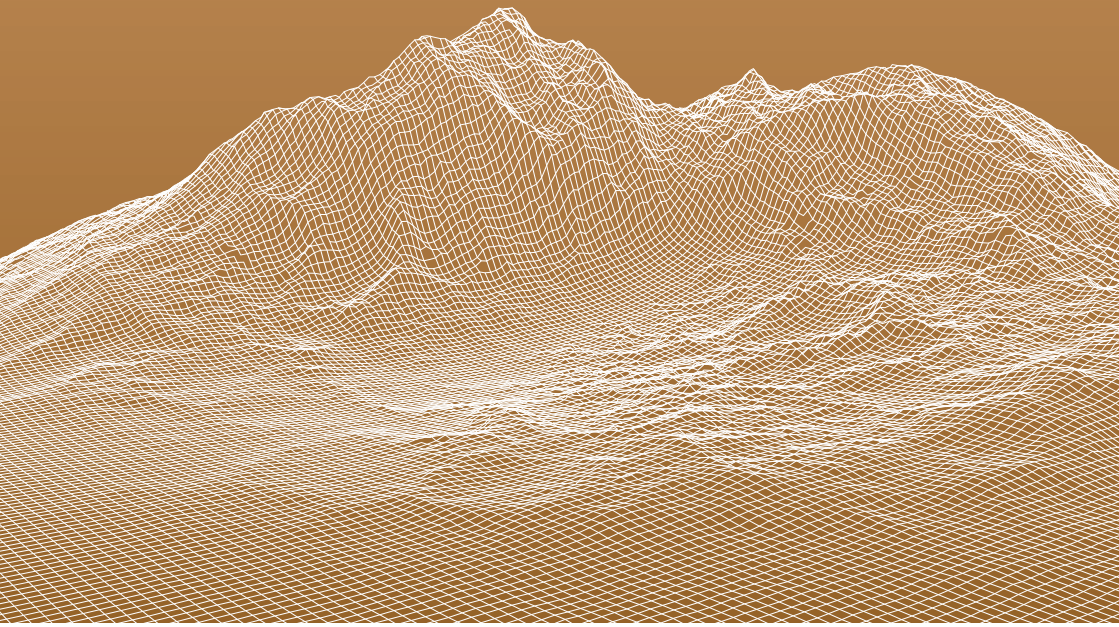
Curriculum for

Geological Engineering

Bachelor of Engineering Program

2020



Pakistan Engineering Council
&
Higher Education Commission
Islamabad

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Contents

PREFACE

The curriculum, with varying definitions, is said to be a roadmap or plan of teaching-learning process that students of an academic program are required to undergo. It includes objectives and learning outcomes, course contents, scheme of studies, teaching approaches, and assessment methodologies. Since knowledge in all fields and sectors is expanding at a faster pace and new disciplines are also emerging; it is imperative that curricula should be dynamic having regular review and updation.

The University Grants Commission (UGC) was the designated as authority to develop, review and revise curricula beyond Class-XII vide Section 3, Sub-Section 2 (ii), Act of Parliament No. X of 1976 titled "Supervision of Curricula and Textbooks and Maintenance of Standard of Education". With the repeal of UGC Act, the same function was assigned to the Higher Education Commission (HEC) under its Ordinance of 2002, Section 10, Sub-Section 1 (v). In compliance with the above provisions, the HEC has been undertaking the development of curricula for new/ emerging fields and revision of curricula after regular intervals through respective National Curriculum Revision Committees (NCRCs) until 2018.

As a policy change and expanding higher education base under HEC, the curriculum review and development task has been shifted to the respective regulators and HEIs. PEC also having mandate under its Act of Parliament and especially after attaining Washington Accord full signatory status and IPEA licensing authority, took up the challenge to review and develop the curricula for engineering programs based on Outcome-Based Education (OBE) System. PEC has therefore constituted an Engineering Curriculum Review and Development (ECRDC) and also subject ECRDCs comprising of eminent engineers and professionals from academia and industry to take up the task of curricula review and updation, while taking all relevant stakeholders on board. Nevertheless, the basic templates developed by HEC NCRCs have been followed as guidelines.

Under OBE based curriculum review and development framework, PEC held national and regional levels stakeholders and industrial consultation workshops engaging HEIs, industry, technical and consulting organizations. The experts' feedback and suggestions were translated into the curriculum review process taking into consideration of the dynamics of technological advancement, industrial needs and management-cum-soft skills for engineering graduates.

This curriculum document would therefore serve as a guideline whereas allowing HEIs to tame/ change within the framework by introducing courses in support of local/ required industrial demand as well as satisfying 12 GAs (Graduate Attributes) covering core and elective courses, considered as beauty of OBE system in the international environment. At the same time, this curriculum framework would fulfill our national, social and economic needs leading towards attainment of Sustainable Development Goals (SDGs-2030). It would also provide the level of competency specified in Pakistan Qualification Framework to make it compatible with international educational standards.

1. Engineering Curriculum Review & Development Committee (ECRDC)

PEC in its efforts towards quality engineering education, took up the challenge of curriculum review and development for engineering programs after due consent of HEC. A high level Engineering Curriculum Review and Development Committee (ECRDC), led by Prof Engr Dr Fazal Ahmad Khalid, Chairman Punjab HEC/ Vice Chairman PEC, was constituted whereas other eminent members are from industry and academia to take up the task of curricula review and updation, besides developing curriculum for new/ emerging fields. The main responsibility of ECRDC is to oversee the entire curriculum review and development process while setting policies and guidelines for the subject ECRDCs working in their respective domains. The 1st meeting of main ECRDC was held on 29th June, 2018 at PEC HQ, Islamabad, wherein the Convener briefed the scope, objective and ToRs of the Committee and also formulated the subject ECRDCs comprising of eminent engineers and professionals from academia and industry.

1.	Engr Prof Dr Fazal Ahmed Khalid Convener, Metallurgy, Materials, Mining Engg & Allied Disciplines	Convener
2.	Engr Prof Dr M. Younus Javed Convener Electrical Engg & Allied Disciplines	Member
3.	Engr Malik Saleem Ullah Saeed Convener Chemical Engg & Allied Disciplines	Member
4.	Engr Dr Wasim Khaliq Convener, Civil Engg & Allied Discipline	Member
5.	Engr. Prof. Dr. Iftikhar Hussain Convener Mechanical and Allied Engineering	Member
6.	Engr Dr Muhammad Ashraf Convener, Agricultural Engg & Allied Disciplines	Member

7	Engr Prof Dr Jameel Ahmed Convener Common to All (Non-Engg Component)	Member
8	Engr Muhammad Raza Chohan Director General, HEC	Member
9.	Engr Dr Nasir Mahmood Khan Additional Registrar (Accreditation), PEC	Member
10.	Engr Dr Ashfaq Ahmed Sheikh, Additional Registrar, CPD	Secretary

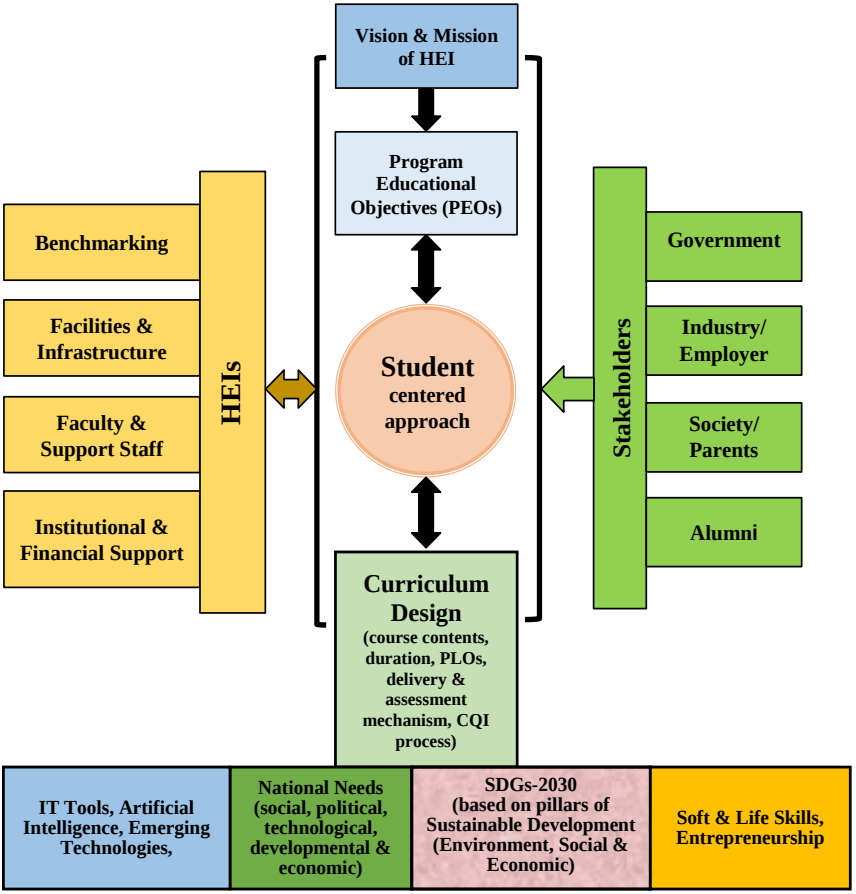
2. ECRDC Agenda

- The ECRDC is responsible to oversee the overall working of curriculum review and development for all engineering programs in terms of strategy, guidance and progress and thereby submission to the relevant forum for adoption/ notification.
- Each Member of ECRDC will also work in the capacity of Convener for respective disciplines as mentioned against their names and as per their ToRs

3. OBE-Based Curriculum Development Framework

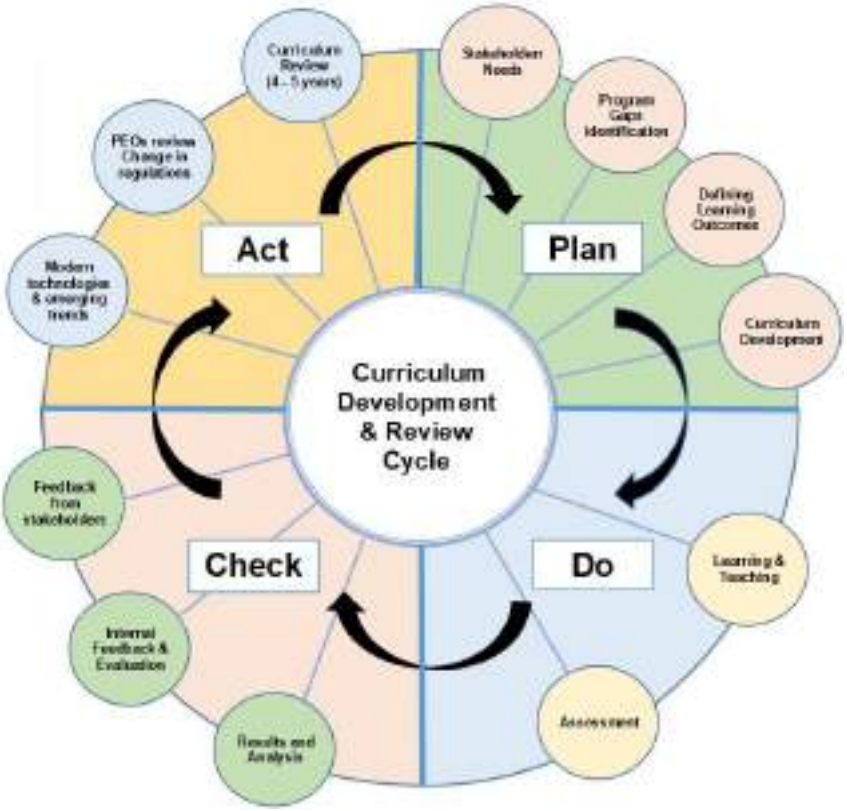
Outcome Based Education (OBE) is an approach of teaching and learning that focuses on what students should be able to attain at the end of the educational program. OBE is a student's centered system which concerns what the students will know and be able to do as learning outcomes. The curriculum development under OBE is therefore an integration of graduate attributes and stakeholders' feedback in cognizance with institution's Vision and Mission.

Outcome-Based Education (OBE) - Curriculum Development Framework



4. PDCA Approach to Curriculum Design and Development

The process of curriculum design and development constitutes various interconnected elements with the objective of achieving the intended purpose of the program. The Plan-Do-Check-Act approach (PDCA) as explained below has been followed in the curriculum development and review process.



Plan. This stage begins with an analysis of the stakeholders' needs of faculty, current and past students, employers and society in general. The stakeholders' needs are translated into human resource terminology i.e. graduate competencies which in turn translated into educational taxonomy and learning outcomes. Based on the learning outcomes, curriculum is designed backward to meet PLOs.

Do. The plan stage is implemented where curriculum is delivered and learning outcomes are assessed to gauge the achievement of PLOs.

Check. This stage involves the analysis of assessment results and feedback from students and faculty. Areas for improvement are identified.

Act. When the learning outcomes are achieved, the curriculum, learning and teaching strategies and assessment methods are standardized. Best practices are shared and improvement is made for the next cycle of PDCA.

5. ECRDC for Civil and Allied Engineering Disciplines

The PEC Engineering Curriculum Review and Development Committee (ECRDC) for Civil and Allied Engineering Disciplines took up the task to develop the curriculum for B.E Geological Engineering degree program. The subject Committee had two meetings on 29-8-2019, and 11-12-2019 at PEC Headquarters Islamabad besides Sub-Group meetings. The Committee comprised of following members:

1.	Engr Dr Wasim Khaliq Associate Professor, NICE National University of Sciences and Technology (NUST) Islamabad	Convener
2.	Engr Prof Dr Abdul Jabbar Sangi Associate Professor Department of Civil Engineering NED University of Engineering & Technology, Karachi	Member
3.	Engr Dr Majid Ali Associate Professor Department of Civil Engineering Capital University of Science and Technology, Islamabad	Member
4.	Engr Prof Dr Hamza Farooq Gabriel Professor, NICE National University of Sciences and Technology (NUST) Islamabad	Member

5.	Engr Prof Dr Habib Ur Rehman Professor Department of Civil Engineering UET, Lahore	Member
6.	Engr Prof Dr M Jamaluddin Thaheem Assistant Professor Construction Engineering and Management National University of Sciences and Technology (NUST) Islamabad	Member
7.	Engr Prof Dr Muhammad Zubair Abu Bakar Dean, Professor Department of Geology Engineering UET, Lahore	Member
8.	Engr Dr Mazhar Iqbal Arshad Associate Professor Transportation and Geotechnical Engineering Department Military College of Engineering MCE, Risalpur	Member
9.	Engr Dr Imran Hafeez Professor Department of Civil Engineering UET, Taxila	Member
10.	Engr Haider Ali Khan Principal Faculty of Engineering Lahore Leads University, Lahore	Member
11.	Engr Dr Izhar Ul Haq Ex-President IEP, Lahore	Member
12.	Engr Ijaz Ahmed Cheema Chief Engineer Planning & Development Provincial Highway Department, Lahore	Member

13.	Engr Prof Dr Bashir Alam Professor Department of Civil Engineering UET, Peshawar	Member
14.	Engr Prof Dr Abdullah Saand Dean Faculty of Egineering, Quaid-e-Awam University of Engineering Science & Technology, Nawabshah	Member
15.	Engr Prof Dr Tauha Hussain Ali Pro-Vice Chancellor Mehran University of Engineering & Technology Jamshoro	Member
16.	Engr Prof Dr Syed Mohammad Ali Director, Earthquake Engineering Center (EEC) University of Engineering and Technology (UET) Peshawar	Member
17.	Engr Prof Dr Muhammad Ashraf Tanoli HoD, Deptt. of Civil Engineering Ghulam Ishaq Khan Institute of Engineering Sciences and Technology, Swabi	Member
18.	Engr Tariq Mehmood Chief Engineer WAPDA House, Lahore	Member
19.	Engr Abdul Qadeer General Manager/Head NESPAK House, Islamabad	Member
20.	Engr. Prof. Dr. Ali Rizwan Bukhari Professor Department of Civil Engineering FAST University, Lahore	Member
21.	Mr Hidayatullah Kasi Deputy Director Higher Education Commission, Islamabad	Rep HEC

22.	Engr. Dr. Ashfaq Ahmed Additional Registrar Pakistan Engineering Council, Islamabad	Secretary
23.	Engr. Muhammad Kashif Ali Assistant Registrar Pakistan Engineering Council, Islamabad	AR-CPD

5.1 Sub Group Geological Engineering

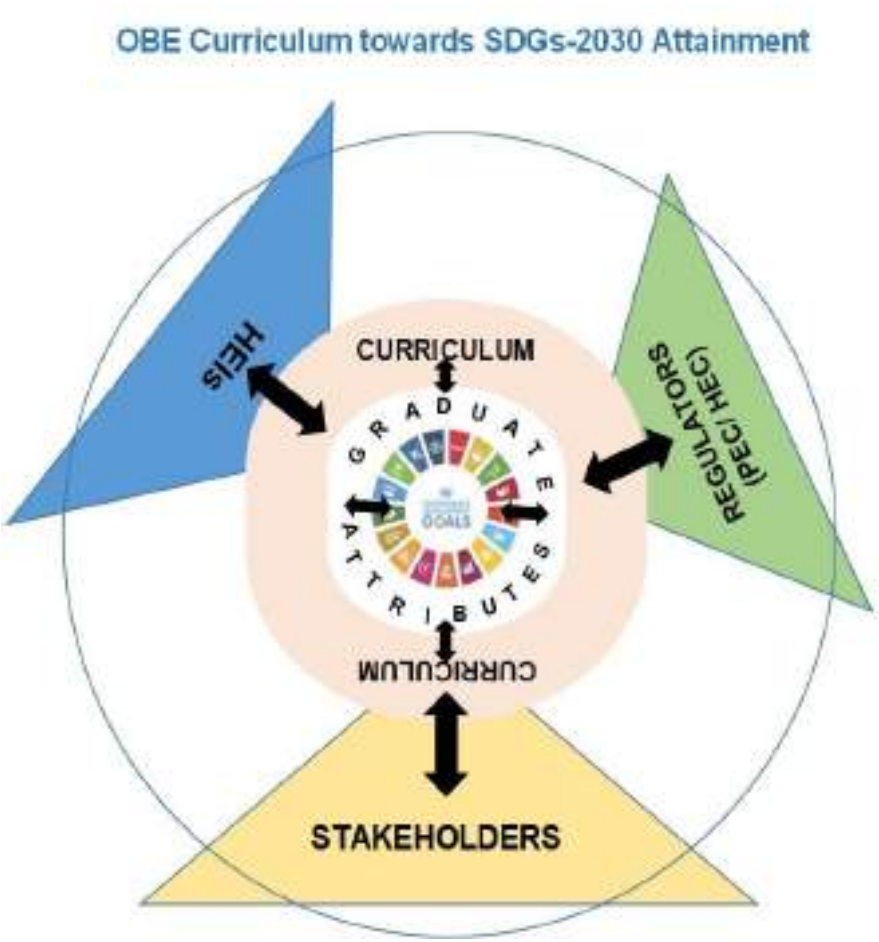
1.	Engr Prof Dr Muhammad Zubair Abu Bakar Professor, Dean Department of Geological Engineering UET, Lahore	Lead Sub-Group
2.	Dr. Muhammad Farooq Ahmed Associate Professor Department of Geological Engineering University of Engineering & Technology, Lahore	Expert
3.	Dr. Hafiz Muhammad Awais Rashid Assistant Professor Department of Geological Engineering University of Engineering & Technology, Lahore	Expert
4.	Mr Hidayatullah Kasi Deputy Director Higher Education Commission, Islamabad	Rep HEC
5.	Engr. Dr. Ashfaq Ahmed Additional Registrar Pakistan Engineering Council, Islamabad	Secretary
6.	Engr. Muhammad Kashif Ali Assistant Registrar Pakistan Engineering Council, Islamabad	AR-CPD

6. Agenda of ECRDC for Civil and Allied Engineering Disciplines

- The Subject ECRDC will work under the overall directions and supervision of main ECRDC, comprising of all Conveners
- The key driving lines for the development of engineering curriculum for each discipline will be the overall policy of Pakistan Engineering Council in connection with international commitments (Washington Accord, IPEA etc.) and Government polices
- Review of polices and stakeholders' feedback relating sector relevant to the respective discipline
- Comparative study of curricula being offered at various engineering universities/institutions following OBE-based system
- Development and finalization of complete scheme and curriculum for respective discipline including all aspects.

