The background of the cover features a complex architectural drawing. The top section shows a detailed floor plan of a building with various rooms, corridors, and structural elements. Below this, there are several vertical and diagonal lines, possibly representing a structural frame or a perspective view of a building. The overall style is technical and precise, typical of architectural blueprints.

# Curriculum for **Building & Architectural Engineering** Bachelor of Engineering Program **2020**



Pakistan Engineering Council  
&  
Higher Education Commission  
Islamabad







**CURRICULUM**

**OF**

**BUILDING & ARCHITECTURAL**

**ENGINEERING**

**Bachelor of Engineering Program**

**2020**

**Pakistan Engineering Council**  
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**Islamabad**

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## **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 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. 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 the dynamics of technological advancement, industrial needs and management-cum-soft skills for engineering graduates.

This curriculum document would 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<br>Convener, Metallurgy, Materials, Mining Engg & Allied Disciplines | Convener |
| 2. | Engr Prof Dr M. Younus Javed<br>Convener Electrical Engg & Allied Disciplines                        | Member   |
| 3. | Engr Malik Saleem Ullah Saeed<br>Convener Chemical Engg & Allied Disciplines                         | Member   |
| 4. | Engr Dr Wasim Khaliq<br>Convener, Civil Engg & Allied Discipline                                     | Member   |
| 5. | Engr. Prof. Dr. Iftikhar Hussain<br>Convener Mechanical and Allied Engineering                       | Member   |
| 6. | Engr Dr Muhammad Ashraf<br>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**

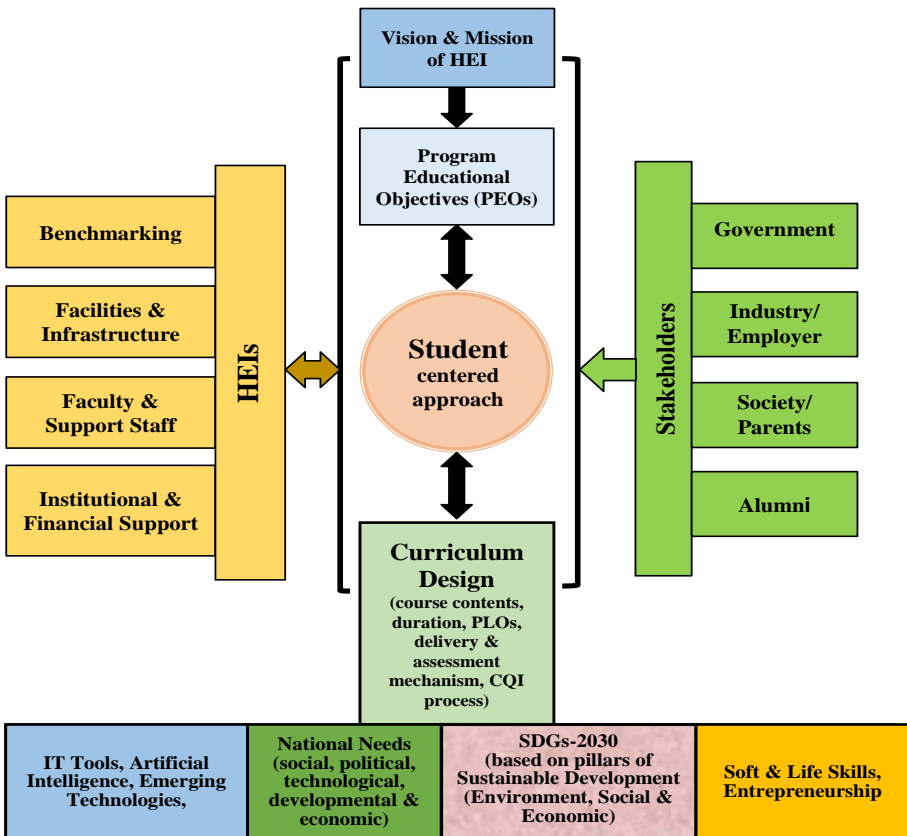
- The ECRDC is responsible to oversee the overall working of curriculum review and development for all engineering programs in terms of strategy, guidance and progress and thereby submission to the relevant forum for adoption/ notification.
- Each Member of ECRDC will also work in the capacity of Convener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



### 3. OBE-Based Curriculum Development Framework

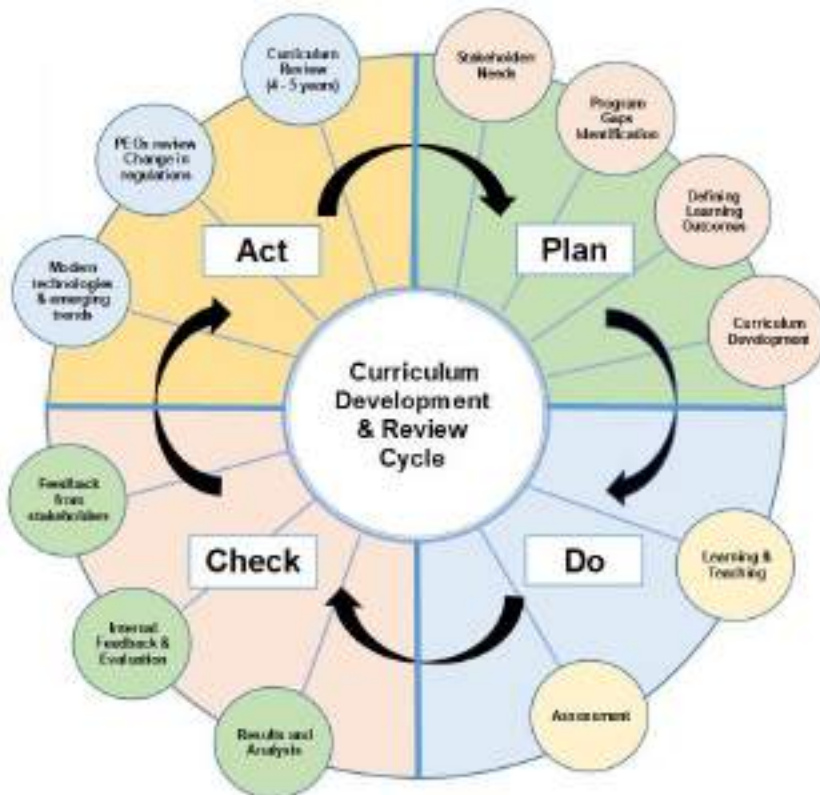
Outcome Based Education (OBE) is an approach of teaching and learning that focuses on what students should be able to attain at the end of the educational program. OBE is a student's centered system which concerns what the students will know and be able to do as learning outcomes. The curriculum development 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 & Allied Engineering**

The PEC Engineering Curriculum Review and Development Committee (ECRDC) Civil and Allied Engineering took up the task to review and update the curriculum for B.E Building and Architectural Engineering degree program. The subject Committee had two meetings on 29-8-2019 and 11-12-2019 at PEC Head Office, Islamabad besides meetings of Sub-Groups on 29-11-2019 and 20-12-19 for Building and Architectural Engineering. The Committee comprised of following members:

