

Minutes of the 30th
Special Meeting of the Board of Studies
Faculty of Engineering Sciences
held on
15th August 2023
through Microsoft Teams



Bahria University Islamabad

Contents

<i>PROCEEDINGS</i>	3
ITEM3001: REVISION OF ROADMAPS OF BS ENVIRONMENTAL SCIENCES, BS GEOLOGY, BS GEOPHYSICS AND BS REMOTE SENSING & GIS AS PER HEC UNDERGRADUATE 2023 POLICY	4
<i>CLOSING OF THE MEETING</i>	4
<i>APPENDAGES:</i>	6
APPENDAGE 3001	6

**Minutes of the 30th Special Meeting of Faculty Board of Studies
Engineering Sciences held on 15th August, 2023 through Microsoft
Teams**

Attendance:

BUIC

Snr. Assoc. Prof. Dr. Said Akbar Khan	HoD(E&ES)	Member
Snr. Assoc. Prof. Dr. Awais Majeed	HoD(SE)	Member
Assoc. Prof. Dr. Shahzad Ahmed	HoD(CE)	Member
Assoc. Prof. Dr. Junaid Imtiaz	HoD(EE)	Member
Snr. Prof. Dr. Shahzad Khalid	CE Department	Member

BUKC

Snr. Assoc. Prof. Dr. Sohaib Ahmad	Associate Dean	Member
Snr. Asst. Prof. Ms. Shaista Iftikhar	Acting HoD(E&ES)	Member

Proceedings

Preliminaries

FBoS-ES meeting took place on 15th August 2023, with the quorum complete, the proceedings commenced at 9 30 hrs, 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.

New Items:

Item3001: Revision of Roadmaps of BS Environmental Sciences, BS Geology, BS Geophysics and BS Remote Sensing & GIS as per HEC Undergraduate 2023 Policy

Sponsor: HoD (E&ES) BUIC

Referral Authority: DBoS E&ES BUIC

Summary of the Case

- On receiving HEC Undergraduate Curriculum Policy and as a result of action against letter BU-HO/Acad/2023/L/1085 dated 25th July 2023, the curriculum of E&ES Undergraduate Programs was reviewed for its alignment with the new HEC Undergraduate 2023 policy
- As per the guide lines of HEC undergraduate 2023 policy, the roadmaps of BS Environmental Sciences, BS Geology, BS Geophysics and BS Remote Sensing & GIS have been revised

Discussion

The sponsor presented the agenda point. The house had a detailed discussion about the sensibility of program, student's intake, cost analysis etc. The house also discussed the curriculum of programme in details. The house recommends the proposed roadmap attached at [appendage 3001](#)

Decision 3001

The case to be forwarded for the approval in ACM.

Closing of the Meeting

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

Prof. Dr Atif Raza Jafri
Dean (ES), Head FBoS
August, 2023

Distribution:

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

Bachelor Programs of Earth & Environmental Sciences Department

Curriculum 2023



**Department of Earth & Environmental Sciences
BAHRIA UNIVERSITY
ISLAMABAD CAMPUS**

Bachelor of Science (BS) Environmental Sciences

Existing Roadmap

Semester - 1

Course code	Course Title	Credit Hours
PAK 101	Pakistan Studies	2
ISL 101	Islamic Studies	2
ENG 103	English I	3
MAT 105/BIO 105*	Mathematics / Fundamentals of Biology	0
CSC 105	Introduction to Computers	3
PHY 101	Physics	3
GEO 105	Physical & General Geology	3
	Total Credit Hours	16

*Academic credit of this course is zero but its contact hours, teaching material and tuition fee are equal to a 3 credit hours course.

Semester - 2

Course code	Course Title	Credit Hours
CHM 105	Chemistry	3
ENG 104	English -II	3
MAT 115	Calculus & Analytical Geometry	3
GEO 110	Fundamental of Geography & Geomorphology	3
ENV 105	Introduction to Environmental Geology	3
ENV 110	Environmental Biology	3
	Total Credit Hours	18

Semester – 3

Course code	Course Title	Credit Hours
ENG 232	Oral Communication	3
MAT 205	Statistics	3
ENV 210	Environmental Chemistry	3
ENV 205	Fundamentals of Ecology	3
ENV 230	Environmental Issues	3
HSS 111	Introduction to IR	3
	Total Credit Hours	18

Note: Students will be offered only one of the HSS subjects.

Semester – 4

Course code	Course Title	Credit Hours
ENV 214	Social Theory of Environment	3
ENV 220	Environmental Microbiology	3
ENV 225	Applied Ecology	3
HSS 107	Introduction to Psychology	3
ENV 236	Introduction to Climate Change	3
ENV 245	Introduction to Oceanography	3
	Total Credit Hours	18

Semester - Summer

Course code	Course Title	Credit Hours
ENV 240	Field Work Report-I	3

Semester - 5

Course code	Course Title	Credit Hours
ENV305	Environmental Monitoring	3
ENV310	Environmental Toxicology	3
ENV315	Environmental Management System	3
ENV320	Environmental Biotechnology	3
ENV 335	Analytical techniques in Environmental Sciences	3
GEO 305	Environmental Geology	3
	Total Credit Hours	18

Semester - 6

Course code	Course Title	Credit Hours
ENV425	Occupational Health & Safety	3
ENV340	Solid Waste Management	3
ENV325	Environmental Engineering	3
ENV345	Environmental Hazard & Management	3
XXX	Elective-1	3
	Total Credit Hours	15

Courses for Elective-1

Course code	Course Title	Credit Hours
GEO 335	Earthquake Seismology	3
GEO 351	Natural Disaster Management	3
ENV 330	Environmental & Natural Resource Economics	3

Semester - 7

Course code	Course Title	Credit Hours
ENV 405	Pollution Control Technologies	3
ENV 415	Natural Resource Management	3
ENV420	Research Methods in Environmental Sciences	2
GEO 420	Hydrogeology	3
GEO ---	Elective - II	3
Total Credit Hours		14

Courses for Elective-II

Course code	Course Title	Credit Hours
GEO 405	Petroleum Engineering	3
GEO 436	Health, Safety and Environment	3
ENV 410	Environmental Impact Assessment	3

Semester - 8

Course code	Course Title	Credit Hours
ENV 440	Energy and Environment	3
ENV 430	Environmental Policies & Law	3
ENV 350	Remote Sensing & GIS for Environment	3
ENV435	Thesis	6
ENV 445	Comprehensive Viva Voce	0
Total Credit Hours		15

Bachelor of Science (BS) Environmental Sciences Proposed Roadmap as Per HEC 2023 Undergraduate Policy

Vision and Mission of Bahria University

Vision: To become a knowledge and creativity driven international university that contributes towards development of society.

Mission: To ensure academic excellence through deliverance of quality education and applied research in a collegiate environment having strong linkages with industry and international community to meet the societal challenges.

Vision of the E&ES Department

To become an advanced research oriented institution in the field of Earth and Environmental Sciences at par with the international standards.

Mission of the E&ES Program

To enable the graduates to meet the challenges in exploring natural resources, identifying national issues and finding mitigations of hazards, and increasing public awareness in protecting the natural environment.

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		✓	✓

Minutes of the 30th FBOS – ES

	Hec Under Graduate Policy 2023	BS-Environmental Sciences Existing Road Map	BS Environmental Sciences Proposed Road Map
Total Credit hrs	120 - 144 credit hrs	135	132
General Education courses C	30 CH (12 courses)	31 CH (11 courses)	33 CH (13 courses)
Natural Sciences	3 CH (1 course)	6 CH (2 courses)	6CH (2 courses)
Social Sciences	2 CH (1 course)	6 CH (2 courses)	2 CH (1 course)
Arts and Humanities	2 CH (1 courses)	0 CH (0 courses)	2 CH (1 courses)
Expository Writing	3 CH (1 courses)	6 CH (2 courses)	3 CH (1 course)
Functional English	3 CH (1 course)	3 CH (1 course)	3 CH (1 course)
Quantitative Reasoning	6 CH (2 courses)	6 CH (2 courses)	6 CH (2 courses)
Ideology & Constitution of Pakistan	2 CH (1 course)	2 CH (1 course)	2 CH (1 course)
Islamiat	2 CH (1 course)	2 CH (1 course)	2 CH (1 course)
Interdisciplinary	12 CH (4 courses)	3 CH (2 courses) 1 Zero CH Course	12 CH (4 courses)
Application of ICT	2+1 CH (1 course)	Nil	2+1 CH (1 course)
Entrepreneurship	2 CH (1 course)	Nil	2 CH (1 course)
Civics & Community Engagement E	2 CH (1 course)	Nil	2 CH (1 course)
Majors	72 CH	92 CH (31 courses) 3 CH field (1 course) 6 CH Thesis	87 CH (27 courses) 3 CH field (1 course) 3 CH Thesis

PROPOSED ROADMAP**SUMMARY**

HEC GUIDELINES	HEC UG POLICY 2023	PROPOSED ROADMAP
General Education Course: 13	30 Credit Hours	33 Credit hours
Major (Disciplinary) Requirements	Minimum 72 Credit Hours	87 Credit Hours
Interdisciplinary/allied courses: 04	12 Credit Hours	12 Credit Hours
Field Work Course: 01	3 Credit Hours	03 Credit Hours
Capstone Project: 01	3 Credit Hours	03 Credit Hours
Total	120-144 Credit Hours	132 Credit Hours

Semester – 1

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
XXX	Ideology & Constitution of Pakistan	2+0	2	0
ISL 102	Islamic Studies	2+0	2	0
ENG 105	Functional English	3+0	3	0
CSC 103	Introduction to Computers and Programming	2+1	2	2
PHY 101	Physics	2+1	2	2
ENV 105	Introduction to Environmental Sciences	3+0	3	0
MAT 105* OR BIO 105*	Fundamentals of Mathematics	0+0	3	0
	Fundamentals of Biology	0+0	3	0
Total Credit Hours		16		

*Academic credit of this course is zero but its contact hours, teaching material and tuition fee are equal to a 3 credit hours course.