Engr Dr. Wasim Khaliq, the Convener highlighted the important benchmarks and international best practices to be considered for the revision of the curriculum while taking into account the Outcome Based Education (OBE) system. He also suggested that the Committee comprising professors and experts from academia, industry and R&D institutions has provided useful input and suggestions covering new developments to be incorporated in the curriculum. He also highlighted the importance of the field of Geological Engineering for achieving sustainable developments while addressing socio-economic issues and challenges envisaged in SDGs-2030 as under and well mapped within the curriculum;

- Goal-1: No Poverty
- Goal-2: Zero Hunger
- Goal-3: Good Health and Well-being
- Goal-4: Quality Education
- Goal-5: Gender Equality
- Goal-8: Decent Work and Economic Growth
- Goal-9: Industrial Innovation and Infrastructure
- Goal-12: Responsible Consumption and Production
- Goal-13: Climate Action



The curriculum therefore has been designed based on above SDGs translating into program objectives and mapped with the scheme of study.

7. Program Objectives (PEOs) and Learning Outcomes (PLOs)

As guidance, the sample Program Educational Objectives (PEOs) and Learning Outcomes (PLOs) are given below for a typical Geological Engineering Program. The HEIs should have their own program objectives, PLOs and CLOs in line with the institution's Vision and Mission, in cognizance with industrial needs as well as national and international trends.

7.1 Program Educational Objectives (PEOs)

The program aims at imparting quality education to Geological Engineering graduates for contributing to the society through modern technologies and practices in line with SDGs especially Goal-1, Goal-2, Goal-3, Goal-4, Goal-5, Goal-8, Goal-9, Goal-12, and Goal-13.

Geological Engineering professionals will be able to:

1. Demonstrate sound knowledge and skills.
2. Work, manage and illustrate effective teamwork, interpersonal skills and professional growth.
3. Undertake professional practice considering ethical, societal and environmental implications.

7.2 Program Learning Outcomes (PLOs)

Program outcomes are the narrower statements that describe what students are expected to know and be able to do by the time of graduation. These relate to the knowledge, skills and attitude that the students acquire while progressing through the program. The program must demonstrate that by the time of graduation the students have attained a certain set of knowledge, skills and behavioral traits, at least to some acceptable minimum level.

The sample Program Learning Outcomes (PLOs) of Geological Engineering are based on graduate attributes of PEC Accreditation Manual 2019 and are given below:

PLO-01: Engineering Knowledge: Ability to apply knowledge of mathematics, science and engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

PLO-02: Problem Analysis: Ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

PLO-03: Design/Development of Solutions: Ability to design solutions for complex engineering problems and design systems, components, or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.

PLO-04: Investigation: Ability to investigate complex engineering 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.

PLO-05: Modern Tool Usage: Ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.

PLO-06: The Engineer and Society: Ability to apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solution to complex engineering problems.

PLO-07: Environment and Sustainability: Ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of, and need for, sustainable development.

PLO-08: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.

PLO-09: Individual and Team Work: Ability to work effectively, as an individual or in a team, on multifaceted and/or multidisciplinary settings.

PLO-10: Communication: Ability to communicate effectively, orally as well as in writing on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentations, make effective presentations, and give and receive clear instructions.

PLO-11: Project Management: Ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team to manage projects in a multidisciplinary environment.

PLO-12: Lifelong Learning: Ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments.

8. Program Salient Features

The undergraduate engineering program has been based on the following salient features:

- **Duration:** 4 years
- **Number of Semesters:** 8
- **Total number of credit hours**: 130 - 136
  - Engineering Domain: minimum 85 Credit Hours
  - Non-Engineering Domain: minimum 30 Credit Hours

  (HEIs have flexibility of 15-21 Credit Hours to add courses either in Engineering, Non-Engineering or both Domains to fulfill the program objectives in line with the overall Vision/ Mission of the Institute concerned).
- **Additional Course or Credit Hours Requirements:** Any addition of course or credit hour requirements as per direction or policy of the Government (Provincial or Federal), HEIs have leverage to cater such needs over and above the prescribed requirements in this document.
- **Number of weeks per semester**: 15 - 18
- **Number of credit hours per semester**: 15 - 18
- **Curriculum:** The engineering curriculum is the most important instrument for grooming the students based on 12 Graduate Attributes (GAs) encompassed under the Program Learning Outcomes (PLOs). In order to inculcate different dimensions of thinking – mathematical, computational, design and creative – among students in Cognitive, Psychomotor and Affective domains, the curriculum is based on the following knowledge profiles:

  WK1 - Natural Sciences: A systematic theory-based understanding of natural sciences applicable to the discipline.

WK2 - Mathematics and Computing: The concept-based mathematical thinking, numerical analysis, statistics and formal aspects of computer and information science to support analysis and modeling applicable to the discipline.

WK3 - Engineering Fundamentals: A systematic, theory-based formulation of engineering fundamentals required in an engineering discipline.

WK4 - Engineering Specialization: The knowledge of engineering specialization that provides theoretical frameworks and bodies of knowledge for the accepted practice areas that are at the forefront in a discipline.

WK5 - Engineering Design: The Design Thinking Knowledge that supports engineering design in a practice area of an engineering discipline.

WK6 - Engineering Practice: The Knowledge of engineering practices (technology) in different practice areas of an engineering discipline.

WK7 - Engineering in Society: A systematic, comprehension-based knowledge of the role of engineers in a society and the professional issues related to practicing engineering profession in a discipline: ethics and the professional responsibility of an engineer to public safety including the impact of an engineering activity i.e. economic, social, cultural, and environmental and sustainability

WK8 - Research Literature: Engagement with selected knowledge in the research literature of the discipline.

The curriculum matrix covering above knowledge profiles should therefore be composed of non-engineering domain (humanities, math, management and natural sciences), and engineering domain with computer science, foundation, breadth, depth and multidisciplinary courses (including safety) so that different streams could be encouraged within each discipline, enabling students to undertake a range of **Complex Problem Solving** and **Complex Engineering Activities**. The students may select electives from any of the streams with guidelines from their respective advisors.

Knowledge Profile* (WK-1 to WK-8)	Knowledge Area	Sub-Area	Courses	Credit Hours
Non-Engineering Domain				
WK-2	Natural Science	Math	As per program requirements	12 – 15
WK-1		Physics	Applied Physics	6 – 9
		Chemistry	Applied Chemistry	
		Natural Science/ Math Elective	As per program requirements	
WK-7	Humanities	English	Written, communication and presentation skills	4 – 7
		Culture	Islamic Studies and Ethics	2
			Pakistan Studies and Global Perspective	2
		Social Science	Social and soft skills	2 – 6
	Management Sciences	Professional Practice	Professional and Project Management	2 – 6
Total (Non-Engineering Domain)				**min 30**
Engineering Domain				
WK-2/ WK-4/ WK-5/ WK-6	Computer and Information Science	ICT/AI/ Data Science/ Cyber Security		6 - 9
WK-3/ WK-2	Foundation Engg Courses		Specific to program objectives and outcomes	22 - 24
WK-4/ WK-2/ WK-1	Core Breadth of Engg discipline		Specific to program objectives and outcomes	23 - 24
WK-5/ WK-6	Core Depth of Engg Discipline		Specific to program objectives and outcomes	22 - 24

WK-1/ WK-2/ WK-3/ WK-4	Multidisciplinary Engg Courses		Specific to program objectives and outcomes	6 - 12
			Occupational Health and Safety (mandatory – 01 Cr Hr)	
WK-6/ WK-8/ WK-7	Final Year Design Project (FYDP/ Capstone	Integration of innovative, creative, technical, management and presentation skills of a graduate towards final year.		6
WK-6/ WK-7	Industrial Training	at least 6 - 8 weeks internship		Qualifying
WK-4/ WK-5/ WK-6/ WK-7/ WK-8/ WK-2	**Innovative and Critical Thinking (under relevant courses):** - Complex Problem Solving - Complex Engineering Activities - Semester Project - Case Studies - Open Ended Labs - Problem Based Learning (PBL)			
Total (Engineering domain)				**min 85**
Total (Credit Hours)				**130 - 136**

* As a specific or more than one knowledge profile to be covered.

- **Industrial Training:** Internship of at least 6 - 8 weeks is mandatory part of degree requirements towards 3rd to 4th year of program; must be supervised, monitored, evaluated, and reflected in the transcripts under a prescribed mechanism and with defined and mapped rubrics with program objectives;
  - Selection of internship in line with elective subjects/ specific streams
  - Qualifying weightage:70%
    - At least 75% attendance is mandatory 10%
    - Assessment report from the employer 50%
    - Evaluation at relevant HEIs/ Deptt – presentation 40%
- **Final Year Design Project (FYDP)/ Capstone:** FYDP aims to challenge innovative, creative, technical, management and presentation skills of a graduate to bring together the learning over the degree program.

- A final year design project (FYDP) is the confluence of an engineering program. Undertaking a final year design project is a compulsory requirement. It should mainly comprise literature search, individual analysis, modeling and simulation, AI (Artificial Intelligence) and computational data analytics, design and putting together various hardware, software, firmware and Algorithm Engineering / Informatics related to the program to demonstrate a functional concept including rapid prototyping, where applicable.
- The FYDP shall include complex engineering problems and design systems, components or processes integrating core areas and meeting specific needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
- A project of this nature should invariably lead to an integration of the knowledge and practical skills as mandated in the program outcomes. In this context, projects of multidisciplinary nature should be encouraged.
- The FYDP should span over two consecutive semesters, i.e. semester 7 & 8, totaling 6-credit hours and should be fully supervised, assessed and reflected in the transcripts under a prescribed mechanism so as to prepare for joining industry after graduation.

- **Faculty:** The faculty must be trained for the Outcome-Based Education (OBE) system. Their familiarity with the program objectives and outcomes, understanding of the Outcome-Based Assessment (OBA) cycle, enthusiasm for developing an effective program, and the ability to become an active player in this regard are the keys to ensure the attainment of program objectives. The faculty is expected to have the ability to ensure proper implementation of the program, and to develop processes for evaluation, assessment and CQI. A formal training program to groom the faculty should be instituted to become effective instructors in applying pedagogical skills in all aspects of Teaching, Learning and Assessment covering all domains of Knowledge, Skills and Attitude.
- **Personal Grooming:** Personal Grooming of young faculty members and students is very important in order to develop and support their professional skills. Therefore, it is required that HEIs should conduct/arrange sessions or counseling hours on regular basis to provide guidance for personal grooming. Personal Grooming is important for positive self-image and increasing the confidence level of the individuals. It would help in enhancing students' self-

esteem and would go a long way in developing an attractive personality by adopting habits like personal hygiene, clothing, appearance, interaction and expressive skills, etc. The students should be motivated and equipped to be entrepreneurs in their relevant field.

- **Presentation and Communication Skills:** Special focus should be given to inculcate communication and presentation skills amongst the graduates through individual and group presentations, technical writing and discussions, throughout the program as a regular feature.

This curriculum has been designed to guide and facilitate the universities and departments to formulate their own programs according to the industrial needs, emerging trends and recent developments in the field of Geological Engineering. The HEIs have flexibility to incorporate changes in the proposed curriculum within given range of credit hours for engineering and non-engineering domain.

9. Framework for Bachelor of Geological Engineering

Knowledge Profile* (WK-1 to WK-8)	Knowledge Area	Sub Area	Course Title	Theory	Lab	Total
				Credit Hours		
WK-7	Humanities	English	Functional English	2	0	2
			Technical Writing and Presentation Skills	2	0	2
			Communication Skills	1	1	2
		Culture	Islamic Studies and Ethics	2	0	2
			Pakistan Studies and Global Perspective	2	0	2
		Social Science	Elective-I (Sociology/ Community Service)	2	0	2
			Elective-II (Engineering Economics)	2	0	2
	Management Sciences	Professional Practice	Elective-I (Project Management/ Engg Management)	2	1	3
			Elective-II (Entrepreneurship)	2	0	2
WK-1/ WK-2	Natural Sciences	Mathematics	Math-1 (Calculus and Analytical Geometry)	3	0	3
			Math-II (Linear Algebra and Differential Equations)	3	0	3
			Math-III (Numerical Analysis)	2	1	3
			Math-IV (Probability and Statistics)	3	0	3
		Applied Sciences	Chemistry for Engineers	2	0	2
			Applied Physics	2	1	3
		Earth Sciences	Mineralogy and Petrology	2	1	3

			Petroleum Geology	2	1	3
			Physical Geology	2	1	3
Total (Non-Engineering Domain)				**38**	**7**	**45**
Engineering Domain						
WK-2/ WK-4/ WK-5/ WK-6	Computer and Information Science	ICT/AI/ Data Science/ Cyber Security	Information and Communication Technologies (ICT)	2	1	3
			Artificial Intelligence	2	1	3
WK-3/ WK-2	Engineering Fundamentals	--	Workshop Practice	0	1	1
			Engineering Mechanics	2	1	3
			Surveying	3	1	4
			Engineering Drawing and Graphics	1	1	2
			Applied Thermodynamics	2	1	3
			Mechanics of Materials	3	1	4
			Fluid Mechanics	3	1	4
			Structural Geology and Stratigraphy	2	1	3
WK-4/ WK-2/ WK-1	Major Based Core (Breadth)		Engineering Geology	3	1	4
			Introduction to GIS/RS	2	1	3
			Earthquake Seismology and Risk Assessment	2	1	3
			Hydrogeology	3	1	4
			Drilling Engineering	2	1	3
			Rock Mechanics	3	1	4
			Geotechnical Engineering-I	3	1	4
			Introduction to Geophysical Exploration Techniques	2	1	3
WK-5/ WK-6	Major Based Core (Depth)		Tunneling and Excavation Engineering	3	1	4

			Major Elective-1	3	1	4
			Environmental Geological Engineering	2	1	3
			Major Elective-2	2	1	3
			Major Elective-3	2	1	3
			Major Elective-4	2	1	3
WK-1/ WK-2/ WK-3/ WK-4	Multi-Disciplinary Engineering Courses		Basic Electrical and Electronics	2	1	3
			Explosives Engineering	2	1	3
			Occupational Health and Safety*	1	0	1
WK-6/ WK7/ WK-8	Final Year Design Project/ Capstone	Industrial/ Innovative/ Creative Project	Senior Design Project –I	0	3	3
			Senior Design Project –II	0	3	3
WK-6/ WK-7	Industrial Training	At least 6 -8 weeks internship		0	0	0
WK-2/ WK-4/ WK-5/ WK-6/ WK-7/ WK-8	**Innovative and Critical Thinking (under relevant Courses):** - Complex Problem Solving - Complex Engineering Activities - Semester Project - Case Studies - Open Ended Labs - Problem Based Learning (PBL)					
Total (Engineering Domain)				**59**	**32**	**91**
Total (Credit Hours)				**97**	**39**	**136**

* to be taught during 1st year of program.