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

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

- |     |   |        |
|-----|---|--------|
| 12. | Engr Ijaz Ahmed Cheema<br>Chief Engineer<br>Planning & Development<br>Provincial Highway Department<br>Lahore   | Member |
| 13. | Engr Prof Dr Bashir Alam<br>Professor<br>Department of Civil Engineering<br>UET, Peshawar   | Member |
| 14. | Engr Prof Dr Abdullah Saand<br>Professor and Dean Faculty of Engineering<br>Quaid-e-Awam University of Engineering, Science &<br>Technology, Nawabshah    | Member |
| 15. | Engr Prof Dr Tauha Hussain Ali<br>Pro-Vice Chancellor<br>Mehran University of Engineering & Technology<br>Jamshoro  | Member |
| 16. | Engr Prof Dr Syed Mohammad Ali<br>Director, Earthquake Engineering Center (EEC)<br>University of Engineering and Technology (UET)<br>Peshawar             | Member |
| 17. | Engr Prof Dr Muhammad Ashraf Tanoli<br>HoD, Deptt. of Civil Engineering<br>Ghulam Ishaq Khan Institute of<br>Engineering Sciences and Technology<br>Swabi | Member |
| 18. | Engr Tariq Mehmood<br>Chief Engineer<br>WAPDA House, Lahore   | Member |

- |     |   |           |
|-----|---|-----------|
| 19. | Engr Abdul Qadeer<br>General Manager/Head<br>NESPAK House<br>Islamabad  | Member    |
| 20. | Engr. Prof. Dr. Ali Rizwan Bukhari<br>Professor<br>Department of Civil Engineering<br>FAST University, Lahore | Member    |
| 21. | Mr. Hidayatullah Kasi<br>Deputy Director<br>Higher Education Commission<br>Islamabad                          | Rep HEC   |
| 22. | Engr. Dr. Ashfaq Ahmed<br>Additional Registrar<br>Pakistan Engineering Council<br>Islamabad                   | Secretary |
| 23. | Engr. Muhammad Kashif Ali<br>Assistant Registrar<br>Pakistan Engineering Council<br>Islamabad                 | AR-CPD    |

### **5.1 Sub Group Building and Architectural Engineering**

- |    |   |                |
|----|---|----------------|
| 1. | Engr. Prof. Dr. Majid Ali<br>Professor Department of Civil Engineering<br>Capital University of Science & Technology<br>Islamabad | Lead Sub-Group |
| 2. | Engr. Abdul Qadeer<br>Industry Expert<br>GM NESPAK Islamabad office   | Member         |

- |    |   |           |
|----|---|-----------|
| 3. | Engr. Kamran Shabbir<br>Lecturer<br>Department of Building & Architectural Engineering<br>University College of Engineering & Technology<br>BZU, Multan | Expert    |
| 4. | Engr. Muhammad Naveed<br>Industry Expert<br>NESPAK, Islamabad Office  | Expert    |
| 5. | Engr. Dr. Khurram Rashid<br>Department of Building & Architectural Engineering<br>University of Engineering & Technology<br>Lahore                      | Expert    |
| 6. | Mr. Hidayatullah Kasi<br>Deputy Director<br>HEC, Islamabad  | Rep HEC   |
| 7. | Engr Dr Ashfaq Ahmed Sheikh<br>Additional Registrar-CPD<br>Pakistan Engineering Council<br>Islamabad  | Secretary |
| 8. | Engr. Muhammad Kashif Ali<br>Assistant Registrar-CPD<br>Pakistan Engineering Council<br>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 policies.
- Review of policies 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.

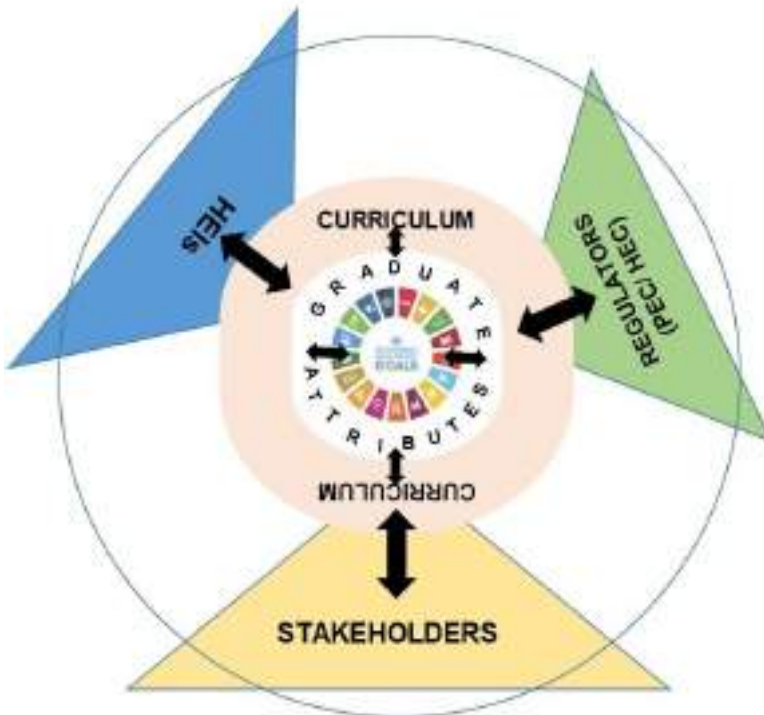
Engr Dr. Wasim Khaliq, the Convener highlighted the important benchmarks and international best practices to be considered for the revision of the curriculum while taking into account the Outcome Based Education (OBE) system. He also suggested that the Committee comprising professors and experts from academia, industry and R&D institutions has provided a useful input and suggestions covering new developments to be incorporated in the curriculum. He also highlighted the importance of the field of Building and Architectural Engineering for achieving sustainable development while addressing socio-economic issues and challenges envisaged in SDGs-2030 as under and well mapped within 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-11: Sustainable Cities and Communities
- Goal-12: Responsible Consumption and Production



- Goal-13: Climate Action

**OBE Curriculum towards SDGs-2030 Attainment**



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

## **7. Program Educational Objectives (PEOs) and Learning Outcomes (PLOs)**

As guidance, the sample Program Educational Objectives (PEOs) and Learning Outcomes (PLOs) are given below for a typical Building and Architectural 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 Building & Architectural 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-11 Goal-12, and Goal-13.

The Building & Architectural Engineers are expected to exhibit after graduation;

1. Sound knowledge along with effective teamwork, management and interpersonal skills.
2. Actively participate in activities for continuous growth and improvement in technical knowledge.
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. Specifically, it is to be demonstrated that the students have acquired the following graduate attributes (GAs):

**PLO1 Engineering Knowledge:** An ability to apply knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.

**PLO2 Problem Analysis:** An ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.

**PLO3 Design/Development of Solutions:** An 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.

**PLO4 Investigation:** An 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.

**PLO5 Modern Tool Usage:** An 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.

**PLO6 The Engineer and Society:** An 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.

**PLO7 Environment and Sustainability:** An ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of, and need for, sustainable development.

**PLO8 Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.

**PLO9 Individual and Team Work:** An ability to work effectively, as an individual or in a team, on multifaceted and /or multidisciplinary settings.

**PLO10 Communication:** An 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 documentation, make effective presentations, and give and receive clear instructions.