Semester – 2

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
CHM 105	Chemistry	2+1	2	2
HSS 320	Technical Writing & Presentation Skills	3+0	3	0
MAT 205	Statistics	3+0	3	0
GEO 110	Fundamental of Geography & Geomorphology	3+0	3	0
ENV 230	Environmental Issues	3+0	3	0
ENV110	Environmental Biology	3+0	3	0
Total Credit Hours		18		

Semester – 3

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
GEO 201	Museology	2+0	2	0
ENV 215	Social Theory of Environment	3+0	3	0
ENV 210	Environmental Chemistry	3+0	3	0
ENV 205	Fundamentals of Ecology	3+0	3	0
PSY 102	Introduction to Psychology	2+0	2	0
ENV 220	Environmental Microbiology	2+1	2	2
XXX	Civics & Community Engagement	2+0	2	0
Total Credit Hours		18		

Semester – 4

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
XXX	Entrepreneurship	2+0	2	0
ENV236	Introduction to Climate Change	3+0	3	0
XXX	Application of ICT	2+1	2	2
ENV 315	Environmental Management System	3+0	3	0
ENV 305	Environmental Monitoring	2+1	2	2
ENV 310	Environmental Toxicology	3+0	3	0
	Total Credit Hours	17		

Semester – 5

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
ENV 320	Environmental Biotechnology	3+0	3	0
ENV 335	Analytical Techniques in Environmental Sciences	2+1	2	2
GEO 305	Environmental Geology	3+0	3	0
ENV 325	Environmental Engineering	3+0	3	0
ENV 330	Environmental & Natural Resource Economics	3+0	3	0
GEO 351	Natural Disaster Management	3+0	3	0
	Total Credit Hours	18		

Semester – 6

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
ENV 345	Environmental Hazard & Management	3+0	3	0
ENV 340	Solid Waste Management	2+1	2	2
ENV 361	Natural Resource Management	3+0	3	0
ENV 355	Urban Environmental Management	3+0	3	0
ENV 240	Environmental Sciences Field Work	0+3	0	6
	Total Credit Hours	15		

Semester – 7

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
GEO 437	GIS & Remote Sensing	2+1	2	2
ENV 461	Water Resource Management	3+0	3	0
ENV 420	Research Methods in Environmental Sciences	2+0	2	0
GEO 420	Hydrogeology	3+0	3	0
ENV 410	Environmental Impact Assessment	3+0	3	0
	Total Credit Hours	14		

Semester – 8

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
GEO 405	Pollution Control Technology	3+0	3	0
ENV 440	Energy and Environment	2+1	2	2
ENV 430	Environmental Policies & Laws	3+0	3	0
ENV 425	Occupational Health & Safety	3+0	3	0
ENV 435	Capstone Project/Thesis	0+3	0	6
	Total Credit Hours	15		

Course Description

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

..... Ideology and Constitution of Pakistan (2 CH)

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.

ISL 102 Islamic Studies (2 CH)

A course of Islamic Studies provides students with a comprehensive overview of the fundamental aspects of Islam, its history, beliefs, practices, and influence on society and familiarize students with a solid foundation in understanding the religion of Islam from an academic and cultural perspective. Ethics, in integrated form will shape the core of the course to foster among students the universal ethical values promoted by Islam.

ENG 105 Functional English (3 CH)

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 presentation.

MAT 105 Fundamentals of Mathematics (0 CH)

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.

CSC 102 Introduction to Computers and Programming (2 CH)

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.

CSL 102 Introduction to Computers and Programming Lab (1 CH)

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.

PHY 101 Physics (2 CH)

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.

PHL 101 Physics Lab (1 CH)

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.

CHM 105 Chemistry (2 CH)

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.

CHL 105 Chemistry Lab (1 CH)

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)

ENG 205 Technical Writing and Presentation Skills (3 CH)

Pre-requisite ENG 105

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.

.....Applications of Information and Communication Technologies (ICT) (2 CH)

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 (Dumb, 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.

.....Applications of Information and Communication Technologies Lab (ICT) (1 CH)

Practical exercises will be carried out in lab

.....Entrepreneurship (2 CH)

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.

.....Civics and Community Engagement (2 CH)

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.

GEO 110 Fundamentals of Geography & Geomorphology (3 CH)

Geomorphological processes; weathering and erosion; glaciers and their erosional and depositional landforms; geological work of wind and associated features; erosional and depositional work of surface and subsurface water; valley and base-level development and its types; drainage pattern, stream meandering and development of flood plains; erosional and depositional work of sea; development of coastal landforms; geomorphic cycles and associated landforms produced by tectonics and volcanic activity; introduction to tectonic

geomorphology; introduction to topographic maps; aerial photographs and satellite imageries.

GEO 201 Museology (2 CH)

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.

ENV 105 Introduction to Environment science (3 CH)

The Course will include Environmental Science introductory class, Introduction to Environmental sciences, Components of Environmental Sciences. Biotic and a biotic factors. Resources and conversation. A biotic 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. Environment health criteria and standards.

BIO 105 Fundamentals of Biology (0 CH)

Definition of Biology, various branches of 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

MAT 205 Statistics (3 CH)

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.

ENV 230 Environmental Issues (3 CH)

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, Water-logging, 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.

ENV 110 Environmental Biology (3 CH)

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 Conservation, Acid Rain

ENV 215 Social Theory of Environment (3 CH)

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

ENV 210 Environmental Chemistry (2 CH)

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 waste water, Waste and solid, Air and gas.

ENL 210 Environmental Chemistry Lab (1CH)

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

ENV 205 Fundamentals Of Ecology (3 CH)

Definition, concepts, history, scope and classification of ecology. Definition, concepts, structure and types of ecosystems. Energy flow in ecosystems. Ecological pyramids. Ecological efficiencies 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.

PSY 102 Introduction to Psychology (2 CH)

The course is designed to introduction to understand the vocabulary and concept of psychology. Understand how critical thinking 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.

ENV 220 Environmental Microbiology (2 CH)

Microorganisms and safety: Harmless microorganisms and assumptions, handling clinical an 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.

ENL 220 Environmental Microbiology Lab (1 CH)

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

ENV 236 Introduction to Climate Change (3 CH)

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, phenological 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.

ENV 315 Environmental Management System (3 CH)

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.

ENV 305 Environmental Monitoring (2 CH)

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.

ENL 305 Environmental Monitoring Lab (1 CH)

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

ENV 310 Environmental Toxicology (3 CH)

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

ENV 320 Environmental Biotechnology (3 CH)

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.

ENV 335 Analytical Techniques in Environmental Sciences (2 CH)

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.

ENL 335 Analytical Techniques in Environmental Sciences Lab (1 CH)

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.

GEO 305 Environmental Geology (3 CH)

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.

ENV 325 Environmental Engineering (3 CH)

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. Detail studies on effects of pollution on human health and environment

ENV 330 Environmental & Natural Resource Economics (3 CH)

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.

GEO 351 Natural Disaster Management (3 CH)

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

ENV 345 Environmental Hazards and Management (3 CH)

Introduction, Types of environmental hazards, Flood control, Information on river flooding, Effects on agro-economy, Slope stability in hilly areas, Types of landslides, their causes and remedial measures, Methods of analysis of slope, Landslide inventory mapping, Information on landslides and their effects on Socio-economic conditions, Study of case histories in Pakistan and abroad, Snow Avalanches, Subsidence mechanism and related problems, Earthquake Hazards. Extreme climatic events, Global circulation of atmosphere, Hurricanes, Tornadoes, Mid-Latitude Cyclone, Thunderstorm

ENV 340 Solid Waste Management (2 CH)

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.

ENL 340 Solid Waste Management Lab (1 CH)

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

ENV 361 Natural Resources Management (3 CH)

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.

ENV 355 Urban Environmental Management (3 CH)

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.

ENV 351 Environmental Sciences Field Work (3 CH)

Four 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.

GEO 437 GIS & Remote Sensing (2 CH)

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).

GEL 437 GIS & Remote Sensing Lab (1 CH)

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 area map, Use symbology.

ENV 461 Water Resources Management (3 CH)

Water strategy, planning and delivery, Market environmentalism and the governance of water, Water quality monitoring and measurement, Water and climate, Wetland ecosystem services, Quantifying river flow, Dams, development and human rights in Pakistan, Flood risk management in Pakistan, Understanding and influencing household water demand in the Pakistan, Water regulation and permitting - How to ensure water quality outcomes Natural flood management - Field visit to Eddleston Water Project

ENV 420 Research Methods in Environmental Sciences (3 CH)

The course is designed to introduction 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

GEO 420 Hydrogeology (3 CH)

Introduction to the hydrology of surface and groundwater supplies; Water bearing properties of rocks; hydrodynamics of flow through porous Materials; Flow nets; Well hydraulics; Analysis and evaluation of pumping test data; Groundwater quality; Occurrence of groundwater in various rock types and sediments; Introduction to techniques used in groundwater exploration and survey. Preparation of water table and piezometric surface maps. Flow-net analysis; study and preparation of hydro-geologic maps; graphical presentation of published chemical data of groundwater, ER survey and groundwater geochemistry.

ENV 410 Environmental Impact Assessment (3 CH)

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.

ENV 405 Pollution Control Technologies (3 CH)

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

ENV 440 Energy and Environment (2 CH)

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.

ENL 440 Energy and Environment (1 CH)

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).

ENV 425 Occupational Health and Safety (3 CH)

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.

ENV 430 Environmental Policies & Laws (3 CH)

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.

Bachelor of Science (BS) Geology Existing Roadmap

Semester - 1

Course code	Course Title	Credit Hours
PAK 101	Pakistan Studies	2
ISL 101	Islamic Studies	2
ENG 103	English I	3
MAT 105*	Mathematics	0
CSC 105	Introduction to Computers	3
PHY 101	Physics	3
GEO 105	Physical & General Geology	3
	Total Credit Hours	16

*Academic credit of this course is zero but its contact hours, teaching material and tuition fee are equal to a 3 credit hours course.