10. Scheme of Study for Bachelor of Geological Engineering

S. No.	Title	Credit Hours	Theory	Lab	Total
Semester I					
1	Basic Electrical and Electronics Engineering	3(2-1)	2	1	3
2	Calculus and Analytic Geometry	3(3-0)	3	0	3
3	Chemistry for Engineers	2(2-0)	2	0	2
4	Engineering Drawing	2(0-2)	0	2	2
5	Physical Geology	3(2-1)	2	1	3
6	Functional English	2(2-0)	2	0	2
7	Pakistan Studies	2(2-0)	2	0	2
8	Occupational Health and Safety	1(1-0)	1	0	1
Total			**14**	**4**	**18**
Semester II					
1	Applied Physics	3(2-1)	2	1	3
2	Linear Algebra and Differential Equations	3(3-0)	3	0	3
3	Structural Geology and Stratigraphy	3(2-1)	2	1	3
4	Information and Communication Technologies (ICT)	3(2-1)	2	1	3
5	Communication Skills	2(1-1)	1	1	2
6	Islamic Studies	2(2-0)	2	0	2
Total			**12**	**4**	**16**
Semester III					
1	Technical Writing and Presentation Skills	2(2-0)	2	0	2
2	Engineering Mechanics	3(2-1)	2	1	3
3	Probability and Statistics	3(3-0)	3	0	3
4	Applied Thermodynamics	3(2-1)	2	1	3

5	Fluid Mechanics	4(3-1)	3	1	4
6	Mineralogy and Petrology	3(2-1)	2	1	3
Total			**14**	**4**	**18**
Semester IV					
1	Numerical Analysis	3(2-1)	2	1	3
2	Surveying	4(3-1)	3	1	4
3	Mechanics of Materials	4(3-1)	3	1	4
4	Workshop Practice	1(0-1)	0	1	1
5	Engineering Economics	2(2-0)	2	0	2
6	Computer Programming	3(2-1)	2	1	3
Total			**12**	**5**	**17**
Semester V					
1	Engineering Geology	4(3-1)	3	1	4
2	Geotechnical Engineering – 1	4(3-1)	3	1	4
3	Petroleum Geology	3(2-1)	2	1	3
4	Introduction to GIS/RS	3(2-1)	2	1	3
5	Rock Mechanics	4(3-1)	3	1	4
Total			**13**	**5**	**18**
Semester VI					
1	Environmental Geological Engineering	3(2-1)	2	1	3
2	Introduction to Geophysical Exploration Techniques	3(2-1)	2	1	3
3	Earthquake Seismology and Risk Assessment	3(2-1)	2	1	3
4	Project Management	3(2-1)	2	1	3
5	Explosives Engineering	3(2-1)	2	1	3
6	Social Science/ Community Service	2(2-0)	2	0	2
Total			**13**	**5**	**17**

Semester VII					
1	Major Elective-1	4(3-1)	3	1	4
2	Drilling Engineering	3(2-1)	2	1	3
3	Major Elective-2	3(2-1)	2	1	3
4	Tunneling and Excavation Engineering	4(3-1)	3	1	4
5	Senior Design Project-1	3(0-3)	0	3	3
Total			**10**	**7**	**17**
Semester VIII					
1	Hydrogeology	4(3-1)	3	1	4
2	Major Elective-3	3(2-1)	2	1	3
3	Major Elective-4	3(2-0)	2	1	3
4	Entrepreneurship	2(2-0)	2	0	2
5	Senior Design Project-2	3(0-3)	0	3	3
Total			**9**	**6**	**15**
Total Credit Hours			**136**		

List of Major Based Core (Depth) Electives Courses - (Proposed)

These are proposed engineering elective courses and the HEIs may further add or choose courses as per their program objectives and needs.

Major Elective – 1

Geotechnical and Rock Engineering (GRE)	**Natural Energy Resource Exploration (NERE)**	**Geo-Environmental Engineering (GEE)**
Geotechnical Engineering – II	Seismic Data Processing and Interpretation	Environmental Aspects of Mining
Statistical Methods in Geology and Engineering	Resource Engineering	Exploration and Environmental Geochemistry

Major Elective – 2

Geotechnical and Rock Engineering (GRE)	**Natural Energy Resource Exploration (NERE)**	**Geo-Environmental Engineering (GEE)**
Geotechnical Site Investigation	Reservoir Engineering	Risk Assessment in Environmental Studies
Fluvial Processes	Surficial Processes, Sedimentation and Stratigraphy	Geological Aspects of Hazardous Waste Management

Major Elective – 3

Geotechnical and Rock Engineering (GRE)	**Natural Energy Resource Exploration (NERE)**	**Geo-Environmental Engineering (GEE)**
Pavement and Foundation Engineering	Petrophysics and Well Logging	Environmental Soil Science
Geomorphology and Terrain Analysis	Petrogenesis and Metallogenesis	Site Remediation Engineering

Major Elective – 4

Geotechnical and Rock Engineering (GRE)	**Natural Energy Resource Exploration (NERE)**	**Geo-Environmental Engineering (GEE)**
Ground Improvement and Geosynthetics	Production Engineering	Environmental Data Analysis
Analysis of Rock Structures	Carbonate Sedimentology	Recycling and Sustainable Engineering

Proposed Electives for Social Science

These are proposed elective courses and the HEIs may further add or choose courses as per their program objectives and needs.

- Sociology for Engineers
- Professional Ethics
- Economics for Engineers
- Sociology
- Social Anthropology
- Understanding Psychology and Human
- Social Psychology
- Organizational Behavior
- Critical Thinking
- Philosophy
- Human Resource Development
- Culture and Society
- Engineering Law

Proposed Electives for Management Sciences

These are proposed elective courses and the HEIs may further add or choose courses as per their program objectives and needs.

- Entrepreneurship
- Entrepreneurship and Marketing
- Engineering Project Management
- Principle of Management
- Engineering Management
- Quality Management Systems
- Textile Marketing
- Industrial Engineering and Management
- Total Quality Management
- Supply Chain Management
- Production Management

Courses for Computer Sciences

- Information and Communication Technologies (ICT)
- Artificial Intelligence
- Cyber Security
- Data Science
- Modelling and Simulation
- Computer Programming and Design

11. Program Specific Lab

The following labs specific to engineering discipline be ensured to cover relevant knowledge domains but not limited to;

- Engineering Geology and Geotechnical Lab
- Geophysics Lab
- Geo-environmental Engineering Lab
- Hydrogeology Lab
- Mineralogy and Petrology Lab
- Computer Lab
- Project & Research Lab

12. Course Details and Teaching-Assessment Approaches

In the following sections, Course Outlines and teaching-assessment approaches are given for guidance based on a typical semester system. The instructors may adopt or adapt accordingly defining CLOs, course delivery plan, innovative teaching approaches and assessment techniques.

12.1 Engineering Domain

Computer and Information Sciences Courses

Information and Communication Technologies (ICT)

Course Outline:

Introducing Computer Systems: Basic Definitions

- Computer and Communication Technology
- The applications of ICT - particularly for Engineers

Basic Operations and Components of a Generic Computer System

- Basic operations: Input, Processing, Output, Storage Basic components: Hardware, Software, Data, Users
- Types of storage devices

Processing Data

- Transforming data into information
- How computers represent and process data
- Processing Devices
- CPU architectures

The Internet

- The Internet and the World Wide Web- browsers, HTML
- URLs/ How DNS works
- Email and other programs

Introduction to Embedded Systems

- What is an Embedded System
- Applications
- Components
- Programming Languages
- Popular Development Platforms

Networking Basics

- Uses of networks
- Common types of networks (LAN, WAN, MAN etc.)
- Introduction to OSI Model
- Future of Networks

Database Management

- Hierarchy of Data
- Maintaining Data
- Database Management Systems

Exposure to ICT Tools and Blogs (Student Assignment)

Protecting your Privacy, your Computer and your Data

- Basic Security Concepts
- Threats to users
- Threats to hardware
- Threats to Data

ICT in Education

Future Trends in ICT

Final Presentations

Tools / Software Requirement

Microsoft Office, Windows, Virtual Box, Netbeans

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- "Introduction to Computers", Peter Norton, 7th Edition, 2013, McGraw-Hill.
- "Computing Essentials", Timothy O'Leary and Linda O'Leary, 2010, McGraw-Hill.
- Using Information Technology: A Practical Introduction to Computers & Communications", Williams Sawyer, 6th Edition, 2005, McGraw-Hill.
- "Discovering Computers, Complete: Your Interactive Guide to the Digital World. Cengage Learning" Shelly GB, Vermaat ME, 2012 Ed.

Computer Programming

Course Outline

Introduction to Programming

- Introduction to Programming Language C++ / Visual BASIC (VB)
- The character set
- Constants, variables and keywords
- Rules of constructing integer
- Real and character constants
- Flow charts and Algorithms

The Loop Control Structure

- The for loop, Nesting of loops
- Multiple initializations in the for loop
- The while loops
- The break statements
- The continue statement
- The do-while loop

The Case Control Structure

- Decisions using switch
- Switch versus if-else ladder
- The go to keyword

Functions

- Function definition
- Passing values between functions
- Functions declaration and prototypes

Arrays and Strings

- Introduction to arrays and strings
- 2D arrays

Programming Languages

Programming for various Engineering Problems

Miscellaneous

- Introduction to pointers
- File handling
- Structures

Introduction to MS Office with advanced applications of MS Excel

Use of MATLAB

Teaching Methodology (Proposed as applicable):

Lecturing, Written Assignments/ Quizzes, Case Studies, Semester Project, Guest Speaker, Industrial Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Gottfried, BS Programming with Structured Basics (Schaum Series), McGraw-Hill. (Latest Edition)
- Deitel & Deitel, T.R. Nieto, Visual C++ 6 (Latest Edition)
- Steven Holzner , Black Book of C++ (Latest Edition)
- Evangelos Petroutsos, Mastering Visual Basic 6, Sybex Computer Books Inc. USA, 1998
- Stephen J. Chapman, MATLAB Programming for Engineers (Latest Edition)

Computer Aided Design

Course Outline:

- Introduction to AutoCAD
- Use basic drawing and text commands
- Use basic editing commands (move, copy, erase, etc.)
- Use advanced editing commands (mirror, fillet, etc.)
- Dimensioning capabilities of Auto CAD
- Create and use layers
- Print or plot a drawing
- Create and using blocks
- Be familiar with hatching capabilities of Auto CAD
- Curves
- 3D modeling
- Multiple Lines
- Geometric Shapes
- Isometric drawings
- Polar Arrays

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Mastering AutoCAD latest edition and AutoCAD LT by George Omura with Brian Benton, (latest edition),.
- AutoCAD® latest edition And AutoCAD Ltd latest edition No Experience required by Donnie Gladfelter.

Introduction to Modeling and Simulation

Course Outline:

Simulation

- Prepare Model Inputs and Outputs
- Configure Simulation Conditions
- Run Simulations
- View and Analyze Simulation Results
- Test and Debug Simulations
- Optimize Performance
- Simulation Guidelines & Best Practices

Modeling

- Design Model Architecture
- Manage Design Data
- Design Model Behavior
- Configure Signals, States, and Parameters
- Configure Inputs and Visualizations
- Analyze and Remodel Design
- Test Model Components
- Modeling Guidelines & Best Practices

Tools/ Software Requirement

- Matlab

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Introduction to Matlab for Engineering Students by David Houcque, Northwestern University latest edition.
- https://www.mathworks.com/help/simulink/simulation.html
- https://www.mathworks.com/help/simulink/modeling.htm

Artificial Intelligence

Course Outline

This course gives a broad overview of the fundamental theories and techniques of Artificial Intelligence.

- Overview of AI Problems;
- Intelligent Behavior: Turing Test, Rationale versus Non-rationale Reasoning;
- Problem Characteristics: Fully versus Partially Observable,
- Single versus Multi agent; Intelligent Agents: reactive, deliberative, goal-driven, utility-driven, and learning agents; Uninformed Search: Depth First, Breadth First, Depth First with Iterative Deepening;
- Informed Search: Hill climbing, A*- Search and their Time and Space Complexity, Local Search, Genetic Algorithm; Game Playing: Minimax, Evaluation functions, Alpha-beta pruning; Propositional and Predicate Logic; Resolution and Theorem Proving; Forward and Backward Chaining;
- Machine Learning: Introduction,
- Supervised learning: Instance based learning, Decision tree, artificial neural networks, Unsupervised Learning: K-means Clustering, Reinforcement Learning.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final exam.

Suggested Books:

- Stuart J. Russell and Peter Norvig, "Artificial Intelligence: A Modern Approach", latest Edition, Prentice Hall, ISBN-13: 978-0136042594.
- Elaine Rich and Kevin Knight, "Artificial Intelligence", latest Edition, McGraw-Hill, ISBN-13: 978-0070522633.
- R. J. Schalkoff, "Artificial Intelligence in Engineering Approach", latest edition, McGraw Hill, ISBN-13: 978-0070550841.
- Peter Jackson, "Introduction to Expert Systems", latest Edition, Addison Wesley, ISBN-13: 978-0201876864.
- Ivan Bratko, "Prolog Programming for Artificial Intelligence", latest Edition, Addison Wesley, ISBN-13: 978-0321417466.

Engineering Foundation Courses

Engineering Drawing and Graphics

Course Outline:

- Introduction, types of lines, lettering, dimensioning, use of pencil and drawing instruments, planning of drawing sheet,
- Projections, types of projections, orthographic projections, plane of projections,
- Four quadrants, Isometric and pictorial projections of solids/machine parts,
- Making of freehand sketches from solid objects and from orthographic projections,
- Sections of joints, screw thread system, nuts and bolts, key and cotter,
- Coupling and simple bearing, pipe connections and engine details,
- Preparation of assembly drawings.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- N. D. Bhatt, N.D. 1990. Elementary Engineering Drawing Plane And Solid Geometry", 30th Edition, Charotar Publishing House.
- Parkinson, A.C. 1939. A First Year Engineering Drawing", Pitman, London.
- Luzjader, W.J. Fundamentals of Engineering Drawing: With an Introduction to Interactive Computer Graphics for Design and Production.
- Baker, A.L. 1893. The Elements of Solid Geometry", Boston, MA: Ginn and Co.

Structural Geology and Stratigraphy

Course Outline:

- Principles of stratigraphy, concept of geological time and its scale, correlation techniques, isostacy and continental drift.
- Construction & Interpretation of stereographic projections.
- Stratigraphy of Pakistan with special emphasis on salt range,
- Introduction to structural geology and its objectives, primary and secondary structures of sedimentary rocks and the determination of dip, strike and thickness of beds, completion of outcrops and construction of cross sections.
- Modes of deformation of rocks, parts, varieties and classification of folds, faults, joints and unconformities, expression of the above features on geological field maps and construction of cross sections, geological mapping and the application of photogrammetry.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- Brookfields M.E. 2004. Principles of Stratigraphy, Blackwell Publishing Ltd.
- Boggs, S. 2006. Principles of Sedimentology and Stratigraphy, 5th Ed, Prentice Hall.
- Shah, S. M. I. 2009. Stratigraphy of Pakistan, 22nd Memoir of Geological Survey of Pakistan.
- Fossen, H. 2010. Structural Geology, Cambridge University Press.
- Billings, M.P. 2016. Structural Geology, 3rd Ed, Pearson, India.

Engineering Mechanics

Course Outline:

- Vectors: Addition and subtraction of vectors, scalar and vector products, differentiation and integration of vectors, laws of triangle, parallelogram and polygon forces, parallel forces, moments and couples, friction, resultant of coplanar forces,
- General conditions of equilibrium of coplanar forces, funicular polygon, common and parabolic category, mechanical advantage and efficiency of simple machines.
- Motion along a straight line with uniform acceleration Tangential and normal components of acceleration, Banking of tracks, Simple harmonic motion projectiles.
- Work and energy power, momentum and conservation of momentum and energy.
- Mechanics practical, experiments illustrating principles of mechanics.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- Hibbeler, R. C. 2003. Engineering Mechanics- Statics and Dynamics, Prentice Hall. (10th Edition)
- Beer, F.P. and E.R. Johnston Jr. 2008. “Vector Mechanics for Engineers”, 7th Edition
- Singer, F.L. 1987. Engineering Mechanics, 4th ed, Harper and Row Publisher.
- Mariam J.L. and L.G. Kraige. 2007. Engineering Mechanics Statics and Dynamics; John Wiley & Sons, 6th Edition

Applied Thermodynamics

Course Outline:

- Thermodynamics, system, process, cycle, forms of energy, energy transfer by heat, energy transfer by work, moving boundary work, properties of pure substances,
- Phase change processes of pure substance, property diagrams for phase change processes, use of property table, ideal gas equation, specific heats,
- Joule's law, internal energy, enthalpy and specific heats of perfect gases, liquids and solids, first law of thermodynamics with its applications,
- Continuity equation, steady flow energy equation and steady flow engineering devices, uniform state and uniform flow processes,
- Second law of thermodynamics, thermodynamic temperature scale, reversible and irreversible processes,
- Entropy and its application to non-flow and flow processes, temperature-entropy and enthalpy entropy diagrams,
- Thermodynamic cycle, Carnot cycle, gas power cycles, vapor power cycles, vapor compression cycle.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- Borgnakke, C. and R.E. Sonntag. 2009. Fundamentals of Thermodynamics 7th Edition , Wiley.
- Sonntag, R.E. and C. Borgnake, 2007. Introduction to Engineering Thermodynamics, 2nd Edition, John Wiley & Sons.
- Stolen, S, T. Grande and N.L. Allan. 2004. Chemical Thermodynamics of Materials: Macroscopic and Microscopic Aspects.

Fluid Mechanics

Course Outline:

- Physical properties of fluids: Density, specific weight, specific volume, specific gravity, surface tension and compressibility.
- Viscosity: Newton's equation of viscosity, units of viscosity, measurement of viscosity, dissipation of energy in lubricated bearings.
- Fluid statics: Pressure, pressure-specific weight-height relationship.
- Unit of pressure: Absolute and gauge pressure.
- Measurement of pressure: Bourden Gauge, manometers and differential manometers. Forces on submerged plane and curved surface and their application
- Flow types: Basic concepts about steady and unsteady flow. Laminar and turbulent flow. Uniform and non-uniform flow, Path lines, streamlines and stream tubes. Velocity and discharge. Equation of continuity, Bernoulli's Theorem, Impulse-momentum equation
- Flow measurement: Measurements of velocity, pitot tube, measurement of discharge, venturimeter, orifices, notches and weirs. Concept of Vena-Contracta
- Steady flow through pipes: Darcy Weisbach equation for flow in pipes, Chezy, Manning and Kutter's formula, Losses in pipe-lines, hydraulic and energy gradients, transmission of energy through pipes, Uniform flow through open channels. (Chezy's and Manning's formulae). Economical cross-section; rectangular, triangular and trapezoidal, Use of pumps and their characteristics.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- Daugherty, R.L., J.B. Franzini and E.J. Finnemore.2001. Fluid Mechanics with Engineering Applications (SI Metric Edition), McGraw-Hill.

- Douglas, J.F., J.M. Gasiorek, J.A. Swaffield and K.B. Jack. 2011. Fluid Mechanics, 6th ed. Pearson Education.
- Bansal, R.K. 2005. A Textbook of Fluid Mechanics and Hydraulic Machines, Laxmi Publications.
- Khurmi, R.S. 1987. A text book of Hydraulics, Fluid Mechanics and hydraulic machinery, S Chand and Co.

Surveying

Course Outline:

- Fundamental Concepts: Definitions, uses & types of surveys, survey measurements, errors and adjustments. Basic Survey Measurements: Distance measurements, levelling, different methods & types of instruments, angle and direction measurement & construction and adjustment of transit & compass, theory, practical and use of stadia surveying.
- Surveying Operation: Plane table traverse - Transit tape traverse, triangulation adjustment of traverse and triangulation network, construction & use of optical alidade, precise measurement of baseline location of details and area measurement, determination of meridian by astronomical observation, topographic maps.
- Mine Surveying: Transfer of co-ordinates level and meridian underground, use of auxiliary telescope, laying out of curves, special mine surveying.
- Field Work: Levelling traversing with plane table and transit-tape traversing, triangulation network practice, survey camp of at least two weeks duration to prepare topographic map.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- Davis and Foote. 1968. Surveying, McGraw-Hill.
- Kanetker, T.P. 1996. Surveying and Levelling. Vol.1&2.
- Staley W.W. 1964. Introduction to Mine Surveying, Stanford University Press.
- Brinker, R.C. 1997. The Surveying Handbook, CBS Publishers and Distributors.
- Abid, S.H. 2000. Mine Surveying. Ministry of Education, Pakistan.