**PLO11 Project Management:** An 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.

**PLO12 Lifelong Learning:** An 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 Science	ICT/AI/ Data Science/ Cyber Security		6 - 9
WK-2/ WK-3	Foundation Engg Courses		Specific to program objectives and outcomes	22 - 24
WK-1/ WK-2/ WK-4	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-7/ WK-8	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 mandatory internship		Qualifying
WK-2/ WK-4/ WK-5/ WK-6/ WK-7/ WK-8	<b>Innovative and Critical Thinking (under relevant courses):</b> - 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 3<sup>rd</sup> to 4<sup>th</sup> 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 Building & Architectural 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 Building & Architectural Engineering

Knowledge Profile WK-1 to WK-8*	Knowledge Area	Sub-Area	Course Title	Theory	Lab	Total
				Credit Hours		
Non-Engineering Domain						
WK-7	Humanities	English	Functional English	2	0	2
			Communication Skills	1	1	2
			Technical Report Writing & Presentation Skills	2	0	2
		Ethics & Culture	Islamic Studies and Ethics	2	0	2
			Pakistan Studies and Global Perspective	2	0	2
		Sociology	Elective-I (Professional Ethics/ Sociology...)	2	0	2
			Elective-II (Engineering Economics)	2	0	2
		Arts		Fine Arts	1	1
			History of Building Technology	1	1	2
	Management Sciences	Professional Practice	Elective-I (Engg Project Management....)	2	1	3
			Elective-II (Entrepreneurship for Engineers)	2	0	2
WK-2	Natural Sciences	Mathematics	Calculus and Analytical Geometry	3	0	3
WK-1/			Differential Equations	3	0	3
			Linear Algebra	2	0	2
			Numerical Analysis	2	1	3
			Probability & Statistics	2	1	3

		Physics	Applied Physics	2	1	3
		Chemistry	Applied Chemistry	2	0	2
Total (Non-Engineering Domain)				35	7	42
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 Foundation		Construction Materials	2	1	3
			Engineering Drawing	1	2	3
			Surveying-I	2	1	3
			Engineering Mechanics	2	1	3
			Mechanics of Solids	3	1	4
			Structural Analysis-I	3	0	3
			Soil Mechanics	2	1	3
			Fluid Mechanics	2	1	3
			Construction Engineering	2	0	2
			Architectural Design-I	1	2	3
WK-4/ WK-2/ WK-1	Major-based Core (Breadth)		Surveying - II	2	1	3
			Quantity Surveying & Cost Estimation	2	1	3
			Reinforced Concrete Design-I	3	1	4
			Environmental Engineering	2	1	3
			Structural Analysis-II	2	0	2
			Environmental Control Systems	2	1	3
			Architectural Design-II	1	2	3

## Curriculum of Building & Architectural Engineering

WK-5/ WK6	Major-based Core (Depth)		Reinforced Concrete Design-II	3	1	4
			Geo Technical & Foundation Engineering	3	1	4
			Building Safety	1	1	2
			Integrated Building Design	1	2	3
			Architectural Design-III	1	2	3
			Elective - I	3	0	3
			Elective - II	3	0	3
WK-3/ WK-4/ WK-2/ WK-1	Multi-Disciplinary Engineering Courses		Electrical Systems for Buildings	1	1	2
			Mechanical Systems for Buildings	1	1	2
			Energy Efficient Buildings	1	1	2
			Occupational Health and Safety (Mandatory)*	1	0	1
			Town Planning	1	1	2
WK-6/ WK-7/ WK-8	Final Year Design Project (FYP)/ Capstone	Industrial/ Innovative/ Creative Project	FYDP (Part-I)	0	3	3
			FYDP (Part-II)	0	3	3
WK-6/ WK-7	Industrial Training	at least 6 - 8 weeks mandatory 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					
Total (Engineering Domain)				58	36	94
Total Credit Hours				93	43	136

\* to be taught during 1<sup>st</sup> year of program.

## 10. Scheme of Studies for Bachelor of Building & Architectural Engineering

COURSE TITLE	TH	LAB	CR	COURSE TITLE	TH	LAB	CR
<b>First Year</b>							
<b>Semester 1</b>				<b>Semester 2</b>			
History of Building Technology	1	1	2	Construction Materials	2	1	3
Functional English	2	0	2	Introduction to Computing	2	1	3
Calculus and Analytical Geometry	3	0	3	Applied Differential Equations	3	0	3
Applied Physics	2	1	3	Pakistan Studies and Global Perspective	2	0	2
Applied Chemistry	2	0	2	Engineering Mechanics	2	1	3
Islamic Studies	2	0	2	Communication Skills	1	1	2
Engineering Drawing	1	2	3	Fine Arts	1	1	2
Occupational Health and Safety	1	0	1				
<b>Total</b>	<b>14</b>	<b>4</b>	<b>18</b>	<b>Total</b>	<b>13</b>	<b>5</b>	<b>18</b>
<b>Second Year</b>							
<b>Semester 3</b>				<b>Semester 4</b>			
Engineering Surveying-I	2	1	3	Mechanics of Solids	3	1	4
Fluid Mechanics	2	1	3	Engineering Surveying - II	2	1	3
Soil Mechanics	2	1	3	Structural Analysis-I	3	0	3
Technical Report Writing & Presentation Skills	2	0	2	Computer Programming	2	1	3
Probability & Statistics	2	1	3	Linear Algebra	2	0	2
Electrical Systems for Buildings	1	1	2	Architectural Design-I	1	2	3
Engineering Economics	2	0	2				
<b>Total</b>	<b>13</b>	<b>5</b>	<b>18</b>	<b>Total</b>	<b>13</b>	<b>5</b>	<b>18</b>

Third Year							
Semester 5				Semester 6			
Numerical Analysis	2	1	3	Structural Analysis-II	2	0	2
Construction Engineering	2	0	2	Quantity Surveying Engineering	2	1	3
Reinforced Concrete Design-I	3	1	4	Energy Efficient Buildings	1	1	2
Environmental Engineering	2	1	3	Architectural Design-II	1	2	3
Environmental Control Systems	2	1	3	Reinforced Concrete Design-II	3	1	4
Mechanical Systems for Buildings	1	1	2	Geo Technical & Foundation Engineering	3	1	4
Total	12	5	17	Total	12	6	18
Fourth Year							
Semester 7				Semester 8			
Project Management	2	1	3	Building Safety	1	1	2
Town Planning	1	1	2	Integrated Building Design	1	2	3
Architectural Design-III	1	2	3	Entrepreneurship for Engineers	2	0	2
Depth Elective - I	3	0	3	Depth Elective - II	3	0	3
Professional Ethics	2	0	2	Senior Design Project-II	0	3	3
Senior Design Project-I	0	3	3				
Total	9	7	16	Total	7	6	13
Total Credits hours					136		

**List of Proposed Depth Electives Courses (two courses from any stream)**

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

<b>Elective Options</b>	<b>Specialization Stream</b>			
	<b>Structural Engineering</b>	<b>Structural Materials</b>	<b>Construction Management</b>	<b>Building Efficiency</b>
	Steel Structures	Sustainable Building Materials	Value Engineering	Green Buildings
	Structural Dynamics	Green Composites	Construction and Safety Management	Zero Energy Buildings
	Earthquake Engineering	Smart Materials	Sustainability in Construction Projects	Building Maintenance
	Computer Aided Structural Analysis and Design			

**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
- Modeling and Simulation
- Computer Programming and Design



## **11. Program Specific Labs**

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

- Structural Engineering Lab
- Geotechnical Engineering Lab
- Construction Lab
- Survey Lab
- Environmental Control System Lab
- Electrical Lab
- Digital Studios
- Project & Research Lab

## **12. Course Detail 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**

#### **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 and Design**

### **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 Petroustos, 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**