Semester - 2

Course code	Course Title	Credit Hours
CHM 105	Chemistry	3
ENG 104	English -II	3
MAT 115	Calculus & Analytical Geometry	3
GEO 110	Fundamental of Geography & Geomorphology	3
GEO 115	Introduction to Geophysics	3
GEO 120	Field Geology	3
	Total Credit Hours	18

Semester – 3

Course code	Course Title	Credit Hours
ENG 232	Oral Communication	3
MAT 205	Statistics	3
GEO 205	Structure Geology	3
CSC 205	Programming Fundamentals	3
GEO 210	Mineralogy & Crystallography	3
<u>One of the Following</u>		
HSS 111	Introduction to IR	3
HSS 115	Introduction to Media Studies	3
HSS 201	Introduction to Anthropology	3
HSS 202	Introduction to Sociology	3
	Total Credit Hours	18

Note: Students will be offered only one of the HSS subjects.

Semester – 4

Course code	Course Title	Credit Hours
GEO 215	Sedimentology	3
GEO 220	Optical Mineralogy	3
GEO 225	Geochemistry	3
GEO 230	Geotectonics	3
MAT 210	Advance Mathematics	3
	Total Credit Hours	15

Semester - Summer

Course code	Course Title	Credit Hours
GEO 235	Geology Field Work & Report-I	3

Semester - 5

Course code	Course Title	Credit Hours
GEO 326	Computing with Matlab	3
GEO 325	Stratigraphy of Pakistan	3
GEO 315	Igneous & Metamorphic Petrology	3
GEO 320	Marine Geology	3
GEO 305	Environmental Geology	3
GEO 310	Paleontology	3
	Total Credit Hours	18

Semester - 6

Course code	Course Title	Credit Hours
GEO 340	Wireline logging	3
GEO 350	Geology of Pakistan	3
GEO 330	Micropaleontology & Biostratigraphy	3
GEO 345	Petroleum Geology	3
GEO 335	Earthquake Seismology	3
	Total Credit Hours	15

Semester - Summer

Course code	Course Title	Credit Hours
GEO 355	Geology Field Work & Report-II	3

Semester - 7

Course code	Course Title	Credit Hours
GEO 410	Engineering Geology	3
GEO 415	Economic Geology	3
GEO 425	Research Methodology	2
GEO 420	Hydrogeology	3
GEO 405	Petroleum Engineering	3
	Total Credit Hours	14

Semester - 8

Course code	Course Title	Credit Hours
GEO 445	Seismic Stratigraphy	3
GEO 430	Geochemical Exploration Technique	3
GEO 435	GIS & Remote Sensing	3
GEO 440	Thesis	6
GEO 465	Comprehensive Viva Voce	0
	Total Credit Hours	15

Bachelor of Science (BS) GEOLOGY

Proposed Roadmap as Per HEC 2023 Undergraduate Policy

Vision and Mission of Bahria University

Vision: To become a knowledge and creativity driven international university that contributes towards development of society.

Mission: To ensure academic excellence through deliverance of quality education and applied research in a collegiate environment having strong linkages with industry and international community to meet the societal challenges.

Vision of the E&ES Department

To become an advanced research oriented institution in the field of Earth and Environmental Sciences at par with the international standards.

Mission of the E&ES Program

To enable the graduates to meet the challenges in exploring natural resources, identifying national issues and finding mitigations of hazards, and increasing public awareness in protecting the natural environment.

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.	Programme 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			✓

Minutes of the 30th FBOS – ES

	Hec Under Graduate Policy 2023	BS Geology Existing Road Map	BS Geology Proposed Road Map
Total Credit hrs	120 - 144 credit hrs	135	132
General Education C courses	30 CH (12 courses)	28 CH (10 courses)	33 CH (13 courses)
Natural Sciences	3 CH (1 course)	6 CH (2 courses)	6CH (2 courses)
Social Sciences	2 CH (1 course)	3 CH (1 courses)	2 CH (1 course)
Arts and Humanities	2 CH (1 courses)	0 CH (0 courses)	2 CH (1 courses)
Expository Writing	3 CH (1 courses)	6 CH (2 courses)	3 CH (1 course)
Functional English	3 CH (1 course)	3 CH (1 course)	3 CH (1 course)
Quantitative Reasoning	6 CH (2 courses)	6 CH (2 courses)	6 CH (2 courses)
Ideology & Constitution of Pakistan	2 CH (1 course)	2 CH (1 course)	2 CH (1 course)
Islamiat	2 CH (1 course)	2 CH (1 course)	2 CH (1 course)
Interdisciplinary	12 CH (4 courses)	12 CH (4 courses)	12 CH (4 courses)
Application of ICT	2+1 CH (1 course)	Nil	2+1 CH (1 course)
Entrepreneurship	2 CH (1 course)	Nil	2 CH (1 course)
Civics & Community Engagement E	2 CH (1 course)	Nil	2 CH (1 course)
Majors	72 CH	95 CH (33 courses) 6 CH field (2 courses) 6 CH Thesis	81 CH (27 courses) 3 CH field (1 course) 3 CH Thesis

PROPOSED ROADMAP**SUMMARY**

HEC GUIDELINES	HEC UG POLICY 2023	PROPOSED ROADMAP
General Education Courses: 13	30 Credit Hours	33 Credit hours
Major (Disciplinary) Requirements	Minimum 72 Credit Hours	81 Credit Hours
Interdisciplinary/allied courses: 04	12 Credit Hours	12 Credit Hours
Field Work Course: 01	3 Credit Hours	03 Credit Hours
Capstone Project: 01	3 Credit Hours	03 Credit Hours
Total	120-144 Credit Hours	132 Credit Hours

ROADMAP**Semester - 1**

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
ENG 105	Functional English	3+0	3	0
PHY 101	Physics	2+1	2	2
CSC 102	Introduction to Computers & Programming	2+1	2	2
MAT 105*	Mathematics	0+0	3	0
	Ideology & Constitution of Pakistan	2+0	2	0
ISL 101	Islamic Studies	2+0	2	0
GEO 105	Physical & General Geology	3+0	3	0
	Total Credit Hours	16		

*Academic credit of this course is zero but its contact hours, teaching material and tuition fee are equal to a 3 credit hours course.

Semester - 2

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
HSS 320	Technical Writing and Presentation Skills	3+0	3	0
CHM 105	Chemistry	2+1	2	2
MAT 115	Calculus & Analytical Geometry	3+0	3	0
GEO 110	Fundamental of Geography & Geomorphology	3+0	3	0
GEO 115	Introduction to Geophysics	3+0	3	0
GEO 120	Field Geology	2+1	2	2
	Total Credit Hours	18		

Semester – 3

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
GEO 201	Muesology	2+0	2	0
XXX	Civics and Community Engagement	2+0	2	0
GEO 205	Structural Geology	2+1	2	2
GEO 210	Mineralogy and Crystallography	2+1	2	2
GEO 215	Geostatistics	3+0	3	0
PSY 102	Introduction to Psychology	2+0	2	0
	Total Credit Hours	15		

Semester – 4

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
XXX	Entrepreneurship	2+0	2	0
GEO 225	Geochemistry	3+0	3	0
GEO 215	Sedimentology	3+0	3	0
GEO 230	Geotectonics	3+0	3	0
XXX	Applications of ICT	2+1	2	2
GEO 221	Optical Mineralogy	3+0	3	0
	Total Credit Hours	17		

Semester – 5

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
GEO 325	Stratigraphy of Pakistan	3+0	3	0
GEO 345	Petroleum Geology	3+0	3	0
GEO 305	Environmental Geology	3+0	3	0
GEO 310	Paleontology	3+0	3	0
GEO 315	Igneous & Metamorphic Petrology	3+0	3	0
GEO 326	Computing with Matlab	2+1	2	2
	Total Credit Hours	18		

Semester - 6

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
GEO 340	Wireline logging	2+1	2	2
GEO 330	Micropaleontology & Biostratigraphy	2+1	2	2
GEO 360	Geological field Work & Report	0+3	0	3
GEO 350	Geology of Pakistan	3+0	3	0
GEO 320	Marine Geology	3+0	3	0
GEO 335	Neotectonics	3+0	3	0
	Total Credit Hours	18		

Semester – 7

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
GEO 425	Research Methodology	3+0	3	0
GEO 410	Engineering Geology	2+1	2	2
GEO 437	GIS & Remote Sensing	2+1	2	2
GEO 420	Hydrogeology	3+0	3	0
GEO 415	Economic Geology	3+0	3	0
	Total Credit Hours	15		

Semester – 8

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
GEO 469	Industrial Mineralogy	3+0	3	0
GEO 475	Mining Geology	3+0	3	0
GEO 430	Geochemical Exploration Techniques	3+0	3	0
GEO 484	Quaternary Geology	3+0	3	0
GEO 440	Thesis / Capstone Project	0+3	0	6
	Total Credit Hours	15		
	Total Degree Credit Hours	132		

Course Description**Course Description of General Education and Foundation Courses for
BS Geology Program****GEO 105 Physical Geology and General Geology (3 CH)**

Fundamentals of physical Geology, including composition and structure of the earth; Surface and ground water; Weathering and erosion; Sedimentation; Glaciations, Diastrophisms, and volcanism; Laboratory exercises in identification of common minerals and rocks; and interpretation of topographic maps; Field trips to nearby localities.

MAT 115 Calculus and Analytical Geometry (3 CH)

Limit of a function and theorems on limits. Calculating limits using limit theorems. One-sided limits. Limits at infinity; Infinite limits. Continuity of functions and theorems on Continuity. The Intermediate Value of theorem; Differentiation rules; Derivatives of algebraic and transcendental functions. Derivative of Composite functions (The chain rule). Implicit differentiation. Higher derivatives. Differentials and errors. Integral as ant derivative; Rules for indefinite integration. Integration by substitution, by Parts and by Partial Fractions.; Trigonometric integrals and trigonometric substitutions; Definite integrals Application to arc length and area between curves; Sequences; Limit of a sequence; Infinite series; Convergent and divergent series; Test for convergence; Power Series; Taylor and McLorin Series. Review of Analytic Geometry (Line, Circle, Conic Sections).