Mechanics of Materials

Course Outline:

- Tensile and compressive loads and stresses,
- Hooke's law, modulus of elasticity, permissible and yield stress and factor of safety,
- Thermal stresses, cross-section of beams,
- Moments of inertia, beam loading, pointed and evenly distributed loads, pure bending of beams, cantilever and simply supported beams, shearing force and bending moment diagrams,
- Shear load and shear stresses in beams, deflection of beams,
- Modulus of rigidity, torsion of circular bars, hollow shafts, strain energy, theory of columns.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- Hibbeler R.C.2016. Mechanics of Materials (10th Ed.), Pearson.
- Pytel A. and F.L. Singer. 1987. Strength of Materials, Harpercollins College Div.

Workshop Practice

Course Outline:

- **Machine Shop:** Detailed study of center lathe and accessories. Plain and Taper turning. Basic lathe operations including turning, facing, simple screw cutting/treading, knurling, grooving (drilling and boring), cutting tools and their grinding. Brief Introduction of shaper, milling sharing and surface and grinding machine, Assigning of practical jobs.
- **Fitting and Fabrication Shop:** The use and care of fitter's tools. Marking out of job. Practice in Metal filing, Sawing, Drilling, Dyeing, Tapping and reaming. Brief introduction and use of power Hack Saw, Arbor Press, Sheet Sharing Machine, Sheet Rolling Machine, Punching Machine and Drilling Machine. Assigning of practical Jobs.
- **Carpentry Shops:** The use and care of tools. Type of Timber, its defect and preservation methods practice in planning and sawing. Different types of wood joints. Study of sawing planning, turning mortise and tenon machines. Assigning of Practical jobs.
- **Electrical Shop:** Electric shocks and treatment. The use and care of tools used by Electrician. Types and uses of cable and electrical accessories for house wiring, practice in simple house wiring, testing methods. Switch gear used on domestic installation and DB system. Earthing System. Assigning of Wiring arrangement practical.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term.

Suggested Books:

- Chapman, W.A.J. Workshop Technology Part-1 An Introductory Course, Edward Arnold.

Engineering Breadth Courses

Engineering Geology

Course Outline:

- Engineering Properties of geological materials:
- Exploration drilling and sampling: Description and classification of soil and rock samples;
- Characterization of fractures and rock masses: Stereonet analysis of discontinuities.
- Rock slope stability analysis, Mode of rock slope failure, analyses and remedies
- Earth and Rock Fill Dams: Definition of an earth dam, types of earth and rock fill dams, Components of an earth dam and their functions.
- General design considerations and typical cross-sections.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- Johnson, R.B. and J.V. Degraff. 1988. Principles of Engineering Geology, Wiley.
- Blyth, F.G.H. and M.H. de Freitas. 1984. A Geology for Engineers, CRC Press.

Geotechnical Engineering - I

Course Outline:

- Significance. Soil, rock and their types and formation. Physical properties of soil: water content, voids ratio, porosity, degree of saturation, specific gravity, unit weight and their determination, mass-volume relationships.
- Soil Classification: Importance of classification tests. Atterberg limits, grain size distribution, Stokes law, classification systems.
- Geotechnical Investigation: Soil exploration, purpose and methods of soil exploration. Probing, test trenches and pits, auger boring, wash boring, rotary drilling, and geophysical methods, soil samplers, disturbed and undisturbed samples. Introductions to geotechnical report writing.
- Permeability and Seepage: Darcy's law, factors affecting permeability, laboratory and field determination of permeability, capillary and its effects. Seepage force. Introduction to flow net. Estimation of seepage quantity. Quicksand condition. Sand boiling Filters.
- Compaction: Fundamentals, moisture-density relationship, compaction standards, factors affecting compaction, field control and measurements of in-situ density. Field compaction equipment.
- Consolidation: Mechanics of consolidation, theory of one dimensional consolidation, assumptions and validity, odometer test and graphical representation of data, compression index, co-efficient of compressibility, time factor, coefficient of volume change and degree of consolidation, primary and secondary consolidation. Normal and pre-consolidated soils.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term.

Suggested Books:

- Aziz Akbar. 2011. Fundamentals of Soil Mechanics.
- Murphy, V.N.S. 2002. Geotechnical Engineering: Principles and Practice of Soil Mechanics and Foundation Engineering, CRC Press.

Introduction to GIS/Remote Sensing

Course Outline:

- GIS-Introduction, principles of GIS, Functional Subsystem, Raster Data Model, Vector Data Model, Attribute Data Model, Coordinate Systems Overview, Discrete Georeferencing, Global Positioning Systems Overview, Projections and transformations, Maps as Representations of the World, Data Transformation,
- Visualization of spatial data, Layers and Projections, Map Design Overlay Analysis, Spatial analysis, Neighborhood functions, Network and overlay analysis, buffering, Spatial data Quality,
- Introduction to Remote Sensing-Basics of Remote Sensing and photogrammetry, Data acquisition, image analysis, image classification, Sensor Systems, Platforms, Digital Image Processing, Applications etc. with case studies with use of software's to solve the geological problems

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- Chakraborty & Sahoo. 2009. Fundamentals of Geographic Information System. Published by Viva books.

Rock Mechanics

Course Outline:

- Classification of Rocks and Rock masses,
- Analysis of stress and strain, basic differential equations in elasticity theory,
- Rock Strength & Failure Criteria, mechanical properties and behavior of rock, in-situ stress measurement,
- Analysis and design of underground openings,
- Stability of rock slopes, Foundation on rocks.
- Methods to improve rock mass responses.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- Goodman, R.E. 1989. Introduction to Rock Mechanics, John Wiley & Sons.
- Barry, H.G. and E.T. Brown. 2012. Rock Mechanics, 3rd Ed. Springer.
- Hoek, E. 2010. Practical Rock Engineering.
- Obert, L. and W.I. Duvall. 1967. Rock Mechanics and the Design of Structure in Rock, Wiley.

Introduction to Geophysical Exploration Techniques

Course Outline:

- Principles and Applications of geophysical methods such as gravity, magnetic, seismic and electrical exploration;
- Acquisition, processing and interpretation of data for subsurface investigations to define geologic structure and evaluate resources.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- Robinson, E. S. and C. Coruh. 1988. Basic Exploration Geophysics, Wiley.
- Gadallah, M. R. and R. Fisher. 2008. Exploration Geophysics: An Introduction, Springer.
- Sroor, M. 2010. Geology and Geophysics in Oil Exploration

Earthquake Seismology & Risk Assessment

Course Outline:

- Earthquake physics introduction to earthquake hazards (e.g. liquefaction, landslides)
- earthquake mechanics; wave propagation, instrumentation, surface waves,
- interpretation of seismograms and earthquake location methods;
- earthquake risk assessment including use of fault, earthquake history, strong ground motion, attenuation, and principles of deterministic and probabilistic earthquake risk assessment;
- Computational and interpretational methods that require computer skills.
- Introduction to GIS/Remote Sensing for earthquake hazard assessments.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- Kramer, S.L. 2003. Geotechnical Earthquake Engineering, Pearson Education.
- Havskov, J. and G.Alguacil. 2004. Instrumentation in Earthquake Seismology Springer, Netherlands.
- Oliveira, C.S., A. Roca and X. Goula. 2006. Assessing and Managing Earthquake Risk Edited Springer, Netherlands.

Drilling Engineering

Course Outline:

- Introduction to various drilling methods,
- Purpose of drilling, planning the well. Cable tool drilling its introduction, equipment relative merits and current applications.
- Rotary drilling- its introduction and basic operations.
- Basic rig components and brief introduction to their function. Mud pumps rating and capacities, Types of bits. Hoisting operation,
- Development in drilling systems.
- Introduction to drilling fluid-composition, function and general.
- Well site Geology-Geotechnical order-anticipated geological sequences, well cutting analysis and redefining assumed lithological boundaries, drill stem testing.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- Bourgoyne, A. T., K.K. Millhein, M.E. Chenevert and F.S. Young. 2016. Applied Drilling Engineering, Society of Petroleum Engineers Inc.
- Rabia, H. 2002. Well Engineering and Construction, London Entrac Consulting Limited.

Hydrogeology

Course Outline:

- Hydrologic Cycle, Measurement of hydrologic parameters, Run off and Stream flow, Infiltration, Runoff Process. Unit Hydrographs, Discharge measurement methods, flow duration curves and discharge analysis for water availability. PMF studies,
- Equations governing single fluid flow through saturated porous media under various geologic conditions. Principles of groundwater flows. Aquifers and its types, general relations between flow systems and water quality, relations between surface and ground water. Darcy's Law, Dupuit's equation, Equation of flow, Well hydraulics, Aquifer evaluation methods, Well design and construction. Saltwater intrusions.
- Groundwater models, Fluid storage, and role of ground water in Geotechnical and geologic problems.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- Patra, K.C. 2008. Hydrology and Water Resources, Alpha Science International Ltd.
- Fetter, C.W. 2000. Applied Hydrogeology, Pearson.
- Todd, D.K. 2004. Groundwater Hydrology (3rd Edition), John Wiley and Sons.
- Subramanya. 1994 Engineering Hydrology (2nd Edition), Aata McGraw Hill Publishing Company, Ltd.
- Freeze, R.A. and J.A. Cherry. 1979. Ground Water, Prentice Hall.

Engineering Depth Courses

Geotechnical Engineering-II

Course Outline:

- Shear Strength: Concept, parameters, Coulomb's law, shear strength of cohesive and non-cohesive soils. Factors affecting shear strength of soil and its applications in engineering. Laboratory and field tests for determination of shear strength.
- Stress Distribution in Soils: Geo-static stresses, Total stress and pore pressure, Effective stress, Vertical stresses induced due to structural loads; Westergaard and Boussinesq's theories. Pressure bulb, Stress distribution diagrams on horizontal and vertical planes. Stress at a point outside the loaded area, Newmark's influence charts, Fadum, Steinnbrenner charts.
- Settlement Analysis: Definition, total settlement, differential settlement, angular distortion, consolidation settlement, elastic or immediate settlement. Settlement calculations, Primary and secondary consolidation settlements, Immediate settlement of cohesive and non-cohesive soils, Causes of settlements and methods of controlling settlement, Limits of allowable total and differential settlement.
- Earth Pressures: Definition, pressure at rest, active and passive earth pressures, Coulomb's and Rankine's theories, Trial wedge and Culmann's method. Earth pressure diagrams for different configurations loading.
- Bearing Capacity of Soils: Definition of ultimate and safe bearing capacities, allowable bearing capacity, gross and net bearing capacities, Methods of obtaining bearing capacity: Presumptive values from codes; merits and demerits. From plate load test. Bearing capacity theories. Bearing capacity from SPT and CPT data.
- Introduction to Soil Improvement Slope Stability: Types of slopes, Factors affecting stability and remedies. Types of failure Methods of analysis; Swedish circular method, Taylor's slope stability number and Bishop's methods.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- Das, B.M. 2005. Fundamentals of Geotechnical Engineering, Thomson Asia Pvt. Ltd., Singapore.
- Atkinson, J. 2007. The Mechanics of Soils and Foundations, 2nd ed., Spon Press.
- Knappett, J. A. and R.F. Craig. 2012. Craig's Soil Mechanics, 8th ed., Spon Press.
- Smith, I. 2014. Smith's Elements of Soil Mechanics, 9th ed., John Wiley and Sons Ltd.

Tunneling & Excavation Engineering

Course Outline:

- Introduction: Fundamental Concepts of Rock Breaking, Classifications of underground structures and site investigation & Geological aspects regarding their design.
- Design & Construction of Underground Structures: Design of shape & size, Excavation methods Drill & Blast, Mechanical Excavation. Tunneling & Shaft Sinking in problematic grounds. Concepts of abrasion and Tool Wear In connection with Mechanical Rock Fragmentation.
- Ground Treatment and Water Control Methods Support and Ventilation during Construction of Underground Structures.
- Instrumentation: Objectives, Collection of design data and monitoring of Excavation during and after Construction.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- Hemphill, G.B. 2013. Practical Tunnel Construction, Wiley, USA.
- Whittaker, B.N. and R.C. Frith. 1990. Tunnelling: Design, Stability and Construction, Institution of. Mining and Metallurgy (IMM): London.
- Chapman, D., N. Metje and A. Stark. 2010. Introduction to Tunnel Construction, CRC Press.
- Bickel, J.O., T.R. Kuesel, and E.H. King. 1996. Tunnel Engineering Handbook Chapman & Hall/ITP Publishing Company, 544 p.
- Hartman, H. L. 1992. SME Mining Engineering Handbook, 2nd Ed., Vol. 1, SME, Littleton, CO. Darling, P. 2011. SME Mining Engineering Handbook, 3rd Ed., SME, Littleton, CO.

Environmental Geological Engineering

Course Outline:

- A geological perspective on current environmental problems their causes and possible solutions. Focus on surface processes,
- Geoharzards, Natural resources and global systems,
- Introduction to engineering geologic mapping for site selection for solid waste disposal facilities,
- Soil-water-contaminant interaction, landfill site selection, design, permitting, construction, operation, and closeout/reclamation.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- Rowe, R.K., 2000. Geotechnical and Geoenvironmental Engineering Handbook; Kluwer Academic Publications, London.
- Reddi, L.N. and H.I. Inyang. 2000. Geoenvironmental Engineering, Principles and Applications; Marcel Dekker Inc. New York.
- Yong, R. N. 2001. Geoenvironmental Engineering, Contaminated Soils, Pollutant Fate, and
- Mitigation; CRC Press, New York.
- Hillel, D.2003. Introduction to Environmental Soil Physics; Academic Press, New York.
- Hillel, D.1982. Introduction to Soil Physics; Academic Press, New York.
- Sparks, D.L.2002. Environmental Soil Chemistry; Academic Press, New York.
- Bagchi, A. 2004. Design of landfills and integrated solid waste management; John Wiley & Sons, Inc., USA.
- Bedient, P.B., H.S. Rifai, and C. J. Newell. 1994. Ground water contamination: transport and remediation. Prentice-Hall International, Inc.
- LaGrega, M.D., P.L. Buckingham, and J.C. Evans. 2010. Hazardous waste management. Waveland Press.
- McBean, E.A., F. A. Rovers, and G. J. Farquhar. 1995. Solid waste landfill engineering and design. New York: Prentice Hall PTR.
- Keller, E.A. 1999. Environmental Geology Eight edition.
- Chiras D.D. 2014. Environmental Science Seventh Edition.
- Testa, S.M. 1993. Geological Aspects of Hazardous waste management
- Freeman, T. 2010. Environmental Geology Laboratory Manual

Geological Aspects of Hazardous Waste Management

Course Outline:

- Nature and classification of hazardous waste
- Regulations for treatment and disposal
- Geological characterization of facility sites
- Design of impoundments, storage and contaminant facilities
- Groundwater monitoring and protection
- Site permitting and licensing planning

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- Rowe, R.K., 2000. Geotechnical and Geoenvironmental Engineering Handbook; Kluwer Academic Publications, London.
- Reddi, L.N. and H.I. Inyang. 2000. Geoenvironmental Engineering, Principles and Applications; Marcel Dekker Inc. New York.
- Yong, R. N. 2001. Geoenvironmental Engineering, Contaminated Soils, Pollutant Fate, and
- Mitigation; CRC Press, New York.
- Hillel, D.2003. Introduction to Environmental Soil Physics; Academic Press, New York.
- Hillel, D.1982. Introduction to Soil Physics; Academic Press, New York.
- Sparks, D.L.2002. Environmental Soil Chemistry; Academic Press, New York.
- Bagchi, A. 2004. Design of landfills and integrated solid waste management; John Wiley & Sons, Inc., USA.
- Bedient, P.B., H.S. Rifai, and C. J. Newell. 1994. Ground water contamination: transport and remediation. Prentice-Hall International, Inc.
- LaGrega, M.D., P.L. Buckingham, and J.C. Evans. 2010. Hazardous waste management. Waveland Press.
- McBean, E.A., F. A. Rovers, and G. J. Farquhar. 1995. Solid waste landfill engineering and design. New York: Prentice Hall PTR.
- Keller, E.A. 1999. Environmental Geology Eight edition.
- Chiras D.D. 2014. Environmental Science Seventh Edition.
- Testa, S.M. 1993. Geological Aspects of Hazardous waste management
- Freeman, T. 2010. Environmental Geology Laboratory Manual

Seismic Data Processing & Interpretation

Course Outline:

- Fundamental concepts of data processing and interpretation techniques.
- Velocity analysis, stacking, filtering, frequency display, muting, convolution, de-convolution, seismic data display, vertical and horizontal sections.
- Data analysis techniques and data interpretation and their use for locating energy resources.
- Seismic data processing and interpretation for hydrocarbon prospecting / exploration.
- Introduction to the computer methods being used for data processing and calibration techniques.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- Edwin S. Robinson & Cahit Coruh. 1988. Basic Exploration Geophysics

Surficial Processes, Sedimentation and Stratigraphy

Course Outline:

- Examination of the genetic link between surficial geological processes and the sedimentary record produced by the processes and environments.
- Depositional environments, stratigraphic successions and principles with a focus on their application to sedimentary basins and hydrocarbon genesis.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- Nichols, G. 2009. Sedimentology and Stratigraphy, 2nd Edition, Wiley-Blackwell.
- Bridge, J.S. and R.V. Demicco. 2008. Earth Surface Processes, Landforms and Sediment Deposits, 1st Edition, Cambridge University Press.
- Schick A. P. 1993. Surficial Processes and Landscape Evolution, Laser pages publishing.

Exploration and Environmental Geochemistry

Course Outline:

- Principles of rock-water interaction and element migration in the near surface environment applied to environmental and exploration geochemistry.
- Analysis, interpretation and evaluation of geochemical data.
- Design of geochemical hazards and formulation of strategies for detecting mineral deposits.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- Holland, H. D. 2005. Environmental Geochemistry, Elsevier.

Fluvial Processes

Course Outline:

- A systematic study of watershed evolution and development and function of the attendant stream composition.
- Morphometry, quasi-equilibrium, classification, fluvial mechanics, fluvial landforms and stream restoration technology.
- Study of latest literature with focus on processes and results.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- Robert, A. 2003. River processes, an introduction to fluvial dynamics, Routledge.
- Chang, H. H. 2008. Fluvial processes in river engineering, Kreiger publishing company.

