime Technologies	2	Interdisciplinary	14
6	None	EEN 450	Introduction to Sports Engineering	3	Interdisciplinary	9
7	None	EEN 438	Introduction to Biomedical Engineering	3	Interdisciplinary	3, 9
8	None	CSC 488	Big Data Analytics	3	Interdisciplinary	9, 17
9	None	CSC 410	Introduction to Cloud Computing	3	Interdisciplinary	9
10	None	EET 461	Industrial Internet Of Things (IIoTs)	3	Interdisciplinary	9
11	None	ESC 472	Medical Robots	3	Major/Disciplinary	3, 9

List of Breadth Core Elective Courses

Electronics Engineering

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1	EEN 224	EEP 468	Power Electronics	3+1	Major/Disciplinary	7, 9
2	EEN 313	EEN 325	Digital Signal Processing	3+1	Major/Disciplinary	9

Telecommunication Engineering

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1	None	CEN 223	Computer Communication & Networks	3+1	Major/Disciplinary	9
2	EEN 313	EEN 325	Digital Signal Processing	3+1	Major/Disciplinary	9

Power Engineering

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1	EEN 211	EEP 331	Power System Analysis	3+1	Major/Disciplinary	7, 9
2	EEN 219	EEN 433	Power Distribution and Utilization	3+1	Major/Disciplinary	7, 11

List of Depth Elective Courses**Electronics Engineering**

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1	EEN 224	EEN 466	Introduction to Nano Technology	3+0	Major/Disciplinary	9
2	EEN 313	CEN 444	Digital Image Processing	3+0	Major/Disciplinary	9
3	EEN 325	ESC 471	Biomedical Instrumentation	3+0	Major/Disciplinary	3, 9
4	None	CSC-464	Computer Vision	3+0	Major/Disciplinary	9
5	None	EEN 451	System Engineering	3+0	Major/Disciplinary	9
6	EEN 224	EEN 316	Instrumentation and measurement	3+1	Major/Disciplinary	9
7	EEN 224	EEN 462	Integrated Electronics	3+1	Major/Disciplinary	9
8	None	EEN 441	Industrial Process Control	3+1	Major/Disciplinary	9
9	EEN 224	EEN 442	Digital Electronics	3+1	Major/Disciplinary	9
10	EEN 224	EEN 444	Opto Electronics	3+1	Major/Disciplinary	9
11	EEN 224	CEN 452	VLSI Design	3+1	Major/Disciplinary	9
12	EEN 224	EEN 445	Industrial Electronics	3+1	Major/Disciplinary	9
13	CEN 120	CEN 442	Digital System Design	3+1	Major/Disciplinary	9
14	EEN 224	EEN 469	Linear Integrated Circuits & Applications	3+1	Major/Disciplinary	9
15	EEN 224	EEN 435	Solid State Devices	3+1	Major/Disciplinary	9

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16	EEN 412	EEN 437	Digital Control Systems	3+1	Major/Disciplinary	9
17	EEN 219	EEN 433	Power Distribution and Utilization	3+1	Major/Disciplinary	7, 11
18	CEN 120	CEN 441	FPGA- Based System Design	3+1	Major/Disciplinary	9
19	EEN 219	EEN 420	Industrial Automation	3+1	Major/Disciplinary	9
20	EEN 224	EEN 471	Microelectronics Technology	3+1	Major/Disciplinary	9
21	None	CEN 223	Computer Communication & Networking	3+1	Major/Disciplinary	9
22	None	CEN 458	Robotics	3+1	Major/Disciplinary	9
23	EEN 311	EET 451	Wave Propagation and Antennas	3+1	Major/Disciplinary	9

Telecommunication Engineering

Proposed Road map aligned with HEC new UG Policy						
Sr. No.	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1	None	EET 471	Emerging Wireless Technologies and RF planning	3+0	Major/Disciplinary	9
2	None	EET 472	Telecommunication policies and standards	3+0	Major/Disciplinary	9
3	None	EET 459	Introduction to Block chain	3+0	Major/Disciplinary	9
4	None	CSC-464	Computer Vision	3+0	Major/Disciplinary	9

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5	None	EEN 451	System Engineering	3+0	Major/Disciplinary	9
6	None	EET 456	Telecom Transmission and Switching Systems	3+0	Major/Disciplinary	9
7	EEN 313	CEN 444	Digital Image Processing	3+0	Major/Disciplinary	9
8	EEN 311	EEN 431	RF and Microwave Engineering	3+1	Major/Disciplinary	9
9	None	EET 463	Optical Fiber Communication	3+1	Major/Disciplinary	9
10	EEN 311	EET 447	Radar Systems	3+1	Major/Disciplinary	9
11	EET 321	EEN 436	Wireless and Mobile Communication	3+1	Major/Disciplinary	9
12	EET 321	EET 449	Satellite Communications	3+1	Major/Disciplinary	9
13	EEN 311	EET 451	Wave Propagation and Antennas	3+1	Major/Disciplinary	9
14	CEN 223	EET 452	Multimedia Communications	3+1	Major/Disciplinary	9
15	None	CSC 453	Information Theory	3+1	Major/Disciplinary	9
16	CEN223	EEN 434	Computer Networks	3+1	Major/Disciplinary	9
17	EET 321	EET 411	Digital Communications	3+1	Major/Disciplinary	9
18	CEN 120	CEN 441	FPGA- Based System Design	3+1	Major/Disciplinary	9
19	EEN 224	EEN 469	Linear Integrated Circuits and Applications	3+1	Major/Disciplinary	9
20	EEN 224	EEN 316	Instrumentation and measurement	3+1	Major/Disciplinary	9

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21	None	EEN 462	Introduction to Quantum Computing Reorganization	3+1	Major/Disciplinary	9
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Power Engineering

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1	EEP 331	EEP 445	Power System Stability & Control	3+0	Major/Disciplinary	7, 9
2	None	EEP 474	Smart Grid	3+0	Major/Disciplinary	7, 9
3	None	EEN 446	Industrial Process Control	3+0	Major/Disciplinary	9
4	None	EEP 449	Distributed Generation and its Grid Integration	3+0	Major/Disciplinary	7, 9
5	None	EEP 450	Power System Economics	3+0	Major/Disciplinary	8, 9
6	None	EEP 451	Optimization Methods in Modern Power Systems	3+0	Major/Disciplinary	9
7	None	EEP 452	LV and HV Electrical Installation guides and Standards	3+0	Major/Disciplinary	9
8	EEN 224	EEN 316	Instrumentation and Measurements	3+1	Major/Disciplinary	9
9	EEN 219	EEP 441	Advanced Electrical Machines	3+1	Major/Disciplinary	9
10	EEN 219	EEP 442	Power Generation	3+1	Major/Disciplinary	7, 9
11	EEN 433	EEP 443	Electrical Power Transmission	3+1	Major/Disciplinary	7, 9

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12	EEN 224	EEP 468	Power Electronics	3+1	Major/Disciplinary	7, 9
13	EEP 331	EEP 444	Power System Protection	3+1	Major/Disciplinary	7, 9
14	EEN 219	EEP 471	Electrical Machine Design and Maintenance	3+1	Major/Disciplinary	9
15	EEN 211	EEP 446	High Voltage Engineering	3+1	Major/Disciplinary	7, 9
16	EEN 313	EEN 325	Digital Signal Processing	3+1	Major/Disciplinary	9
17	EEN 224	EEP 472	Industrial Drives	3+1	Major/Disciplinary	9
18	EEP 331	EEP 475	FACTS and HVDC Transmission	3+1	Major/Disciplinary	7, 9
19	None	CEN 223	Computer Communication & Networking	3+1	Major/Disciplinary	9
20	EEN 412	EEN 437	Digital Control System	3+1	Major/Disciplinary	9
21	EET 321	EET 474	Digital Communication System	3+1	Major/Disciplinary	9
22	EEN 224	EEN 469	Linear Integrated Circuits and Applications	3+1	Major/Disciplinary	9
23	EEN 224	EEP 474	PLC and Industrial Drives	3+1	Major/Disciplinary	9
24	EEN 224	EEN 445	Industrial Electronics	3+1	Major/Disciplinary	7, 9
25	None	EEN 434	Computer Networks	3+1	Major/Disciplinary	9
26	None	EEP 448	Renewable Energy Systems	3+1	Major/Disciplinary	7, 9

Course Outlines

Course Title: Linear Algebra and Differential Equations

Course Code: GSC 123

Credit Hours: 3+0

Prerequisite: None

Objectives:

Linear algebra is the study of matrices, vector spaces and linear transformations. The main objective of this course is to help students learn in a rigorous manner, the tools and methods essential for studying the solution spaces of problems in robotics. This course introduces the solution of ordinary differential equations. Use known differential equations types to model and understand situations involving exponential growth or decay and second order physical systems such as driven spring-mass systems.

Course Learning Outcomes (CLOs):

CLO 1: Define the basic ideas of vector algebra, matrices and identify different methods of solving First order ordinary differential equations & 2nd order ordinary differential equations.

CLO 2: Apply the knowledge of linear algebra to model and solve linear systems that appear in engineering sciences which are helpful in image processing, control theory, etc.

CLO 3: Analysis different Engineering systems using the concept of First order & Higher Order Differential Equations.

	PLO 1	PLO 2
CLO 1	P	
CLO 2		P
CLO 3		P

Course Outline:

Week 1. Linear Algebra Linearity and linear dependence of vectors, basis, dimension of a vector space, field matrix and type of matrices (singular, non- singular, symmetric, non- symmetric, upper, lower, diagonal),

Week 2. Rank of a matrix using row operations and special method, echelon and reduced echelon forms of a matrix,

Week 3. determination of consistency of a system of linear equation using rank, matrix of linear transformations,

Week 4. eigen value and eigen vectors of a matrix, Diagonalization.

Week 5. Applications of linear algebra in relevant engineering problem.

Week 6. 1st Order Differential Equations Basic concept: Formation of differential equations and solution of differential equations by direct integration and by separating the variables:

Week 7. Homogeneous equations and equations reducible to homogeneous from;

Week 8. Linear differential equations of the order and equations reducible to the linear form.

Week 9. Bernoulli's equations and orthogonal trajectories, Applications of linear and non-linear equations

Week 10. Special types of 2nd order differential equations with constant coefficients and their solutions: The operator D; Inverse operator I/D

Week 11. Solution of differential by operator D methods; Special cases, Cauchy's differential equations; Simultaneous differential equations

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- Week 12. Simple application of differential equations in relevant Engineering.
- Week 13. Partial Differential Equation basic concepts and formation of partial differential equations
- Week 14. Linear homogeneous partial differential equations and relations to ordinary differential equations
- Week 15. Solution of first order linear and special types of second and higher order differential equations;
- Week 16. D' Alembert's solution of the wave equation and two dimensional wave equations: Lagrange's solution; Various standard forms.

Resources:

- Elementary Linear Algebra by Howard Anton Seven Edition
- Advance Engineering Mathematics by Erwin Kreyszig Seven Edition
- Differential Equation A modeling Perspective by Robert L. Barrelli
- Introduction to Differential Equation by J. Farlaw
- Differential Equation by G. zill

Grading Rubric

Assessment Method	CLO 1	CLO 2	CLO 3
Final Exam (50)	10	15	25
Midterm Exam (20)	15	5	
Assignments (20)	5	7	8
Quizzes (10)	3	3	4
Total (100)	33	30	37

Course Title: Chemistry

Course Code: GSC 340

Credit Hours: 2

Prerequisite: None

Objectives:

This course is aimed at introducing engineering students to fundamental chemical concepts and principles. This course covers the qualitative and quantitative aspects of scientific measurement, the nature of matter, gases, liquids and solids, energy, atomic theory, properties of elements, chemical bonding, molecular structure and properties, stoichiometry, thermochemistry, and nuclear chemistry.

Course Learning Outcomes (CLOs):

CLO 1: (C1): Describe the basic principles and methods of chemistry, such as the metric system, scientific notation, and significant figures the atomic theories, trends of the periodic table of the elements.

CLO2: (C2): Explain bonding, molecular geometry, chemical formulas, gas laws, thermodynamics, nuclear chemistry and applications of chemistry in electrical engineering.

	PLO-1
CLO 1	P
CLO 2	P

Course Outline:

- Week 1. Matter and Measurements
 Week 2. Physical and chemical properties of matter; mathematical operations involving significant figures.
 Week 3. Arrangement of the periodic table
 Week 4. The Atom
 Week 5. Electron configurations
 Week 6. Lewis structures for molecules
 Week 7. Bonding
 Week 8. Chemical Formulas and Equations
 Week 9. States of Matter
 Week 10. Ideal Gas Law
 Week 11. Thermodynamics
 Week 12. Enthalpy change
 Week 13. Acid-Base and Oxidation-Reduction Reactions
 Week 14. pH calculations and use the pH scale to classify solutions as acidic, basic, or neutral.
 Week 15. Nuclear Chemistry, Different types of nuclear decay
 Week 16. Applications of chemistry in electrical engineering

Resources:

- Zumdahl S. Chemistry, 8th Edition, Houghton Mifflin, Boston, 2003
 Applied Chemistry for Electrical Engineering , by Dr Adwin Jose P
 Chemistry: The Molecular Nature of Matter (Jespersen and Hyslop, 7th Edition, Wiley)

Grading Rubric

Assessment Method	CLO 1	CLO 2
Final Exam (50)	15	35
Midterm Exam (20)	15	5
Assignments (20)	10	10
Quizzes (10)	5	5
Total (100)	45	55

Course Title: Distributed Generation Systems and its Grid Integration

Course Code: EEP 449

Credit Hours: 3+0

Pre-Requisite: None

Course Learning Outcomes:

CLO 1: Understand the basic operation, control and modelling of distributed energy systems.

CLO 2: Analyse the characteristics of micro grid and impact of distribution source on the microgrid.

CLO 3: Apply standards and grid codes for integrating distribution sources.

	PLO 1	PLO 4	PLO 12
CLO 1	P		
CLO 2		P	
CLO 3			P

Objectives:

The course has been designed to help students understand the concept of distributed generation. The course will also enhance the skill of students to analyse the impact on grid integration & to study the concept of microgrid and its configuration.

Contents:

Introduction to distribution generation system, renewables application as distribution sources, concept of distributed generations, topologies, selection of sources, regulatory standards/ framework, Standards for interconnecting Distributed resources to electric power systems: IEEE 1547. DG installation classes, security issues in DG implementations. Energy storage elements. Requirements for grid interconnection, limits on operational parameters, voltage, frequency, THD, response to grid abnormal operating conditions, islanding issues. Impact of grid integration with NCE sources on existing power system: reliability, stability and power quality issues. Concept and definition of microgrid, microgrid drivers and benefits, review of sources of microgrids, typical structure and configuration of a microgrid, AC and DC microgrids, Power Electronics interfaces in DC and AC microgrids, Modes of operation and control of microgrid: grid connected and islanded mode, Active and reactive power control, protection issues, anti-islanding schemes: passive, active and communication based techniques, microgrid communication infrastructure, Power quality issues in microgrids, regulatory standards, Microgrid economics.