GEO 115 Introduction to Geophysics (3 CH)

Introduction to geophysics and geodynamics of earth. Elementary study of the gravitational, seismic, magnetic, thermal, and radioactive properties of the earth; Classification and brief description of various methods of geophysics such as seismic; gravity, magnetic; electrical,

radioactive, geomagnetism and paleomagnetism. Interpretations of data and their applications to the scientific and economic exploration of the earth's interior.

GEO 120 Field Geology (2 CH)

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.

GEL 120 Field Geology Lab(1 CH)

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

GEO 205 Structural Geology (2 CH)

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.

GEL 205 Structural Geology Lab(1 CH)

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.

GEO 210 Mineralogy and Crystallography (2 CH)

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

GEL 210 Mineralogy and Crystallography Lab(1 CH)

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.

GEO 215 Geostatistics (3 CH)

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.

GEO 225 Geochemistry (3 CH)

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.

GEO 215 Sedimentology (3 CH)

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.

GEO 230 Geotectonics (3 CH)

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.

GEO 220 Optical Mineralogy (3 CH)

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.

GEO 325 Stratigraphy of Pakistan (3 CH)

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.

GEO 345 Petroleum Geology (3 CH)

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.

GEO 310 Paleontology (3 CH)

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.

GEO 315 Igneous & Metamorphic Petrology (3 CH)

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.

GEO 326 Computing with Matlab (2CH)

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.

GEL 326 Computing with Matlab Lab (1 CH)

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.

GEO 340 Wireline Logging (2 CH)

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.

GEO 340 Wireline Logging (1 CH)

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

GEO 330 Micropaleontology and Biostratigraphy (2 CH)

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

GEL 330 Micropaleontology and Biostratigraphy Lab (1 CH)

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

GEO 360 Geological Field Work & Report (3 CH)

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.

GEO 350 Geology of Pakistan (3 CH)

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.

GEO 320 Marine Geology (3 CH)

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

GEO 335 Neotectonics (3 CH)

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

GEO 425 Research Methodology (3 CH)

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.

GEO 410 Engineering Geology (2 CH)

Basic concept of Engineering Geology; Mass-wasting, landslide and other rock movements; Uplift and settlement problems; Excavation and tunneling; 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.

GEL 410 Engineering Geology Lab (1 CH)

Sieve analysis, slake durability, moisture content, determination of elastic limit, determination of plasticity limit, coring techniques, void ratios, porosity, angle of repose, and other geotechnical properties of soils. Uniaxial and Triaxial Testing; tensile, compressive and shear tests of rocks.

GEO 415 Economic Geology (3 CH)

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.

GEO 469 Industrial Mineralogy (3 CH)

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.

GEO 475 Mining Geology (3 CH)

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.

GEO 430 Geochemical Exploration Techniques (3 CH)

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.

GEO 484 Quaternary Geology (3 CH)

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 eoline deposits).

Bachelor of Science (BS) Geophysics Existing Roadmap

Semester - 1

Course code	Course Title	Credit Hours
PAK 101	Pakistan Studies	2
ISL 101	Islamic Studies	2
ENG 103	English I	3
MAT 105*	Mathematics	0
CSC 105	Introduction to Computers	3
PHY 101	Physics	3
GEO 105	Physical & General Geology	3
	Total Credit Hours	16

*Academic credit of this course is zero but its contact hours, teaching material and tuition fee are equal to a 3 credit hours course.

Semester - 2

Course code	Course Title	Credit Hours
CHM 105	Chemistry	3
ENG 104	English -II	3
MAT 115	Calculus & Analytical Geometry	3
GEO 110	Fundamental of Geography & Geomorphology	3
GEO 115	Introduction to Geophysics	3
GEO 120	Field Geology	3
	Total Credit Hours	18

Semester – 3

Course code	Course Title	Credit Hours
ENG 232	Oral Communication	3
MAT 205	Statistics	3
GEO 205	Structure Geology	3
CSC 205	Programming Fundamentals	3
GEO 210	Mineralogy & Crystallography	3
<u>One of the Following</u>		
HSS 111	Introduction to IR	3
HSS 115	Introduction to Media Studies	3
HSS 201	Introduction to Anthropology	3
HSS 202	Introduction to Sociology	3
	Total Credit Hours	18

Note: Students will be offered only one of the HSS subjects.

Semester – 4

Course code	Course Title	Credit Hours
GEO 215	Sedimentology	3
GEO 240	Gravity & Magnetic Exploration Techniques	3
GEO 365	Electrical & Radioactive Techniques	3
GEO 230	Geotectonics	3
MAT 210	Advance Mathematics	3
	Total Credit Hours	15

Semester - Summer

Course code	Course Title	Credit Hours
GEO 250	Geology and Geophysical Field Work and Report-I	3

Semester - 5

Course code	Course Title	Credit Hours
GEO 326	Computing with Matlab	3
GEO 325	Stratigraphy of Pakistan	3
GEO 315	Igneous & Metamorphic Petrology	3
GEO 320	Marine Geology	3
GEO 305	Environmental Geology	3
GEO 370	Geomagnetism & Paleomagnetism	3
	Total Credit Hours	18

Semester - 6

Course code	Course Title	Credit Hours
GEO 340	Wireline logging	3
GEO 350	Geology of Pakistan	3
GEO 367	Seismic Data Acquisition & Planning	3
GEO 345	Petroleum Geology	3
Elective 1	<u>One of the Following</u>	
GEO 335	Earthquake Seismology	3
GEO 351	Natural Disaster Management	3
ENV 330	Environmental & Natural Resource Economics	3
	Total Credit Hours	15

Semester - Summer

Course code	Course Title	Credit Hours
GEO 375	Geology and Geophysical Field Work and Report-II	3

Semester - 7

Course code	Course Title	Credit Hours
GEO 470	Seismic Data Processing	3
GEO 415	Economic Geology	3
GEO 425	Research Methodology	2
GEO 420	Hydrogeology	3
Elective 2	<u>One of the Following</u>	
GEO 405	Petroleum Engineering	3
GEO 436	Health, Safety and Environment	3
ENV 410	Environmental Impact Assessment	3
	Total Credit Hours	14

Semester - 8

Course code	Course Title	Credit Hours
GEO 445	Seismic Stratigraphy	3
GEO 475	Seismic Data Interpretation	3
GEO 435	GIS & Remote Sensing	3
GEO 460	Thesis	6
GEO 465	Comprehensive Viva Voce	0
	Total Credit Hours	15

Bachelor of Science (BS) Geophysics

Proposed Roadmap as Per HEC 2023 Undergraduate Policy

Vision and Mission of Bahria University

Vision

To become a knowledge and creativity driven international university that contributes towards development of society.

Mission

To ensure academic excellence through deliverance of quality education and applied research in a collegiate environment having strong linkages with industry and international community to meet the societal challenges.

Vision and Mission of Earth & Environmental Sciences

Vision

To become an advanced research oriented institution in the field of Earth and Environmental Sciences at par with the international standards.

Mission

To enable the graduates to meet the challenges in exploring natural resources, identifying national issues and finding mitigations of hazards, and increasing public awareness in protecting the natural environment.

PROGRAM EDUCATIONAL OBJECTIVES (PEO's)

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 (PLO's)

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 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 PLO'S and PEO'S

S. No	Programme 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 Under Graduate Policy 2023	BS-Geophysics Existing Road Map	BS Geophysics Proposed Road Map
Total Credit hrs	120 - 144 credit hrs	135	132
General Education courses C	30 CH (12 courses)	28 CH (10 courses)	33 CH (13 courses)
Natural Sciences	3 CH (1 course)	6 CH (2 courses)	6CH (2 courses)
Social Sciences	2 CH (1 course)	3 CH (1 courses)	2 CH (1 course)
Arts and Humanities	2 CH (1 courses)	0 CH (0 courses)	2 CH (1 courses)
Expository Writing	3 CH (1 courses)	6 CH (2 courses)	3 CH (1 course)
Functional English	3 CH (1 course)	3 CH (1 course)	3 CH (1 course)
Quantitative Reasoning	6 CH (2 courses)	6 CH (2 courses)	6 CH (2 courses)
Ideology & Constitution of Pakistan	2 CH (1 course)	2 CH (1 course)	2 CH (1 course)
Islamiat	2 CH (1 course)	2 CH (1 course)	2 CH (1 course)
Interdisciplinary	12 CH (4 courses)	12 CH (4 courses)	12 CH (4 courses)
Application of ICT	2+1 CH (1 course)	Nil	2+1 CH (1 course)
Entrepreneurship	2 CH (1 course)	Nil	2 CH (1 course)
Civics & Community Engagement E	2 CH (1 course)	Nil	2 CH (1 course)
Majors	72 CH	95 CH (33 courses) 6 CH field (2 courses) 6 CH Thesis	81 CH (27 courses) 3 CH field (1 course) 3 CH Thesis

PROPOSED ROADMAP**SUMMARY**

HEC GUIDELINES	HEC UG POLICY 2023	PROPOSED ROADMAP
General Education Courses: 13	30 Credit Hours	33 Credit hours
Major (Disciplinary) Requirements	Minimum 72 Credit Hours	81 Credit Hours
Interdisciplinary/allied courses: 04	12 Credit Hours	12 Credit Hours
Field Work Course: 01	3 Credit Hours	03 Credit Hours
Capstone Project: 01	3 Credit Hours	03 Credit Hours
Total	120-144 Credit Hours	132 Credit Hours

ROADMAP**Semester - 1**

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
ENG 105	Functional English	3+0	3	0
PHY 101	Physics	2+1	2	2
CSC 102	Introduction to Computers & Programming	2+1	2	2
MAT 105*	Mathematics	0+0	3	0
	Ideology & Constitution of Pakistan	2+0	2	0
ISL 101	Islamic Studies	2+0	2	0
GEO 105	Physical & General Geology	3+0	3	0
	Total Credit Hours	16		

*Academic credit of this course is zero but its contact hours, teaching material and tuition fee are equal to a 3 credit hours course.