Statistical Methods in Geology and Engineering

Course Outline:

- Statistical methods in engineering and geological applications including environmental data analyses.
- Introduction to spatial correlation analysis and geostatistical techniques.
- Kriging for resource evaluation and estimation.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- Cheeney R. F. 1983. Statistical methods in Geology, Unwin Hyman.

Environmental Aspects of Mining

Course Outline:

- Applied and fundamental research issues pertaining to permitting.
- Legal environment of reclamation and environmental impact assessment.
- Post- mining land-use selection and mine planning for optimum reclamation of all mines: metal, non-metal and coal.
- Unit operations for reclamation.
- Drainage, backfill, soil replacement, revegetation and maintenance.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- Ripley, E. A. and R.E. Redmann. 1995. Environmental Effects of Mining, St. Lucie press.

Reservoir Engineering

Course Outline:

- Depositional environments, basic structures, and hydrocarbon traps
- Large scale exploration techniques
- The properties of reservoir rock, such as porosity, fluid saturation, pore volume, and permeability
- Reservoir fluid properties, such as API gravity, formation volume factor, gas solubility, density, and viscosity
- Common classes of reservoirs according to the types of fluids they contain and their characteristic performance
- Sources of reservoir data

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- Ahmed, T. 2010. Reservoir engineering handbook, Elsevier.

Risk Assessment in Environmental Studies

Course Outline:

- Overview of the basic concepts of ecological risk assessment.
- Evaluate various components of risk assessment, including human health, environmental, occupational, ecological, and risk management.
- Significant case studies are used to illustrate the assessment process.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- Robson, M. G. 2007. Risk Assessment for Environmental Health, John Wiley and sons.
- Colow, P. P. 1998. Environmental Risk Assessment and Management, Wiley-Blackwell.

Geotechnical Site Investigation

Course Outline:

- Methods of field investigation, testing, and monitoring for geotechnical and hazardous waste sites, including:
- drilling and sampling methods, sample logging (rock, rock cuttings, and soil), field testing methods, instrumentation, and trench logging.
- Technical writing for investigations (reports, memos, proposals, work plans) and simulated investigations (using a computer simulator).

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- National Research Council, 1984. Geotechnical Site Investigation for Underground Projects, National academy press.

Resource Engineering

Course Outline:

- Characterization of major ore deposits using petrological,
- geochemical and geophysical engineering sciences including tectonic setting, age, rock composition, mineralogy and textures,
- geochemical and geophysical signatures of mineral deposits.
- Design of ore deposit models and exploration programs including ore processing and environmental issues.
- Determination of paragenetic sequences, estimation of ore grade.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- Ma, Y. Z. and S.A. Holditch. 2015. Unconventional Oil and Gas Resources Handbook, Gulf professional publishing.

Petrophysics & Well Logging

Course Outline:

- Introduction of physical properties of rocks and their importance,
- Petrophysical characteristics and their relation with formation evaluation.
- Introduction to well logging, fundamental concepts and its uses, Log interpretation problems.
- Theory and application of Spontaneous Potential (SP) log, Resistivity logs, normal devices, focused tools,
- Induction tools, radioactivity, well logging, gamma ray, neutron, sonic logging, temperature logging, caliper logging, quantitative and qualitative analysis, study of various well logs.

- Log analysis of subsurface geology.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- Asquith, G. B., D. Krygowski and C.R. Gibson. 2004. Basic Well Log Analysis (2nd Ed.).
- Halliburton A.D. 2001. Basic Petroleum Geology and Log Analysis.

Pavement & Foundation Engineering

Course Outline:

- Introduction to Foundation Engineering, Definitions, purpose and types,
- General requirements of foundations, depth of footings, selection of foundation types,
- Geotechnical designs of isolated, combined mat and strap foundations, differential settlements and cracks, proportioning of footings for given settlement or equal settlements.
- Proportioning of footings for given settlements.
- Dewatering for foundation construction. Introduction to deep foundations.
- Types of piles, load carrying capacity of piles. Group action, negative skin fraction, pile load test. Foundation construction.
- Types of pavement, wheel loads, equivalent single wheel load, repetition and impact factors, load distribution characteristics, highway and airport pavements compared.
- Design consideration, method of design of pavements, group index, C.B.R. and water guard methods, construction and maintenance, pavement evaluation and rehabilitation.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- Das B.M. 2005. Principals of Foundation Engineering, 7th Edition, Thomson Asia Pvt. Ltd., Singapore.
- Qureshi, M.S. and Akbar A. 2011. Fundamentals of Soil Mechanics.

Geomorphology and Terrain Analysis

Course Outline:

- Study of geomorphic processes,
- Landform development and surficial materials.
- Stresses evaluation of the engineering properties of terrain for site selection
- Design of engineered structures.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- Smith, M., P. Paron and J. Griffith. 2011. Geomorphological Mapping: Methods and Applications, Elsevier.

Ground Improvement and Geosynthetics

Course Outline:

- Improvement in or modification to the Engineering properties of a soil that carried out at a site where the soil in the natural state doesn't possess properties that are acceptable to us for the proposed geotechnical Engineering activities.
- Evaluation of the improved performance of foundations, earth structures, earth retaining structures and underground structures constructed on, within or using the soil.
- Engineering properties of soft, weak and compressible deposits, principles of treatment-loading (static and Dynamic),
- Accelerated flow, Reinforcement, Vertical drains, Granular piles, soil nailing, Anchors.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- Kirsch K. and Bell A. 2012. Ground Improvement, 3rd Edition, CRC press.
- Han J. 2015. Principles and Practice of Ground Improvement, Wiley.

Production Engineering

Course Outline:

- Introduction to Production Engineering, fundamental concepts, following the hydrocarbons production cycle.
- Reservoir engineering fundamental notions, focusing then in the effect of well completion in production and finally concentrating in the most common operations and well interventions.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- Guo B., Lyons W. C. and Ghalambor A. 2007. Petroleum production engineering. Gulf professional publishing

Site Remediation Engineering

Course Outline:

- Introduction Sorption Volatilization Metals in soil Bio-basics Site assessment
- In-situ Remediation - overview Remediation - SVE Remediation - Thermal Remediation - Chemical Remediation - Bio Remediation
- Metals Natural attenuation and containment

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- Suthersan, S. S., J. Horst, M. Schnobrich and N. Welty. 2016. Remediation Engineering, CRC press.

Environmental Soil Science

Course Outline:

- Importance of soils as a major component of the environment.
- Physical, chemical and biological properties of soils and how these relate to land management.
- Needs of environmental science in hydrology,
- Wetland delineation and function,
- Environmental planning, and environmental assessment and management.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- Botkin, D. and E. Keller. 2014. Environmental Science- Earth as a living planet, Jon Wiley and Sons.

Petrogenesis and Metallogenesis

Course Outline:

- Application of fundamental principles of igneous petrology, geochemistry and fluid-rock interaction to metallogeny and ore genesis.
- Training in ore microscopy and mineral paragenesis with mineral chemistry and lithogeochemical data for selected case studies.
- Understanding of ore forming processes.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- Zoheir, B., D.M. Doronzo, E. Schingaro and J.S. Armstrong-Altrin. 2019. Petrogenesis and Exploration of Earth's Interior, Springer.

Carbonate Sedimentology

Course Outline:

- The origin, composition and diagenesis of carbonate rocks.
- Study of modern carbonate sediments and depositional environments,
- Development and design of facies models,
- Petrographic and geochemical analysis of limestone and dolostone.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- Tucker, M. E. and V.P. Wright. 1990. Carbonate Sedimentology, Wiley.

Analysis of Rock Structures

Course Outline:

- Characterization and analysis of rock deformation and fractures at all scales.
- Geometic, kinematic and dynamic analysis of rock structures,
- Mechanics of rock deformation (stress and strain) in geotechnical engineering problems

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- Sakurai, S. 2017. Back Analysis in Rock Engineering, CRC Press.

Environmental Data Analysis

Course Outline:

- Application of statistical principles for the design of measurement systems and sampling programs.
- Introduction to experimental design.
- Graphical data analysis. Description of uncertainty.
- Model parameter estimation methods.
- Trend analysis. Statistics of extreme.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- Zhang, Z. 2016. Environmental data analysis, De Gruyter.

Recycling and Sustainable Engineering

Course Outline:

- An engineering perspective on use of technology for sustainable environmental purification and infrastructure based on effective utilization of mining, industrial and domestic byproducts.
- Green methods of recycling.
- Effective conversion of biomass and municipal wastes to energy-generating systems.
- Sludge Disposal and reuse.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- Grohens, Y., S.K. Kumar, A. Boudenne and Y. Weimin., (Eds.). 2013. Recycling and Reuse of Materials and Their Products. CRC Press.
- Lottermoser, B. G. 2011. Recycling, reuse and rehabilitation of mine wastes. Elements, 7(6), 405-410.
- Goodship, V.(Ed.). 2009. Management, recycling and reuse of waste composites. Elsevier.
- Vigneswaran, S. M. Sundaravadivel. 2004. Recycle and reuse of domestic wastewater. Wastewater Recycle, Reuse, and Reclamation, 1.

Multidisciplinary Engineering Courses

Basic Electrical and Electronics Engineering

Course Outline:

- D.C. Machine: Types of excitation, operation and characteristics of serifs, shunt and compound generators and motors, armature reaction elementary, treatment of communication and interlopes, stators, selection of motors.
- Elementary transmission and distribution, DC and AC systems transmission voltages, elements of house wiring meagre testing distribution, switching and fusing from the utilization points of view, earthling of apparatus and neutral.
- A.C. Circuits: Series and parallel circuits and their combination, improvement of power factor by condensers, three phase alternating currents, advantages over single phase, vector diagrams for the balanced three phase system.
- The Transformer: Basic principles, ratio of transformation, iron and copper losses, efficiency, regulation, brief discussion and uses of instrument transformers and auto transformers, three phase transformers, stars and delta connections, Scott connections constructional features and cooling of transformers, protection from fire hazards (description only).
- A.C. Generators: Construction and working principles of alternator frequency, simple EMF equation. polyphase generation. A.C. Motors: Concept of rotating field, polyphase induction motor, production of torque, slip, squirrel cage and slipping motors, starting of motors, synchronous motor construction production of torque and starting characteristics, selection of A.C. Motors, measuring instruments, basic principles of construction and operation of moving iron dynamometer and hot wire instruments, (no calculations) power and energy meters, elementary considerations.
- Storage Batteries: Lead and nickel iron cells, charge and discharge, quantity and energy efficiencies.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term.

Suggested Books:

- Theraja, B.L. and A. K Theraja. 2012. Textbook of Electrical Technology", 25th Edition, Chand (S.) & Co Ltd ,India.
- Robert L and R.L. Boylestad. 2010. Introductory Circuit Analysis, 12th Ed. Prentice Hall.
- Chapman, S.J. 2003. Electric Machinery Fundamentals", 4th Edition McGraw-Hill Science/Engineering/Math.
- Admiralty. Examples in Electrical Calculations. ASIN: B003MR22VS.

Explosives Engineering

Course Outline:

- Explosives history and development of explosives, ingredients and chemistry, explosives properties,
- Classification & characteristics of commercial explosives including permissible explosives and blasting agents,
- Initiation systems, rock breakage theories,
- Principles of priming & explosives loading,
- Fundamentals of surface & underground blast designs, controlled blasting techniques, ground vibrations & air blast,
- Safety in explosives handling & blasting.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- Fletcher, D. and D'Andrea, 1995. Explosives and Blasting Procedures Manual (IC 8925).
- Explosive and Rock Blasting, Atlas Powder Company, 1987.
- Olofsson, S.O. 1990. Applied Explosive Technology for Construction and Mining, Nora Boktryckeri AB.
- Blaster's Handbook. 2011. 18th Edition, ISEE.

Occupational Health and Safety

Course Description:

This course introduces the student to the study of workplace occupational health and safety. The student will learn safe work practices in offices, industry and construction as well as how to identify and prevent or correct problems associated with occupational safety and health in these locations as well as in the home.

Learning Outcomes:

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

1. Identify hazards in the home, laboratory and workplace that pose a danger or threat to their safety or health, or that of others.
2. Control unsafe or unhealthy hazards and propose methods to eliminate the hazard.
3. Present a coherent analysis of a potential safety or health hazard both verbally and in writing, citing the Ontario Occupational Health and Safety Regulations as well as supported legislation.
4. Demonstrate a comprehension of the changes created by WHMIS and OSHA legislation in everyday life.

Course Outline:

Health and Safety Foundations

a. Nature and scope of health and safety
b. Reasons/benefits and barriers for good practices of health and safety
c. Legal frame work and OHS Management System

Fostering a Safety Culture

a. Four principles of safety- RAMP (Recognize, Assess, Minimize, Prepare)
b. Re-thinking safety-learning from incidents
c. Safety ethics and rules
d. Roles and responsibilities towards safety
e. Building positive attitude towards safety
f. Safety cultures in academic institutions

Recognizing and Communicating Hazards

a. Hazards and Risk
b. Types of hazards: Physical (mechanical and non-mechanical), Chemical (Toxic and biological agents), electrical, fire, construction, heat and temperature, noise and vibration, falling and lifting etc.
c. Learning the language of safety: Signs, symbols and labels

Finding Hazard Information

a. Material safety data sheets
b. Safety data sheets and the GHS (Globally Harmonized Systems)

Accidents & Their Effect on Industry

a. Costs of accidents
b. Time lost
c. Work injuries, parts of the body injured on the job
d. Chemical burn injuries
e. Construction injuries
f. Fire injuries

Assessing and Minimizing the Risks from Hazards

a. Risk Concept and Terminology
b. Risk assessment procedure
c. Risk Metric's
d. Risk Estimation and Acceptability Criteria
e. Principles of risk prevention
f. Selection and implementation of appropriate Risk controls
g. Hierarchy of controls

Preparing for Emergency Response Procedures

a. Fire
b. Chemical Spill
c. First Aid
d. Safety Drills / Trainings:
    - Firefighting
    - Evacuation in case of emergency

Stress and Safety at Work environment

a. Workplace stress and sources
b. Human reaction to workplace stress
c. Measurement of workplace stress
d. Shift work, stress and safety
e. Improving safety by reducing stress
f. Stress in safety managers
g. Stress and workers compensation

Incident investigation

a. Importance of investigation
b. Recording and reporting
c. Techniques of investigation
d. Monitoring
e. Review
f. Auditing Health and Safety

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Mid-semester exam, report writing/presentation, assignment, project report, quizzes, end-semester exam

Suggested Books:

- The A-Z of health and safety by Jeremy Stranks, 2006.
- The Manager's Guide to Health & Safety at Work by Jeremy Stranks, 8th edition, 2006.
- Occupational safety and health law handbook by Ogletree, Deakins, Nash, Smoak and Stewarts, second edition, 2008.

12.2 Non-Engineering Domain

Earth Sciences

Physical Geology

Course Outline:

- Introduction to various branches of geology,
- Origin of earth and its place in universe,
- Interior of earth and chemical composition of the earth crust, Mountain building and valley formation, drainage pattern and their types, weathering and erosion,
- Theory of plate tectonic, earthquake and volcanism,
- Introduction to rocks and mineral,
- Occurrence of economical minerals deposits of Pakistan.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- Plummer, C.M. 2001. Physical Geology Earth Revealed, Mc-Graw Hill, 4th Ed.
- Tarbuck, E.J. and F.K. Lutgens and D.G. Tasa. 2014. Earth: An Introduction to Physical Geology, Pearson.

Petroleum Geology

Course Outline:

- Petroleum origin and migration
- Source rocks, Reservoir rocks and its types
- Subsurface environments
- Reservoir dynamics
- Anticlinal theory
- The reservoir Traps
- Causes of dry holes
- Introduction to sedimentary basins
- Petroleum systems, plays and prospects
- Stratigraphic sequence
- Basin modeling techniques
- Regional tectonic setting
- Geology of sedimentary basins with existing oil and gas field in Pakistan
- A brief review of Pakistan and World petroleum resources

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- Selley, R.C. 1998. Elements of Petroleum Geology, Academic Press.
- Halliburton, A. D. 2001. Basic Petroleum Geology and log analysis, Haliburton Manual.
- Kadri, I. B. 1995. Petroleum Geology of Pakistan.
- Levorson, A. I. and Berry F. A. 1967. Geology of Petroleum, W.H. Freeman and Co.,San Francisco, USA.

Mineralogy & Petrology

Course Outline:

- Introduction to crystal groups,
- Mineral chemistry, mineral recognition, genesis,
- Classification and identification of rocks and their recognition in hand specimens and in the field.
- Ore & coal microscopy for study of thin & polished sections.
- Megascopic identification of minerals.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written assignments/Quizzes, Case Studies relevant to Engg. disciplines, Semester project, Guest speaker, Industrial/Field visits, Group discussion, Report Writing.

Assessment:

Mid-term, Report writing/Presentation, Assignment, Project report, Quizzes, Final term

Suggested Books:

- Perkins, D. 2010 Mineralogy, Pearson, 3rd Ed.

English Courses

Functional English

Area Scope:

The knowledge units in this area collectively encompass the following:

- Follow English vocabulary and skills to use it in professional life.
- Identify common errors usually made by the Learners of English as second language
- Practice English correctly in speaking and writing

Course Outlines:

- Public Speaking
- The Art of Creating a Power Point Presentation.
- Interacting with the Opposite Gender
- Classroom Etiquettes and Teachers' Expectations
- Articles
- Prepositions
- Homophones
- Punctuation
- Tenses in English Grammar
- Formal Letter Writing
- Summary writing
- Organizing and planning your writing
- Sensory Perception in writing.
- Critical thinking
- Final Term Project

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- P. C. Wren & H. Martin "High School English Grammar & Composition".
- Colin W. Davis & Andrew J. Watts New Expressway For English 1 (New Edition)
- Herta A. Murphy & Herbert William Hildebrandt. Effective Business Communications
- Diana Hacker. A Writer's Reference
- Sadat Ali Shah. Exploring The World Of English
- J. Thomson and A. V. Martinet. Practical English Grammar, "University Physics", 13th Edition

Communication Skills

Area Scope:

The knowledge units in this area collectively encompass the following:

- Communicate effectively using intermediate- to-advanced level English while developing the understanding of essentials of communication skills.
- Participate in group discussions by attentive listening, questioning to clarify ideas, eliciting responses, or disagreeing in a constructive way.