Textbook(s):

- Integration of Distributed Generation in the Power System by Math Bollen And Fainan Hassan
- Voltage Source Converters in Power Systems: Modeling, Control and Applications”, Amir naserYezdani, and Reza Iravani, IEEE John Wiley Publications.
- Power Switching Converters: Medium and High Power”, Dorin Neacsu, CRC Press, Taylor & Francis, 2006.

Course Title: Power System Economics

Course Code: EEP 450

Credit Hours: 3+0

Pre-Requisite: None

Course Learning Outcomes (CLOs) and Program Learning Outcomes (PLOs)

Mapping:

CLO 1: Understand the electric power sector regulation and compare different type of regulation.

CLO 2: Analyse the concept of energy markets trusted to attain an adequate level of investment in generation capacity.

CLO 3: Compare the market regulation of generation from renewable energy sources with respect to generation from other sources and identify the reason of separate regulatory regimes.

	PLO 1	PLO 6	PLO 12
CLO 1	P		
CLO 2		P	
CLO 3			P

Objectives:

This course provides students with a good theoretical knowledge and understanding of power system economics. The basic principles of power system economics (main regulatory regimes and pricing principles) will be analysed to combine power system analysis and economic appraisal, providing an insight and ability to estimate future developments. Technical and economic implications of transition to a low-carbon energy systems will be discussed.

Contents:

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Power market fundamentals; pricing power, energy, and capacity; power supply and demand; Marginal cost in a power market; Market structure; Reliability and investment policy; reliability and generation; operating reserve pricing; requirement of installed capacity; Market architecture; day ahead market design; ancillary services; Market for operating reserves; defining Market power, modelling market power.

Textbook(s):

- Power System Economics: Designing Market for Electricity by Steven Stoft
- Fundamentals of Power System Economics by Daniel S. Kirschen, Goran Strbac

Course Title: Optimization Methods in Modern Power Systems

Course Code: EEP 451

Credit Hours: 3+0

Pre-Requisite: None

Course Learning Outcomes (CLOs) and Program Learning Outcomes (PLOs)

Mapping:

CLO-1: To understand the theory of optimization methods and algorithms developed for solving various types of optimization problems (C1).

CLO-2: To analyse the optimum AC and DC power flow (C2).

CLO3: Use programming tools to solve various types of optimization problems (C3).

	PLO 1	PLO 2	PLO 5
CLO 1	P		
CLO 2		P	
CLO 3			P

Objectives:

Students will understand the operation of power networks from a control and optimization perspective. They will learn how mathematical tools and computational methods are used for the design, modelling, planning, and real-time operation of power grids.

Contents:

Introduction to optimization, Meaning of optimization, Types of problems, Linear programming, Basic solution, Simplex method and LU decomposition, Unconstrained optimization, Minimization and maximization of convex functions, Gradient descent method, Method of steepest descent, Newton's method, Multi objective optimization problems, Evolutionary optimization algorithms, Economic Dispatch, DC Optimal Power Flow, AC Optimal Power Flow, Power optimization problems such as state estimation, unit commitment, optimal power flow, and transmission planning, Efficient

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optimization and numerical algorithms for mixed-integer nonlinear problems, Control and optimization for renewable energy, Unit commitment.

Textbook(s):

- An Introduction to Optimization by E.K. Chong and S.H. Zak, Wiley-Interscience.
- Convex optimization Stephen Boyd, and Lieven Vandenberghe, Cambridge university press, 2004.
- Allen J. Wood, Bruce F. Wollenberg, and Gerald B. Sheble, Power Generation, Operation, and Control (3rd edition), Wiley, 2013.

Course Title: LV and HV Electrical Installation guides and Standards

Course Code: EEP 452

Credit Hours: 3+0

Pre-Requisite: None

Course Learning Outcomes (CLOs) and Program Learning Outcomes (PLOs) Mapping:

CLO-1: Interpret rules and regulation for electrical wiring comprising of cable selection and load calculation. (C1).

CLO-2: Get knowledge for inspection and testing of electrical installation according to national and international standards (C2).

	PLO 1	PLO 8
CLO 1	P	
CLO 2		P

Objectives:

In this course the students will understand the simple LV and HV electrical drawings, systems, and testing. They will also develop an understanding and knowledge of safe systems of work, for tasks on or near electrical equipment at LV and HV level. Also, national, and international standard for electrical installation will be taught.

Contents:

Introduction to Electrical Safety, basic electrical theory, proving dead with approved methods and indicators, safe use of multi-meters and their limitations, Test leads to GS38 standard, Basic three phase principles – Single and three phase generation, Prospective fault currents, LV protection – Fuses, Circuit Breakers, Transformers, RCD's, Discrimination and diversity in electrical systems, Earthing methods and bonding and the importance of earthing, Induction motor operation, starting methods

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and testing, electrical test equipment – The safe use of the ‘Megger’, Capacitance and inductance in electrical circuits – Safety implications, Motor protection - Thermal, magnetic electro mechanical and electronic relays, Feeder, transformer and generator protection overview, Methods of achieving discrimination with time, magnitude and comparison, Understanding of the component parts in common electrical control panels - overloads, isolator, timers, relays, control, indication and power circuits, Reading and understanding schematic diagrams, Competence – familiarity with LV and HV installed systems, Safe systems of work for dead fault finding techniques and practice, Electric arcs awareness session, Switching sequences for HV systems – Precautions; dead, isolated and earthed; risks, identified, Document, methods, general safety, Switching procedure and instructions, Preparing exercises in syndicate groups, basic switching instructions and fault finding tasks, HV switching exercise

Textbook(s):

- Electrical Installation Guide: According to IEC International Standards
- Handbook of Electrical Installation Practice, Geoffrey Stokes

Minutes of the 32nd FBOS – ES
Academic Road Map for UG Program
Faculty of Engineering Sciences

Program Title: **BS ROBOTICS AND INTELLIGENT SYSTEMS**

Duration: **4 YEARS**

Total Credit Hours: **131**

Endorsement References:

A: Recommendations of DBOS dated **28th August 2023**

B: Recommendations of FBOS dated **03 Sep 2023**

Summary of Credit Hours

Sr. No.	Category as per HEC new UG Policy	Credit Hours/Contact Hours	
		Existing Road Map	Proposed New Road Map
1.	General Education (Mandatory)	35	36
2.	Major/Disciplinary (Mandatory)	63	60
3.	Interdisciplinary (Mandatory)	12	12
4.	Electives toward specialization	14	17
5.	Non-Credit courses (contact hours) – Tajweed, Quran and Hadith (Compulsory for Muslim students)	-	8 Contact Hours
6	Internship (Mandatory)	-	Non-Credited
7.	Capstone Project (Mandatory)	6	6
8	Double Major (Optional)	-	-
9.	Minor (Optional)	-	-
Total		130	131

Semester-wise Revised Road map of BS RIS

Semester 1

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1	None	GSC 114	Applied Physics	2	Natural Science (Gen. Edu)	4, 7

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2	None	GSL 113	Applied Physics Lab	1	Natural Science (Gen. Edu)	4, 7
3	None	GSC 110	Applied Calculus and Analytical Geometry	3	Quantitative Reasoning (Gen. Edu)	4
4	None	ISL 101/HSS 116	Islamic Studies/Ethics	2	Islamic Studies/Ethics (Gen. Edu)	4, 5, 10, 16
5	None	ENG 101	Functional English	3	Functional English (Gen. Edu)	4
6	None	CSC 110	Computing Fundamentals	2	Disciplinary	4
7	None	CSL 110	Computing Fundamentals Lab	1	Disciplinary	4
8	None	EEL 121	Engineering Drawing & CAD	1	Disciplinary	9
9	None	ISL 107	Tajweed	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
10	None	GSC-103	Fundamentals of Mathematics-I	3 Contact Hours	Non-Credit course** (Gen. Edu)	4
Total Credit Hours				15		

*Only for Muslim students

** For Pre-Medical Students only

Semester 2

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1	XXXX	XXXX	Social Sciences Elective-I	2	Social Science (Gen. Edu)	5, 10, 11, 16, 17

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2	None	GSC 123	Linear Algebra and Differential Equations	3	Quantitative Reasoning (Gen. Edu)	4
3	None	GSC 115	Circuit Analysis	3	Disciplinary	4, 9
4	None	GSL 115	Circuit Analysis Lab	1	Disciplinary	4, 9
5	None	CSC 113	Computer Programming	3	Applications of Information and Communication Technologies (ICT) (Gen. Edu)	4
6	None	CSL 113	Computer Programming Lab	1	Applications of Information and Communication Technologies (ICT) (Gen. Edu)	4
7	None	MSC 231	Engineering Mechanics	3	Disciplinary	4
8	None	XXXX	Management Elective	2	Management Science (Gen. Edu)	8, 11, 16, 17
9	None	ISL 108	Understanding Quran-I	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
10	None	GSC-104	Fundamentals of Mathematics-II	3 Contact Hours	Non-Credit course** (Gen. Edu)	4
Total Credit Hours				18		

*Only for Muslim students

** For Pre-Medical Students only

Semester 3

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention)

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						relevant SDG No.
1	None	CEN 120	Digital Logic Design	3	Disciplinary	4, 8, 9
2	None	CEL 120	Digital Logic Design Lab	1	Disciplinary	4, 8, 9
3	CSC 113	CSC 210	Object Oriented Programming	3	Disciplinary	4, 8
4	CSC 113	CSL 210	Object Oriented Programming Lab	1	Disciplinary	4, 8
5	None	RIS 231	Introduction to Robotics	3	Disciplinary	3, 4, 8, 9, 11, 16
6	None	RIL 231	Introduction to Robotics Lab	1	Disciplinary	3, 4, 8, 9, 11, 16
7	None	GSC 122	Probability and Statistics	3	Quantitative Reasoning (Gen. Edu)	3, 4, 8
8	None	EEL 113	Engineering Workshop	1	Disciplinary	9
9	None	ENG 134	Communication Skills	2	Arts and Humanities (Gen. Edu)	4, 17
10	ISL 108	ISL 109	Understanding Quran-II	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				18		

*Only for Muslim students

Semester 4

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)

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1	GSC 110	GSC 220	Complex Variable & Transforms	3	Quantitative Reasoning (Gen. Edu)	4
2	XXXX	XXXX	IDEE – I	3	Interdisciplinary	3, 4, 8, 9
3	XXXX	XXXX	IDEE - I Lab	1	Interdisciplinary	3, 4, 8, 9
4	CSC 210	AIC 201	Artificial Intelligence	3	Disciplinary	3, 8, 9, 11, 16
5	CSC 210	AIL 201	Artificial Intelligence Lab	1	Disciplinary	3, 8, 9, 11, 16
6	None	PAK 105	Pakistan Studies & Global Perspective	2	Ideology and Constitution of Pakistan (Gen. Edu)	10, 16
7	None	XXXXX	Civics and Community Engagement Elective	2	Civics and Community Engagement Elective (Gen. Edu)	3, 10, 11, 16, 17
8	None	ENG 320	Technical Writing &	3	Expository Writing (Gen. Edu)	4, 17
9	ISL 109	ISL 110	Understanding Quran-III	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				18		

*Only for Muslim students

Semester 5

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1	XXXX	XXXX	IDEE – II	3	Interdisciplinary	3, 4, 8, 9
2	XXXX	XXXX	IDEE - II Lab	1	Interdisciplinary	3, 4, 8, 9
3	CSC 210	RIS 361	Robotic System & Programming	3	Disciplinary	3, 9
4	CSC 210	RIL 361	Robotic System & Programming Lab	1	Disciplinary	3, 9
5	GSC 220	EEN 412	Linear Control System	3	Disciplinary	3, 9
6	GSC 220	EEL 412	Linear Control System Lab	1	Disciplinary	3, 9
7	None	RIS 241	Sensors & Actuators	3	Disciplinary	3, 8, 9, 11
8	None	RIL 241	Sensors & Actuators Lab	1	Disciplinary	3, 8, 9, 11
9	ISL 110	ISL 111	Understanding Quran-IV	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				16		

*Only for Muslim students

Semester 6

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)

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1	XXXX	XXXX	IDEE – III	3	Interdisciplinary	3, 4, 8, 9
2	XXXX	XXXX	IDEE - III Lab	1	Interdisciplinary	3, 4, 8, 9
3	CEN 120	CEN 440	Embedded Systems Design	3	Disciplinary	3, 8, 9
4	CEN 120	CEL 440	Embedded Systems Design Lab	1	Disciplinary	3, 8, 9
5	AIC 201	RIS 364	Machine Learning	3	Disciplinary	3, 8, 9
6	AIC 201	AIL 301	Machine Learning Lab	1	Disciplinary	3, 8, 9
7	XXXX	XXXX	RIS Elective I	3	Major	3, 8, 9
8	ISL 111	ISL 112	Understanding Quran-V	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 5, 10, 16
Total Credit Hours				15		

*Only for Muslim students

Semester 7

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1	EEN 412	RIS 362	Robot Modelling & Control	3	Disciplinary	3, 8, 9
2	EEN 412	RIL 362	Robot Modelling & Control Lab	1	Disciplinary	3, 8, 9
3	XXXX	XXXX	RIS Elective II	3	Major	3, 8, 9
4	XXXX	XXXX	RIS Elective II Lab	1	Major	3, 8, 9
5	AIC 301	RIS 474	Introduction to Deep Learning	3	Disciplinary	3, 8, 9

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6	AIC 301	RIL 474	Introduction to Deep Learning Lab	1	Disciplinary	3, 8, 9
7	None	FYP 400	Project -I	3	Capstone Project	1 to 17
8	ISL 112	ISL 113	Seerah-I	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				15		

*Only for Muslim students

Semester 8

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1	XXXX	XXXX	RIS Elective III	3	Major	3, 8, 9
2	RIS 231	RIS 481	Machine Vision & Robotics	3	Disciplinary	3, 8, 9
3	XXXX	XXXX	RIS Elective IV	3	Major	3, 8, 9
4	XXXX	XXXX	RIS Elective IV Lab	1	Major	3, 8, 9
5	XXXX	XXXX	RIS Elective V	3	Major	3, 8, 9
6	None	FYP 400	Project-II	3	Capstone Project	1 to 17
7	ISL 113	ISL 114	Seerah-II	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 5, 10, 16
Total Credit Hours				16		

*Only for Muslim students

List of Elective Courses: Interdisciplinary Courses (IDEE 12 credit hours)