### **Construction Materials**

#### **Course Outline**

#### **Materials and their Properties**

- Introduction of materials
- Construction materials
- Physical, mechanical and chemical properties
- Electrical and thermal properties

#### **Binding Materials (Cement and Lime)**

- Introduction and manufacture of Ordinary Portland Cement
- Constituents of cement
- Types of cement and their use
- Properties and field tests of cement
- Special cements
- Introduction and preparation of lime
- Setting and hardening of lime
- Applications of lime
- Comparison (cost and characteristics) of lime and cement

#### **Fine & Coarse Aggregates and Stones**

- Definition and introduction of aggregates
- Mechanical and physical properties of aggregates
- Importance and methods of grading of aggregates
- Introduction, types, applications, characteristics of good building stones
- Artificial stones

#### **Cementitious Materials**

- Introduction and methods of preparation of paste
- Properties and application of paste
- Introduction and methods of preparation of mortars
- Properties and application of mortars
- Introduction about concrete

- Components and manufacture of concrete, properties of concrete
- Types of concrete

### **Metals (Steel and Aluminum)**

- Introduction to steel
- Mechanical and physical properties of steel
- Application of steel in various engineering projects
- Introduction to aluminum
- Mechanical and physical properties of aluminum

### **Ceramics, Bricks and Blocks**

- History and evolution of ceramics
- Manufacture of ceramics
- Properties and applications of ceramics in buildings
- History and evolution of bricks
- Properties and applications of bricks
- Dimensions, manufacture and classification of bricks
- History and evolution of blocks
- Properties and applications of blocks
- Dimensions, manufacture and classification of blocks

### **Glass and Wood**

- Constituents of glass and methods of manufacture.
- Types, use and significance of glass
- Advantages and drawbacks of glass
- Structure of tree and general characteristics
- Types, seasoning and preservation of wood
- Lamination of wood

### **Pavement Materials**

- Bitumen
- Asphalt
- Road Metal

### **Steel and its Tests**

### **Miscellaneous Construction Materials**

- Asbestos, Plaster of Paris, Abrasives
- Rubber, Cork, Plastics
- Paint
- Thermometry and acoustics
- Bamboo
- Natural, artificial and steel fibers
- Modern Materials (Fiber reinforced polymer etc.)

### **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:**

- Edward Allen, Joseph Iano, (2013), Fundamental of Building Construction Materials and Methods, 6th Edition, John Wiley & Sons. NY
- William F., Smith, (2009), Foundation of Materials Science & Engineering, 5th Edition, McGraw Hill.
- Duggal, S. K, (2010), Building Materials, New Age International.

## **Engineering Drawing**

### **Course Outline**

#### **Introduction to Engineering Drawing**

- Drawing, sketch, painting and map
- Drawing instruments and their use
- Type of drawing lines and appropriate uses
- General rules for drawing lines
- Gothic lettering
- Dimensioning

- Planning of a drawing sheet
- Drawing types with respect to technicality (Survey plan, contour plan, geotechnical plan, infrastructures drawing, architectural drawing, structural drawing, plumbing drawing, electrical drawing, HVAC drawing)
- Drawing types with respect to project execution (Proposals/PC-1 drawing, Submission /Tender drawing, Working /Construction drawing, Completion / As-built drawing)

### **Conceptual Drawings and Projection system**

- Conceptual drawing
- Projection system and its variables
- Classification of projections
- Perspective and parallel projections
- Oblique projection
- Axonometric projection (isometric projection)
- Orthographic projections (First-angle and third-angle projection) and their comparison
- Importance of line types and rules
- Glass box concept and six principle views
- Comparison between isometric and orthographic views
- Sections, Details behind the cutting plane, Parts not sectioned
- Scaling

### **Architectural Plan, Elevation and Section of a Simple Building**

- Architectural views (Plan, elevation and section) of a simple building
- General terminologies and symbols including schedule of opening
- Architectural design of a house
- Seismic requirement for architectural design
- General notes

### **Structural Details of a Simple Building**

- Foundation plan
- Plinth plan
- Lintel plan
- Slab plan

- Cross-sectional details of foundation, columns, vertical stiffeners, plinth band, lintel band, lintels, beams and slabs
- General notes

### **Architectural and Structural Details of Boundary Wall and Staircase**

- Plan, elevation and section of a boundary wall
- Structural design considerations
- Simple staircase and its components terminology
- Architectural details of a simple stair
- Structural details of a simple stair
- Types of stairs

### **Structural Details of Water Tank**

- Base slab
- Top slab
- Section
- Sump pit detail
- Cover detail
- General notes

### **Plumbing, Sanitation and Roof Drainage Plan of a Simple Building**

- Typical water supply system
- Water and waste water removal system
- Roof drainage slopes
- Standard Plumbing symbols
- General notes

### **Electrical and HVAC Drawings of a Simple Buildings**

- Typical layout of electrification
- Symbols used for electrical layout
- Typical layout of HVAC
- Symbols used for HVAC layout
- General notes

**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:**

- Horchsel R. P; Engineering Drawing and Geometry, John Willy & Sons, 2nd Edition, 2002.
- Jensen C.H and Mason F. H. S “Drafting Fundamentals”, McGraw Hill, 5th Edition.
- N. D. Bhatt; Engineering Drawing, 50th Edition (2010), Charotar Book Stall
- Parkinson, A. C. A First Year Engineering Drawing. English language Book Society. Reprint 1964.
- Basics of Engineering Drawing by Dr. Zahid Ahmed Siddiqi, 2016.

## **Surveying-I**

### **Course Outline**

#### **Introduction**

- Introduction to land surveying
- Definitions of basic surveying terms branches and their application
- Instruments used

#### **Survey Techniques**

- Distance measurement techniques
- Compass survey
- Traversing and triangulation
- Plane table surveying
- Computation of areas and volumes by various methods
- Tacheometry
- Theodolite survey

### **Modern Methods in Surveying**

- Principles of EDM operation, EDM characteristics
- Total stations, field procedures for total stations in topographic surveys
- Construction layouts using total station

### **Leveling and Contouring**

- Methods and types of levels, precise leveling
- Methods and applications of contouring

### **Computations and Plotting**

- Maps and plans, plotting, contour maps, profiles, cross-sections, prismoidal formula.
- Computations of area and volumes by graphical analysis and use of surveying software

### **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:**

- Wolf P. R. & Ghilani C. D., (2012), Elementary Surveying-An introduction to Geometrics, 13th Edition, Prentice Hall, USA.
- Kavanagh, B., (2014), Surveying principles and Application, Prentice Hall (9th Edition).
- Irvine, W., (1995), Surveying for Construction, McGraw-Hill (4th Edition).
- Davis, R. E., (1966), Surveying Theory and Practice, McGraw-Hill (7th Edition).
- Russel, P. W. and Brinker, C., (1997), Elementary Surveying, Harper Collins (9th Edition).
- James M. Anderson and Edward M. Mikhail, (1984), Introduction to Surveying, International Student Edition, McGraw-Hill Book Company

## **Engineering Mechanics**

### **Course Outline:**

#### **System of Forces**

- Force System, Resultant, and resolution of co-planar forces using parallelogram, triangle & polygon law and funicular polygon.
- Simple cases of resultant and resolution of forces in space.