Course Outlines:

By the end of the semester students will have skills including:

Writing Skills

- Vocabulary Building
- Writing Skills: Essays and Letters
- Common Writing Errors
- Purposeful Writing

Reading Skills

- Skimming and Scanning
- Critical Reading
- Reading for Understanding
- Techniques and strategies to develop sound vocabulary.

Listening Skills

- Introduction to Communication Process
- Seven Cs of Communication
- Types of Listening
- Listening for Comprehension

Speaking Skills

- Verbal and Non-Verbal Communication
- Basics of Presentation Skills
- Presentation Strategies and public speaking skills.
- Use of Audio-Visual Aids
- Basics of Group Communication
- Listening Skills
- Communicate effectively in job interviews.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Anchor in English-II (Lessons 1-5), A SPELT Publication
- Christopher Fry, "Summary Writing (Book-I)", Oxford University Press
- College Essays by John Langland
- Barron's TOFFL iBT Edition
- Communication Skills for Engineers by Sunita Marshal and C.Muralikrishna

Technical Writing and Presentation Skills

Area Scope:

The knowledge units in this area collectively encompass the following:

- The students will be able to write technically correct statements, assignments, final year project report, project proposal, short report and research paper
- The students would be able to their write CV, cover letter and business/ professional Correspondence meeting all criteria
- The students would be able to present their work/ research at a technical forum.

Course Outlines:

- Introduction to Technical writing
- Proposal write-up and improvement strategies Introduction to research and research types choosing research problems and research advisors How to carry out research
- Formulation – Problem statement, Literature
- Review
- Design - Methodology
- Analysis - Data analysis and interpretation Good writing style techniques
- Uses of correct words
- Presenting and publishing research
- Write business/professional correspondence, cover letter and CV
- Writing meeting minutes

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Writing for Computer science by Justin Zobel Research Methodologies – A step by step guide for beginners, Ranjit Kumar.

Mathematics Courses

Linear Algebra

Area Scope:

The knowledge units in this area collectively encompass the following:

- To comprehend basic concepts of Linear Algebra and optimization
- To apply techniques of Linear Algebra and optimization for solution of engineering problems

Course Outline:

System of Linear Equations and Applications

- Overview of linear system of equations, Cases of unique solution, No solution and infinite solutions,
- Echelon form, Gauss elimination method, Inversion of matrix in the context of solution of system of equations, LU factorization, Row space and column space
- Relevant engineering case studies such as Network analysis, Traffic Flows, Balancing chemical reaction, Leontief Input-output model, Finding max stress in compound cylinder, Applications of linear systems in force balancing of structures, Markov process

Vector Spaces and Transformations

- Vector Spaces: Real vector spaces, Subspaces, Basis and dimension, Rank, Nullity
- Gram-Schmidt process for finding orthonormal basis
- Linear Transformation, Kernel of Transformation, Range of Transformation, Matrix of Transformation,
- Applications: Cryptography, Coding and decoding, Breaking of codes, Robotic Applications of linear transformations

Eigenvalues and Eigen Vectors

- Eigenvalues, Eigenvectors, Similar matrices, Diagonalization,
- Quadratic forms, Positive definite Matrices, Singular Value Decomposition, Inner product Spaces

- Applications of linear Algebra: Constructing curves and surfaces, Computer graphics, Genetics

Linear Programming

- Solution Introduction to linear programming, Optimization, Graphical method, Simplex method, Optimization problems in engineering and economics
- Dual simplex methods, Duality theory, Primal and dual problems, transportation models, north-west corner, least-cost and Vogel's approximations methods,
- Assignment model, the transshipment model and other relevant engineering case studies

Application of Linear Algebra in Dynamical Systems

- Numerical System of linear ODEs, Eigenvalue problems, Homogeneous and nonhomogeneous system of ODE.
- Dynamical systems, Population dynamics, Prey-Predator models, Stability analysis

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Introductory Linear Algebra: By Bernard Kolman and David R. Hill, Latest Edition.
- Elementary Linear Algebra: By Howard Anton and Chris Rorrers, Latest Edition.

Calculus and Analytical Geometry

Area Scope:

- To develop a clear understanding of fundamental concepts of single variable calculus
- To apply concepts of differentiation and integration to solve complex engineering problems

Course Outline:

Analytical Geometry:

- Review of vectors, scalars and vector products.
- Three dimensional coordinate system and equation of straight line and plane

Functions Limit and Continuity:

- Review of functions and graphs,
- Limits & Continuity,
- Techniques of Finding Limits,
- Discontinuity,
- Limits of Sine and Cosine and Exponential Functions

Differentiation:

- Introduction to Derivatives
- Examples of Derivatives
- Derivative as Rate of Change
- Derivative's Rules
- Implicit Differentiation
- Higher order derivatives
- Leibnitz Theorem

Applications of Derivatives:

- Applications of Derivatives
- Monotonic functions
- Optimization problems
- Relative and Absolute extrema
- First and second derivative tests

- Point of inflection
- Concavity
- Curvature
- Indeterminate Forms and L' Hospital rule
- Differentials

Integration:

- Integrals and Properties of Integrals
- Techniques of Integration
- Integration by Parts
- Definite Integrals
- Integration of Trigonometric
- Exponential and Inverse Functions
- Integration by Partial Fractions
- Reduction Rules

Applications of Integration:

- Applications of Integration
- Area under the curve
- Area between curves
- Solids of Revolution
- Volume of Solids of revolution by disk washer, Cylindrical shell & Cross Section Methods
- Center of Pressure and Depth of Center of Pressure
- Center of mass
- Arc length

Improper Integrals:

- Improper Integral
- Integrals and Singularities
- Convergence of improper integrals

Infinite Sequence and Series:

- Sequence and Infinite Series
- Convergence and Divergence of sequences and series
- Positive Term Series
- Integral Test
- Basic Comparison Test
- Limit Comparison Test
- Ratio and Root tests
- Alternating series
- Absolute and Conditional Convergence

Power and Taylor Series:

- Power series
- Maclaurin and Taylor Series and its Applications

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Thomas' Calculus by George B. Thomas, Jr., Maurice D. Weir, Joel R. Hass, Pearson, USA.
- Swokowski, Onlinick & Pence: Calculus
- Robert T. Smith & Roland B. Minton: Calculus
- Calculus: Early Transcendentals by James Stewart. Brooks/Cole USA.

Differential Equations

Area Scope:

The knowledge units in this area collectively encompass the following:

- To define basic mathematical concepts related to differential equations
- To describe different types of analytical methods for solution of differential equations
- To formulate different engineering problems in the form of differential equations

Course Outline:

Basic Concepts and Modeling

a. Linear Differential equations, Non-Linear, Differential equations, Solutions of differential equations, General solutions, Particular solutions, Initial and boundary value problems, Degree and order of ODEs
b. Formulation of first-order ODEs: Case studies related to finding age of fossils, Mixing problems and free fall motion, Finding temperature of a building, RL, RC circuits, Airplane take-off problem, Population dynamics and logistic equations etc.

Analytical Methods of Solution for First-order ODEs

a. Variable separable method, Reduction to variable separable form, Homogeneous equations, Differential equations reducible to homogeneous form, Solution of the related ODE models by these methods
b. Exact equations, Integrating factors, Linear equations and related examples, Bernoulli's equations, Orthogonal trajectories and solution of the related ODE models by these methods

Mathematical Models Based on Second-order ODEs

a. Formulation of a single RLC circuit, Spring mass systems, Earthquake model of a single story building
b. Bungee Jumper model, Bridge collapse problem etc.

Analytical Methods of Solution for Second-order ODEs

a. Homogeneous linear ODEs, Method of reduction order , Wronskain determinant to check independence of the solution, and related examples
b. Cauchy-Euler equations and related examples, Non-homogeneous linear ODEs, Method of undetermined coefficients
c. Method of variation of parameters and related example
d. Analytical solution of the related ODE models by these methods

Series Solution for Second-order ODEs

a. Series solution of ODEs and convergence tests
b. Series solution of Legendre equation, Frobenious method of solution for Bessel equation and related applications

Laplace Transform

a. Laplace Transform, Derivation of Basic formulae, Inverse Laplace Transform, First shift theorem
b. Laplace transform of integrals and derivative, Solution of second order ODEs by Laplace Transform, Unit step function and its Laplace transform, Second shift theorem, Convolution
c. Application of Laplace transform to a system of ODEs and related applications

Partial Differential Equations

a. Partial Differential Equations and their types, Applications of partial differential equations in Engineering
b. Method of Separation of Variables Method (MSVM) and solution of wave equation by the MSVM
c. Method of Separation of Variables Method (MSVM) and solution of heat equation by the MSVM

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Advanced Engineering Mathematics by Erwin Kreyzig, John Wiley & Sons Inc. Latest Edition.
- Differential Equation with Boundary Value problems by D. G. Zill, M. R Cullen Latest Edition, Brooks/Cole Publishers.
- A First Course on Differential Equations with Modelling Applications by D. G. Zill, Latest Edition, Brooks/Cole Publishers.
- An Introduction to Mathematical Modelling by Bender, E.A., Latest Edition, Wiley, New York.

Numerical Analysis

Area Scope:

The knowledge units in this area collectively encompass the following:

- To comprehend different numerical techniques such as: error propagation, interpolation, differentiation, integration, eigenvalues and solution of algebraic and differential equations
- To apply the numerical techniques to different linear and nonlinear engineering problems

Course Outline

Error Analysis and Interpolation

a. Error analysis, Types of error, Sources of error, Norms of vectors and matrices, Computer arithmetic, Condition number of a matrix, Significant digits and loss of significant digits, Floating point arithmetic, Binary and decimal representation, Single and double precision
b. Interpolation: Newton forward and backward difference formula for interpolation, Central difference interpolation formulae, Lagrange's interpolation, Error in interpolation, Linear least square approximation, Interpolation versus least square approximation, Relevant engineering case studies

Numerical Differentiation and Integration

a. Derivation of numerical differentiation of first order and second order derivatives using two points, three points, and five points formulas along with its application in engineering, Relevant case studies
b. Numerical integration: Trapezoidal rule, Simpson's rules, Composite Trapezoidal Simpson Rules and Romberg integration, Applications of numerical in engineering, Relevant case studies

Methods of Solution a System of Linear Equations

a. Solution of system of linear algebraic equations, Gauss elimination method
b. LU factorization, Tridiagonal solver
c. Applications of these methods in engineering disciplines, Relevant case studies

Iterative Methods for Linear and Nonlinear Equations

a. Numerical Solution of nonlinear equations: Bisection method, Newton's method, Secant method, Convergence analysis of these methods
b. Newton's method for system of nonlinear equations
c. Solution of system of linear equations by Jacobi, Gauss Seidel and SOR methods, Applications of these methods in engineering disciplines, Relevant case studies

Numerical Methods for IVPs and BVPs

a. Euler's method and its variations, Taylor's higher order methods, Error analysis, Consistency, stability and convergence
b. Runge-Kutta methods of order 2, 3, and 4, Stiff ODEs, Consistency, stability and convergence
c. Linear multistep methods, Numerical solution of system of ODEs
d. Numerical solution of BVPs by Finite Difference Method
e. Applications in engineering: Some relevant case studies

Numerical Methods for Computing Eigenvalues

a. Eigenvalues and Eigenvectors of matrix: power method,
b. Inverse power method, Shifted inverse power method.
c. Applications of eigenvalues in engineering disciplines.

Numerical Optimization

a. Unconstrained Optimization,
b. Golden search ratio, Lagrange Multipliers,
c. Method of steepest descent
d. Applications of optimization in engineering disciplines

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Numerical Analysis: By Richard L. Burden, J. Douglas Faires, Latest Edition
- Numerical methods for scientist and engineers by R.W. Hamming (Latest Edition)
- Numerical methods for Engineers by Steven C. Chapra and R. P. Canale (Latest Edition)

Probability & Statistics

Area Scope:

The knowledge units in this area collectively encompass the following:

- To understand the basic concept of Statistics and Probability and their need in engineering.
- To Describe properties and classifications of probability density functions, regression analysis and interval estimation
- To Apply different probability and statistics techniques in engineering problems

Course Outline

Basic Statistics

a. Statistics, Branches of Statistics, Importance of statistics, population, sample, observation, variables, measurement of variable, Data, primary data, secondary data

Data Presentation

a. Frequency distribution (grouped, ungrouped), stem and leaf display, histogram, frequency polygon, cumulative frequency polygon, Simple & Multiple Bar diagrams

Measure of Central Tendency

a. Arithmetic Mean (A.M), Geometric Mean (G.M), Harmonic Mean (H.M), Quantiles (Median, Quartiles, Deciles, Percentiles), Mode, Applications of Averages

Measure of Dispersion

a. Background, Range, Quartile deviation, Mean deviation, Variance, Standard deviation, Coefficient of variation, Moments, Moments ratios, Skewness, Kurtosis
b. Applications in different Engineering Disciplines

Simple Regression, Correlation and Curve Fitting

a. Introduction to regression theory, Simple linear regression line, Line fitting by least square methods, Coefficient of determination,
b. Simple correlation, coefficient of correlation, fitting of a first and second degree curve, fitting of exponential and logarithmic Curves, related problems.
c. Principle of least squares.

Probability and Random Variables

a. Probability review, Laws of probability, Conditional probability, Bayesian theorem, independent, dependent events.
b. Random variables, Discrete and Continuous random variables, Probability mass and density functions, Distribution functions, Mathematical expectation,
c. Variance of random variable, Bivariate distribution, Joint probability distribution, Moment generating function

Probability Distributions

a. Discrete distributions:
b. Bernoulli distribution, Binomial, Geometric, Negative binomial, Hyper-geometric, Poisson distribution, Properties and application of these distributions.
c. Continuous Distributions: Uniform Distribution, Exponential distribution, Normal distribution, Applications

Sampling and Sampling Distributions

a. Introduction, Population, Parameter & Statistic, Objects of sampling, Sampling distribution of Mean, Standard errors, Sampling & Non-Sampling Errors,
b. Random Sampling, Sampling with & without replacement, Sequential Sampling, Central limit theorem.
c. Applications in relevant engineering discipline

Statistical Inference and Testing of Hypothesis

a. Introduction to inferential statistics, Estimation, hypothesis testing of population mean, proportion,
b. Variance, Applications in Engineering

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Introduction to Statistical theory part 1, by Sher Muhammad Chuadary (Latest Edition)
- Advanced Engineering Mathematics, by Erwin Kreyszig (Latest Edition)
- Probability and Statistics for Engineers and Scientists, by Antony Hayter.
- Elementary Statistics, by Bluman.

Complex Variables & Transforms

Area Scope:

The knowledge units in this area collectively encompass the following:

- Explain the concept of complex number system, complex function, limit, continuity, differentiability and integral of complex valued functions
- Utilize the theory of complex integration and power series (Taylor series. Laurent series) to solve problems from the area of residue calculus
- Apply various transforms to solve complex integration.

Course Outline

Introduction

a. Review of complex numbers, Complex valued functions, Elementary functions (exponential and logarithmic functions, Trigonometric and hyperbolic functions and theirs inverses),
b. Limits and continuity,
c. Applications in Engineering

Complex Differentiation and Integration

a. Derivatives of complex valued functions, Differentiability,
b. Analyticity, Cauchy Riemann Equations, Harmonic Functions,
c. Complex integrals, Cauchy-Goursat Theorem, Independence of Path, Cauchy's Integral Formulas and Their Consequences, Applications

Power Series

a. Taylor Series, Laurent Series, Singularities, Zeros and poles, Residue integration method, Residue theorem,
b. Conformal mapping

Laplace Transformation

a. Linearity, Scaling, First shifting theorem, Heaviside's Shifting theorem,
b. Inverse Laplace transformation, Properties of inverse Laplace,
c. Convolution theorem, Applications in relevant engineering discipline

Special functions and Fourier Transforms

a. (Gamma, Beta functions, Periodic functions, Error function),
b. Fourier Series, Fourier Sine and Cosine series,
c. Fourier transform, Fourier cosine and sine transform, properties.
d. Applications in relevant engineering discipline

Z-Transformation

a. Z-transform, Properties of Z-transform, linearity and scaling, Standard Z-transform, Inverse Z-transform,
b. Inverse Z- transform by using residue, convolution theorem of Z-transform,
c. Formation of difference equation and its solution using Z-transform.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Advanced Engineering Mathematics, by Erwin Kreyszing, Latest Edition
- Complex Variables and Applications by Churchill, Latest Edition
- R. J. Beerends, Fourier and Laplace Transform, Cambridge University Press, Latest Edition.
- Jeffry A, Advanced Engineering Mathematics, Elsevier, Latest Edition

Multivariate Calculus

Area Scope:

The knowledge units in this area collectively encompass the following:

- To develop a clear understanding of fundamental concepts of multivariable variable calculus
- To describe of the concept of gradient, multiple integrals in rectangular, polar, cylindrical and spherical coordinates, directional derivatives, and optimization problems
- To apply the concepts line integrals, surface integrals, volume integrals, Green's, Stokes', Gauss theorems to different engineering problems

Course Outline:

Geometry of Space:

Analytical Space Geometry, Cylindrical and Spherical coordinates, Lines in space, Intersection of Line and a Plane

Vector-Valued Functions and Motion in Space:

Functions of several variables, their limits and continuity, Quadratic Surfaces, Parametric representation of curves, Velocity and Acceleration, Arc length, Tangent, Normal, Bi-normal, Curvature & Torsion

Partial Differentiation:

Partial derivatives, Total Differentials, Chain Rule with More Variables, Directional derivatives

Applications of Partial Derivatives:

Optimization Problems, Extrema of functions of several variables, Conditional extrema, Lagrange Multipliers and Example

Multiple Integrals:

Double Integration, Order of Integration, Double Integrals in Polar Coordinates, Applications: Mass and Average Value, Moment of Inertia, Triple Integrals, Rectangular and Cylindrical Coordinates, Applications and Examples, Triple Integrals in Spherical Coordinates

Vectors in 3 Space:

Introduction to vectors, Scalar and vector product, Volume of parallelepiped and tetrahedron, Gradient of a Scalar Field, Divergence of a Vector Field, Curl of a Vector Field

Integration in Vector Fields:

Line Integral, Integration Around Closed Curves. Work Done, Potential and Related Examples, Conservative and non-Conservative Fields, Green's Theorem, Divergence Theorem, Stoke's Theorem, Applications of Double and Triple integrals

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Thomas' Calculus by George B. Thomas, Jr., Maurice D. Weir, Joel R. Hass. Pearson, USA.
- George B. Thomas, Jr. and Ross L. Finney, Calculus and Analytic Geometry
- Swokowski, Onlinick & Pence: Calculus
- Robert T. Smith & Roland B. Minton: Calculus
- Calculus: Early Transcendental by James Stewart, Brooks/Cole USA

Applied Physics

Area Scope:

The knowledge units in this area collectively encompass the following:

Course Outline:

Vectors:

Review of vectors, Ordinary Differentiation of Vector, Gradient of Scalar field, Divergence and Curl of Vector Field, Line, surface and volume integrals with their applications.