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1	CSC 210	CSC 221	Data Structures & Algorithm	3	Interdisciplinary	3, 4, 8, 9
2	CSC 210	CSL 221	Data Structures & Algorithm Lab	1	Interdisciplinary	3, 4, 8, 9
3	None	EEN 313	Signal & Systems	3	Interdisciplinary	3, 4, 8, 9
4	None	EEL 313	Signal & Systems Lab	1	Interdisciplinary	3, 4, 8, 9
5	GSC 115	EEN 224	Electronic Devices and Circuits	3	Interdisciplinary	3, 4, 8, 9
6	GSC 115	EEL 224	Electronic Devices and Circuits Lab	1	Interdisciplinary	3, 4, 8, 9
7	GSC 115	EEP 468	Power Electronics	3	Interdisciplinary	3, 4, 8, 9
8	GSC 115	EEL 468	Power Electronics Lab	1	Interdisciplinary	3, 4, 8, 9
9	None	CEN 223	Computer Communication & Networks	3	Interdisciplinary	3, 4, 8, 9
10	None	CEL 223	Computer Communication & Networks Lab	1	Interdisciplinary	3, 4, 8, 9
11	GSC 114	EEN 312	Electrical Machines	3	Interdisciplinary	3, 4, 8, 9
12	GSC 114	EEL 312	Electrical Machines Lab	1	Interdisciplinary	3, 4, 8, 9
13	GSC 114	EEN 316	Instrumentation and measurement	3	Interdisciplinary	3, 4, 8, 9
14	GSC 114	EEL 316	Instrumentation and	1	Interdisciplinary	3, 4, 8, 9

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			measurement Lab			
15	None	EET 321	Communication Systems	3	Interdisciplinary	3, 4, 8, 9
16	None	EEL 321	Communication Systems Lab	1	Interdisciplinary	3, 4, 8, 9
17	None	CEN 444	Digital Image Processing	3	Interdisciplinary	3, 4, 8, 9
18	None	CEL 444	Digital Image Processing Lab	1	Interdisciplinary	3, 4, 8, 9

List of Elective Courses:

Robotics & Intelligent Systems Elective Courses (5 courses 17 credit hours)

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1	CSC 113	RIS 363	Internet of things (IoT)	3	Major	3, 8, 9
2	RIS 241	RIS 482	Introduction to Haptics	3	Major	3, 8, 9
3	RIS 362	RIS 483	Introduction to Humanoid Robots	3	Major	3, 8, 9
4	RIS 362	RIS 484	Advanced Modelling of Robotics	3	Major	3, 8, 9
5	GSC 123	RIS 485	Optimal Kinematic Design of Robots	3	Major	3, 8, 9
6	RIS 361	RIS 486	Distributive Robotics/Swarm Robotics	3	Major	3, 8, 9
7	None	CSC 410	Introduction to Cloud Computing	3	Major	3, 8, 9
8	GSC 113	RIS 489	Mechanics of Materials	3	Major	3, 8, 9
9	RIS 231	RIS 486	Swarm Robotics	3	Major	3, 8, 9
10	None	RIS 471	Robot Process Automation	3	Major	3, 8, 9

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11	None	RIS 471	Robot Process Automation Lab	1	Major	3, 8, 9
12	None	RIS 473	Introduction to R Programming	3	Major	3, 8, 9
13	None	RIL 473	Introduction to R Programming Lab	1	Major	3, 8, 9
14	CEN 444	CSC 464	Computer Vision	3	Major	3, 8, 9
15	CEN 444	CSL 464	Computer Vision Lab	1	Major	3, 8, 9
16	AIC 201	RIS 475	Human Robot Interaction	3	Major	3, 8, 9
17	AIC 201	RIL 475	Human Robot Interaction Lab	1	Major	3, 8, 9
18	AIC 201	RIS 476	Artificial Neural Network	3	Major	3, 8, 9
19	AIC 201	RIL 476	Artificial Neural Network Lab	1	Major	3, 8, 9
20	AIC 201	RIS 487	AI for Computer Games	3	Major	3, 8, 9
21	AIC 201	RIL 487	AI for Computer Games Lab	1	Major	3, 8, 9
22	AIC 301	RIS 488	Chatbots	3	Major	3, 8, 9
23	AIC 301	RIL 488	Chatbots Lab	1	Major	3, 8, 9

Social Science Electives (2 credit hours)

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1	None	HSS 424	Engineering Ethics	2	Social Science (Gen. Edu)	5, 10, 11, 16, 17
2	None	HSS 217	Introduction to Sociology	2	Social Science (Gen. Edu)	5, 10, 11, 16, 17

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3	None	HSS 119	Introduction to International	2	Social Science (Gen. Edu)	5, 10, 11, 16, 17
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Management Science Electives (2 credit hours)

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1	None	HSS 423	Entrepreneurship	2	Entrepreneurship (Gen. Edu)	8, 11, 16, 17
2	None	MGT 421	Leadership	2	Management Science (Gen. Edu)	8, 11, 16, 17
3	None	EMG 222	Principles of Management	2	Management Science (Gen. Edu)	8, 11, 16, 17
4	None	HSS 412	Engineering Economics	2	Management Science (Gen. Edu)	8, 11, 16, 17
Total Credit Hours				8		

Course Outlines

Course Title: Machine Learning

Course Code: RIS 364

Credit Hours: 3+1

Prerequisite: Introduction to AI

Objectives:

This course provides a thorough introduction to the theoretical foundations and practical applications of ML. We will learn fundamental algorithms in supervised learning and unsupervised learning. We will not only learn how to use ML methods and algorithms but will also try to explain the underlying theory building on mathematical foundations. While reviewing the several problems and algorithms to carry out classification, regression, clustering, dimensionality reduction, we will focus on the core fundamentals which unify all the algorithms. The theory discussed in class will be tested in assignments, quizzes and exams.

Course Learning Outcomes (CLOs):

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CLO 1: (C2): Describe basic machine learning concepts, theories and applications.

CLO 2: (C3): Use statistical techniques for classification and measuring their accuracy.

CLO 3: (C3): Apply supervised learning and un-supervised learning techniques for classification.

	PLO 1	PLO 2	PLO 3
CLO 1	P		
CLO 2		P	
CLO 3			P

Course Outline:

Week 1. Course Introduction, Machine Learning Overview, Supervised Learning: Formulation, Setup, Train-test split, Generalization.

Week 2. k-Nearest Neighbor (kNN) Algorithm, Algorithm Formulation, Distance Metrics, Choice of k, Algorithm Convergence, Storage, Time Complexity Analysis, Fast kNN

Week 3. The Curse of Dimensionality and Connection with kNN, Dimensionality Reduction: Feature Selection and Extraction, Principal Component Analysis

Week 4. Classifier Performance Evaluation: Confusion Matrix Sensitivity, Specificity, Precision Trade-offs, ROC, AUC, F1-Score and Matthew's Correlation Coefficient

Week 5. Multi-class Classification, Evaluation, Micro, Macro Averaging,

Week 6. Regression: Linear Regression, Polynomial Regression, Overfitting

Week 7. Gradient Descent Algorithm, Regularization

Week 8. Probability Review, Bayesian Learning Framework, MAP and ML Hypothesis, Linear Regression as ML estimation, Naive Bayes Classifier

Week 9. Naïve Bayes Classifier for Text Classification, Bayesian Networks Introduction

Week 10. Logistic Regression: Mathematical Model, Decision Boundaries, Loss/Cost Function, Gradient Descent, Multi-class Logistic Regression

Week 11. Perceptron and Perceptron Classifier, Perceptron Learning Algorithm and its Geometric Intuition,

Week 12. Perceptron Learning Algorithm Convergence, SVM Overview

Week 13. Hard SVM, Soft SVM, Kernel Trick

Week 14. Neural Networks Introduction, Model, Forward Pass

Week 15. Neural Networks: Back Propagation

Week 16. Unsupervised Learning, Clustering Overview, K-means Clustering, Agglomerative Clustering.

Resources:

- Pattern Recognition and Machine Learning, Christopher M. Bishop
- Machine Learning: a Probabilistic Perspective, Kevin Murphy
- Machine Learning, Tom Mitchell
- The Elements of Statistical Learning: Data mining, Inference, and Prediction, by Hastie, Tibshirani, Friedman
- Information Theory, Inference, and Learning Algorithms, David Mackay

Tools

- Python, Matlab

Grading Rubric

Assessment Method	CLO 1	CLO 2	CLO 3
Final Exam (50)	10	15	25
Midterm Exam (20)	15	5	
Assignments (20)	5	7	8
Quizzes (10)	3	3	4
Total (100)	33	30	37

Course Title: Linear Algebra and Differential Equations

Course Code: GSC 123

Credit Hours: 3+0

Prerequisite: None

Objectives:

Linear algebra is the study of matrices, vector spaces and linear transformations. The main objective of this course is to help students learn in a rigorous manner the tools and methods essential for studying the solution spaces of problems in robotics. This course introduces the solution of ordinary differential equations. Use known differential equation types to model and understand situations involving exponential growth or decay and second order physical systems such as driven spring-mass systems.

Course Learning Outcomes (CLOs):

CLO 1: Define the basic ideas of vector algebra, matrices and identify different methods of solving First order ordinary differential equations & 2nd order ordinary differential equations.

CLO 2: Apply the knowledge of linear algebra to model and solve linear systems that appear in engineering sciences which are helpful in image processing, control theory, etc.

CLO 3: Analysis different Engineering systems using the concept of First order & Higher Order Differential Equations.

	PLO 1	PLO 2
CLO 1	P	
CLO 2		P
CLO 3		P

Course Outline:

- Week 1. Linear Algebra Linearity and linear dependence of vectors, basis, dimension of a vector space, field matrix and type of matrices (singular, non- singular, symmetric, non- symmetric, upper, lower, diagonal),
- Week 2. Rank of a matrix using row operations and special method, echelon and reduced echelon forms of a matrix,
- Week 3. determination of consistency of a system of linear equation using rank, matrix of linear transformations,
- Week 4. eigen value and eigen vectors of a matrix, Diagonalization.
- Week 5. Applications of linear algebra in relevant engineering problem.
- Week 6. 1st Order Differential Equations Basic concept: Formation of differential equations and solution of differential equations by direct integration and by separating the variables:
- Week 7. Homogeneous equations and equations reducible to homogeneous from;
- Week 8. Linear differential equations of the order and equations reducible to the linear form.
- Week 9. Bernoulli's equations and orthogonal trajectories, Applications of linear and non-linear equations
- Week 10. Special types of 2nd order differential equations with constant coefficients and their solutions: The operator D; Inverse operator I/D
- Week 11. Solution of differential by operator D methods; Special cases, Cauchy's differential equations; Simultaneous differential equations
- Week 12. Simple application of differential equations in relevant Engineering.
- Week 13. Partial Differential Equation basic concepts and formation of partial differential equations
- Week 14. Linear homogeneous partial differential equations and relations to ordinary differential equations
- Week 15. Solution of first order linear and special types of second and higher order differential equations;
- Week 16. D' Alembert's solution of the wave equation and two dimensional wave equations: Lagrange's solution; Various standard forms.

Resources:

- Elementary Linear Algebra by Howard Anton Seven Edition
- Advance Engineering Mathematics by Erwin Kreyszig Seven Edition
- Differential Equation A modeling Perspective by Robert L. Barrelli
- Introduction to Differential Equation by J. Farlaw
- Differential Equation by G. zill

Grading Rubric

Assessment Method	CLO 1	CLO 2	CLO 3
Final Exam (50)	10	15	25
Midterm Exam (20)	15	5	
Assignments (20)	5	7	8
Quizzes (10)	3	3	4
Total (100)	33	30	37

Appendage 3204

Roadmap of BCE

Academic Road Map for UG Programs Faculty of Engineering Sciences

Program Title: Bachelor of Computer Engineering (BCE)

Duration: 4 Years

Total Credit Hours: 136

Endorsement References:

A: Recommendations of DBOS dated 28-Sep-23

B: Recommendations of FBOS dated 06-Oct-23

Summary of Credit Hours

Sr. No.	Category as per PEC Revised Guidelines	Credit Hours/Contact Hours	
		PEC Revised Guidelines	BCE Roadmap - BU
1.	General Education	Min 38	44
2.	Engineering	Min 72	79
3.	Multidisciplinary	Min 6	7
4.	FYDP Capstone Project	6	06
5.	Flexible Engineering/ Non-Engineering Courses (may be adjusted as per the requirements)	8-14	-
	Total:	130-136	136

Minutes of the 32nd FBOS – ES

Knowledge Profile (WK-1 to WK-8)	Knowledge Area	Sub-Area	Courses	Credit Hours	Courses
			PEC Revised		BCE Alignment
Non-Engineering Domain					
WK2			Quantitative Reasoning-I /Equivalent	3	Applied Calculus & Analytical Geometry
			Quantitative Reasoning-II /Equivalent	3	Probability & Statistics
WK-1	Natural Science	Math	Advanced/Applied Math Courses	6-9	Differential Equations Linear Algebra Complex Variables & Transforms
		Natural Science (Physics, Chemistry, Math)	Applied Physics	3-9	Applied Physics
			Applied Chemistry		-
			Math Elective		Numerical Analysis
WK-7		English	Functional English	3	Functional English
			Expository Writing	3	Technical Writing
	Humanities	Culture	Islamic Studies/Ethics	2	Islamic Studies / Ethics Tajweed** Understanding Quran-I** Understanding Quran-II** Understanding Quran-III** Understanding Quran-IV** Understanding Quran-V** Seerah-I** Seerah-II**
			Ideology and Constitution of Pakistan	2	Pakistan Studies & Global Perspective
			Arts & Humanities (Languages etc.)	2	Communication Skills

Minutes of the 32nd FBOS – ES

	Social Science	Social Science	2	Social Science Elective-I	
		Applications of ICT	5	Computing Fundamentals	
		Civics and Community Engagement		Social Science Elective-II	
	Management Science	Professional Practice	Project Management	Community Support Program	
			Entrepreneurship	2	MS-Elective-I
Total (Non-Engineering Domain)				Min 38	
Knowledge Profile (WK-1 to WK-8)	Knowledge Area	Sub-Area	Courses	Credit Hours	Courses
			PEC Revised		BCE Alignmen
Engineering Domain					
WK-2/ WK-4/ WK-5/ WK-6	Computer and Information Sciences	AI/ Data Science / Cyber Security		6-9	Discrete Structures
					Computer Programming
WK-2/ WK-3	Foundation Engineering Courses	Specific to Program	22-24	Workshop Practices	
				Digital Logic Design	
				Circuit Analysis	
				Electronic Devices & Circuits	
				Object Oriented Programming	
				Data Structures & Algorithms	
				Signals & Systems	
WK-4/ WK-2/ WK-1	Core Breadth of Engineering Discipline			Computer Communication & Networks	
					Microprocessors & Interfacing
					Operating Systems
					Database Management Systems
					Software Engineering