Semester - 2

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
HSS 320	Technical Writing and Presentation Skills	3+0	3	0
CHM 105	Chemistry	2+1	2	2
MAT 115	Calculus & Analytical Geometry	3+0	3	0
GEO 110	Fundamental of Geography & Geomorphology	3+0	3	0
GEO 115	Introduction to Geophysics	3+0	3	0
GEO 120	Field Geology	2+1	2	2
	Total Credit Hours	18		

Semester – 3

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
GEO 201	Muesology	2+0	2	0
XXX	Civics and Community Engagement	2+0	2	0
GEO 205	Structure Geology	2+1	2	2
GEO 210	Mineralogy and Crystallography	2+1	2	2
GEO 215	Geostatistics	3+0	3	0
PSY 102	Introduction to Psychology	2+0	2	0
	Total Credit Hours	15		

Semester – 4

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
XXX	Entrepreneurship	2+0	2	0
XXX	Gravity & Magnetic Exploration Techniques	3+0	3	0
GEO 215	Sedimentology	3+0	3	0
GEO 230	Geotectonics	3+0	3	0
XXX	Applications of ICT	2+1	2	2
GEO 335	Earthquake Seismology	3+0	3	0
	Total Credit Hours	17		

Semester – 5

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
GEO 325	Stratigraphy of Pakistan	3+0	3	0
GEO 345	Petroleum Geology	3+0	3	0
GEO 327	Environmental Geophysics	3+0	3	0
GEO 364	Electrical & Radioactive Exploration Techniques	2+1	2	2
GEO 332	Rock Physics	3+0	3	0
GEO 326	Computing with Matlab	2+1	2	2
	Total Credit Hours	18		

Semester - 6

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
GEO 340	Wireline logging	2+1	2	2
GEO 367	Seismic Data Acquisition & Planning	3+0	3	0
GEO 362	Geological & Geophysical field Work & Report	0+3	0	3
GEO 350	Geology of Pakistan	3+0	3	0
GEO 379	Introduction to Machine Learning	2+1	2	2
GEO 311	Reservoir Geophysics	3+0	3	0
	Total Credit Hours	18		

Semester – 7

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
GEO 425	Research Methodology	3+0	3	0
GEO 470	Seismic Data Processing	3+0	3	0
GEO 437	GIS & Remote Sensing	2+1	2	2
GEO 421	Ground Water Investigation	2+1	2	2
GEO 445	Seismic Stratigraphy	3+0	3	0
	Total Credit Hours	15		

Semester – 8

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
GEO 476	Seismic Data Interpretation	2+1	2	2
GEO 479	Geospatial Techniques	2+1	2	2
GEO 480	Geophysical Softwares	2+1	2	2
GEO 481	Mining Geophysics	3+0	3	0
GEO 440	Thesis / Capstone Project	0+3	0	6
	Total Credit Hours	15		
	Total Degree Credit Hours	132		

Course Description

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

GEO 240 Gravity and Magnetic Exploration Techniques (3 CH)

Introduction, fundamental principles, units of gravity, roll of mass & density in gravity, distribution of density inside earth, methods of determining value of “g”, gravity acquisition, flattening effect of earth, gravity processing including gravity reduction, different types of correction with their mathematical derivation, Bouger anomaly, regional and residual effect, gravity modeling of ore bodies, methods of finding out density & thickness of ore bodies. Introduction to magnetic method, significance in oil exploration, magnetic force, definition, unit, advantages & disadvantages, planning of survey, magnetic moment, magnetic induction & magnetic permeability, intensity of magnetization, magnetic reduction, magnetism in rocks and minerals, remnant magnetization, susceptibility contrast, magnetism of earth (geomagnetism), hysteresis loop, interpretation of magnetic data.

GEO 335 Earthquake Seismology (3 CH)

Causes and effects of earthquakes; Methods to locate and to assign magnitudes to earthquakes; Types of elastic waves, their propagation, travel-time curves and applications to the study of earth’s interior; Earthquake risk analysis and expectations; man-made earthquakes and seismometry. Earthquake Seismology and the mathematical analysis of seismological processes on the basis of elastic wave theory. Seismic waves and their analysis in earthquake seismology. Frequency, magnitude, energy of an earthquake and their relationship. Source parameters and their determination. Composite fault plane solutions of earthquakes and their determination. Geographical distribution of important earthquakes. Earthquakes and their implication on the tectonics of the area. Specified problems on data processing analysis, fault solutions and interpretation.

GEO 327 Environmental Geophysics (3 CH)

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.

GEO 364 Electrical and Radioactive Techniques (2 CH)

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.

GEL 364 Electrical and Radioactive Techniques (1 CH)

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

GEO 332 Rock Physics (3CH)

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

GEO 367 Seismic Data Acquisition and Planning (3 CH)

Introduction to exploration seismology, Elasticity, Basic of seismic techniques and methods, Reflection seismic and refraction seismic, Concept of elastic (seismic) waves, Elastic moduli's, laws governing seismic method like Snell's law, Fermat's principle, Huygen's principle, 2D and 3D seismic technique, Seismograms, Source wavelet, Attenuation and its factors, Transmission and Reflection coefficients, Refracted and Reflected seismic waves and internal earth's structure, Single layer case, Multilayer case, Calculating travel time, velocity, Dip, layer thickness. Seismic velocities, Dix average formula and calculation, Multifold reflection, Seismic surveying instruments, Sources and recording system of land and marine, Analog and Digital recording system, Seismic crew, Field Operations, Spread types, CDP profiling and sounding, crooked line reflection

GEO 362 Geological & Geophysical field Work & Report (3 CH)

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; Use of Electrical resistivity meter and its data acquisition and data interpretation. A written Geological report at the end of semester.

GEO 379 Introduction to Machine Learning (2 CH)

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

GEL 379 Introduction to Machine Learning Lab (1 CH)

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

GEO 311 Reservoir Geophysics (3CH)

Introduction to Reservoir Geophysics. Petroleum reservoir description and characterization with particular emphasis on Seismic techniques. Physical properties of rocks and fluids and why they are influencing on geophysical measurements. Seismic properties of a reservoir depicted in seismic data. Introduction and uses of seismic attributes. Introduction and uses of AVO analyses. Introduction of Gassmann-Biot theory. Role of Reservoir Simulation, Rock Physics and Seismic in Reservoir Monitoring.

GEO 470 Seismic Data Processing (3 CH)

Main tasks of seismic data processing, correct for recording strategies, ray-path geometries, data recoding techniques, signal to noise ratio, clearest possible image of the subsurface, transcription, vibroseis data and correlation, shot summing, initial statics, deconvolution, gain recovery, trace editing, resampling, spatial sampling, spatial filtering, FK filtering, FX de-convolution, multichannel filtering, CMP gather, de-multiple, dip move out, NMO correction, mute, equalization, CMP stack, datum correction, migration, band pass filter, dynamic correction, seismic velocities, picking velocities, residual statics, display.

GEO 421 Ground Water Investigation (2 CH)

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.

GEL 421 Ground Water Investigation Lab (1 CH)

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.

GEO 445 Sequence Stratigraphy (3CH)

Introduction, history, concept and significance of sequence stratigraphy; data sources: seismic reflections, outcrops, well logs, core; seismic facies; sea level changes, their causes and effects; accommodation, eustatic and relative sea curve; hierarchy of sequence stratigraphic elements; types of sequences and systems tracts; applications to hydrocarbon exploration and basin analysis.

GEO 476 Seismic Data Interpretation (2 CH)

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.

GEL 476 Seismic Data Interpretation Lab (1 CH)

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

GEO 479 Geospatial Techniques (2 CH)

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.

GEL 479 Geospatial Techniques Lab(1 CH)

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

GEO 480 Geophysical Softwares (2 CH)

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.

GEL 480 Geophysical Softwares (1 CH)

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.

GEO 481 Mining Geophysics

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

Bachelor of Science (BS) Remote Sensing & GIS

Existing Roadmap

Semester – 1

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
PAK 102	Pakistan Studies	3+0	3	0
RGS 103	Fundamentals of GIS	2+1	2	1
ENG103	English I	3+0	3	0
MAT 105*	Mathematics	3+0	3	0
CSC 105	Introduction to Computers and Programming	2+1	2	1
PHY 101	Physics	2+1	2	1
ISL 102	Islamic Studies	2+0	2	0
OR SOC 360	Ethics			
Total Credit Hours		16		

*Academic credit of this course is zero but its contact hours, teaching material and tuition fee are equal to a 3 credit hours course.

Semester – 2

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
ENG 104	English II	3+0	3	0
RGS 104	Physical Geography	3+0	3	0
MAT 115	Calculus & Analytic Geometry	3+0	3	0
RGS 105 Pre req: RGS 104	Fundamentals to Earth Science	2+1	2	1
RGS 106 Pre-req: RGS 104	Introduction to Remote Sensing	2+1	2	1
MTB 111	Introduction to Film Making & Analysis	2+1	2	1
Total Credit Hours		18		

Semester – 3

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
CHM 105	Chemistry	2+1	2	1
HSS 320	Technical Writing & Presentation Skills	3+0		
RGS 201 Pre req: CSC 103	Introduction to Cartography	2+1	2	1
RGS 202 Pre req: RGS 104	GPS & Surveying	2+1	2	1
PSY 107	Introduction to Psychology	3+0	3	0
HSS 111	Introduction to International Relations	3+0		
Total Credit Hours		18		

Semester – 4

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
MAT 205	Statistics	3+0	3	0
RGS 315	Human Geography	3+0	3	0
RGS 204 Pre-req: RGS 106	Introduction to Photogrammetry	2+0	2	0
RGS 206 Pre req: RGS 203	Database Management Systems	2+1	2	1
RGS 207 Pre req: RGS 106	Active Remote Sensing & Space Laws	3+0	3	0
RGL 251	Field Work and Report-I	1+2	1	2
	Total Credit Hours	17		

Semester – 5

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
RGS 315	Human Geography	3+0	3	0
RGS 316 Pre req: RGS 207	Microwave & Hyper Spectral RS	2+1	2	1
RGS 317 Pre req: RGS 206	Spatial Decision Support Systems	3+0	3	0
RGS 318 Pre req: RGS 201 RGS 203	Spatial Data Infrastructure & Visualization	2+1	2	1
RGS 319	Multidisciplinary Applications of GIS & RS	2+1	2	1
RGS 320	Geospatial Project Management	3+0	3	0
	Total Credit Hours	18		