#### **Equilibrium of Rigid Bodies**

- Conditions of equilibrium of co-planar forces, analytical and graphical formulations.
- Free body concept, conditions of support and attachment to other bodies, Support Reactions under different types of loading.
- Introduction to shear force and bending moment diagrams. Degree of restraint and static determinacy.
- Statically determinate problems, Equilibrium of two-force and three-force bodies.

#### **Properties of areas**

- Geometrical properties of plane areas, first moment of area, centroid, second moment of area, principal axes, polar second moment of area and radius of gyration.

#### **Friction**

- Coulomb's theory of friction.
- Problems involving friction on flat and curved surfaces.

#### **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:**

- Hibbeler, R. C. Engineering Mechanics- Statics and Dynamics, Prentice Hall (13th Edition), 2013
- Ferdinand P. Beer and E. Russel Johnston Jr. “Vector Mechanics for Engineers”, 7th Edition, 2008
- F. L. Singer, Engineering Mechanics, 4th ed, Harper and Row Publisher, 1987.
- J. L. Mariam & L. G. Kraige; Engineering Mechanics Statics and Dynamics; John Wiley & Sons, 6th Edition, 2007

**Mechanics of Solids**

**Course Outline:**

**Stress, Strain and Mechanical Properties of Materials**

- Uniaxial state of stress and strain
- Relationships between elastic Constants
- Response of materials under different sets of monotonic loading (including impact)
- Normal and shearing stress and strains
- Distribution of direct stresses on uniform and non-uniform members
- Thermal stresses and strains
- Difference between stress and pressure
- Lateral strain, Volumetric Strain, Poisson’s Ratio

**Bending Theory**

- Relationship between load, shear force and bending moment
- Theory of bending
- Moment of resistance and section modulus
- Application of flexural formula,
- Bending and shearing stress distribution in beams
- Stresses in composite sections

**Spring and Strain Energy**

- Open coil springs
- Closed coil Spring

- Leaf springs
- Strain Energy due to direct loads, shear force, bending moments, torque and impact loads.

### **Theory of Torsion**

- Theory of torsion of solids and hollow circular shafts
- Shearing stress distribution, angle of twist, strength and stiffness of shaft

### **Stress and Strain Transformations**

- Biaxial state of stresses
- Resolution of stresses
- Principal plane, principal stresses and strains
- Graphical representation of stress and strains, Mohr's circle of stresses and strains

### **Theory of Plasticity**

- Plastic limit analysis for ductile materials and
- Plastic limit analysis for brittle materials
- Collapse mechanism

### **Theory of Elasticity**

- Analysis of stresses and strains due to combined effect of axial, bending and twisting
- Forces/Moments
- Stress and deformation relationships

### **Enhanced Topics Related to Beam Bending and Shear**

- Unsymmetrical bending
- Analysis of Curved Beam
- Shear center and shear flow
- Introduction to circumferential and radial stresses in curved beams,
- Correction of Circumferential Stress in curved beams having I, T-cross section

### **Fatigue:**

- Fatigue due to cyclic loading
- Discontinuities and stress concentration

- Corrosion fatigue,
- Low cyclic fatigue
- $\epsilon$ -N relations

### **Application of Mechanics of Solid in Engineering Applications**

- Energy methods-General area of application and its usefulness.
- Use of stress strain curve for selection of materials

### **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:**

- Strength of Materials, A. Patel and F. L. Singer, Latest Edition
- Mechanics of Solids & Strength of Materials, F.V. Warnock and P.P. Benham, Latest Edition
- Mechanics of Materials, J. M. Gere and B. J. Goodno 7th Edition

## **Structural Analysis-I**

### **Course Outline**

#### **Introduction to Structural Analysis**

- Types of structures
- Structural idealization and loads
- Redundancy and stability of structures

#### **Analysis of Determinate Pin Jointed Structures**

- Method of joints
- Method of sections
- Method of moments and shears
- Graphical method

### **Analysis of Statically Determinate Rigid Jointed Plane Frames**

- Axial force diagrams
- Shear force diagrams
- Bending moment diagrams

### **Moving Loads**

- Influence lines for reactions
- Shear force and bending moment in statically determinate beams and paneled girders
- Influence lines for member forces in pin jointed frames
- Calculation of maximum stress function (reaction, shear, bending moment, axial force) in these structures

### **Three Hinged Arches, Cables and Suspension Bridges**

- Basic considerations in analysis and design
- Moving loads on three hinged arches and suspension bridge

### **Rotation and Deflection**

- Rotation and deflection of beams by moment area method
- Conjugate beam method
- Castigliano's second theorem
- Rotation and deflection of plane trusses and frames
- Principle of virtual work, unit load method, graphical method

### **Software Application**

- Introduction to SAP
- Introduction to ETABS

### **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:**

- R. C. Hibbler, Structural Analysis, Prentice Hall, 9th Edition (2016).
- C.K. Wang, Intermediate Structural Analysis, McGraw-Hill. (5th or later Edition).
- K. M. LEET & Chia-Ming Uang, Fundamentals Structural Analysis Prentice Hall, 7th Edition, 2009.
- H. H. West, Fundamentals of Structural Analysis, John Willey-New York, 2nd Edition, 2002.
- N.J. Alexander Chajes, Structural Analysis, Prentice Hall, 3rd Edition, 1995.W. J. Spencer, Fundamental Structural Analysis, Palgrave MacMillon, 1988 New York, Inc

## **Soil Mechanics**

### **Course Outline**

#### **Introduction**

- Applications of soil mechanics in engineering practice
- Types of soils and their properties
- Formation of soils

#### **Index Properties of Soil**

- Weight-volume relationships
- Plasticity of soil
- Structure of soil

#### **Engineering Classification of Soil**

- Important classification of soil
- Grain size distribution by sieve analysis
- Hydrometric analysis
- Atterberg's limits
- Classification systems

#### **Permeability and Seepage in Soils**

- Darcy's law

- Factors affecting permeability
- Laboratory and field determination of permeability
- Introduction to equipotential lines
- Introduction to flow nets
- Estimation of seepage quantity and gradients

### **Stress Distribution and Shear Strength of Soil**

- Geostatic stresses,
- Total stresses and pore pressure,
- Columb's law,
- Shear strength of cohesive and non-cohesive soils
- Laboratory and field tests for determination of shear strength

### **Settlement Analysis**

- Definition, total settlement, differential settlement, angular distortion, immediate settlement.
- Primary and secondary consolidation settlements.
- Normally and pre-consolidated soils.
- Mechanics of consolidation, theory of one-dimensional consolidation, assumptions and validity
- Determination of compression index and coefficient of consolidation, magnitude and time rate of consolidation settlement.
- Determination of consolidation and elastic settlements.
- Causes of settlement and methods of controlling settlement.
- Allowable total and differential settlement.