Minutes of the 32nd FBOS – ES

					Digital Signal Processing		
WK-5/ WK-6	Core Depth of Engineering Discipline		Specific to Program	22-24	Computer Architecture & Organization		
					Digital System Design		
					CEDE-I		
					CEDE-II		
					CEDE-III		
					CEDE-IV		
				Min 72			
WK-1/ WK-2/ WK-3/ WK-4	Multi- Disciplinary Engineering Courses		Specific to Program Objectives and outcome	6	MDEE-I		
					MDEE-II		
WK-6/ WK-7/ WK-8	Final Year Design Project (FYDP)/ Capstone		Occupational Health and Safety (mandatory – 01 CH)	1	Occupational Health and Safety		
					Project-I		
WK-6/WK-7	Qualifying		Final Year Design Project (FYDP)/ Capstone	6	Project-II		
					Internship (06-08 Weeks)		
WK-2 / WK-4 / WK-5 / WK-6 / WK-7 / WK-8	Innovative & Critical Thinking (under relevant courses) - Complex Problem Solving - Complex Engineering Activities - Semester Project - Case Studies - Open-Ended Labs - Problem-Based Learning (PBL)				Innovative & Critical (under relevant courses) - Complex Problem Solving - Complex Engineering Activities - Semester Project - Case Studies - Open-Ended Labs - Problem-Based Learning (PBL)		
Total (Engineering Domain)				Min 84			
Flexible Engineering / Non Engineering Courses may be adjusted as per requirement				8-14			
Total (Credit Hours)				130-136	Total (Credit Hours)		

**Courses Compulsory for Muslim Students

Summary of Credit Hours

Sr. No.	Category as per HEC new UG Policy	Credit Hours/Contact Hours
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Minutes of the 32nd FBOS – ES

		Existing Road Map	Proposed New Road Map
1.	General Education (Mandatory)	44	44
2.	Major/Disciplinary (Mandatory)	72	72
3.	Interdisciplinary (Mandatory)	14	14
4.	Electives toward specialization	-	-
5.	Non-Credit courses (contact hours) – Tajweed, Quran and Hadith (Compulsory for Muslim students)	-	1 Contact hour per week for 8-Semesters
6	Internship (Mandatory)	-	6-8 Weeks non-credited (mandatory)
7.	Capstone Project (Mandatory)	6	6
8	Double Major (Optional)	-	-
9.	Minor (Optional)	-	-
Total		136	136

Semester-wise Revised Roadmap of BCE

Semester 1

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre- requisit e Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1	None	GSC 110	Applied Calculus & Analytical Geometry	3	General Education	9
2	None	ISL 101 /HSS 116	Islamic Studies / Ethics	2	General Education	4, 5, 16
3	None	CSC 110	Computing Fundamentals	2	General Education	9
4	None	CSL 110	Computing Fundamentals Lab	1	General Education	9

Minutes of the 32nd FBOS – ES

5	None	GSC 113	Applied Physics	3	General Education	9
6	None	GSL 113	Applied Physics Lab	1	General Education	9
7	None	ENG 101	Functional English	3	General Education	8
8	None	EEL 112	Workshop Practices	1	Major/Disciplinary (Mandatory)	9
9	None	ISL 107	Tajweed	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				16		

*Only for Muslim students

Semester 2

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1	None	GSC 120	Linear Algebra	2	General Education	9
2	GSC 113	CEN 121	Circuit Analysis	3	Major/Disciplinary (Mandatory)	9
3	GSC 113	CEL 121	Circuit Analysis Lab	1	Major/Disciplinary (Mandatory)	9
4	None	CSC 113	Computer Programming	3	Interdisciplinary (Mandatory)	9
5	None	CSL 113	Computer Programming Lab	1	Interdisciplinary (Mandatory)	9
6	None	PAK 103	Pakistan Studies & Global Perspective	2	General Education	16
7	None	ENV 101	Occupational Health & Safety	1	Interdisciplinary (Mandatory)	3, 11, 15

Minutes of the 32nd FBOS – ES

8	None	CEN 120	Digital Logic Design	3	Major/Disciplinary (Mandatory)	9
9	None	CEL 120	Digital Logic Design Lab	1	Major/Disciplinary (Mandatory)	9
10	None	ISL 108	Understanding Quran -I	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				17		

*Only for Muslim students

Semester 3

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1	None	CSC 115	Discrete Structures	3	Interdisciplinary (Mandatory)	9
2	GSC 113	EEN 224	Electronic Devices & Circuits	3	Major/Disciplinary (Mandatory)	9
3	GSC 113	EEL 224	Electronic Devices & Circuits Lab	1	Major/Disciplinary (Mandatory)	9
4	CSC 113	CSC 210	Object Oriented Programming	3	Major/Disciplinary (Mandatory)	9
5	CSC 113	CSL 210	Object Oriented Programming Lab	1	Major/Disciplinary (Mandatory)	9
6	None	HSS 118	Communication Skills	2	General Education	4

Minutes of the 32nd FBOS – ES

7	GSC 110	GSC 220	Complex Variables & Transforms	3	General Education	9
8	-	-	Social Science Elective-I	2	General Education	16
9	ISL 108	ISL 109	Understanding Quran -II	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours			18			

*Only for Muslim students

Semester 4

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1	GSC 110	GSC 210	Differential Equations	3	General Education	9
2	CSC 210	CSC 221	Data Structures & Algorithms	3	Major/Disciplinary (Mandatory)	9
3	CSC 210	CSL 221	Data Structures & Algorithms Lab	1	Major/Disciplinary (Mandatory)	9
4	None	EEN 313	Signals & Systems	3	Major/Disciplinary (Mandatory)	9
5	None	EEL 313	Signals & Systems Lab	1	Major/Disciplinary (Mandatory)	9
6	CEN 120	CEN 321	Microprocessors & Interfacing	3	Major/Disciplinary (Mandatory)	9
7	CEN 120	CEL 321	Microprocessors & Interfacing Lab	1	Major/Disciplinary (Mandatory)	9
8			MS-Elective-I	3	General Education	11, 14

Minutes of the 32nd FBOS – ES

9	ISL 109	ISL 110	Understanding Quran -III	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				18		

*Only for Muslim students

Semester 5

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre- requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1	CSC 221	CSC 320	Operating Systems	3	Major/Disciplinary (Mandatory)	9
2	CSC 221	CSL 320	Operating Systems Lab	1	Major/Disciplinary (Mandatory)	9
3	ENG 101	HSS 321	Technical Writing	2	General Education	8
4	CEN 120	CEN 221	Computer Architecture & Organization	3	Major/Disciplinary (Mandatory)	9
5	CEN 120	CEL 221	Computer Architecture & Organization Lab	1	Major/Disciplinary (Mandatory)	9
6	EEN 313	EEN 325	Digital Signal Processing	3	Major/Disciplinary (Mandatory)	9
7	EEN 313	EEL 325	Digital Signal Processing Lab	1	Major/Disciplinary (Mandatory)	9
8	None	CEN 223	Computer Communication & Networks	3	Major/Disciplinary (Mandatory)	9
9	None	CEL 223	Computer Communication & Networks Lab	1	Major/Disciplinary (Mandatory)	9

Minutes of the 32nd FBOS – ES

10	ISL 110	ISL 111	Understanding Quran-IV	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours			18			

*Only for Muslim students

Semester 6

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1			CEDE-I	3+1	Major/Disciplinary (Mandatory)	12
2	CSC 210	CSC 220	Database Management Systems	3	Major/Disciplinary (Mandatory)	9
3	CSC 210	CSL 220	Database Management Systems Lab	1	Major/Disciplinary (Mandatory)	9
4	None	SEN 220	Software Engineering	3	Major/Disciplinary (Mandatory)	9
5	None	GSC 122	Probability & Statistics	3	General Education	9
6			MDEE-I	3+0/2+1	Interdisciplinary (Mandatory)	9
7	ISL 111	ISL 112	Understanding Quran – V	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours			17			

*Only for Muslim students

Semester 7

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention

Minutes of the 32nd FBOS – ES

	Course Code					relevant SDG No.
1	CEN 221	CEN 442	Digital System Design	3	Major/Disciplinary (Mandatory)	9
2	CEN 221	CEL 442	Digital System Design Lab	1	Major/Disciplinary (Mandatory)	9
3			MS-Elective-II	2	General Education	8
4			CEDE-II	3+1	Major/Disciplinary (Mandatory)	12
5		ESC 498	Project-I	3	Capstone Project (Mandatory)	9
6	GSC 120	GSC 321	Numerical Analysis	2	General Education	9
7	GSC 120	GSL 321	Numerical Analysis Lab	1	General Education	9
8	None	ISL 113	Seerah – I	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				16		

*Only for Muslim students

Semester 8

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1		ESC 499	Project-II	3	Capstone project (Mandatory)	9
2			CEDE-III	3+1	Major/Disciplinary (Mandatory)	12
3			CEDE-IV	3+1	Major/Disciplinary (Mandatory)	12

Minutes of the 32nd FBOS – ES

4			MDEE-II	3+0/2+1	Interdisciplinary (Mandatory)	9
5			Social Science Elective-II	2	General Education	16
6	ISL 113	ISL 114	Seerah – II	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				16		

*Only for Muslim students

List of Elective Courses

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment (please mention relevant SDG No.)
1	None	SEN 320	Human Computer Interaction	3	Interdisciplinary (Mandatory)	9
2	None	CEN 429	Introduction to Block Chain Technologies	3	Interdisciplinary (Mandatory)	9
3	None	CSC 449	Neural Networks & Fuzzy Logic	3	Interdisciplinary (Mandatory)	9
4	EEN 313	CEN 458	Robotics	2+1	Interdisciplinary (Mandatory)	9
5	None	CEN 426	Introduction to Virtual Reality	3	Interdisciplinary (Mandatory)	9
6	None	SEN 420	Software Quality Assurance	3	Interdisciplinary (Mandatory)	9, 4
7	EEN 224	CEN 457	VLSI Design	2+1	Interdisciplinary (Mandatory)	9

Minutes of the 32nd FBOS – ES

8	None	CSC 457	Data Mining & Warehousing	2+1	Interdisciplinary (Mandatory)	9
9	None	GEO 437	GIS & Remote Sensing	3	Interdisciplinary (Mandatory)	9, 12
10	None	GEO 436	Health Safety & Environment	3	Interdisciplinary (Mandatory)	3, 11
11	None	CEN 427	Biomedical Engineering	3	Interdisciplinary (Mandatory)	9
12	None	SEN 449	Business Process Automation	3	Interdisciplinary (Mandatory)	8, 12
13	None	EEN 467	Control Engineering	3	Interdisciplinary (Mandatory)	9, 12
14	None	SEN 448	Software Applications and Mobile Devices	2+1	Interdisciplinary (Mandatory)	9
15	SEN 220	CSC 323	Compiler Construction	3	Interdisciplinary (Mandatory)	9
16	SEN 220	CSC 315	Theory of Automata	3	Interdisciplinary (Mandatory)	9
17	CSC 320	CEN 411	Cloud & Distributed Computing	3+1	Major/Disciplinary (Mandatory)	9
18	CEN 321	CEN 449	Internet of Things	3+1	Major/Disciplinary (Mandatory)	9, 12
19	CEN 321	CEN 440	Embedded System Design	3+1	Major/Disciplinary (Mandatory)	9
20	EEN 313	CEN 409	Artificial Intelligence & Machine Learning	3+1	Major/Disciplinary (Mandatory)	9, 12
21	EEN 313	CEN 444	Digital Image Processing	3+1	Major/Disciplinary (Mandatory)	9
22	CSC 113	CEN 408	System & Network Security	3+1	Major/Disciplinary (Mandatory)	9

Minutes of the 32nd FBOS – ES

23	CSC 320	CEN 454	System Programming	3+1	Major/Disciplinary (Mandatory)	9
24	CSC 320	CEN 407	High Performance Computing	3+1	Major/Disciplinary (Mandatory)	8, 9
25	CSC 221	CEN 326	Algorithm Design and Analysis	3+1	Major/Disciplinary (Mandatory)	8, 9
26	EEN 325	CEN 425	Hardware Design for DSP & ML	3+1	Major/Disciplinary (Mandatory)	9
27	CEN 442	CEN 462	Hardware Verification	3+1	Major/Disciplinary (Mandatory)	9
28	None	EMG 201	Engineering Project Management	3	General Education	8
29	None	MGT 423	Engineering Management	3	General Education	8
30	None	MTM 101	Introduction to Maritime Industry	3	General Education	14
31	None	EMG 222	Principles of Management	2	General Education	8
32	None	HSS 423	Entrepreneurship	2	General Education	8
33	None	HSS 412	Engineering Economics	2	General Education	8, 12
34	None	HSS 413	Sociology for Engineers	2	General Education	8
35	None	HSS 424	Engineering Ethics	2	General Education	4, 16
36	None	HSS 541	Organizational Behavior	2	General Education	16

Appendage 3205

Roadmap of BSE
Academic Road Map for UG Program
Faculty of Engineering Sciences

Program Title: Bachelor of Software Engineering (BSE)

Duration: 4 Years

Total Credit Hours: 134

Endorsement References:

A: Recommendations of FBOS dated 06-Oct-23

Summary of Credit Hours

Sr. No.	Category as per HEC new UG Policy	Credit Hours/Contact Hours	
		Existing Road Map	Proposed New Road Map
1.	General Education (Mandatory)	36	39
2.	Major/Disciplinary (Mandatory)	85	82
3.	Interdisciplinary (Mandatory)	7	7
4.	Electives toward specialization	-	-
5.	Non-Credit courses (contact hours) – Tajweed, Quran and Hadith (Compulsory for Muslim students)	-	8 Contact hours
6	Internship (Mandatory)	-	6-8 Weeks non-credited (mandatory)
7.	Capstone Project (Mandatory)	6	6
8	Double Major (Optional)	-	-
9.	Minor (Optional)	-	-
		Total	134
			134

Breakdown of Courses as Per PEC Guidelines

Knowledge Profile (WK-1 to WK-8)	Knowledge Area	Sub-Area	Sub-Area	Courses	Credit Hours	BU-BSE Revised Course Categorization
						Existing
				Revised	Course Title	Credit Hrs
Non-Engineering Domain						

Minutes of the 32nd FBOS – ES								
WK-2	Natural Science	Math	Math	***Quan titativ e Reaso ning-I (or equival ent course s for all Engin ering Discipli nes)	3	Applied Calculus & Analytical Geometry	3	
			***Quan titativ e Reaso ning- II (or equival ent course s for all Engin ering Discipli nes)	3	Probability & Statistics	3		
			***Adv anced/ Applie d Math Course s (as per require ment of the Engin ering Discipli nes)	6-9	Numerical Analysis	3		
					Linear Algebra	3		
				12-15	Total	12		
WK-1	Physics	Natural Science	***Applie d Physic s	3-9	Applied Physics	3		