Semester – 6

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
GEO 425	Research Methodology	3+0	3	0
RGS 330 Pre req: CSC 103	Web GIS	2+1	2	1
RGS 331 Pre-req: RGS 106	Digital Image Processing	2+1	2	1
RGS 332 Pre req: RGS 202	Satellite Navigation Systems	3+0	3	0
RGS 320	Geospatial Project Management	3+0	3	0
	Total Credit Hours	15		

Semester – 7

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
RGS 319	Multidisciplinary Applications of GIS & RS	2+1	2	1
RGS 361 Pre-req: RGS 319	Integrated Geospatial Technologies	2+1	2	1
ENV 425	Occupational Health & Safety	3+0	3	0
ENV 425	Occupational Health & Safety	3+0	3	0
GEL 321	Computing with MATLAB Lab	2+1	2	1
	Total Credit Hours	15		

Semester – 8

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
RGS 471	Legal and Social Issues in Geospatial Sciences	3+0	3	0
RGS 451 RGL 451	Computer Aided Drafting/Drawing Computer Aided Drafting/Drawing Lab	2+1	2	1
RGS 455 RGL 455	Land & Water Information System Land & Water Information System Lab	2+1	2	1
RGS 453	Environmental Geography	2+1	2	1
RGS 490	Thesis	0+6	0	6
	Total Credit Hours	18		

Bachelor of Science (BS) Remote Sensing and GIS Proposed Roadmap as Per HEC 2023 Undergraduate Policy

Vision and Mission of Bahria University

Vision

To become a knowledge and creativity driven international university that contributes towards development of society.

Mission

To ensure academic excellence through deliverance of quality education and applied research in a collegiate environment having strong linkages with industry and international community to meet the societal challenges.

Vision and Mission of Earth & Environmental Sciences

Vision

To become an advanced research oriented institution in the field of Earth and Environmental Sciences at par with the international standards.

Mission

To enable the graduates to meet the challenges in exploring natural resources, identifying national issues and finding mitigations of hazards, and increasing public awareness in protecting the natural environment.

PROGRAM EDUCATIONAL OBJECTIVES (PEO's)

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 (PLO's)

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'S and PEO'S

T. 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 Under Graduate Policy 2023	BS-RS & GIS Existing Road Map	BS RS & GIS Proposed Road Map
Total Credit hrs	120 - 144 credit hrs	135	132
General Education courses	30 CH (12 courses)	36 CH (12 courses)	30 CH (12 courses)
Natural Sciences	3 CH (1 course)	6 CH (2 courses)	6CH (2 courses)
Social Sciences	2 CH (1 course)	3 CH (1 courses)	2 CH (1 course)
Arts and Humanities	2 CH (1 course)	6 CH (2 courses)	2 CH (1 courses)
Expository Writing	3 CH (1 course)	6 CH (2 courses)	3 CH (1 course)
Functional English	3 CH (1 course)	3 CH (1 course)	3 CH (1 course)
Quantitative Reasoning	6 CH (2 courses)	6 CH (2 courses)	6 CH (2 courses)

Minutes of the 30th FBOS – ES

Ideology & Constitution of Pakistan	2 CH (1 course)	3 CH (1 course)	2 CH (1 course)
Islamiat	2 CH (1 course)	3 CH (1 course)	2 CH (1 course)
Interdisciplinary	12 CH (4 courses)	6 CH (2 courses)	12 CH (4 courses)
Application of ICT	2+1 CH (1 course)	3 CH (1 course)	2+1 CH (1 course)
Entrepreneurship	2 CH (1 course)	Nil	2 CH (1 course)
Civics & Community Engagement	2 CH (1 course)	Nil	2 CH (1 course)
Majors	72 CH	75 CH (25 courses) 6 CH field (2 course) 6 CH Thesis	84 CH (28 courses) 3 CH field (1 course) 3 CH Thesis

PROPOSED ROADMAP**SUMMARY**

HEC GUIDELINES	HEC UG POLICY 2023	PROPOSED ROADMAP
General Education Course: 13	30 Credit Hours	30 Credit hours
Major (Disciplinary) Requirements	Minimum 72 Credit Hours	84 Credit Hours
Interdisciplinary/allied courses: 04	12 Credit Hours	12 Credit Hours
Field Work Course: 01	3 Credit Hours	03 Credit Hours
Capstone Project: 01	3 Credit Hours	03 Credit Hours
Total	120-144 Credit Hours	132 Credit Hours

Semester – 1

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
XXXX	Ideology & Constitution of Pakistan	2+0	2	0
RGS 103	Fundamentals of GIS	2+1	2	1
ENG103	Functional English	3+0	3	0
MAT 105*	Mathematics (for Pre-Med.)	3+0	3	0
CSC 105	Introduction to Computers and Programming	2+1	2	1
ENV 105	Introduction to Environmental Sciences	2+1	2	1
PHY 101	Physics	2+0	2	0
ISL 102/ OR SOC 360	Islamic Studies	2	2	0
	Ethics			
Total Credit Hours		16		

*Academic credit of this course is zero but its contact hours, teaching material and tuition fee are equal to a 3 credit hours course.

Semester – 2

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
HSS 320	Technical Writing & Presentation Skills	3+0	3	0
RGS 104	Physical Geography	2+1	2	1
MAT 115 Pre-req: MAT 105	Calculus & Analytic Geometry	3+0	3	0
GEO 201	Museology	2+0	2	0
RGS 105 Pre req: RGS 104	Fundamentals to Earth Science	2+1	2	1
RGS 106 Pre-req: RGS 104	Introduction to Remote Sensing	2+1	2	1
Total Credit Hours		17		

Semester – 3

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
	Entrepreneurship	2+0	2	0
CHM 105	Chemistry	2+1	2	1
RGS 201 Pre req: CSC 103	Introduction to Cartography	2+1	2	1
RGS 202 Pre req: RGS 104	GPS & Surveying	2+1	2	1
PSY 107	Introduction to Psychology	2+0	2	0
XXXX	Civic& Community Engagement	2+0	2	0
	Total Credit Hours	15		

Semester – 4

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
MAT 205	Statistics	3+0	3	0
RGS 315	Human Geography	3+0	3	0
RGS 204 Pre-req: RGS 106	Introduction to Photogrammetry	2+1	2	1
RGS 206 Pre req: RGS 203	Database Management Systems	2+1	2	1
RGS 207 Pre req: RGS 106	Active Remote Sensing & Space Laws	3+0	3	0
RGL 251	Geospatial Field Work and Report-I	1+2	1	2
	Total Credit Hours	18		

Semester – 5

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
GEL 326	Computing with MATLAB, Lab	2+1	2	1
RGS 316 Pre req: RGS 207	Microwave & Hyper Spectral RS	2+1	2	1
RGS 317 Pre req: RGS 206	Spatial Decision Support Systems	3+0	3	0
RGS 318 Pre req: RGS 201 RGS 203	Spatial Data Infrastructure & Visualization	2+1	2	1
RGS 319	Multidisciplinary Applications of GIS & RS	2+1	2	1
RGS 320	Geospatial Project Management	3+0	3	0
	Total Credit Hours	18		

Semester – 6

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
GEO 425	Research Methodology	3+0	3	0
RGS 330 Pre req: CSC 103	Web GIS	2+1	2	1
RGS 331 Pre-req: RGS 106	Digital Image Processing	2+1	2	1
RGS 332 Pre req: RGS 202	Satellite Navigation Systems	3+0	3	0
RGS 320	Geospatial Project Management	3+0	3	0
	Total Credit Hours	18		

Semester – 7

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
RGS 453	GIS for Disaster Management	3+0	3	0
RGS 361 Pre-req: RGS 319	Integrated Geospatial Technologies	2+1	2	1
RGS 453	Geospatial Techniques	2+1	2	1
ENV 425	Occupational Health & Safety	3+0	3	0
RGS 454	Spatial Data Modelling	2+1	2	1
	Total Credit Hours	15		

Semester – 8

Course code	Course Title	Credit Hours	Contact Hours	
			Theory	Lab
RGS 471	Legal and Social Issues in Geospatial Sciences	3+0	3	0
RGS 451	Computer Aided Drafting/Drawing	2+1	2	1
RGS 455	Land & Water Information System	2+1	2	1
RGS 456	GIS Programming & Python	2+1	2	1
RGS 490	Cap stone project	0+3	0	3
	Total Credit Hours	15		

**Course Description of General Education and Foundation Courses for
BS Remote Sensing & GIS**

..... Ideology and Constitution of Pakistan (2 CH)

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.

ISL 102 Islamic Studies (2 CH)

A course of Islamic Studies provides students with a comprehensive overview of the fundamental aspects of Islam, its history, beliefs, practices, and influence on society and familiarize students with a solid foundation in understanding the religion of Islam from an academic and cultural perspective. Ethics, in integrated form will shape the core of the course to foster among students the universal ethical values promoted by Islam.

ENG 105 Functional English (3 CH)

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 presentation.

MAT 105 Fundamentals of Mathematics (0 CH)

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.

CSC 102 Introduction to Computers and Programming (2 CH)

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.

CSL 102 Introduction to Computers and Programming Lab (1 CH)

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.

PHY 101 Physics (2 CH)

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.

PHL 101 Physics Lab (1 CH)

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.

CHM 105 Chemistry (2 CH)

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.

CHL 105 Chemistry Lab (1 CH)

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)

ENG 205 Technical Writing and Presentation Skills (3 CH)

Pre-requisite ENG 105

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.

..... Applications of Information and Communication Technologies (ICT) (2 CH)

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 (Dumb, 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.

.....Applications of Information and Communication Technologies Lab (ICT) (1 CH)

Practical exercises will be carried out in lab

..... Entrepreneurship (2 CH)

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.

.....Civics and Community Engagement (2 CH)

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.

GEO 201 Museology (2 CH)

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.

MAT 205 Statistics (3 CH)

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.