### **Soil Compaction**

- Mechanism, moisture density relationship
- Compaction standards
- Factors affecting compaction
- Field control and measurement of in-situ density
- Field compaction equipment
- Relative density

**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:**

- Introduction to Soil Mechanics by Baraja, M. Das (1983), (Latest Edition).
- An Introduction to Geotechnical Engineering by Holtz and Kovac.
- Basic Soil Mechanic by R. Whitlow, (Latest Edition).
- Geotechnical Engineering by Cernika, (Latest Edition).
- Theoretical Soil Mechanics by Terzaghi, (Latest Edition).
- Fundamentals of Soil Mechanics by Aziz Akbar and Siddique Qureshi, 2nd Edition

**Fluid Mechanics**

**Course Outline**

**Introduction**

- Solids and fluids (liquids and gases)
- Units and dimensions
- Physical properties of fluids; density, specific weight, specific volume, specific gravity, surface tension, compressibility
- Viscosity and its measurement
- Newton's equation of viscosity
- Hydrostatics
- Kinematics
- Hydrodynamics
- Hydraulics

## **Fluid Statics**

- Pressure intensity and pressure head
- Pressure and specific weight relationship
- Absolute and gauge pressure
- Measurement of pressure
- Piezometer, manometer
- Pressure transducers
- Differential manometer and Borden gauge

## **Forces on Immersed Bodies**

- Forces on submerged planes & curved surfaces and their applications
- Buoyancy and floatation
- Equilibrium of floating and submerged bodies

## **Fluid Kinematics**

- Steady and unsteady flow
- Laminar and turbulent flow
- Uniform and non-uniform flow
- Path line streamlines and stream tubes
- Velocity and discharge
- Control volume
- Equation of continuity for compressible and incompressible fluids

## **Hydrodynamics**

- Different forms of energy in a flowing liquid
- Bernoulli's equation and its application
- Energy line and Hydraulic Gradient Line
- Introduction to density currents, free and forced vortex
- Forces on pressure conduits, reducers and bends, stationary and moving blades
- Torques in rotating machines

## **Flow Measurement**

- Orifices and mouthpieces, sharp-crested weirs and notches
- Pitot tube and pitot static tube
- Venturi meter, orifice meter



### **Steady Flow through Pipes**

- Darcy-Weisbach equation for flow in pipes
- Losses in pipe lines
- Hydraulic grade lines and energy lines
- Pipes in series and parallel
- Transmission of energy through pipes
- Introduction to computer aided analysis of pipe networks

### **Uniform Flow in Open Channels**

- Chezy's and Manning's equations
- Bazin's and Kutter's equations
- Most economical rectangular and trapezoidal sections

### **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:**

- Daugherty, R. L., J. B. Franzini and Fenimore, Fluid Mechanics with Engineering Application, McGraw-Hill New York (Latest Edition)
- Monson Young, Fundamentals of Fluid Mechanics, (Latest Edition)
- Douglas, Fluid Mechanics, McGraw-Hill Inc.
- Jack P. Fundamentals of Fluid Mechanics, McGraw-Hill Inc.
- Merle Potter, Mechanics of Fluid, CL- Engineering (2011)

## **Construction Engineering**

### **Course Outline**

#### **Introduction**

- Construction projects and their types
- Construction Project Delivery Methods
- Project goals and objectives, Project categories
- Construction Industry of Pakistan
- Construction project regulations, Building permits, delivery methods, codes and construction standards
- Overview of Construction Sustainability

#### **Acceptance and Rejection of Materials as Per Standards**

#### **Construction Equipment**

- Types of construction equipment
- Productivity estimation for different heavy equipment
- Construction equipment economics for analysis of owning and operating costs
- Overview of maintenance and repair aspects of construction equipment

#### **Construction Methodology**

- Site selection and orientation of building
- Excavation and Related aspects: Methodologies for Excavation in different types of soils, stability of excavations, and solution of particular problems arising out of condition of sub-soil at site e.g. de-watering, shoring and bracing, sheet piling etc., Protection of adjacent Structures and water proofing.
- Foundations: Method of construction for different types of footings, piling works.
- Plain Concrete: Slab on grade, plain cement concrete floors
- Design and use of formwork for various building units/ members, and overview of temporary structures
- Methods of concreting vertical and horizontal members, including mechanized placement, ready mix concrete, mass concreting.
- Structural Construction (reinforced concrete frame construction such as; columns, beams, slab, roof), pre-stressed concreting
- Masonry Construction

- Wood Works (doors, windows, floors etc.)
- Finishing works (paint, tiling, marble, metal finishing works etc.)
- Construction joints, Plinth beams and plinth protection.
- Planar and non-planar Construction aspects related to services.
- Overview of Steel Construction

### **Overview of Construction Aspects of Infrastructure Engineering Projects**

- Retaining structures, hydraulic structures, underwater concreting and pavements.

### **Developments in Construction Technology**

- Introduction to advanced construction and maintenance technologies (trenchless construction, short-creating and retrofitting)
- Mechanized construction (pre-cast construction, tilt-up construction etc.)
- Introduction to use of Virtual Environment for Construction

### **Teaching Methodology (Proposed as applicable):**

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

### **Assessment:**

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

### **Suggested Books:**

- Stephens W. Nunnally, Construction Methods and Management, 8th Edition, 2013
- Metha M., Scarborough W., Armpriest D. 2013 Building Construction: Principles, Materials, and Systems, Pearson
- Fundamentals of Building Construction: Materials and Methods, 5th Edition. Edward Allen
- Huntington, W. C. Building Construction, John Wiley & Sons. (Latest Edition)
- R. L. Peurifoy, W. B. Ledbetter, C. J. Schexnayder, Cliff J. Schexnayder. Construction Planning Equipment and Method. 5th Edition, McGraw-Hill Companies
- Thompson J. F., Building Construction, Butterworld London.

## **Architectural Design-I**

### **Course Outline:**

#### **Introduction**

- Introduction to architectural design concepts.
- Study the theory of Architectural Design.
- Study the basic Elements of Architectural Design.
- Study the Principles of Architectural Design.
- Study of National and International architects' works and design philosophies

#### **AutoCAD**

- Introduction to AutoCAD.
- Importance and Applications of CAD files in offices.
- Study the basic Commands and Tools.
- Preparation of 2D drawings including plans, elevations, sections and details etc.
- Preparation of 3d model, views and details.
- Making presentation and working drawings.

#### **Software Application**

- Introduction to AutoCAD
- Introduction to 3D Max

#### **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:**

- Residential Interior Design by Maureen Mitton and Courtney Nystuen.
- Bernard S. Palm and Alf Yarwood, Introduction to AutoCAD 2016, 2D & 3D Design, 1st Edition

- Mastering AutoCAD 2019 and AutoCAD LT 2019 by George Omura & Brian C. Benton
- Time Savers & Standards

## **Engineering Breadth Courses**

### **Surveying - II**

#### **Course Outline**

##### **Highway and Railway Curves**

- Circular curves, deflections and chord calculations
- Setting out circular curves by various methods
- Compound curves, reverse, vertical, parabolic curves
- Computation of high or low point on a vertical curve
- Design considerations, spiral curves, spiral curve computations
- Approximate solution for spiral problems, super elevations

##### **Construction Surveys**

- Introduction, horizontal and vertical control
- Buildings, rail roads, Route surveys
- Pipeline and other construction surveys

##### **Hydrographic Surveys**

- Objectives of hydrographic survey and electronic charting
- Vertical control, depth and tidal measurements
- Position fixing techniques
- Sounding plan, horizontal control

##### **Control Surveys**

- Geodesy universal transverse Mercator grid system
- Modified transverse Mercator grid system
- Lambert projection
- Computations for lambert projection

### **Field Astronomy**

- Solar and stellar observations for position and azimuth determination

### **Photogrammetry**

- Introduction
- Application of aerial and terrestrial photogrammetry
- Stereoscopy

### **GPS surveying techniques and applications**

- Survey planning, initial ambiguity resolution
- Vertical positioning

### **Tunnel Surveying**

- Introduction
- Use of gyroscope

### **GIS**

#### **Software Application**

- Introduction to GIS
- Introduction to RS

### **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:**

- Wolf P. R. & Ghilani C. D., (2012), Elementary Surveying – An introduction to Geomatics, 13th Edition, Prentice Hall, USA.
- Thomas, M. Lillesand & Ralph W. Kiefer, (2005), Remote Sensing and Images Interpretation, 5th edition, John Wiley & Sons, Inc.