Minutes of the 32nd FBOS – ES							
	Che mistr y	(Physi cs, Chemi stry, Math)	***Appl ied Chemi stry				
	Natur al Scie nce/ Math Electi ve		***Mat h Electiv e				
				3-9	Total	3	
WK-7	Huma nities	Engli sh	Englis h	** Functi onal Englis h	3	Functional English	3
				** Exposi tory Writing	3	Technical Writing & Presentation Skills	3
				6	Total	6	
	Cultu re	Cultur e	** Islam ic Studie s OR Religio us Educat ion/ Ethics in lieu of Islamic studies for non- Muslim stud ents	2	Islamic Studies/Ethics	2	
			** Ideolo gy and Constit ution of Pakist an	2	Pakistan Studies and Global Perspective	2	

Minutes of the 32nd FBOS – ES

			* Arts & Humanities (Languages or study of religion)	2	Effective Communication Skills	2
			6		Total	6
		Social Science	*** Social Science	2	CSP	0
					Social Science Elective - II	2
			** Applications of ICT	5	Computing Fundamentals	3
			** Civics and Community Engagement		Social Science Elective - I (** Civics and Community Engagement)	2
			7		Total	7
Management Sciences	Professional Practice	Professional Practice	*** Project Management	2	Management Science Elective-I	3
			** Entrepreneurship	2	Management Science Elective-II (Entrepreneurship)	2
			4		Total	5
Total (Non-Engineering)		Total (Non-Engineering)		Min 38		
Total (Non Engineering)						39

Knowledge Profile (WK-1 to WK-8)	Knowledge Area	Sub-Area	Sub-Area	Courses	Credit Hours	BU Revised Course Categorisation		
		Existing		Revised		Course Title	Credit Hrs	
		Engineering Domain						

Minutes of the 32nd FBOS – ES

WK-2/ WK-4/ WK-5/ WK-6/	Computer and Informa- tion Scienc- es	ICT/ AI/ Data Scie- nce/ Cyber Secu- rity	AI/ Data Scienc- e/ Cyber Securi- ty		6 — 9	Computer Programming	4
						Information Security	3
					6-9	7	
WK- 3/WK-2	Found ation Engg Cours es	Found ation Engg Cours es	Specifi c to progra m objecti ves and outco mes	22 — 24	Discrete Structures	3	
					Computer Architecture and Logic Design	4	
					Object Oriented Programming	4	
					Operating Systems	4	
					Database Management System	4	
					Computer Communication & Networks	4	
					Data Structures & Algorithms	4	
					27		
WK- 4/WK- 2/WK-1	Core Breadt h of Engg discipli ne	Core Breadt h of Engg discipli ne	Specifi c to progra m objecti ves and outco mes	22 — 24	Introduction to Software Engineering	3	
					Software Requirement Engineering	3	
					Design and Analysis of Algorithms	3	
					Software Design & Architecture	3	
					Software Construction	3	
					Human Computer Interaction	3	
					Cloud Computing	3	
					Software Project Management	3	

Minutes of the 32nd FBOS – ES

					22-24		24
WK-5/ WK-6/	Core Depth of Engg discipli ne	Core Depth of Engg discipli ne	Specifi c to progra m objecti ves and outco me	22 — 24	Formal Methods in Software Engineering	3	
					Software Quality Engineering	3	
					Engineering Elective-I*	3	
					Engineering Elective-II*	3	
					Engineering Elective-III*	3	
					Engineering Elective-IV*	3	
					Engineering Elective-V*	3	
					Engineering Elective-VI*	3	
							24
							82
WK- 4/WK- 3/WK- 2/WK-1	Multidi sciplin ary Engg Cours es	Multidi sciplin ary Engg Cours es	Occup ational Health and Safety (mand atory- 01 Cr Hr)	6	Occupational Health and Safety	1	
					MDEE-I*	3	
			Specifi c to progra m objecti ves and outco me		MDEE-II*	3	
				6			7
WK-6/ WK-8/ WK-7	Final Year Desig n Projec t	Integ ratio n of innov ative, creati	Final Year Design Project (FYDP)/ Capstone		6	Final Year Project I	3
						Final Year Project II	3

Minutes of the 32nd FBOS – ES

	(FYDP)/ Capstone	ve, technical, management and presentation skills of a graduate towards final year.					
					6		6
WK-6/ WK-7/	I ndustri al Traini ng	a t least 6 - 8 week s inter nship	Internship (06-08 Weeks)	Mandatory & Qualifying	Internship (06-08 Weeks)		Mandator y & Qualifyin g
				Total (Engin eering domai n)	Min 84		
Total (Engineering)						95	
Total Credit Hrs						134	

Minutes of the 32nd FBOS – ES
Semester-wise Revised Roadmap of BSE

Semester 1

Sr. No .	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs Alignmen t
1	None	CSC 110	Computing Fundamentals	2	General Education	9
2	None	CSL 110	Computing Fundamentals Lab	1	General Education	9
3	None	CSC 113	Computer Programming	3	Major/Disciplinary (Mandatory)	9
4	None	CSL 113	Computer Programming Lab	1	Major/Disciplinary (Mandatory)	9
5	None	ENG 101	Functional English	3	General Education	4
6	None	GSC 110	Applied Calculus & Analytical Geometry	3	General Education	9
7	None	GSC 114	Applied Physics	2	General Education	9
8	None	GSL 113	Applied Physics Lab	1	General Education	9
9	None	ENV 101	Occupational Health and Safety	1	Interdisciplinary (Mandatory)	3
10	None	ISL 107	Tajweed	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				17		

*Only for Muslim students

Semester 2

Sr. No .	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs Alignmen nt
1	None	CSC 115	Discrete Structures	3	Major/Disciplinary (Mandatory)	9
2	Computer Programming (CSC 113)	CSC 210	Object Oriented Programming	3	Major/Disciplinary (Mandatory)	9
3	Computer Programming (CSC 113)	CSL 210	Object Oriented Programming Lab	1	Major/Disciplinary (Mandatory)	9
4	None	SEN 120	Introduction to Software Engineering	3	Major/Disciplinary (Mandatory)	9
5	Functional English (ENG 101)	ENG 134	Effective Communication Skills	2	General Education	4
6	None	ISL 101	Islamic Studies*/Ethics **	2	General Education	5, 10
7	None	GSC 121	Linear Algebra	3	General Education	9
8	ISL 107	ISL 108	Understanding Quran- I	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				17		

*Only for Muslim students

**Only for Non-Muslim students

Semester 3

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs Alignmen nt
1	CSC 210	CSC 221	Data Structures & Algorithms	3	Major/Disciplinary (Mandatory)	9

Minutes of the 32nd FBOS – ES

2	CSC 210	CSL 221	Data Structures & Algorithms Lab	1	Major/Disciplinary (Mandatory)	9
3	SEN 120	SEN 211	Software Requirements Engineering	3	Major/Disciplinary (Mandatory)	9
4	None	GS C 122	Probability & Statistics	3	General Education	9
5		-	Social Science Elective-I	2	General Education	4
6	None	CEN 220	Computer Architecture & Logic Design	3	Major/Disciplinary (Mandatory)	9
7	None	CEL 220	Computer Architecture & Logic Design Lab	1	Major/Disciplinary (Mandatory)	9
8	None	PAK 103	Pakistan Studies and Global Perspective	2	General Education	5, 10, 11
9	ISL 108	ISL 109	Understanding Quran-II*	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours					18	

*Only for Muslim students

Semester 4

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment
1	CEN 220	CSC 320	Operating Systems	3	Major/Disciplinary (Mandatory)	9
2	CEN 220	CSL 320	Operating Systems Lab	1	Major/Disciplinary (Mandatory)	9
3	CSC 113	CSC 220	Database Management Systems	3	Major/Disciplinary (Mandatory)	9
4	CSC 113	CSL 220	Database Management Systems Lab	1	Major/Disciplinary (Mandatory)	9
5	CSC 221	CSC 321	Design & Analysis of Algorithms	3	Major/Disciplinary (Mandatory)	9

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6	SEN 211	SEN 221	Software Design & Architecture	2	Major/Disciplinary (Mandatory)	9
7	SEN 211	SEL 221	Software Design & Architecture Lab	1	Major/Disciplinary (Mandatory)	9
8	-	-	Management Science Elective-I	2	General Education	4
9	ISL 109	ISL 110	Understanding Quran-III	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				16		

*Only for Muslim students

Semester 5

Sr. No	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment
1	None	CEN 223	Computer Communication & Networks	3	Major/Disciplinary (Mandatory)	9
2	None	CEL 223	Computer Communication & Networks Lab	1	Major/Disciplinary (Mandatory)	9
3	GSC 110	SEN 323	Formal Methods in Software Engineering	3	Major/Disciplinary (Mandatory)	9
4	SEN 221	SEN 311	Software Construction	2	Major/Disciplinary (Mandatory)	9
5	SEN 221	SEL 311	Software Construction Lab	1	Major/Disciplinary (Mandatory)	9
6	-	-	Engineering Elective-I**	3	Electives toward specialization	9
7	-	-	MDEE-I**	3	Interdisciplinary (Mandatory)	9
8	-	-	Social Science-II	2	General Education	5,10,11
9	ISL 110	ISL 111	Understanding Quran-IV	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16

Total Credit Hours	18
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*Only for Muslim students

**Course is either 2+1 or 3+0 depending on the included lab component

Semester 6

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs Alignment
1	SEN 120	SEN 321	Software Quality Engineering	3	Major/Disciplinary (Mandatory)	9
2	None	SEN 320	Human Computer Interaction	3	Major/Disciplinary (Mandatory)	9
3	None	ENG 320	Technical Writing & Presentation Skills	3	General Education	4
4	-	-	Engineering Elective-II**	3	Electives toward specialization	9
5	-	-	Engineering Elective-III**	3	Electives toward specialization	9
6	None	SEN 401	Cloud Computing	2	Major/Disciplinary (Mandatory)	9
7	None	SEL 401	Cloud Computing Lab	1	Major/Disciplinary (Mandatory)	9
8	ISL 111	ISL 112	Understanding Quran-III	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4 ,10, 16
Total Credit Hours				18		

*Only for Muslim students

**Course is either 2+1 or 3+0 depending on the included lab component

Semester 7

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs Alignment
1	None	FYP 400	Final Year Project I	3	Capstone project (Mandatory)	1, 2, 3, 4, 5, 7, 8, 9, 10, 12, 13, 15
2	SEN 120	SEN 410	Software Project Management	3	Major/Disciplinary (Mandatory)	9

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3	None	CSC 407	Information Security	3	Major/Disciplinary (Mandatory)	9
4	GSC 110	GSC 321	Numerical Analysis	2	Major/Disciplinary (Mandatory)	9
5	GSC 110	GSL 321	Numerical Analysis Lab	1	Major/Disciplinary (Mandatory)	9
6	-	-	Engineering Elective-IV **	3	Electives toward specialization	9
7	-	-	Management Science Elective-II	3	General Education	4
8	ISL 112	ISL 113	Seerah-I	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				18		

*Only for Muslim students

**Course is either 2+1 or 3+0 depending on the included lab component

Semester 8

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs alignment
1	None	FYP 400	Final Year Project II	3	Capstone project (Mandatory)	1, 2, 3, 4, 5, 7, 8, 9, 10, 12, 13, 15
2	-	-	Engineering Elective-V **	3	Electives toward specialization	9
3	-	-	Engineering Elective-VI **	3	Electives toward specialization	9
4	-	-	MDEE-II	3	Interdisciplinary (Mandatory)	9
5	ISL 113	ISL 114	Seerah-II	1 Contact Hour	Non-Credit course Tajweed, Quran and Hadith (Compulsory*)	4, 10, 16
Total Credit Hours				12		

*Only for Muslim students

** Course is either 2+1 or 3+0 depending on the included lab component

Minutes of the 32nd FBOS – ES
List of Elective Courses

Sr. No.	Proposed Road map aligned with HEC new UG Policy					
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	HEC Category	17 UN SDGs Alignment
1	GSC 110	GSC 210	Differential Equations	3+0	Interdisciplinary (Mandatory)	9
2	GSC 110	GSC 220	Complex Variables and Transforms	3+0	Interdisciplinary (Mandatory)	9
3	GSC 122	GSC 445	Operations Research	3+0	Interdisciplinary (Mandatory)	9
4	GSC 122	CEN 450	Simulation and Modeling	2+1	Interdisciplinary (Mandatory)	9
5	GSC 114	GSC 446	Physics-II (Mechanics)	3+0	Interdisciplinary (Mandatory)	9
6	GSC 122	GSC 440	Stochastic Processes	3+0	Interdisciplinary (Mandatory)	9
7	CSC 320	SEN 439	System Programming	2+1	Interdisciplinary (Mandatory)	9
8	CSC 320	CEN 453	Real Time Systems	3+0	Interdisciplinary (Mandatory)	9
9	CSC 315	CSC 323	Compiler Construction	2+1	Interdisciplinary (Mandatory)	9
10	GSC 110	CSC 453	Information Theory	3+0	Interdisciplinary (Mandatory)	9
11	CSC 113	SEN 460	IoT Application Development	2+1	Interdisciplinary (Mandatory)	9
12	None	CEN 122	Digital Design	2+1	Interdisciplinary (Mandatory)	9
13	None	CSC 448	Introduction to Bio-Informatics	3+0	Interdisciplinary (Mandatory)	9
14	None	CEN 459	Robotics	2+1	Interdisciplinary (Mandatory)	9
15	None	CSC 315	Theory of Automata	3+0	Interdisciplinary (Mandatory)	9
16	None	CEN 439	Embedded System Design	2+1	Interdisciplinary (Mandatory)	9
17	None	SEN 429	Fault Tolerant Systems	3+0	Interdisciplinary (Mandatory)	9
18	None	SEN 449	Business Process Automation	3+0	Interdisciplinary (Mandatory)	9
19	None	HSS 422	Engineering Ethics	3+0	Interdisciplinary (Mandatory)	3,10
20	CSC 113	CSC 313	Visual Programming	2+1	Electives toward specialization	9