PSY 102 Introduction to Psychology (2 CH)

The course is designed to introduction to understand the vocabulary and concept of psychology. Understand how critical thinking 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.

ENV 425 Occupational Health and Safety (3 CH)

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.

GEO 326 Computing with Matlab (2CH)

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.

GEL 326 Computing with Matlab Lab (1 CH)

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.

GEO 425 Research Methodology (3 CH)

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.

RGS 104 Physical Geography (2 CH)

Scope and status of physical Geography, The basic concept and theories in physical Geography, Factors of Landform Development, Desert Landforms, Glaciers and their topographic effects, Karsts topography, Type of soil, Factors and elements of weather and climate, Composition and structure of atmosphere, Horizontal and vertical distribution of temperature, The distribution of pressure and seasonal variations, Wind Circulation, Humidity and forms of condensation, Classification of Climate, Characteristic features of the oceans, Temperature, salinity distribution, cause and effects, Ocean circulation: Waves, currents and tides, their nature, causes and effects and impact on man and environment.

RGL 104 Physical Geography Lab (1CH)

Study and identification of landforms using air photos and General topographic sheet, Use and making of various models showing various types of landforms, Recording and observation of weather data from a mini weather station, Identification of cloud types, Drawing of World map showing continents and oceans using Google Earth.

RGS 105 Fundamentals of Earth Science (2 CH)

Overview of Earth, Geological Framework of Earth, Structure and Composition of Earth; Deformation and Mountain Building Processes, Rock Cycle Volcanoes, Identification of rocks and minerals in hand specimen, Identification of different rock units and geological structures in field, Geological Hazards; Earthquakes, Tsunamis, Floods, Landslides, Mass-movements, Geological Time Scale; Cenozoic, Mesozoic, Paleozoic, Fossils and Evolution, Global Change in the Earth System, Economic Geology; Exploration and Exploitation of Natural Resources, Petroleum Basins of Pakistan. Field visit to different nearby rocky area.

RGL 105 Fundamentals of Earth Science Lab (1 CH)

Identification of rocks and minerals in hand specimen, Identification of different rock units and geological structures in field; Preparation of Geological Maps; Field visit of different geological sections and land for and hazard prone areas.

RGS 106 Introduction to Remote Sensing (2 CH)

Definition and History of satellite Remote sensing, Remote sensing and earth energy budget, Electromagnetic spectrum and radiation, Elements of Remote Sensing operation, Physical foundation of Visible, Infrared and microwaves remote sensing, high and low resolution remote sensing, Theoretical explanation of reflection, absorption and transmission, High resolution multi-spectral data, Introduction to Aerial Photograph, Sensor Systems, Platforms (Types and Orbital Characteristics), Thermal Infrared (Characteristics, TIR Band Properties, TIR Image Interpretation, Intro to Microwave (Importance and applications), Digital Image Processing (Overview of computer based image processing), Applications (agriculture, urban, natural resources etc.)

RGL 106 Introduction to Remote Sensing Lab (1 CH)

Introduction to labs, Layer stacking, Pixel Data, Single band image interpretation, False color predictions, False color composite Images Interpretation, Visual Interpretation of aerial photographs,

Minutes of the 30th FBOS – ES

Various sensors data comparison, Thermal Infrared Image interpretation, Intro to ERDAS Imagine, display, Geo-linking, Zooming, Identification of target features.

RGS 201 Introduction to Cartography (2 CH)

Course Outline: Introduction to Cartography, Nature of Cartography, Map Types. History of Cartography, Map Symbols, Lettering, Scale and direction, Coordinate systems, Map Projections Graphical and datum, Map Projections Mathematical. Perspective, non-perspective, conventional, Generalization, Thematic Maps, Descriptive Statistics, Class Intervals, Choropleth Maps, Proportional Symbol Maps, Dot Maps, Isarithmic Maps, Cartograms, Flow Maps, Graduated Colour Maps, Map Compilation, Map Design, Map Production Software.

RGL 201 Introduction to Cartography Lab (1 CH)

Map reading, Assignment on Types of Maps symbology, Development of Symbol Charts, Development of Graphical Map Projections, Large to small scale map conversion, Data classification and Thematic Mapping, Map composite development, Misleading cartography.

RGS 202 GPS & Surveying (2 CH)

Introduction to GPS, GPS Data, Position and Time from GPS, Pseudo-Range Navigation, Receiver Position, Velocity, and Time, Carrier Phase Tracking (Surveying), GPS Satellite Signals, GPS Error Sources, GPS survey procedure, Differential GPS Techniques. Overview of surveying, objects and classifications of surveying, scales, survey tasks, survey principles and methods, accuracy and precision, measurement and errors, coordinate systems and computation, direct distance measurements, errors in measurement of distance and corrections, height measures, leveling and its types, bench marks, leveling staff, sources of errors in leveling and accuracies, angular measurements, reading systems of optical theodolites, indirect distance measurements, reciprocal leveling, traverse survey, triangulation and trilateration.

RGL 202 GPS & Surveying Lab (1 CH)

GPS value reading, Easting Northing & elevation, Map Projections and Datum Settings, GPS based surveys, tracking and data processing, Planimetric & vertical errors calculations, Instrumental surveys will be included for measuring the distance, angles and heights. Major emphasis will be towards theodolite and leveling surveys.

RGS 103 Fundamentals of GIS (2 CH)

Introduction, Definitions, Key components of GIS, Functional Subsystem, Raster Data Model, Vector Data Model, Attribute Data Model, Data Acquisition Techniques, Data sources, Data capturing techniques and procedures, Data Transformation, Visualization of spatial data, Layers and Projections, Map Design: Symbols to Portray Points, Lines and Volumes, Graphic Variables, Visual Hierarchy, Data Classification Graphic Approach, Mathematical Approach, Spatial Analysis: Overlay Analysis, Spatial analysis, Neighborhood functions, Network and overlay analysis, buffering, Spatial data Quality: Components of Data Quality, Micro Level Components, Macro Level Components, Usage Components Sources of Error, Accuracy, Project work.

RGL 103 Fundamentals of GIS Lab (1 CH)

Introduction to GIS Lab (hardware / software), Raster/Vector/Attribute Data Display, Scanning, Digitization, coordinate based point mapping, Raster / Vector Conversion, Digitization of Map features, Data layer integration and display of different projections, Map layout, Data Classification and Thematic Mapping, Handling with Topological Errors, Overlay and network analysis.

RGS 204 Introduction to Photogrammetry (2 CH)

Introduction, history and Overview, Analog, analytical, and digital photogrammetry, Photogrammetric cameras, Sensor, films and filters, Data acquisition methods. Single photograph properties, Spatial measurement and scale calculation, Problems with aerial photograph and rectification of a single aerial photograph, Aerial Photograph Interpretation, Types of Aerial Photograph and mosaics, Stereoscopic Analysis DEM generation, Orthophotography/Orthoimage, applications.

RGL 204 Introduction to Photogrammetry Lab (1 CH)

Comparison of formats, Area and scale measurement, Parallax and radial displacement, Visual interpretation of aerial photographs, vertical airphotos, Mirror stereoscopic interpretation, Orthorectification, case studies.

RGS 206 Database Management Systems (3 CH)

Basic database concepts; Entity Relationship modeling, Relational data model and algebra, Structured Query language; RDBMS; Database design, functional dependencies and normal forms; Transaction processing and optimization concepts; concurrency control and recovery techniques;

Database recovery techniques; Database security and authorization, Database normalization process techniques, Query optimization (Relational Algebra), Small Group Project implementing a database. Concepts of database securities, Development of a GUI interface.

RGS 207 Active Remote Sensing & Space Laws (3 CH)

Introduction to Active Remote Sensing Types of Active Remote Sensing. Advantages and Disadvantages of Active Remote sensing, Sensor and Platform (Space and airborne, MSS, TM, ETM, HRV, LISS, IKONOS-2, Quick bird-2, AVHRR and others), working Mechanism, Spectral Characteristics of multispectral images, Basic Concepts, Image Geometry, Data Compression and Reconstruction, Image Pre-processing and Classification, Field Verification, Data Fusion Techniques. Space Laws, History, International Space Agency, SUPARCO, Satellite Launching; Mechanism, Space Ethics. Applications of Active Remote Sensing and Space Laws.

RGS 315 Human Geography (3 CH)

Scope and Status of human Geography, Basic concepts and theories including Environmental determinism, Possibilism, and cognitive behaviorism, Population: Population distribution, density and growth. Population change including migration, Population composition and Structure, Human Activities: Primary, secondary and Tertiary (agriculture, mining, forestry animal husbandry, poultry, light and heavy industries, transport and trade and tourism) and their impacts on environment, Natural resources, distribution and utilization: Renewable and non-renewable resources e.g., Air, land, water, fauna and flora fossil fuel metallic and non-metallic minerals, Energy generation and consumption, Human Settlements: Evolution and housing types, Urban and Rural contrast, Land Use/land cover Pattern e.g. Commercial, Industrial and Residential, Open and Green Spaces, Transport, Theories of urban structure e.g., Concentric Zone Theory, Multiple Nuclei Theory, Sector Theory, Rural Settlements, Dispersed, Nucleated and Ribbon Settlements, City-Size, Distribution, Rank-Size Rule, Primate Cities.

RGS 316 Microwave & Hyper Spectral RS (2 CH)

Introduction of new and advanced developments that are taking place especially in microwave and hyper spectral remote sensing. Basic concepts, Types of sensors, History, Advantages and Disadvantages of Active Remote sensing; data acquisition, working mechanism, Spectral and spatial characteristics of microwave and hyper spectral images (RADAR, SRTM, SAR, AIRSAR, SLAR etc.); RADAR Image Geometry and interferometry, Data Compression and Reconstruction, RADAR Image Preprocessing and Classification, Field Verification, Data Fusion Techniques, Microwave Applications, Hyperspectral Remote Sensing Channels and Spectral Libraries Sensors (AIS, AIVIS etc.); Applications of Radar and hyper spectral datasets, Image Interpretation.