Mechanics:

Newton Laws and their Applications (Simple Accelerometer, Banked Curve and Rotor), Frictional Forces and determination of Co-efficient of Friction, Work-Energy Theorem, applications of law of Conservation of Energy, Angular Momentum, Centre of Mass of two-particles, Many-particles and Solid Object, Rotational inertia of solid bodies.

Electricity & Magnetism:

Electric field due to Discrete and Continuous Charge Distributions, Electrostatic Potential of discrete and Continuous charges, Gauss's Law and its Applications, Lorentz Force and Hall Effect, Ampere's Law, Magnetic Field due to current element (Circular Current Loop and Solenoid)

Waves &Oscillations:

Types of Waves and Superposition Principle, Wave Speed on a stretched string, Wave equation, Energy & Power of a Wave, Principle of Superposition and Standing Waves. Line and Surface Integrals with applications, Simple Harmonic Oscillator, Damped Harmonic Oscillation, Forced Oscillation.

Optics and Lasers:

Huygens Principle, Two-slit interference, Single-Slit Diffraction, Resolving power of Optical Instruments, Lasers and laser light, Working principle of lasers

Atomic and Nuclear Physics:

Planck's explanations of Black Body Radiation, Photoelectric Effect, Compton Effect, De-Broglie Hypothesis, X-rays and Moseley's Law, Atomic Nucleus and Properties of Nucleus, Radioactive Decay and Radioactive Dating.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), written assignments/quizzes, tutorials, case studies relevant to engineering disciplines, semester project, guest speaker, industrial/field visits, group discussion, report writing

Assessment:

Mid-semester exam, report writing/presentation, assignments, project report, quizzes, end-semester exam

Suggested Books:

- Halliday, Resnick and Walker, "Fundamentals of Physics" 10th Edition Extended
- Hugh D. Young and R.A. Freedman, University Physics. 12th Edition
- Raymond A Serway and John W. Jawett, Jr. Physics for Scientists and Engineers with modern Physics, 09th Edition.

Chemistry for Engineers

Area Scope:

This chemistry course emphasizes the fact that engineers should have a significant understanding in basic sciences such as chemistry. The contents of the course are context based and are thoroughly related to real world problems such as clean energy devices, combustion, and environmental degradation.

Course Outline:

Introduction:

Chemical calculations and stoichiometry, chromatography, thermogravimetry; algebraic method of balancing chemical equations.

Structure and Chemical Bonding:

Electronic configuration; metallic, ionic and covalent bonding; electronegativity, bond polarity, and bond strength, mass spectrometry and atomic mass unit.

Electrochemistry:

Laws of electrolysis, the electromotive force (EMF), galvanic cells, batteries, corrosion (theories, inhibition and protection).

Air pollution:

Interaction of solar radiation with atoms and molecules in the atmosphere,

Aqueous Solutions:

The equilibrium state, equilibrium constants, Le Chatelier's principle, quantitative calculations; acid-base equilibria, pH, buffers. Standardization of solutions for titration.

Nano-chemistry:

Thin films, Physical Vapor Deposition (PVD), Chemical Vapor Deposition (CVD)

Polymers and Adhesive Chemistry:

The systematic chemistry of carbon compounds; nomenclature and properties of common organic functional groups; fundamentals of polymer chemistry; adhesives and bonding fundamentals.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Chemistry: The Molecular science, Olmsted and William (1994)
- Applied Chemistry: A textbook for Engineers and Technologists by Roussak and Gesser (2013)
- Chemistry, The Molecular Nature of Matter and Change with Advanced Topics Martin S. Silberberg and Patricia G. Amateis, McGraw-Hill Education, 8th Edition (2017)
- Environmental Chemistry, Colin Baird and Michael Cann, 3rd Edition (2005)

- General Chemistry, Kenneth W. Whitten et al. 6th Edition (2000)
- Chemistry, The Central Science, Theodore L. Brown et al. 13th Edition (2014)
- Water Chemistry, Stanley E. Manahan, CRC Press (2011)
- General Chemistry by Donald A. McQuarrie et al , 4th ed. 2011

Social Sciences Courses

Sociology for Engineers

Area Scope:

This course is meant to provide engineering students, with an opportunity to view the discipline of sociology from the engineering perspective and will highlight its application to engineering profession. This will also enable the engineers to fit their technical ideas into a socially acceptable product /project in a more successful manner. The knowledge units in this area collectively encompass the following:

- To introduce to the methods and philosophy of the social science to help their understanding of the socio-cultural dimension of human existence as a fundamental reality in engineering projects etc.
- To provide opportunity for students to begin the process of considering social problems/ issues while designing engineering products.
- To allow engineers to play a pro-active role in critical discussions of social issues specifically.
- To demonstrate comprehension of roles and functions of various social institutions, state organizations, Professional bodies and relationships for analyzing their social impact Assessment.

Course Outline:

Fundamental Concepts and Importance of Sociology for Engineers

What is sociology? Nature, Scope, and Importance of Sociology, Sociological Perspectives and Theories, Social Interactions, Social Groups/ Social Institutions & heir interface with Engineering Project/services, Sociology & Impact of Technology & Engineering Products/Projects on Society.

Cultural Impacts of Engineering Projects on Society

Definition of Culture, Types of Culture & Elements of Culture, Culture & Power, Authority, Dominance Socialization and Personality, Role of Engineering Projects on Culture, social norms and values of Society, Cultural Infusion of Engineers in Society

Theoretical Perspective of Sociology: Diffusion and Innovation; Adoption and Adaptation; Social development; Community Development

Community Development & Social consequences of Industrialization, Development Processes of Societal Development, Cooperation and Conflict in Community Development in Engineering Context.

Understanding of Societal & Ethical Norms and Values for Engineers

Engineering Ethics, Engineering product/services for Less privileged, Role of Engg & Technology in addressing Social inequality, Core Social Values/Norms affecting Engg Performance

Organizational Social Responsibility (OSR) of Engineers

- Extenttowhichdevelopmentintendstosensitizesocietalandunder-privileged needs
- Gender inclusiveness and balance
- Special and Disadvantaged Community of the Area
- Planning for community inclusiveness
- Societal Obligation of Engineers

Engineers, Society and Sustainability

Social System and Concept of Sustainable Development Technology and Development, Population Dynamics in Pakistan, Causes and Consequences of Unplanned Urbanization, Community Development, Programs in Pakistan, Community Organization & Engineering Projects, Population, Technological & Industrial expansion and Development with focus on social/human/ethical dimensions.

Industrial & Organizational Psychology

Interpersonal Relations, Interpersonal Behavior, Formation of Personal Attitudes, Language and Communication, Motivations and Emotions, Impact of Technology on human feelings and level of Sensitivity

Climate Change and Ecological Friendliness from Engineering Perspective

Ecological Processes, Ecosystem and Energy, Impact of Engineering Projects on Eco System & Human Ecology, Industrial & Environmental impact on Population & General Masses, Technological Intervention, Ecosystem and Physical Environment,

Social Impact of Technology & Engineering Products & Services (Solid Waste Disposal, Pollution control etc.).

Social Approaches and Methodologies for Development Administration & Stakeholders Analysis:

All Phases of the Project (pre, post and execution) Structured, Focused Group, Stakeholder Consultative Dialogues etc. Dynamics of Social Change, Sociology of Change and Industrial Development, Social Change due to Technology Driven Economic Growth.

SIA (Social Impact Assessment):

Base line and need-assessment, evaluation and impact assessment surveys of the development projects. Role of Engg & Technology for Creating Social Cohesiveness & Societal Integration. Technology Based change in Collective Behavior, Social Audit of Engineering Projects.

Engineering Intervention for Social Stratification.

Factors of Social Stratification, Engineering Interventions for addressing Social Stratification, Social Mobilization through Technological Innovation.

Case Studies of Different Development Projects in Social Context

Teaching Methodology (Proposed as applicable):

Lectures (audio,/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Project / Field Visits, Group discussion, Community Service, Report Writing, Social Impact Review and Social Audit of Engg Project

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Godhade, J. B., and S.T. Hunderkari. 2018. Social Responsibility of Engineers. International Journal of Academic Research and Development. Latest edition.
- Nichols, S.P. and Weldon, W.F. latest edition. Professional Responsibility: The Role of Engineering in Society Center for Electro-mechanics, The University of Texas at Austin, USA.
- Aslaksen, E.W. latest edition. The Relationship between Engineers and Society: is it currently fulfilling its potential? Journal and Proceedings of the Royal Society of New SouthWales, latest edition. Gumbooya Pty Lte, Allambie Heights, Australia.
- Bell, S. Engineers, Society and Sustainability. Synthesis Lectures on Engineers, Technology, and Society. Edited by Caroline Baillie, University of Western Australia. Morgan and Claypool Publishers, latest edition
- Jamison, A., Christensen, S.H., and Lars, B. latest edition. A Hybrid Imagination: Science and Technology in Cultural Perspective.
- Vermaas,P.,Kroes,P.,Poet,l.,andHoukes,W.latestedition.APhilosophyofTechnology:FromTechnical Artefacts to Socio technical systems.
- Mitcham, C., and Munoz, D. Humanitarian Engineering. Morgan and Claypool Publishers, latest edition
- Riley, D. Engineering and Social Justice. Morgan and Claypool Publishers.
- Bugliarello, G. latest edition. The Social Functions of Engineering: A Current Assessment, A Chapter in "Engineering as A Social Enterprise".

Sociology

Area Scope:

The knowledge units in this area collectively encompass the following:

- To introduce the necessary subject knowledge and understanding required for the successful study of Sociology and related Social Science disciplines at undergraduate.
- To develop skills of application, analysis and evaluation in the context of the study of Social Science.
- To develop a knowledge and understanding of sociology both at a global and national level.

- To introduce the planning and organization skills necessary to develop as independent, autonomous learners.
- To develop the confidence and competence of the students as learners and to assist them in taking some responsibility for their own learning through directed study and reading.

Course Outline:

- Introduction: Sociological Perspective,
- The Development of Sociology,
- The Role of Values in Sociology, Prejudice In Early Sociology,
- Theoretical Perspective in Sociology. Culture: Components of Symbolic Culture, Subcultures and Counter Cultures, Cultural Universals, Animals and Culture,
- Technology and Global Village, Sociology and New Technology.
- Socialization: Social Development of Self, Mind, and Emotions,
- Socialization into Gender Social Structure and Interaction,
- Social Institutions. Research in Sociology: Research Model, Research Methods. Experiments, Ethics,
- Bureaucracy and Formal Organizations, Rationalization of Society, Formal Organizations and Bureaucracy,
- Voluntary Associations Social Classes, Economy, Politics, Power and Authority, Family, Medicine, Health and Illness, Population and Urbanization, Social Movements
- Social Psychology with special reference to attitudes, attributions and behavior, Emotions, Cognition and Thinking, Reasoning, Problem- Solving and Creativity, Personality, Intelligence, and Abnormal Behavior, etc.
- Introduction to the Field of Organizational Behaviour
- Conflict and Negotiation in the Workplace
- Leadership in Organizational Settings and Organizational Culture
- Ethics: In General an introduction and the development of ethical theory.
- Ethics in Islam, a comprehensive view with different ethics approaches and Ethics Theories
- Research Methods for Society and Sociology

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Henslin, Sociology: A Down-to-Earth Approach, latest edition.
- D. Kendall, Sociology in our Times. Wadsworth Pub Co, latest edition.

Engineering Economics

Area Scope:

- Apply the appropriate engineering economics analysis method(s) for problem solving i.e. present worth, annual cost, rate of return, payback, break-even, benefit-cost ratio
- Evaluate the cost effectiveness of individual projects using the methods learnt, draw inferences for investment decisions, and compare the life cycle cost of multiple projects.
- Compute the depreciation of an asset using standard depreciation techniques to assess its impact on present or future value

Course outline

Engineering Economics

- Role of engineers in business
- Economic decisions v/s design decisions
- Large scale engineering projects and types of strategic economic decisions
- Fundamental principles of engineering economics

Interest Rate and Economic Equivalence

- Interest: The Cost of Money
- Economic Equivalence
- Development of Formulas for Equivalence Calculation
- Unconventional Equivalence Calculations

Understanding Money and Its Management

- Nominal and Effective Interest Rates
- Equivalence Calculations with Effective Interest Rates and with Continuous Payments
- Changing Interest Rates
- Debt Management
- Investing in Financial Assets

Present-Worth Analysis

- Project Cash Flows
- Initial Project Screening Methods: payback Screening and Discounted Cash Flow Analysis
- Variations of Present-Worth Analysis
- Comparing Mutually Exclusive Alternatives

Annual Equivalent-Worth Analysis

- Annual Equivalent-Worth Criterion
- Capital Costs versus Operating Costs
- Applying Annual-Worth Analysis
- Life-Cycle Cost Analysis
- Design Economics

Rate-of-Return Analysis

- Rate of Return and Methods of Finding It
- Internal Rate-of-Return Criterion
- Mutually Exclusive Alternatives

Cost Concepts Relevant to Decision Making

- General Cost Terms; Classifying Costs for Financial Statements
- Cost Classifications for Predicting Cost Behavior
- Future Costs for Business Decisions
- Estimating Profit from Production

Depreciation and Corporate Taxes

- Asset Depreciation: Economic versus Accounting
- Book and Tax Depreciation Methods (MACRS)
- Depletion
- Income Tax Rate to be used in Economic Analysis
- The Need for cash Flow in Engineering Economic Analysis

Developing Project Cash Flows

- Cost-Benefit Estimation for Engineering Projects
- Developing Cash Flow Statements

Project Risk and Uncertainty

- Origins of Project Risk
- Methods of Describing Project Risk: Sensitivity, Break-Even and Scenario Analysis

Special Topics in Engineering Economics

- Replacement Decisions
- Capital Budgeting Decisions
- Economic Analysis in the Service Sector

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Contemporary Engineering Economics by Chan S. Park, latest edition, Pearson ISBN: 9780134105598
- Engineering Economic Analysis by Donal G. Newnan, Jerome P. Lavelle, Ted G. Eschenbach, latest edition, Oxford University Press, ISBN: 978-0199339273)
- Engineering Economy by Leland T. Blank and Anthony Tarquin.

Social Psychology

Area Scope:

To impart knowledge of social psychology of attraction; attitudes and prejudice; altruism and aggression; personal and social identities; conformity; group influence and their applications in the real world.

Course Outline:

- Principles of sociology and psychology with emphasis on the individual and his/her reciprocal interaction with groups,
- Basic psychological factors, attribution and perception of others, attitudes and attitudinal change, social attitudes, altruism, helping others, aggression, hurting others, prejudice, disliking others, discrimination and stereotypes,
- Language and communication, society and cultures, culture and personality, small groups and their relation to the individual, leadership and group dynamics. Attraction, attitudes and prejudice; altruism and aggression; personal and social identities, conformity, group influence, moral and ethical issues, harassment,
- Corruption and its control, thinking processes and decision making.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Edward Alsworth Ross, "Social Psychology", Macmillan, latest edition.
- Emory Stephen Bogardus, "Essentials of Social Psychology", Univ. of Southern, California Press, latest edition.
- Hewstone, M., & Stroebe, W. (Eds.), "Introduction to Social Psychology", 3rd ed., Oxford: Blackwell Publishers, latest edition.
- Lesko, W.A. "Readings in social psychology General, classic, and contemporary selections, latest edtion,

Community Services

Area Scope:

Community service-learning provides a variety of benefits to the students and the community service has a unique way of developing an individual's leadership skills, sense of community, civic ethic, self-esteem, and other personal characteristics. Every service activity benefits a specific individual or group. Whether it is building homes for the poor, serving victims of chronic or terminal illness, tutoring children, addressing environmental needs or any other service, there is a person or group who ultimately benefits from your time. Finally, the organization where you conduct your service benefits enormously. Volunteers can make important contributions to Community benefit agencies (nonprofit) and government programs in their attempt to deal with the complex and growing needs of society.

Course Outline:

- Develop and implement service programs
- Develop workplace communication strategies
- Analyze impacts of sociological factors on clients in community work and services
- Manage and promote diversity
- Manage legal and ethical compliance
- Facilitate workplace debriefing and support processes

- Reflect on and improve own professional practice
- Manage work health and safety
- Assess co-existing needs
- Coordinate complex case requirements
- Develop, facilitate and review all aspects of case management
- Provide case management supervision
- Undertake project work
- Lead and manage team effectiveness
- Manage personal work priorities and professional development
- Manage meetings

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Schools and Community: The Communitarian Agenda in Education By James Arthur; Richard Bailey, Falmer Press, latest edition.
- Studying Service-Learning: Innovations in Education Research Methodology by Shelley H. Billig, Alan S. Waterman , Lawrence Erlbaum Associates, latest edition.

Organizational Behavior

Course Outline:

Introduction to Organizational Behavior

- Organizational Disciplines and topics
- Psychological Perspective
- Social-Psychological Perspectives

Structure and Control in Organization

- Introduction of Bureaucracy
- Managerial Work
- Contingency theory
- Organizational Design

Individual and Work Learning

- Learning Theories
- Learning and Work

Stress

- Types of Stress and Work
- Occupational Stress Management

Individual Differences

- Personality and its factors
- Personality dimensions and social learning Intelligence

Motivation and Job Satisfaction

- Needs at Work
- Theories of Motivation and job satisfaction
- Correlates of Job satisfaction

Group and Work

- Social Interaction
- Dramaturgy and impression Management
- Social Skill

Group and Inter group Behavior

- Group Structure & Norms
- Group Processes
- How throne Studies

Leadership

- Leadership as an attribute
- Leadership Style

Patterns of Work

- Work-the classical approach
- Marx, Weber, & The critique of labor
- Foucault & Disciplinary Power
- Conflict and Consent in Work
- The labor Process debate
- Work place control and resistance
- Industrial conflict and industrial relations

Organizational Culture

- Organizational culture and strategic management
- Exploring organizational culture
- Evaluating concept of culture

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engineering disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Finchan, R., & Rhodes, P. latest edition, Principles of Organizational Behaviour, Oxford.
- Noe, R., Hollenbeck, J. Gerhart, B., & Wright, P. latest edition, Human Resource Management, 5th ed., McGraw Hill.
- Newstrom John W. (2007), Organizational Behaviour, (12th Ed), McGraw Hill.
- Luthan Fred, (2005), Organizational Behaviour, McGraw Hill Inc.
- Robins, Stephen, (2005), Organizational Behaviour, McGraw Hill Inc.