Minutes of the 32nd FBOS – ES

21	CSC 113	CSC 445	Principles of Programming Languages	3+0	Electives toward specialization	9
22	CSC 210	SEN 328	Game Application Development	2+1	Electives toward specialization	9
23	CSC-113	SEN 441	Mathematical Tools For Software Engineering	3+0	Electives toward specialization	9
24	GSC 122	CSC 441	Natural Language Processing	3+0	Electives toward specialization	9
25	CSC 210	CSC 456	Distributed Computing	2+1	Electives toward specialization	9
26	CSC 220	CSC 460	Data Mining	2+1	Electives toward specialization	9
27	CSC 220	CSC 454	Data Warehousing	3+0	Electives toward specialization	9
28	SEN 120	CSC 458	Management Information Systems	3+0	Electives toward specialization	9
29	CSC 220	SEN 326	Advanced Database Management Systems	2+1	Electives toward specialization	9
30	CSC 220	SEN 327	Distributed Database Systems	3+0	Electives toward specialization	9
31	GSC 121	CEN 445	Digital Image Processing	2+1	Electives toward specialization	9
32	CEN 445	CSC 464	Computer Vision	3+0	Electives toward specialization	9
33	SEN 120	SEN 335	Object Oriented Software Engineering	2+1	Electives toward specialization	9
34	SEN 311	SEN 411	Software Re-Engineering	3+0	Electives toward specialization	9
35	CSC 113	SEN 310	Web Engineering	2+1	Electives toward specialization	9
36	CSC 113	SEN 461	Secure Programming	2+1	Electives toward specialization	9
37	SEN 120	SEN 429	DevOps	3+0	Electives toward specialization	9
38	CSC 113	AIC 301	Machine Learning	2+1	Electives toward specialization	9
39	None	SEN 448	Software Applications For Mobile Devices	2+1	Electives toward specialization	9
40	None	SEN 324	Software Metrics & Estimation	3+0	Electives toward specialization	9
41	None	SEN 450	Design Pattern	3+0	Electives toward specialization	9
42	None	SEN 452	Agile Development	3+0	Electives toward specialization	9

Minutes of the 32nd FBOS – ES

43	None	CSC 411	Artificial Intelligence	2+1	Electives toward specialization	9
44	None	SEN 443	Introduction to Soft Computing	2+1	Electives toward specialization	9
45	None	SEN 331	Scientific Computing	3+0	Electives toward specialization	9
46	None	SEN 330	Agent Based Computing	3+0	Electives toward specialization	9
47	None	SEN 459	Mobile and Pervasive Computing	3+0	Electives toward specialization	9
48	None	CEN 451	Data Encryption & Security	3+0	Electives toward specialization	9
49	None	CSC 495	Introduction to Data Science	2+1	Electives toward specialization	9
50	None	SEN 332	Big Data Analytics	3+0	Electives toward specialization	9
51	None	SEN 455	Knowledge Based Management Systems	3+0	Electives toward specialization	3
52	None	SEN 453	Information System Audit	3+0	Electives toward specialization	9
53	None	CSC 444	Computer Graphics	2+1	Electives toward specialization	9
54	None	SEN 329	Digital Animation	3+0	Electives toward specialization	9
55	None	SEN 493	Multimedia Systems	3+0	Electives toward specialization	9
56	None	SEN 424	Semantic Web	2+1	Electives toward specialization	9
57	None	SEN 456	Usability Engineering	3+0	Electives toward specialization	9
58	None	HSS 217	Introduction to Sociology	2+0	Humanities & Social Sciences Elective	4
59	None	HSS 119	Introduction to International Relations	2+0	Humanities & Social Sciences Elective	4
60	None	HSS 121	Introduction to Media Studies	2+0	Humanities & Social Sciences Elective	4
61	None	HSS 218	Introduction to Anthropology	2+0	Humanities & Social Sciences Elective	4
62	None	HSS 457	Organizational Behavior	2+0	Humanities & Social Sciences Elective	4
63	None	HSS 107	Introduction to Psychology	2+0	Humanities & Social Sciences Elective	3

Minutes of the 32nd FBOS – ES

64	None	HSS 413	Sociology for Engineers	2+0	Humanities & Social Sciences Elective	4, 9, 11, 16, 17
65	None	SEN 442	Software Engineering Economics	2+0	Humanities & Social Sciences Elective	4, 9, 12
66	None	ENG 121	English Literature	2+0	Humanities & Social Sciences Elective	4
67	None	HSS 462	Foreign Language	2+0	Humanities & Social Sciences Elective	4
68	None	HSS 463	Accounting & Finance	2+0	Humanities & Social Sciences Elective	4
69	None	HSS 464	Civics and Community Engagement	2+0	Humanities & Social Sciences Elective	4
70	None	MGT 111	Principles of Management	3+0	Management Science Elective	4, 11, 12
71	None	HSS 453	Human Resource Management	3+0	Management Science Elective	4, 11, 12
72	None	MGT 423	Engineering Management	3+0	Management Science Elective	4, 9, 12
73	None	HSS 423	Entrepreneurship	2+0	Management Science Elective	4, 8, 9, 17
76	None	MTM 101	Introduction to Maritime Industry	3+0	Management Science Elective	14

Appendage 3206

**Roadmap of PhD Environmental Sciences, Geology, Geophysics
Academic Road Map for PhD Programs
Faculty of Engineering Sciences**

Program Title: PhD Environmental Sciences

Duration: 3 to 8 years

Total Credit Hours: 54

Endorsement References:

- A: Recommendations of DBOS dated 27-Sep-23
- B: Recommendations of FBOS dated 03-Oct-23

Summary of Credit Hours

Sr. No.	Courses as per HEC new GE Policy 2023 (All courses at Ph.D. level must be 800 level)	Credit Hours	
		Existing Road Map	Proposed New Road Map

Minutes of the 32nd FBOS – ES

1.	Major/Disciplinary	9	9
2.	Electives Courses	9	9
3.	Interdisciplinary courses	-	-
3.	Thesis	36	36
4.	Deficiency course in case of candidate from other domain or interdisciplinary domain	-	6-9 *
Total		54	54

*Subject to allocation of deficiency courses by admission committee.

Semester-wise Revised Road map of PhD Environmental Sciences

Semester 1

Sr. No.	Proposed Road map aligned with HEC Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1	None	ENV 801	Recent Trends in Environmental Sciences	3	4, 13
2	None	ENV 802	Advanced Ecosystem Management	3	11, 14, 15
3	None	-	Elective course	3	-
Total Credit Hours				9	

Semester 2

Sr. No.	Proposed Road map aligned with HEC Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1	None	ENV 803	Environmental Health Risk Assessment	3	3, 8
3	None	-	Elective course	3	-
3	None	-	Elective course	3	-
Total Credit Hours				9	

Semester 3

Sr. No.	Proposed Road map aligned with HEC new UG Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1		THS 900	PhD Thesis	3	4, 9
Total Credit Hours				3	

Semester 4

Sr. No.	Proposed Road map aligned with HEC new UG Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1		THS 900	PhD Thesis	3	4, 9
Total Credit Hours				3	

Semester 5

Sr. No.	Proposed Road map aligned with HEC new UG Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1		THS 900	PhD Thesis	3	4, 9
Total Credit Hours				3	

Semester 6

Sr. No.	Proposed Road map aligned with HEC new UG Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1		THS 900	PhD Thesis	3	4, 9
Total Credit Hours				3	

List of Electives Courses

Sr. No.	Proposed Road map aligned with HEC Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1	None	ENV 804	Independent Research Study	3	4
2	None	ENV 805	Air Pollution & Control	3	7, 13, 15
3	None	ENV 806	Environmental Seminar	3	4
4	None	ENV 807	Field Trips to Industries	3	7, 8, 9
5	None	ENV 808	Environmental Monitoring, Sampling and Analysis	3	6, 13, 14, 15
6	None	ENV 809	Environmental Data Analysis	3	4, 8

Minutes of the 32nd FBOS – ES

7	None	ENV 810	Critical Review of Literature	3	4
8	None	ENV 811	Environmental Pollution and Climate Change	3	13, 14, 15
9	None	ENV 812	Advanced Environmental Legislation and Regulations	3	12, 16
10	None	ENV 813	Hazardous Solid Waste Management	3	6, 11 14, 15
11	None	ENV 814	Natural Resources & Associated Problems	3	11, 12
12	None	ENV 815	Environmental Social Issues	3	10, 12
13	None	ENV 816	Alternative Energy Sources	3	7
14	None	ENV 817	Advanced Research Methodology	3	4, 17

List of Deficiency Courses

Deficiency courses can be selected from 700-level courses of MS Environmental Sciences Roadmap, as recommended by the Admission Committee.

Minutes of the 32nd FBOS – ES
Academic Road Map for PhD Programs
Faculty of Engineering Sciences

Program Title: **PhD Geology**

Duration: 3 to 8 Years

Total Credit Hours: 54

Endorsement References: A: Recommendations of DBOS dated 27-Sep-2023

B: Recommendations of FBOS dated 03-Oct-2023

Summary of Credit Hours

Sr. No.	Courses as per HEC new GE Policy 2023 (All courses at Ph.D. level must be 800 level)	Credit Hours	
		Existing Road Map	Proposed New Road Map
1.	Major/Disciplinary	9	9
2.	Electives Courses	9	9
3.	Interdisciplinary courses	-	-
3.	Thesis	36	36
4.	Deficiency course in case of candidate from other domain or interdisciplinary domain	-	6-9 *
Total		54	54

*Subject to allocation of deficiency courses by admission committee.

Minutes of the 32nd FBOS – ES
Semester-wise Revised Road map of PhD Geology

Semester 1

Sr. No.	Proposed Road map aligned with HEC new UG Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1		GEO 801	Tectonic Evolution of Pakistan	3	9
2		GEO 802	Geosciences Seminar	3	4, 9
3		GEO 8XX	Elective course-I	3	-
Total Credit Hours			9		

Semester 2

Sr. No.	Proposed Road map aligned with HEC new UG Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1		GEO 871	Advanced Petroleum Geology	3	8
2		GEO xx	Elective course- II	3	-
3		GEO 8xx	Elective course-III	3	-
Total Credit Hours			9		

Semester 3

Sr. No.	Proposed Road map aligned with HEC new UG Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1		THS 900	PhD Thesis	3	4, 8, 9
Total Credit Hours			3		

Semester 4

Sr. No.	Proposed Road map aligned with HEC new UG Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1		THS 900	PhD Thesis	3	4, 8, 9
Total Credit Hours			3		

Semester 5

Sr. No.	Proposed Road map aligned with HEC new UG Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1		THS 900	PhD Thesis	3	4, 8, 9
Total Credit Hours			3		

Semester 6

Sr. No.	Proposed Road map aligned with HEC new UG Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1		THS 900	PhD Thesis	3	4, 8, 9
Total Credit Hours			3		

List of Electives Courses

Sr. No.	Proposed Road map aligned with HEC new UG Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1		GEO 831	Igneous Petrogenesis	3	4, 8
2		GEO 832	Stable Isotope Geoscience	3	4, 8
3		GEO 833	Ore Mineralogy	3	4, 8
4		GEO 834	Geochemical Prospecting	3	4, 8
5		GEO 835	Radiogenic Isotopes Geoscience	3	4, 8
6		GEO 836	Ore Petrology	3	4, 8
7		GEO 837	Applied Mineralogy	3	4, 8
8		GEO 838	Fluid Inclusions	3	4, 8
9		GEO 839	Gemmology	3	4, 8
10		GEO 840	Metamorphic Petrogenesis	3	4, 8
11		GEO 841	Advanced Geochemistry	3	4, 8
12		GEO 842	Advanced Mineralogy	3	4, 8
13		GEO 843	Mineral Prospecting and Exploration	3	4, 8
14		GEO 844	Mineral Deposit Evaluation	3	4, 8
15		GEO 845	Carbonate Sedimentology	3	4, 8
16		GEO 846	Clastic Sedimentology	3	4, 8
17		GEO 847	Petroleum Geochemistry	3	4, 8
18		GEO 848	Advanced Marine Geology	3	4, 8
19		GEO 814	Hydrocarbon Exploration Techniques	3	4, 8
20		GEO 850	Advanced Basin Analysis	3	4, 8

Minutes of the 32nd FBOS – ES

21		GEO 851	Reservoir Characterization	3	4, 8
22		GEO 852	Advanced Micropaleontology	3	4, 8
23		GEO 853	Advanced Sequence Stratigraphy	3	4, 8
24		GEO 854	Watershed Management	3	3, 4, 6, 15
25		GEO 855	Contaminant Hydrogeology	3	3, 4, 6, 15
26		GEO 856	Advanced Rock Mechanics	3	4, 11
27		GEO 857	Advanced Soil Mechanics	3	4, 11
28		GEO 858	Advanced Quantitative Hydrogeology	3	4, 6, 15
29		GEO 859	Advance Engineering Geology	3	4, 11
30		GEO 860	Ground Water Modeling (Flow and Transport)	3	4, 6, 15
31		GEO 861	Advanced Hydrogeochemistry	3	4, 6, 15
32		GEO 862	Desertification	3	4, 13
33		GEO 863	Geotechnical Engineering	3	4, 11
34		GEO 866	Advanced Instrumentation	3	4, 9
35		GEO 867	Glaciology	3	4, 13
36		GEO 868	Advanced Structural Geology	3	4, 9
37		GEO 829	Advanced Earthquake Seismology	3	11, 15
38		GEO 869	Geostatistics	3	4, 7, 12, 13
39		GEO 826	Disaster Risk Management	3	4, 11, 15
40		GEO 870	Advanced Geoinformatics	3	4, 8, 9
41		GEO 810	Petrophysics	3	4, 8
42		ESC 801	Research Methods in PhD Studies	3	4

List of Deficiency Courses

Deficiency courses can be selected from 700-level courses of MS Geology Roadmap, as recommended by the Admission Committee.

Academic Road Map for PhD Programs
Faculty of Engineering Sciences

Program Title: PhD Geophysics

Duration: 3 to 8 years

Total Credit Hours: 54

Endorsement References:

A: Recommendations of DBOS dated 27th September 2023

B: Recommendations of FBOS dated 3rd October 2023

Summary of Credit Hours

Sr. No.	Courses as per HEC new GE Policy 2023 (All courses at Ph.D. level must be 800 level)	Credit Hours/Contact Hours	
		Existing Road Map	Proposed New Road Map
1.	Major/Disciplinary	9	9
2.	Electives Courses	9	9
3.	Interdisciplinary courses	-	-
3.	Thesis	36	36
4.	Deficiency course in case of candidate from other domain or interdisciplinary domain	Nil	6-9 *
Total		54	54

* Subject to allocation of deficiency courses by the Admission Committee.