- Kavanagh Barry, (2010), Surveying with Construction Applications, 7th Edition, Pearsons Education.

## **Quantity Surveying Engineering**

### **Course Outline**

#### **Quantity Takeoff**

- Review of basic take-off mathematics and measurement Units.
- Takeoff Rules and Measurement Accuracy
- Organization of take-off
- Quantity take-off and Pricing of Labor, Material and Equipment for; Sitework, Concrete, Masonry, Carpentry, and Finishes Works.
- Estimating Procedures and Considerations for Concrete Retaining Wall, Piles, Steel Truss, Road, Sewer and Water Mains Pipe Works
- Maintaining of Measurement Books

#### **Development of Estimates, Pricing and Related Aspects**

- Types and methods of estimates (conceptual estimates, preliminary, detailed estimates)
- Rate analysis
- Labor productivity
- Cost analysis of construction materials
- Estimate Setup, Overhead, Profit, Sources of Estimating Errors, Escalation, Contingency Life-Cycle Costing and Analysis.
- Concept of Cost Code
- Use of different types of indices for conceptual estimates
- FIDIC Billing

#### **Contractual Aspects Related to Bidding**

- Specifications and their types for various items of construction projects
- Overview of payment schemes in construction projects
- Preparation of tender/bid proposal documents evaluation methods of proposals and bids.
- Preparation of documents for bid submissions

- Overview of Standard form of contract/bidding documents with special reference to clauses related to cost related issues of the projects (such as PEC, FIDIC, AIA etc.) General practice in government departments for schedule of rates and specifications

### **Software Application**

- Introduction to Autodesk Navis works

### **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:**

- Marks Kalin, Robert S. Weygant, Harold J. Rosen & John R. Regenar, Construction Specifications Writing: Principles and Procedures, 2010, Wiley.
- Stephen J. Peterson, Construction Estimating Using Excel, Prentice Hall
- Standard Form of Bidding Documents by Pakistan Engineering Council
- Jimmie Hinze, Construction Contracts, 3rd Edition, 2010, McGraw-Hill

## **Reinforced Concrete Design-I**

### **Course Outline**

#### **Plain Concrete (Properties, Application and Testing)**

- Concrete constituent material and its mechanical properties
- Properties of freshly mixed concrete
- Durability aspects and factors contributing towards durability
- Creep and shrinkage of concrete
- Mix design and quality control
- Additives and admixtures
- Air entrainment
- Lightweight concrete



- Hot and cold weather concrete
- Precast concrete with special reference to cement concrete blocks
- Determination of fundamental structural properties of concrete and non-destructive testing (NDT)

### **Reinforced Concrete (Basic Principles, Working Stress and Ultimate Strength Method)**

- Basic principles of reinforced concrete design and associated assumptions, behavior of reinforced concrete members in flexure, design philosophy, design codes, factor of safety and load factors, prevailing methods of design of reinforced concrete members
- Working stress method, serviceability criteria and checks for deflection, crack width, and crack spacing, Importance of working stress method related to pre-stress
- Ultimate strength method, analysis of prismatic and non-prismatic sections in flexure, compatibility-based analysis of sections and code requirements for flexure

### **Structural Framing and Load Calculations of a Simple Structure for Gravity Design**

- Structural framing
- Load calculations, types of basic loads, service and factored load combinations
- Load distribution and calculations for slabs, beams, columns and footings

### **Slab Analysis and Design for Gravity Loading**

- One-way solid and ribbed slabs
- Two-way solid slabs using coefficient method
- General discussion on other slab systems
- Design detailing

### **Beam Analysis and Design for Gravity Loading**

- Flexure analysis and design of beams (singly, doubly, rectangle section, T/L sections, simple span, one end and both end continuous etc.)
- Shear analysis and design of beams
- Design detailing

## **Columns**

- Analysis of sections in pure compression,
- Design of short columns under pure compression and with eccentric loading,
- Design detailing

## **Footings**

- Isolated footings
- Structural design of simple rectangular footing and combined footing.
- Design detailing

## **Concrete Detailing (Bond, Anchorage & Development Length)**

- Design and detailing for bond, anchorage, development length, laps and splices

## **Software Application**

### **Design using SAP or ETABS**

### **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:**

- Hassoun, M. N. & Al-Manaseer, A, (2015), Structural Concrete: Theory and Design, 6th Edition.
- Chu-Kia Wang, Charles G. Salmon, José A. Pincheira, (2006), Reinforced Concrete Design, Wiley; 7th Edition
- Arthur H Nilson, David Darwin, Charles W. Dolan, Arthur Nilson, Charles Dolan, (2016) Design of Concrete Structures. 14th Ed., McGraw-Hill
- James K Wight and James G. Macgregor, Reinforced design: Mechanics and design, (2011), 6th Edition
- M. Neville, (2011), Properties of Concrete, 5th edition, John Wiley
- N.V. Nayak & A.K. Jain, Handbook on Advanced Concrete Technology
- Concrete Structures, Part-I, 3rd Edition, by Zahid Ahmed Siddiqi, 2016

## **Environmental Engineering**

### **Course Outline**

#### **Introduction**

- Environmental Engineering
- Water Engineering
- Sanitary Engineering
- Air & Noise Pollution

#### **Water**

- Water chemistry and characteristics
- Water Pollution
- Water Demand and Supply
- Water Quality
- Water Sampling and Testing
- Water Treatment
- Miscellaneous Water Treatment Techniques
- Water Distribution

#### **Standards (NEQS) and International Standards.**

- Sewer system (Types, shapes, size and materials of sewers, pipe strengths and tests)
- Design, construction, laying and maintenance of sewage system
- Separate & Combined systems
- Sewer appurtenances

#### **Estimation of Sewage Quantities**

- Population characteristics
- Population forecasting
- Waste water generation
- Rainfall intensity formulas, hydrograph & weather flow, sewage quantities
- Variations and rates of flows
- Velocity gradient & limiting velocities.

### **Characteristics of Sewage**

- Sampling techniques and examination of wastewater (Physical, chemical and microbiological parameters) Biochemical Oxygen demand (BOD)
- Chemical Oxygen Demand (COD)
- Microbiology of sewage
- Effluent disposal guideline and standards
- Pakistan National Environmental Quality

### **Sewage Treatment and Disposal: Primary, Secondary & Tertiary Treatment**

- Screening grit chamber, skimming tanks & sedimentation tanks
- Activated sludge treatment, trickling filters
- Rotating biological contactors
- Aerobic systems, lagoons and oxidation ponds, etc.