Professional Ethics

Area Scope:

The objective of this course is to grasp ideals and principles as they have been spelled out in a variety of traditional ethical systems and to apply these conceptual structures and guidelines to major problems and dilemmas of engineering practices in a corporate culture.

Course Outline:

- Engineering Ethics, Ethical concepts, and Types
- Moral Autonomy, Kohlberg's & Gilligan's Theory
- Profession and Professionalism
- Moral Reasoning, Ethical Theories
- Critique codes of ethics
- Moral frameworks, Personal commitments and professional life
- Engineering as social experimentation
- Involving the public in the design process, Case studies for engineering as social experimentation
- Assessment of safety and risk, Design considerations, uncertainty
- Risk-benefit analysis, Safe-exit and fail safe systems
- Case Studies for the Design Process Case studies in impact of safety/risk on design
- Employee/employer rights and responsibilities
- Confidentiality and conflict of interest

- Whistle-blowing, case studies on professional behavior/policies on the job
- Environment, sustainable development, Multinational corporations, globalization of engineering

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Ethics in Engineering 4th edition, by Mike W. Martin, Roland Schinzinger, McGraw-Hill, New York, 2005.
- Fundamentals of Engineering Economics, 3rd ed., by Chan S. Park
- Engineering Ethics: Concepts and Cases,4th edition, by Charles E. Harris, Michael S. Pritchard, Michael J. Rabins, Wadsworth, 2008.
- The Seven Habits of Highly effective people by Stephan r. Covey
- Principle Centered Leadership Stephan r. Covey
- Change your lens change your life by (Faiez H. Seyal)
- How to Manage by Ray Wild
- Happiness by Richard Layard

Cultural Courses

Islamic Studies and Ethics

Course Description:

The Islam is a religion of peace and harmony for all humans based on knowledge and guidance in the Holy Quran. The basic teachings of Islam are comprehensive, practicable and universal. Therefore, this course briefly presents the vision of life and applied aspects of ethical system.

Area Scope:

- To enhance understanding of Islamic Culture and Civilization
- To understand values and social system in Islam
- To improve students' ethical and professional skill and critical thinking

Course Outline:

Islam – Religion of Peace and Harmony

- Basic Concepts – Islam, Quran and Hadith
- Faith and Religious Life
  - Selected Verses of Surah Al-Baqara Related to Faith (Verse No-284-286)
  - Selected Verses of Surah Al-Mumanoon Related to Characteristics of Faithful (Verse No-1-11)

Islamic Culture and Civilization

- Basic Concepts and of Characteristics of Islamic Culture and Civilization
- Education System of Islam
- Political System of Islam – Dynamics, Sovereignty and Institutions
- Economic System of Islam – Principles, Riba, Trade and Commerce
- Acceptance of Other Religions – Interfaith Harmony
- Foreign Policy

Social System of Islam

- Basic Concepts of Social System in Islam
- Elements of Family and their Rights - Parents, Women, Husband & Wife, Children
- Inheritance – Rights and Laws

- Social Rights – Neighbors, Relatives and Society
- Equality and Brotherhood
  - Selected Verses of Surah al-Furqan Related to Social Ethics (Verse No.63-77)
- Concept of Welfare State – Period of Khilafat-e-Rashida

Professional Ethics and Morality

- Basic Concepts - Islam and Ethics
  - Selected Verses of Surah Al-Inam Related to Ihkam (Verse No-152-154)
- Profession and Professionalism in Islam
- Characteristics of a Professional
  - Truthfulness, Honesty, Sincerity, Patience, Gratitude, Meditation and Research
- Role for Human Safety and Environment
- Time Management
- Prophet Muhammad (PBUH) – Role Model
  - Selected Verses of Surah Al-Hujrat Related to Adab Al-Nabi (Verse No-1-18)
  - Selected Versus of Surah Al-Ihzab Related to Adab Al-Nabi (Verse No. 6, 21, 40, 56, 57, 58)

Islam and Science

- Islam and Science
- Role of Muslims in Science and Education
- Critical Thinking and Innovation
  - Selected Verses of Surah Al-Hashar (18,19,20) Related to thinking, Day of Judgment
  - Selected Verses of Surah Al-Saf Related to Tafakar, Tadabar (Verse No1,14)

Note: All topics should be taught/covered in the light of relevant Verses from Holy Quran and Ahadiths.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Al-Qur'ān **القرآن (**selected text).
- Sayyid Tāhir Rasūl Qādri **52 دروس قرآن** (Karachi: Islamic Research Academy, 7th ed., 2017).
- Sayyid Hasan-uddin Ahmad**, تعلیمات قرآنی** 2-vols., (Karachi: Jasarat Publications, 1998).
- Muhammad Shafi', **معارف القرآن**, (Karachi: Dar-ul-Isha'at, 2000).
- Sayyid Abu'l A'lā Mawdūdī, **تفہیم القرآن** 6vols., (Lahore: Islamic Publications, 1998). [Preambles of all (114) chapters.]
- Amin Ahsan Islahi, **تدبرالقرآن** (Lahore: Farān Publications, 2005).
- Khawaja Abdul Waheed, **موضوعات قرآن وانسانی زندگی** (Islamabad: Islamic Research Institute, 3rd ed., 1997).
- Khurram Murad, **رب کا پیغام** (Lahore: Manshūrat, Mansoora, 2000)
- Hameed ullah Muhammad, "Emergence of Islam", Islamic Research Institute (IRI), Islamabad
- Hameed ullah Muhammad, "Muslim Conduct of State" Sh Muhammad Ashraf, Kashmir Bazar, India (Latest Edition)
- Hameed ullah Muhammad, "Introduction to Islam" Compiled by The CSS Point, www.thecsspoint.com
- Hussain Hamid Hassan, "An Introduction to the Study of Islamic Law" leaf Publication Islamabad, Pakistan, (Latest Edition).
- H.S. Bhatia, "Studies in Islamic Law, Religion and Society" Deep & Deep Publications New Delhi (1989).
- Islamic Education by A. S. Bukhari & M. D Zafar, Latest Edition.
- Muslim's character by M. Al-Ghazali, Latest Edition.

Pakistan Studies and Global Perspective

Area Scope:

The knowledge units in this area collectively encompass the following:

- Have a better understanding of the rationale for the creation of Pakistan.
- Enable students to contribute in social, political and economic growth of Pakistan.
- Become a part of strong nation with a sense of ownership and responsibility towards Pakistan
- Play an active role toward sustainable development of Pakistan in global perspective.

Course Outline: **Time Duration**

Historical and Ideological Perspective **5 hrs**

a. Pakistan Movement
   - Aligarh Movement
   - Two Nations Theory

b. Founders of Pakistan
   - Allama Muhammad Iqbal
   - Quaid-e-Azam Muhammad Ali Jinnah
   - Other Leaders (Women and other Pakistan Movement Leaders)

c. Quaid's Vision for Pakistan

d. Kashmir – An unfinished Agenda of Partition

Constitution of Pakistan **4 hrs**

a. An overview of constitutional development in Pakistan
b. Salient features of the Constitution of 1973
c. Constitutional Amendments
d. Fundamental Rights and Responsibilities of Citizens

Contemporary Pakistan **4 hrs**

a. Pakistan's society, culture and demography – celebrating diversity
b. Current Challenges: social, economic, environmental, political and external
c. Nation's resilience in War on Terror

Economy of Pakistan **4 hrs**

a. An overview of Economy
b. Services, Manufacturing and Agricultural Profile of Pakistan
c. Regional Economic Cooperation
d. One Belt One Road (OBOR) – CPEC

Land of Opportunities **4 hrs**

a. Physical features: diversity and beauty
b. Natural resources - mineral, water, energy, agriculture & livestock, and marine resources
c. Tourism and Culture

Pakistan's Foreign Policy **5 hrs**

a. Foreign Policy – Principles and Objectives
b. Relations with Neighbors
c. Major Economies
d. Muslim World
e. Geo-political and strategic significance of Pakistan in Regional and Global Politics

Pakistan in pursuit of Global Agenda **4 hrs**

a. SDGs-2030 - Pakistan Goals
b. Commitments on Climate Change
c. Peace and Security

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Khalid B. Sayeed, Pakistan: The Formative Phase 1857 – 1948, Pakistan Publishing House, 1960
- Gulam Allana, Quaid-e-Azam: the story of Pakistan, Ferozsons, 1967.
- Shahid M. Amin, Pakistan's Foreign Policy: A Reappraisal, Oxford University Press, 2010.
- S. Akbar Zaidi, Issues in Pakistan's economy, Oxford University Press, 2003.
- Hamid Khan, Constitutional & political history of Pakistan, Oxford University Press, 2003
- Rafi Raza, *Pakistan in Perspective 1947-1997*, Oxford University Press, 2003
- Sharif-ul-Mujahid, *The Ideology of Pakistan*, Progressive Publishers, 1974.
- Ziring Lawrence, *Pakistan in the Twentieth Century,* Oxford University Press, 1997 -
- Burke S. M. & Ziring Lawrence, *Pakistan's Foreign Policy,* Oxford University Press, 1973. Mohammad Qadeer , Pakistan
- Climate Change Policies-Ministry of Climate Change, Islamabad- http://mocc.gov.pk/
- Sustainable Development Goals (SDGs)- www.pc.gov.web/sdg/sdgpak
- Economic Survey of Pakistan- http://finance.gov.pk/survey_1617.html
- Foreign Policies- Ministry of Foreign Affairs, Pakistan http://mofa.gov.pk/
- Population Census of Pakistan- Economic Survey of Pakistan http://finance.gov.pk/survey_1617.html
- Issues in Pakistan's Economy by S. Akbar Zaidi, ISBN: 0195790529.
- Pakistan's Foreign Policy: A Reappraisal by Shahid M. Amin. ISBN: 0195798015
- Newspapers editorial and selected journalistic writings on current affairs.
- Pakistan (Lands, Peoples, & Cultures) by Carolyn Black, Bobbie Kalman. ISBN: 0778797147

Management Sciences Courses

Engineering Project Management

Area Scope:

The primary objective of this course is to get the fair understanding of core issues pertaining to Engineering Project Management. This course is aimed at providing both basic and some advanced exposure to emerging trends in the field of Project Management, so as to enable the engineering professionals of tomorrow to successfully complete sophisticated projects within the constraints of capital, time, and other resources with due regards to stakeholders set of expectations. Engineering students will learn key Project Management skills and strategies and will be able to face emerging challenges.

Core Objectives:

- To develop competencies in project costing, budgeting, and financial appraisal;
- To gain exposure to project Planning Control and Management, using standard tools and schedule variance analysis;
- To appreciate the elements of risk and quality in hi-tech projects;
- To learn Project Management by "practice", through the medium of "End of Semester Group Project"; and
- To appreciate and understand the use of computers in Project Management, especially a tool like MS Project & Primavera etc.

Course Outline:

Project Management Concepts

History of Project Management, Introduction to Project Management, Project, Program & Portfolio Management, Project characteristics, Objectives& Requirements, Project Phases/Stages, Project Life Cycle, Project Environment, Project Scope & Project Charter, Project Manager, Project Stakeholder Analysis.

Project Proposal Development

Project Proposal, Characteristics of good proposal, Types of Proposals, Request for Proposal, Request for Quotation etc.). Proposal Templates etc.

Project Feasibility

Brief review of various aspects of Project Feasibility like Technical, Social, Managerial, Economic, Financial & Marketing, Administrative etc.

Project Selection Criteria (Economic Analysis of Engineering Projects)

Using Break Even Analysis, Cost Benefit Ratio, Internal Rate of Return, Net Present Value etc.

Project Contract & Procurement Management

Engineering contracts, Type of contracts, understanding of procurement Process & Cycle, PPRA Rules

Project Planning and Scheduling

Project Planning (Resource & HR Planning), Work Breakdown Structure, Project Network & Scheduling, Manning Schedule and Activity Charts, Critical Path Method (CPM)/Project Evaluation & Review Techniques

Project Costing & Estimation

Cost Estimation in Projects, Cost components in projects and methods for cost estimation in projects, Cost Control in Projects, Estimation of Outstanding Work, Earned Value Management, Schedule & cost variance analysis

Project HRM & Communication Management

Effective organization and communication for Successful Projects, Project Organizational Structures (Project matrix and project based organizations), Project HR Plan preparation, HR Need Assessment and HR Matrix, Building and Managing effective project team, Selection & control mechanism of HRM in Projects, Effective Communication Plan.

Project Risk Management

Definitions Project Risk, Project Risk Management Tools, Types of Project Risk, Project Risk Assessment, Risk Identification and Mitigation, Monitoring & Controlling Risk, Generic Risk Management Strategies & Technique.

Computer Application in Project Management

Basic/Elementary Introduction and hands on basic exposure of use of MS Project & Primavera P6 Software in Project Management

Project Quality Management

Defining Quality, Quality Assurance, Quality Management, 7 Quality Improvement Tools as applied to Project Management, Project Quality Management Plan, Quality Management Processes and Strategies

Project Closure & Termination

Project Evaluation, defining project success, Project Completion Criteria, Project Audit, Project Termination &When to close a project, the termination process, Project Close Up & lesson learnt, & Project Archive

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Project Management: A system Approach to Planning, Scheduling and Controlling latest Edition, Harold Kerzner
- Bennett, F. Lawrence. Latest edition. *The management of engineering*. New York: Wiley.
- Cleland, David. Latest edition *Field guide to project management.* New York: Wiley.
- Eisner, H. *Essentials of project management and systems engineering management*. New York: Wiley, latest edition.
- Frame, J. D. *Managing projects in organizations*. San Francisco: Jossey-Bass
- Goldratt, Eliyahu. Latest edition Critical chain. North River Press.
- Haynes, M.E. *Project management: From idea to implementation*. Los Altos, CA: Crisp Publications latest edition.
- Lewis, James, *Project planning, scheduling & control*. New York: McGraw-Hill, latest edition.

- Lewis, James, P. Latest edition. *Mastering project management*. New York: McGraw-Hill
- Lientz, Bennet & Rea, Kathryn. Latest edition. *Project management for the 21st century*. San Diego: Academic Press.
- Miller, Roger & Lessard, Donald. Latest edition. *The strategic management of large engineering projects.* Cambridge, MA: MIT Press.
- Nicholas, J.M. *Managing business & engineering projects*. Englewood Cliffs, NJ: Prentice Hall, latest edition
- Shtub, Avraham, Bard, Jonathan, & Globerson, Shlomo. 1994. *Project management: Engineering, technology, and implementation.* Englewood Cliffs, Prentice-Hall latest edition.
- Project Management by Adrienne Watt, latest edition.
- J.R. Meredith and S.J. Mantel. Project Management: A Managerial Approach. John Wiley and Sons. New York. Latest edition.

Entrepreneurship

Area Scope:

- Develop a business plan with an appropriate business model
- Demonstrate the ability to provide a self-analysis in the context of an entrepreneurial
- career
- Demonstrate the ability to find an attractive market that can be reached economically

Course Outlines:

- Basic Concept-Entrepreneurship
- Innovation and Entrepreneurship
- Basic Plan Development Cycle
- Intellectual Rights
- Financial and Legal Modalities
- Marketing
- Industrial Competiveness

- Gap Analysis, Critical Thinking and Idea Generation
- Business Plan Development
- Successful Case Studies (local)

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Michael J Etzel, Bruce J Walker, William J Stanton, Marketing, McGraw-Hill, latest edition.
- William D. Bygrave and Andrew Zacharak, Entrepreneurship 2nd Edition, Wiley, latest edition.
- Entrepreneurship by Hisrich, McGraw- Hill, latest edition.
- Principles of Marketing, Cotrell McGraw- Hill, latest edition.
- Paul Burns and Jim Dew Hurst: Small Business and Entrepreneurship, latest edition.
- P.N. Singh: Entrepreneurship for Economic Growth, latest edition.
- Peter F. Drucker: Innovation and Entrepreneurship Peter F. Drucker, latest edition.
- John B. Miner: Entrepreneurial Success, latest edition.
- “Marketing that Works: How Entrepreneurial Marketing Can Add Sustainable Value to Any Sized Company”, by Leonard Lodish, Howard Morgan, Shellye Archambeau and Jeffrey Babin, Pearson FT Press, latest edition.
- "Entrepreneurial Marketing," Lessons from Wharton's Pioneering MBA Course, Morgan, H. L., A. Kallianpur, and L. M. Lodish, John Wiley & Sons, latest edition.

Principles of Management

Area Scope

- The focus will be on the learning fundamental principles of management and of managing people and organization.
- Develop analytical and conceptual framework of how people are managed in small, medium and large public and private national and international organizations.

Course Contents:

- Introduction, overview and scope of discipline
- The evolution and emergence of management thought
- Management functions
- Planning concepts, objectives, strategies and policies
- Decision making
- Organizing; departmentalization, line/staff authority, commitments and group decision making
- Staffing: principles of selection, performance, career planning
- Leading: Motivation, leadership, communication
- Controlling: the system, process and techniques of controlling
- Management and Society: future perspective

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- Stephen P. Robins, Mary Coulter: Management, latest edition.
- H. Koontz Odonnel and H. Weihrich: Management, latest edition.
- Mc Farland: Management: Foundation and Practice, latest edition.
- Robert M. Fulmer: The New Management, latest edition.

Engineering Management

Course Outlines

- Industrial networks
- Fundamentals of Product and Process development
- Business Community and New Generations of Managers
- Practical Skills Knowledge and Experience in Commercialization of New Technological Inventions
- Use of Multidisciplinary Science Based Knowledge,
- Problem Solving, Teamwork and Outreach Activity,
- Major steps in proof of concept to intellectual property protection,
- Prototype development
- Fabrication and assembly routes
- Materials procurement,
- Identification and creation of new markets
- Development of business plan
- Appropriate technology and marketing
- Distribution and financing
- Routes and strategies for specific technology under development.

Teaching Methodology (Proposed as applicable):

Lectures (audio/video aids), Written Assignments/ Quizzes, Tutorials, Case Studies relevant to engg disciplines, Semester Project, Guest Speaker, Industrial/ Field Visits, Group discussion, Report Writing

Assessment:

Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

Suggested Books:

- R. A. Bulgelman, Strategic Management of Technology and innovation, latest Edition McGraw Hill.

Available at:
http://www.pec.org.pk