Minutes of the 32nd FBOS – ES
Semester-wise Revised Road map of PhD Geophysics

Semester 1

Sr. No.	Proposed Road map aligned with HEC new PG Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1		GEO 814	Hydrocarbon Exploration Techniques	3	8, 4
2		GEO 828	Contemporary Trends in Geosciences	3	4
3		GEO 8xx	Elective course I	3	
Total Credit Hours			9		

Semester 2

Sr. No.	Proposed Road map aligned with HEC new PG Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1		GEO 803	Seismic Imaging Techniques	3	4, 8
2		GEO 8xx	Elective course II	3	-
3		GEO 8xx	Elective course III	3	-
Total Credit Hours			9		

Semester 3

Sr. No.	Proposed Road map aligned with HEC new PG Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1		THS 900	PhD Thesis	9	4, 8, 9
Total Credit Hours			9		

Semester 4

Sr. No.	Proposed Road map aligned with HEC new PG Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1	None	THS 900	PhD Thesis	9	4, 8 , 9

Total Credit Hours | 9

Semester 5

Sr. No.	Proposed Road map aligned with HEC new PG Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1	None	THS 900	PhD Thesis	9	4, 8, 9
Total Credit Hours		9			

Semester 6

Sr. No.	Proposed Road map aligned with HEC new PG Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1	None	THS 900	PhD Thesis	9	4, 8, 9
Total Credit Hours		9			

List of Electives Courses

Sr. No.	Proposed Road map aligned with HEC new PG Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1		ESC 801	Research Methods in PhD Studies	3	4
2		GEO 801	Tectonic Evolution of Pakistan	3	4
3		GEO 804	3D Seismic Attributes for Reservoir Characterization	3	8, 12
4		GEO 805	3D Seismic Acquisition in Offshore & Onshore	3	4, 8
5		GEO 806	Reservoir Modeling	3	8, 12
6		GEO 807	GIS applications in Geophysics	3	9, 11, 12, 13
7		GEO 808	Signal Processing in Geophysics	3	4
8		GEO 809	Geosciences Software	3	4
9		GEO 810	Petrophysics	3	8
10		GEO 811	Advanced Reflection Seismology	3	4, 8
11		GEO 812	Mining Geophysics	3	8, 9
12		GEO 813	Gravity & Magnetic Modeling	3	8
13		GEO 826	Disaster Risk Management	3	9, 11
14		GEO 829	Advanced Earthquake Seismology	3	9, 11
15		GEO 850	Advanced Basin Analysis	3	8
16		GEO 851	Reservoir Characterization	3	8
17		GEO 853	Advanced Sequence Stratigraphy	3	4
18		GEO 868	Advanced Structural Geology	3	4, 13
19		GEO 869	Geostatistics	3	4, 9
20		GEO 871	Advanced Petroleum Geology	3	8
21		GEO 872	Advanced Electrical Methods	3	6, 7

List of Deficiency Courses

Minutes of the 32nd FBOS – ES

Course will be selected from MS Geophysics with 700 code, as per recommendation of Admission Committee.

Course Outline for PhD Geophysics

Course Name: Advanced Electrical Methods

Course Code: GEO 872

Credit Hours: 3

Pre-requisite: None

Course Objectives

The objectives of this course are:

- Introduce students to electrical resistivity prospecting methods and their applications in investigating subsurface conditions.
- Provide students with opportunities to develop acquisition, processing and interpretation skills using the electrical methods.

Course Learning Outcomes

1. Understand the various electrical prospecting methods applicable in geophysical exploration.
2. Explain the basic principles of Self Potential, Induced Polarization and Electrical Resistivity Methods.
3. Explain the field procedures applicable to each method

Course Contents

Principle and theory of Electrical Resistivity method and knowledge of current flow in the Earth. Electric potentials and fields. Static charge distributions. Resistivity Imaging study its survey designing for Geophysical Electrical Exploration. Field procedures including Instruments and electrode arrangements. Processing and interpretation of resistivity data. Its limitations, advantages and disadvantages. Basic principle and theory of Induced polarization method its field procedure, data acquisition, interpretation, limitations, advantages and disadvantages. Basic principle and theory of Self potential method its field procedure, data acquisition, interpretation, limitations, advantages and disadvantages. Basic principle and theory of Electromagnetic method including Telluric Method and Magneto telluric Method, survey designing, data acquisition, interpretation, limitations, advantages and disadvantages. Basic principle and theory of Charge body potential Method Mise A La Masse method and its applications. Study of case histories of all electrical methods.

Resources

- Kaufman, A. A., Alekseev, D., & Oristaglio, M. (2014). *Principles of electromagnetic methods in surface geophysics*. Newnes.
- Fitch, A. A. (Ed.). (2012). *Developments in Geophysical Exploration Methods—3*. Springer Science & Business Media.
- Fitch, A. A. (Ed.). (2012). *Developments in Geophysical Exploration Methods—3*. Springer Science & Business Media.
- Kaufman, A. A., & Anderson, B. (2010). *Principles of electric methods in surface and borehole geophysics*. Elsevier.
- Yungul, S. H. (1996). *Electrical methods in geophysical exploration of deep*

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sedimentary basins. Springer.William R. Shadish, Thomas D. Cook, Donald T. Campbell, 2001, Experimental and Quasi-Experimental Designs for Generalized Causal Inference. Houghton Mifflin. 623

Appendage 3207

Roadmap of PhD CS

Academic Road Map for PhD Programs Faculty of Engineering Sciences

Program Title: PhD Computer Science

Duration: 3 to 8 Years

Total Credit Hours: 54

Endorsement References:

A: Recommendations of DBOS dated 26-Sep-23

B: Recommendations of FBOS dated 03-Oct-23

Summary of Credit Hours

Sr. No.	Courses as per HEC new GE Policy 2023 (All courses at Ph.D. level must be 800 level)	Credit Hours/Contact Hours	
		Existing Road Map	Proposed New Road Map
1.	Major Disciplinary/University Requirement	-	3
2.	Electives Courses	18	15
3.	Interdisciplinary courses	-	-
3.	Thesis	36	36
4.	Deficiency course in case of candidate from other domain or interdisciplinary domain	-	6-9 *
Total		54	54

*Subject to allocation of deficiency courses by admission committee.

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Semester-wise Revised Road map of PhD CS

Semester 1

Sr. No.	Proposed Road map aligned with HEC Graduate Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1	None	ESC 801	Research Methods in PhD Studies	3	4
2			Elective I	3	-
3			Elective II	3	-
Total Credit Hours			9		

Semester 2

Sr. No.	Proposed Road map aligned with HEC Graduate Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1			Elective III	3	-
2			Elective IV	3	-
3			Elective V	3	-
Total Credit Hours			9		

Semester 3

Sr. No.	Proposed Road map aligned with HEC new PG Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1			Comprehensive exam	0	
2		THS 900	PhD Thesis	9	4, 8, 9
Total Credit Hours			9		

Semester 4

Sr. No.	Proposed Road map aligned with HEC new PG Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1		THS 900	PhD Thesis	9	4, 8, 9
Total Credit Hours				9	

Semester 5

Sr. No.	Proposed Road map aligned with HEC new PG Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1		THS 900	PhD Thesis	9	4, 8, 9
Total Credit Hours				9	

Semester 6

Sr. No.	Proposed Road map aligned with HEC new PG Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1		THS 900	PhD Thesis	9	4, 8, 9
Total Credit Hours				9	

List of Electives Courses

Sr. No.	Proposed Road map aligned with HEC new PG Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)

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1		CEN 807	Advance distributed systems	3	4, 9, 11
2		SEN 819	Advance Neural Networks & Fuzzy Logic	3	3, 4, 11
3		SEN 811	Data Warehousing and Mining	3	3, 4, 9, 11
4		DSC 807	Advanced Deep Learning	3	3, 4, 7, 9
5		EET 851	Mobile and ad-hoc Networks	3	9
6		CSC 819	Research Trends in Machine Learning	3	3, 4, 7, 9
7		CSC 851	Advanced Pattern Recognition	3	3, 4, 9, 11
8		SEN 862	Emerging Trends in Big Data Analytics	3	9
9		CSC 881	Advanced Cloud Computing	3	3, 4, 9, 11
10		CSC 820	Advance Topics in Operating Systems	3	4, 9, 11
11		EET 835	Advance Topics in 5G and Beyond Communications	3	3, 8, 9
12		EET 850	Wireless Sensor Networks	3	9
13		SEN 802	Special Topics in Software Engineering	3	3, 4, 7, 8, 9
14		SEN 818	Secure Software Systems	3	9, 16
15		EET 832	Advance topics in Network Security	3	3, 8, 9, 16
16		CEN 820	High Performance Computer Architecture	3	9
17		DSC 800	Advanced Data Analytics	3	3, 4, 7, 9
18		CSC 841	Advanced Computational Linguistics	3	3, 4, 11
19		DSC 802	Advanced Data Visualization	3	3, 4, 7, 9

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20		CSC 860	Advanced Complexity Theory and Algorithms	3	4, 11
21		CEN 808	Advanced Techniques in System Modeling and Simulation	3	9
22		SEN 816	Middleware For Networked and Distributed Systems	3	9
23		CSC 800	Advanced AI Networking	3	3, 4, 9, 11
24		CSC 882	Advanced Wireless Communications	3	3, 4, 9, 11
25		SEN 861	Semantic Web Modeling and Applications	3	9
26		SEN 864	Knowledge Representation and Reasoning	3	9
27		ISC 821	Advance Topics in Cryptography	3	3, 4, 11
28		SEN 808	Computer and Cybersecurity	3	9, 16
29		SEN 809	Internet of Things: Design and Applications	3	3, 4, 9, 13,14,15
30		EET 837	Advanced Data Communication Systems	3	8, 9
31		SEN 853	Advanced Power-Aware Computing	3	9,7,12
32		ISC 843	Advanced Penetration Testing & Vulnerability Analysis	3	4, 8, 9

List of Deficiency Courses

Deficiency courses can be selected from 700-level courses of MS CS Roadmap, as recommended by the Admission Committee.

Appendage 3208**Roadmap of PhD Mathematics****Academic Road Map for PhD Programs
Faculty of Engineering Sciences**Program Title: PhD MathematicsDuration: 3 to 8 yearsTotal Credit Hours: 54

Endorsement References:

- A: Recommendations of 23rd DBOS dated 26-Sep-2023
 B: Recommendations of FBOS dated 03-Oct-23

Summary of Credit Hours

Sr. No.	Courses as per HEC new GE Policy 2023 (All courses at Ph.D. level must be 800 level)	Credit Hours/Contact Hours	
		Existing Road Map	Proposed New Road Map
1.	Major Disciplinary / University Requirement	-	3
2.	Electives Courses	18	15
3.	Interdisciplinary courses	-	-
3.	Thesis	36	36
4.	Deficiency course in case of candidate from other domain or interdisciplinary domain	-	6-9 *
Total		54	54

*Subject to allocation of deficiency courses by admission committee.

Minutes of the 32nd FBOS – ES
Semester-wise Revised Road map of PhD Mathematics

Semester 1

Sr. No.	Proposed Road map aligned with HEC Graduate Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1	None	ESC 801	Research Methods in PhD Studies	3	4
2			Elective I	3	-
3			Elective II	3	-
Total Credit Hours			9		

Semester 2

Sr. No.	Proposed Road map aligned with HEC Graduate Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1			Elective III	3	-
2			Elective IV	3	-
3			Elective V	3	-
Total Credit Hours			9		

Semester 3

Sr. No.	Proposed Road map aligned with HEC new PG Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1			Comprehensive exam	0	
2		THS 900	PhD Thesis	9	4, 8, 9
Total Credit Hours			9		

Semester 4

Sr. No.	Proposed Road map aligned with HEC new UG Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1		THS 900	PhD Thesis	9	4, 8, 9
Total Credit Hours			9		

Semester 5

Sr. No.	Proposed Road map aligned with HEC new UG Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1		THS 900	PhD Thesis	9	4, 8, 9
Total Credit Hours				9	

Semester 6

Sr. No.	Proposed Road map aligned with HEC new UG Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1		THS 900	PhD Thesis	9	4, 8, 9
Total Credit Hours				9	

List of Electives Courses

Sr. No.	Proposed Road map aligned with HEC new UG Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1		MAT 810	Advanced Elastodynamics	3	4
2		MAT 811	Modelling and Simulation of Dynamical Systems	3	4
3		MAT 812	Advanced Finite Element Analysis	3	4
4		MAT 813	Advanced Multivariate Methods and Analysis	3	4
5		MAT 814	Advanced Near Rings	3	4
6		MAT 815	Advanced Quantum Theory	3	4
7		MAT 816	Advanced Semigroup Theory	3	4
8		MAT 817	Nonlinear Waves	3	4
9		MAT 818	Advanced Partial Differential Equations II	3	4
9		MAT 819	Advanced Functional Analysis II	3	4
10		MAT 820	Advanced Numerical Solution of Partial differential Equations	3	4
11		MAT 821	Advanced Group Theory II	3	4
12		MAT 822	Advanced Non-Newtonian Fluid	3	4, 9
13		MAT 823	Advanced Perturbation Methods	3	4

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14		MAT 824	Advanced topics in Cryptography	3	4, 9, 11
15		MAT 825	Advanced Fluid Dynamics-II	3	4, 9
16		MAT 826	Advanced Lie Group Methods for Differential Equations	3	4
17		MAT 827	Advanced Heat and Mass Transfer	3	4, 9

List of Deficiency Courses

Deficiency courses can be selected from 700-level courses of MS Mathematics Roadmap, as recommended by the Admission Committee.

Roadmap of PhD CE
Academic Road Map for PhD Programs
Faculty of Engineering Sciences

Program Title: PhD Computer Engineering

Duration: 3 to 8 Years

Total Credit Hours: 54

Endorsement References:

A: Recommendations of DBOS dated 28-Sep-2023

B: Recommendations of FBOS dated 03-Oct-2023

Summary of Credit Hours

Sr. No.	Courses as per HEC new GE Policy 2023 (All courses at Ph.D. level must be 800 level)	Credit Hours/Contact Hours	
		Existing Road Map	Proposed New Road Map
1.	Major Disciplinary/ <i>University Requirement</i>	-	3
2.	Electives Courses	18	15
3.	Interdisciplinary courses	-	-
3.	Thesis	36	36
4.	Deficiency course in case of candidate from other domain or interdisciplinary domain	-	6-9 *
Total		54	54

*Subject to allocation of deficiency courses by admission committee.