RGL 316 Microwave & Hyper Spectral RS Lab (1 CH)

Introduction to Microwave Image Processing Module, Microwave Image Comparisons, Visual Interpretation of Radar Images, Radar Image pre-processing (Total Power Image, Like and Unlike Polarization, Ground Resolution, Rectification and Registration, Optical and RADAR data fusion case studies.

RGS 317 Spatial Decision Support Systems (3 CH)

Decision Making Processes (Introduction, Major decision-making Paradigms, Models of decision making, Different types of problem, Hierarchy of decisions); Methods and techniques to support spatial decisions; Performance modelling and types of criteria, Measurement Scales, Uncertainty in decision making process Decision Support Systems (Introduction, Origin, Definition and components, Fundamental Phases, Characteristics and Capabilities of DSS); GIS and Decision Support Systems, Integration of GIS and DSS Multicriteria Evaluation (Criteria properties, Criteria weighting, Pair wise comparison, Ranking techniques, Rating techniques, Sensitivity analysis, Redistribution criteria weight, Option Ranking methods, Weighted summation, Ideal point, Rank order); Methods and Tools for Collaborative Decision- Making; Consensus Evaluation; Conflict Analysis.

RGS 318 Spatial Data Infrastructure & Visualization (2 CH)

Need and main components of Spatial Data Infrastructure (SDI), Metadata concepts, its structures and functionality, System Architecture for SDI Interoperability; Client Server Architecture, Data Quality Information (DQI) Accuracy, Precision, Bias Error Modeling, Problems of information sharing (Heterogeneities), Distributed database concept, SDI Technologies; Legal aspects of SDI. Introduction to spatial data visualization, Visualization Process, Visualization Strategies, Statistical and Visual Foundation, Principles of Symbolization, Principles of Colour, Tri-Simulate (chromatic Model, Intensity,

Hue and Saturation, Map Design Process, Mapping Techniques; Map Animation, Virtual Reality, Electronic Atlases and Multimedia.

RGL 318 Spatial Data Infrastructure & Visualization Lab (1 CH)

Comparison of working SDI's, Development of Metadata according to Standards, Development of Architecture of SDI, Data Standardization, Data transformations and translations, Data Modeling Abstraction of real world, Types of abstraction, 3D Modelling.

RGS 319 Multidisciplinary Application of GIS & RS (3 CH)

Introduction to the scope of both GIS and satellite remote sensing in modern era, identification of trending applications for mapping and modelling of natural hazards/disasters (urban floods, earthquakes, tsunami, land sliding etc.) water related issues, environmental issues, administrative and managerial issues, land cover/ land uses, developmental projects, watershed management, urban planning, rural areas planning etc. Related lab work considering scope of course, interest of students, data and software resource availability.

RGS 320 Geospatial Project Management (3 CH)

Overview, project management, project organization, projection selection models and techniques, Cost Benefit analysis, Project planning, project scheduling, project monitoring, reporting and controlling, and project termination.

RGS 330 Web GIS (2 CH)

Basic concepts and theory of interactive platform, as the combination of web and GIS (Geographic Information Systems). Introduction to the expanding scope of web and mobile-based mapping applications of GIS. Cloud GIS. Introduction to Google Earth Engine. Development procedures of Web GIS applications to e-government, e-business, e-science, and daily life, public services etc. Online maps and geospatial intelligence using various spatial data layers as web layers and maps.

RGL 330 Web GIS Lab (1 CH)

Build interactive web based GIS app that use geospatial data in an attractive format. Create a map tour application using ArcGIS Online. Create web apps with ArcGIS Web AppBuilder or HTML, ArcJava Script.

RGS 331 Digital Image Processing (2 CH)

Data Sources and Procurement, Data Formats (BSQ, BIL, BIP, etc.) Theory of Image Processing Techniques; Image Subsetting & Enhancement, Image Cleaning, Atmosphere Path Correction,, Image Mosaicing and Color Balancing, Image Rectification, Registration and Re-sampling, Band Ratios, Vegetation Indices, Image Filtering, Difference Images, Principal Component Analysis, Classification Schemes, Types, Algorithms, Field data collection, Qualitative and quantitative techniques, sampling techniques, Error matrices, Ground-Verification (Field Verification). Demonstration of image processing software.

RGL Digital Image Processing Lab (1 CH)

Intro to lab and software, Image Management (Import/Export & Display), Enhancement Techniques, Spectral and spatial digitizing (image masking), Mosaicing and color balancing, Rectification and Registration and Re-sampling, Band Ratio, Vegetation Indices, Difference images, Image filters, Signature selection, Supervised, Unsupervised and Hybrid classification, ISODATA, MDM, MLC, and Bayesian classification, Error Matrix Generation, Classification validation, field work. Project work will be based on data sets obtained from resource monitoring agencies such as SUPARCO).

RGS 332 Satellite Navigation Systems (3 CH)

Fundamental framework and applications of modern global navigation satellite systems (GNSS) and inertial navigation systems (INS). Need and evolution of GPS Modernization as Global Navigation Satellite System (GNSS). The course gives an overview of satellite based radio navigation systems such as: GPS, GLONASS, GALILEO and BEIDOU, the basics of receiver design, wave propagation in the atmosphere; Geodesy, the geodetic fundamentals of navigation e.g., positioning, reference- and coordinate systems and computational methods for navigation and positioning on the surface of the earth.

RGS 360 Spatial Data Analysis (2 CH)

Introduction to spatial data type, Potentials of spatial data, Spatial Analysis, Point pattern analysis, Lines and networks, Area objects and spatial autocorrelation, types of area objects, Geometric properties of areas, Boundary Analysis, Buffering and neighbourhood function, Proximity Analysis,

Neighbourhood Function/Analysis, Modelling and storing field data, Spatial interpolation, type, Methods / algorithms, Derived measures on surfaces, Map overlay, Vector and raster overlay operations, Problems in simple Boolean polygon overlay, Multivariate data, multidimensional space, Multivariate data and multidimensional space, Distance, difference and similarity, Cluster analysis, PCA, New approaches to spatial analysis, Interpolation techniques, surface modelling, DTM/DEM, Multi-criteria and Multi-attribute Modelling, Uncertainties in spatial modelling. Spatial data interpretation.

RGL 360 Spatial Data Analysis Lab (1 CH)

Assignment on Spatial Analysis for various applications, Geo-coding and Point analysis exercise, Network analysis, Areal analysis exercise, Buffer analysis exercise, Multivariate analysis, Assignment on advanced spatial analysis, Interpolation of elevation data and surface modeling, Suitability analysis, Risk Modeling, Assignment on uncertainties in spatial modelling.

RGS 361 Integrated Geospatial Technologies (2 CH)

Use of geospatial techniques and methods (database designs, field surveys, GIS, GPS, satellite remote sensing images of active and passive sensors, programming algorithms) to design and development geospatial products and applications.

RGL 361 Integrated Geospatial Technologies Lab (1 CH)

Introduction to any GIS software (QGIS, ArcGIS, Geometica etc.) which can handle integrated datasets and perform meaningful data integration. Generate integrated data products for further analysis, interpretation and application.

RGS 471 Legal and Social Issues in Geospatial Sciences (3 CH)

Introduction to the course, standardization of spatial objects, ethical issues, spatial areas, legal aspects of data, use data from other organizations, legal issues in vector data and raster data, reporting and controlling etc. Map ethics (making, production, publishing); Social and ethical issues in cartography, data modelling and spatial data visualization etc.

RGL 251 Geospatial Field Work & Report-I (3 CH)

One-week fieldwork, demonstration of field instruments used to collect geospatial data; Basic mapping procedures of surveying using GPS and other mapping tools for measuring the distance, angles and heights. Map reading, Understanding of standard symbology such as Survey of Pakistan symbology; Development of Symbol Charts. Identification of features in the field such as rocks, terrains, land cover, vegetation, land use objects, and other physical objects. Preparation of spatial database and a basic map.

RGS 490 Capstone Project (3 CH)

Students will be required to conduct research work during Final Year Project work considering their keen interest in any subdomain of Remote Sensing or GIS.

RGS 451 Computer Aided Drafting/Drawing (2 CH)

Course Outline:

Introduction to engineering drawing/map, concept of lines, polygons, orthographic projection, projection of points, projection of lines, solids of revolution, introduction to Auto CAD map, drawing of 2D figure, drawing views of 3D Solids, Topology and Errors,

RGL 451 Computer Aided Drafting/Drawing Lab (1 CH)

Introduction to CAD Environment, Concept of reference systems, unit systems, points, reference plane, Drawing Lines, poly lines, 2nd order curves, polygons, cross-sectional areas, solid of revolution, shading, textures, rendering, etc.

RGS 453 GIS for Disaster Management (3 CH)

Spatial information Post-Disaster Impact and Damage Analysis, The use of satellite imagery for disaster relief and recovery, Impact analysis and preliminary damage assessment, Building damage assessment, Pre-Disaster Risk Assessment, Hazard Assessment, Elements at risk and vulnerability assessment, Types and methods of risk assessment, risk evaluation, cost-benefit analysis, Risk Information for Risk Reduction Planning, Risk evaluation, Visualization of risk information, Risk information and spatial planning, Disaster risk zoning, Flood Mapping, Disease mapping and prediction, Land degradation and Monitoring, Food security and environmental monitoring, Monitoring urban sprawl, GIS and disaster management cycle, GIS and Emergency Shelters, GIS and distribution of Relief, Challenges of using GIS in disaster management, GPS and its applications in Disaster management, risk assessment maps, GIS models in disaster management; assembling spatial information for disaster management and analysis, GIS and fire monitoring.

RGS 454 Spatial Data Modelling (2 CH)

Introduction to Fields, Objects, Geometry, Objects represented in raster, Vector Structure, Vector data representing the geometry of geographical objects, Networks and graphs, Properties of Graphs, graph areas and error checking procedures, Terrain object classed and generalization hierarchy's aggregation hierarchies, object association, Fuzzy set theory, fuzzy boundaries, Uncertainties of Spatial Objects.

RGL 454 Spatial Data Modelling Lab (1 CH)

Preparation of Symbolic Charts for representation of Earth Features, Assignment on Geometry of spatial objects, Utility Network Analysis, Spatial data generalization and aggregation.