Minutes of the 32nd FBOS – ES
Semester-wise Revised Road map of PhD CE

Semester 1

Sr. No.	Proposed Road map aligned with HEC Graduate Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1	None	ESC 801	Research Methods in PhD Studies	3	4
2			Elective I	3	-
3			Elective II	3	-
Total Credit Hours			9		

Semester 2

Sr. No.	Proposed Road map aligned with HEC Graduate Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1			Elective III	3	-
2			Elective IV	3	-
3			Elective V	3	-
Total Credit Hours			9		

Semester 3

Sr. No.	Proposed Road map aligned with HEC new PG Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1			Comprehensive exam	0	
2		THS 900	PhD Thesis	9	4, 8, 9
Total Credit Hours			9		

Semester 4

Sr. No.	Proposed Road map aligned with HEC Graduate Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
		THS 900	PhD Thesis	9	4, 8, 9

Semester 5

Sr. No.	Proposed Road map aligned with HEC Graduate Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
		THS 900	PhD Thesis	9	4, 8, 9
Total Credit Hours				9	

Semester 6

Sr. No.	Proposed Road map aligned with HEC Graduate Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
		THS 900	PhD Thesis	9	4, 8, 9
Total Credit Hours				9	

List of Electives Courses

Sr. No.	Proposed Road map aligned with HEC Graduate Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1		CEN 807	Distributed Systems Architecture and Design	3	9
2		CEN 808	Advanced Techniques in System Modeling and Simulation	3	9
3		CEN 821	Microprocessor System Optimization and customization	3	9, 12
4		CEN 840	Advanced Embedded System Design	3	9
5		CEN 842	Digital Systems Integration and Design	3	9

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6		CEN 845	Image Analysis and Pattern Recognition	3	3, 9
7		CEN 852	Modern Approaches in VLSI System Design	3	9
8		CEN 853	Real-Time Systems Engineering & Design	3	9
9		CEN 855	Advanced Parallel Processing Computer Systems	3	9
10		DSC 807	Advanced Deep Learning	3	3, 4, 7, 9, 11
11		CSC 820	Advanced Topics in Operating Systems	3	4, 9, 11
12		CSC 819	Research Trends in Machine Learning	3	3, 4, 7, 8, 9, 11
13		CSC 851	Advanced Pattern Recognition	3	3, 4, 9, 11
14		CSC 864	Advanced Computer Vision	3	9
15		CSC 881	Advanced Cloud Computing	3	3, 4, 9, 11
16		SEN 820	Emerging Trends in Human Computer Interaction	3	9
17		SEN 862	Emerging Trends in Big Data Analytics	3	9
18		EET 827	Advanced Wireless Communication Systems	3	3, 8, 9
19		EET 831	Modern Digital Communications Systems	3	3, 9

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20		EET 832	Advance topics in Network Security	3	3, 8, 9, 16
21		EET 834	Emerging Trend in Optical Fiber Networks	3	3, 9
22		EET 835	Advance Topics in 5G and Beyond Communications	3	3, 8, 9
23		EET 850	Wireless Sensor Networks	3	9
24		EET 851	Mobile and ad-hoc Networks	3	9
25		EEN 824	On-Chip Interconnection Networks	3	9
26		EEN 829	Design and Applications of Real Time DSP Systems	3	3, 9
27		EEN 831	Statistical Signal Processing	3	3, 9
28		CSC 800	Advanced AI Networking	3	3, 4, 8, 9, 11
29		CEN 820	High Performance Computer Architecture	3	9
30		CEN 854	MOS VLSI Circuit Design	3	9
31		EET 836	AI for Future Communication Systems	3	3, 8, 9
32		EET 837	Advanced Data Communication Systems	3	8, 9
33		EET 829	Optimization Techniques	3	9
34		CSC 841	Advanced Computational Linguistics	3	3, 4, 11
35		CSC 860	Advanced Complexity Theory and Algorithms	3	4, 11
36		DSC 800	Advanced Data Analytics	3	3, 4, 7, 8, 9, 11

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37		DSC 802	Advanced Data Visualization	3	3, 4, 7, 8, 9, 11
38		SEN 818	Secure Software Systems	3	9, 16
39		SEN 808	Computer and Cybersecurity	3	9, 16
40		SEN 809	Internet of Things: Design and Applications	3	3, 4, 9, 13,14,15
41		EEN 832	Fuzzy Logic and Neural Network Based Intelligent control systems	3	3, 9
42		EEN 833	Advanced Computer vision for Robotics	3	3, 8, 9
43		EEN 834	Human-Robot Interaction	3	3, 8, 9
44		EEN 835	Medical Devices & Robotics	3	3, 8, 9
45		CEN 841	ASIC Design Methodology	3	9

List of Deficiency Courses

Deficiency courses can be selected from 700-level courses of MS CE Roadmap, as recommended by the Admission Committee.

Appendage 3210**Roadmap of PhD EE**

Academic Road Map for PhD Programs
Faculty of Engineering Sciences

Program Title: PhD Electrical EngineeringDuration: 3 to 8 YearsTotal Credit Hours: 54

Endorsement References:

A: Recommendations of DBOS dated 28-Sep-23B: Recommendations of FBOS dated 03-Oct-23**Summary of Credit Hours**

Sr. No.	Courses as per HEC new GE Policy 2023 (All courses at Ph.D. level must be 800 level)	Credit Hours/Contact Hours	
		Existing Road Map	Proposed New Road Map
1.	Major Disciplinary/University Requirement	-	3
2.	Electives Courses	18	15
3.	Interdisciplinary courses	-	-
3.	Thesis	36	36
4.	Deficiency course in case of candidate from other domain or interdisciplinary domain	-	6-9 *
Total		54	54

*Subject to allocation of deficiency courses by admission committee.

Minutes of the 32nd FBOS – ES
Semester-wise Revised Road map of PhD EE

Semester 1

Sr. No.	Proposed Road map aligned with HEC Graduate Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1	None	ESC 801	Research Methods in PhD Studies	3	4
2			Elective I	3	-
3			Elective II	3	-
Total Credit Hours			9		

Semester 2

Sr. No.	Proposed Road map aligned with HEC Graduate Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1			Elective III	3	-
2			Elective IV	3	-
3			Elective V	3	-
Total Credit Hours			9		

Semester 3

Sr. No.	Proposed Road map aligned with HEC new PG Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1			Comprehensive exam	0	
2		THS 900	PhD Thesis	9	4, 8, 9
Total Credit Hours			9		

Semester 4

Sr. No.	Proposed Road map aligned with HEC new PG Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1		THS 900	PhD Thesis	9	4, 8, 9
			Total Credit Hours	9	

Semester 5

Sr. No.	Proposed Road map aligned with HEC new PG Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1		THS 900	PhD Thesis	9	4, 8, 9
			Total Credit Hours	9	

Semester 6

Sr. No.	Proposed Road map aligned with HEC new PG Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1		THS 900	PhD Thesis	9	4, 8, 9
			Total Credit Hours	9	

List of Electives Courses

Sr. No.	Proposed Road map aligned with HEC new PG Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1		EEN 827	Modern Control Theory	3	3, 9
2		EEN 828	Advanced Nonlinear Control Systems	3	3, 9
3		EEP 801	Power Management in Wired and Wireless communications Systems	3	3, 7, 9
4		EEP 802	Advanced Low Power System Design	3	3, 7, 9
5		EEP 803	Advanced Power System Deregulation	3	
6		EEN 829	Design and Applications of Real Time DSP Systems	3	3, 9
7		EET 830	Emerging Trend in Cognitive Cooperative Networks	3	3, 9
8		EET 831	Modern Digital Communications Systems	3	3, 9
9		EEN 830	Dynamic Systems Modeling & Simulation	3	3, 8, 9
10		EET 832	Advance topics in Network Security	3	3, 8, 9, 16
11		EET 833	Smart Antennas	3	8, 9
12		EET 827	Advanced Wireless Communication Systems	3	3, 8, 9
13		EEP 804	Advanced Power System Stability and Dynamics	3	3, 7, 9
14		EET 834	Emerging Trend in Optical Fiber Networks	3	3, 9

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15		EEP 805	Artificial Intelligence Techniques in Power Systems Design	3	3, 8, 9
17		EET 835	Advance Topics in 5G and Beyond Communications	3	3, 8, 9
18		EEN 831	Statistical Signal Processing	3	3, 9
19		CEN 807	Distributed Systems Architecture and Design	3	9
20		CEN 808	Advanced Techniques in System Modeling and Simulation	3	9
21		CEN 821	Microprocessor System Optimization and customization	3	9, 12
22		CEN 840	Advanced Embedded System Design	3	9
23		CEN 842	Digital Systems Integration and Design	3	9
24		CEN 845	Image Analysis and Pattern Recognition	3	3, 9
25		CEN 852	Modern Approaches in VLSI System Design	3	9
26		CEN 853	Real-Time Systems Engineering & Design	3	9
27		CEN 855	Advanced Parallel Processing Computer Systems	3	9
28		DSC 807	Advanced Deep Learning	3	3, 4, 7, 9, 11
29		CSC 819	Research Trends in Machine Learning	3	3, 4, 7, 8, 9, 11
30		CSC 851	Advanced Pattern Recognition	3	3, 4, 9, 11

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31		CSC 864	Advanced Computer Vision	3	9
32		CSC 881	Advanced Cloud Computing	3	3, 4, 9, 11
33		SEN 862	Emerging Trends in Big Data Analytics	3	9
34		SEN 819	Advanced Neural Networks & Fuzzy Logic	3	3, 4, 11
35		EET 829	Optimization Techniques	3	9
36		EEN 832	Fuzzy Logic and Neural Network Based Intelligent control systems	3	3, 9
37		EEN 833	Advanced Computer vision for Robotics	3	3, 8, 9
38		EEN 834	Human-Robot Interaction	3	3, 8, 9
39		EEN 835	Medical Devices & Robotics	3	3, 8, 9
40		EET 836	AI for Future Communication Systems	3	3, 8, 9
41		EET 837	Advanced Data Communication Systems	3	8, 9
42		EEP 806	Modern Trends in Power system Analysis	3	7, 9
43		EEP 807	Modern Power System Protection	3	7, 9
44		CEN 820	High Performance Computer Architecture	3	9
45		CEN 841	ASIC Design Methodology	3	9
46		CEN 854	MOS VLSI Circuit Design	3	9
47		DSC 800	Advanced Data Analytics	3	3, 4, 7 ,8, 9, 11
48		CSC 800	Advanced AI Networking	3	3, 4, 8, 9, 11
49		SEN 809	Internet of Things: Design and Applications	3	3, 4, 9, 13,14,15
50		SEN 808	Computer and Cybersecurity	3	9, 16

List of Deficiency Courses

Deficiency courses can be selected from 700-level courses of MS EE Roadmap, as recommended by the Admission Committee.

Roadmap of PhD SE

Academic Road Map for PhD Programs
Faculty of Engineering Sciences

Program Title: PhD Software Engineering

Duration: 3 to 8 Years

Total Credit Hours: 54

Endorsement References:

A: Recommendations of DBOS dated 28-Sep-23

B: Recommendations of FBOS dated 03-Oct-23

Summary of Credit Hours

Sr. No.	Courses as per HEC new GE Policy 2023 (All courses at Ph.D. level must be 800 level)	Credit Hours/Contact Hours	
		Existing Road Map	Proposed New Road Map
1.	Major Disciplinary / University Requirement	-	03
2.	Electives Courses	18	15
3.	Interdisciplinary courses	-	-
3.	Thesis	36	36
4.	Deficiency course in case of candidate from other domain or interdisciplinary domain	-	6-9 *
Total		54	54

*Subject to allocation of deficiency courses by admission committee.

Semester-wise Revised Road map of PhD SE

Semester 1

Sr. No.	Proposed Road map aligned with HEC Graduate Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1	None	ESC 801	Research Methods in PhD Studies	3	4
2			Elective I	3	-
3			Elective II	3	-
Total Credit Hours			9		

Semester 2

Sr. No.	Proposed Road map aligned with HEC Graduate Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1			Elective III	3	-
2			Elective IV	3	-
3			Elective V	3	-
Total Credit Hours			9		

Semester 3

Sr. No.	Proposed Road map aligned with HEC new PG Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1			Comprehensive exam	0	
2		THS 900	PhD Thesis	9	4, 8, 9
Total Credit Hours			9		

Semester 4

Sr. No.	Proposed Road map aligned with HEC new PG Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
		THS 900	PhD Thesis 9	9	4, 8, 9
Total Credit Hours		9			

Semester 5

Sr. No.	Proposed Road map aligned with HEC new PG Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
		THS 900	PhD Thesis 9	9	4, 8, 9
Total Credit Hours		9			

Semester 6

Sr. No.	Proposed Road map aligned with HEC new PG Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
		THS 900	PhD Thesis 9	9	4, 8, 9
Total Credit Hours		9			

List of Electives Courses

Sr. No.	Proposed Road map aligned with HEC new PG Policy				
	Pre-requisite Course Code	Course Code	Course Title	Credit Hours	17 UN SDGs alignment (please mention relevant SDG No.)
1		SEN 820	Emerging Trends in Human Computer Interaction	3	9
2		SEN 856	Advance Topics in Usability Engineering	3	3,9
3		SEN 823	Formal Models & Methods in Software Engineering	3	9, 11
4		SEN 863	Advanced Software Engineering Methods & Practices	3	9
5		SEN 859	Advanced Software Re-Engineering	3	9
6		SEN 858	Emerging Trends in Component - Based Software Engineering	3	9
7		SEN 812	Agile Methods	3	8
8		SEN 815	Verification & Validation	3	9
9		SEN 813	Advanced Software Requirement Engineering	3	9
10		SEN 857	Advanced Empirical Software Engineering	3	9
11		SEN 801	Model Driven Software Engineering	3	9
12		SEN 802	Special Topics in Software Engineering	3	3, 4, 7, 8, 9
13		SEN 854	Web Computing Research Strategies	3	9

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14		SEN 855	Advanced topics in Service-Oriented Computing	3	9
15		SEN 816	Middleware For Networked and Distributed Systems	3	9
16		CSC 881	Advanced Cloud Computing	3	3, 4, 9, 11
17		CEN 807	Distributed Systems Architecture and Design	3	9
18		SEN 803	Advanced e-Learning Systems	3	4,9
19		SEN 861	Semantic Web Modeling and Applications	3	9
20		SEN 864	Knowledge Representation and Reasoning	3	9
21		SEN 860	Emerging Trends in Complex Adaptive System	3	9
22		CEN 808	Advanced Techniques in System Modeling and Simulation	3	9
23		DSC 802	Advanced Data Visualization	3	3, 4, 7, 8, 9, 11
24		SEN 862	Emerging Trends in Big Data Analytics	3	9
25		DSC 807	Advanced Deep Learning	3	3, 4, 7, 9, 11
26		CSC 841	Advanced Computational Linguistics	3	3, 4, 11
27		CSC 851	Advanced Pattern Recognition	3	3, 4, 9, 11
28		CSC 819	Research Trends in Machine Learning	3	3, 4, 7, 8, 9, 11
29		DSC 802	Advanced Data Visualization	3	3, 4, 7, 8, 9, 11

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30		DSC 800	Advanced Data Analytics	3	3, 4, 7, 8, 9, 11
31		CEN 845	Image Analysis and Pattern Recognition	3	3, 9
32		SEN 853	Advanced Power-Aware Computing	3	9,7,12
33		SEN 814	Ubiquitous Computing and Interaction	3	9
34		ISC 821	Advance Topics in Cryptography	3	3, 4, 11
35		CSC 820	Advanced Topics in Operating Systems	3	4, 9, 11
36		CEN 820	High Performance Computer Architecture	3	9
37		EET 837	Advanced Data Communication Systems	3	8, 9
38		EET 832	Advance topics in Network Security	3	3, 8, 9, 16
39		CEN 842	Digital Systems Integration and Design	3	9
40		EEN 831	Statistical Signal Processing	3	3, 9
41		SEN 818	Secure Software Systems	3	9, 16
42		SEN 808	Computer and Cybersecurity	3	9, 16
43		SEN 809	Internet of Things: Design and Applications	3	3, 4, 9, 13,14,15

List of Deficiency Courses

Deficiency courses can be selected from 700-level courses of MS SE Roadmap, as recommended by the Admission Committee.