### **Sewage Disposal**

- Receiving body assimilation capacity
- Stream pollution and self-recovery, sludge handling, treatment & disposal
- Effluent re-use

### **Building Drainage**

- Soil pipes, anti-syphon pipes and waste water pipes
- Sanitary fixtures and traps
- House connection and testing of house drainage
- Cross connection and back syphon age control

### **Solid Waste Management**

- Types, characteristics, sources and quantities of solid waste
- Collection, disposal (Landfill, incineration, RDF, waste to energy) and recycling

### **Software Applications**

### **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:**

- Mackenzie L. Davis, David A. Cornwell, Introduction to Environmental Engineering, 4th Edition, 2008
- McGraw-Hill Science/Engineering/Math; 4th Edition (October 3, 2006)
- S. Peavy, D. R. Rowe, George Technological, Environmental Engineering
- Terence J. McGhee, Water Supply and Sewerage, 6th Edition, McGraw Hill
- Howard McGraw-Hill Publishing Company; 7th Edition (March 1987)
- Environmental Impact Assessment for Waste Treatment and Disposal Facilities, Petts J., Eduljee G., John Wiley & Sons Inc. UK
- Environmental Engineering, Gerard K., McGraw-Hill International Edition
- Integrated Solid Waste Management, George T., Latest Edition

## **Structural Analysis-II**

### **Course Outline**

#### **Analysis of Indeterminate Structures Using Force Approach**

- Compatibility methods for beams and frames with and without support settlement

#### **Analysis of Indeterminate Structures Using Displacement Approach**

- Moment distribution for beams and frames for prismatic and non-prismatic members with and without side-sway and support settlement
- Slope deflection method for beams and frames with and without support settlement

#### **Matrix Methods**

- Introduction to flexibility method
- Introduction to stiffness method
- Development of member and structure stiffness matrices
- Bending moment and shear force diagrams

- Use of appropriate software for matrix operations

### **Finite Element Method**

- Introduction to finite elements
- Shape functions for bar element

### **Software Application**

- Introduction to Autodesk Robot Structural Analysis

### **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:**

- Hibbeler, R. C., (2011), Structural Analysis, Prentice Hall; 8th Edition.
- Aslam Kassimali, (2014), Structural Analysis, 5th Edition
- Wang, C. K., (1984), Intermediate Structural Analysis, McGraw-Hill Education - Europe.
- West, H. H., (1989), Analysis of Structures: An Integration of Classical and Modern Methods, John Wiley and Sons Ltd; 2nd Edition.
- Alexander, Chajes, (1990), Structural Analysis
- Rizwan, S.A., (2003), Theory of Indeterminate Structures, 2nd Edition.

## **Environmental Control Systems**

### **Course Outline**

#### **The Building as a Thermal System**

- Thermal comfort,
- Factors affecting thermal comfort,
- Thermal balance of the human body.
- An account of materials and their properties such as;

- a. thermal conductivity,
- b. Absorptivity,
- c. insulation value and
- d. Thermal transmission.
- Heat gain and heat loss by the building components

### **Passive Design Strategies**

- Architectural Design Considerations for Hot arid climate.
- Passive and Active Design of buildings,
- Introduction to passive design strategies.
- Solar angles and solar charts.
- Sun control and shading devices in interior and exterior of the buildings such as shades, louvers and blinds.
- Introduction to renewable energy sources, such as; Tidal, Bio-mass, Nuclear etc.
- Energy situation in Pakistan and energy conservation

### **Acoustics**

- Introduction to acoustics,
- Sound (production and transmission).
- Sound and vibration control,
- Air born sound transmission,
- Bypassing of sound barriers,
- Structural born sound transmission,
- Damping of vibration and sound absorption,
- Measurement and calculation of reverberation time.
- Types of Materials and their acoustical properties:
- Acoustical design for room acoustics.
- Analysis and design techniques for control of air-borne and structural born voice generated from variety of sources such as traffic, human beings, mechanical and electrical equipment

### **Software Application**

- Introduction to Autodesk Ecotect Analysis

**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:**

- Estimating Controls Systems for Heating, Ventilating and Air Conditioning: A Guide to Pricing Temperature Control Systems for Communal Buildings by Harry J. Edwards
- Electrical and Mechanical Services in High Rise Building: Design and Estimation Manual: Including Green Buildings by A.K. Mittal

## **Architectural Design-II**

### **Course Outline**

#### **Introduction to Building by-laws**

- Public sector departments like LDA, MDA etc.
- Private sector departments like DHA, Bahria Town etc.

#### **Architectural Details of a Simple Two Storied Residential Building**

- Broad prospective about architectural detail
- Ground floor plan
- First floor plan
- Roof and mumty plan
- All sides Elevations
- Longitudinal and transverse sections
- Preparation of 2D drawing on AutoCAD
- Preparation of 3D model on AutoCAD
- Application of materials on 3D model by Max software



### **Architectural Design of Educational Institutional Building (Department, admin block)**

- Broad prospective about architectural details
- Key Plan, site plan, master plan
- Ground floor plan
- First floor plan
- Roof plan
- All sides Elevations
- Longitudinal and transverse sections
- Preparation of 3D model on AutoCAD
- Application of materials on 3D model by Max software

### **Preparation of Working Drawings**

- Ground floor plan
- First floor plan
- Roof plan
- All sides Elevations
- Different X-sections
- Preparation of 2D drawing on AutoCAD

### **Software Application**

- Application of Autodesk Revit Architecture

### **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:**

- 1.Time-savers standards for building types (Fourth Edition) by Joseph De Chira & Michael J. Crosbie

## **Engineering Depth Courses**

### **Reinforced Concrete Design-II**

#### **Course Outline**

##### **Flat Slab, Flat Plate & Waffle Slab**

- Analysis and design of flat plate for flexure and shear under gravity loading.
- Analysis and design of flat slabs for flexure and shear under gravity loading.
- Analysis and design of waffle slabs for flexure and shear under gravity loading.

##### **Design for Torsion**

##### **Slender Columns**

- Analysis and design of slender columns subjected to combined flexure and axial loading,
- Guidelines for design of shear walls-an over view.

##### **Design of Different Types of Foundations**

- Analysis and design of eccentric, strap, strip and mat footings
- Pile caps.

##### **Stairs, Water Tanks, Reservoirs**

- Analysis and Design of Various Types of Stairs and Staircases,
- Analysis and Design of water tanks and reservoirs.

##### **Prestressing Principles & Design Philosophy**

- Principles of prestressing, properties of high strength materials,
- Importance of high strength concrete and steel used in prestressing,
- Behavioral aspects of prestressed beams and comparison with reinforced concrete beams,
- Post tensioning and pre-tensioning techniques,
- Profiles of post-tensioned tendons, bonded and non-bonded tendons, comparison and hard-ware requirements.
- Prestress losses, immediate and time dependent losses, lump sum and detailed estimation of prestress loss.
- Analysis and design of prestressed beams.

## **Introduction to Earthquake Resistant Design of Structures**

### **Design of Gravity and Cantilever Retaining Walls.**

## **Introduction to Computer Aided Analysis and Design**

### **Software Application**

- Design using Autodesk Robot Structural Analysis

### **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:**

- Hassoun, M. N. & Al-Manaseer, A, (2015), Structural Concrete: Theory and Design, 6th Edition.
- Chu-Kia Wang, Charles G. Salmon, José A. Pincheira, (2006), Reinforced Concrete Design, Wiley; 7th Edition
- Arthur H Nilson, David Darwin, Charles W. Dolan, Arthur Nilson, Charles Dolan, (2016) Design of Concrete Structures. 14th Ed., McGraw-Hill
- James K Wight and James G. Macgregor, Reinforced design: Mechanics and design, (2011), 6th Edition
- Nilson A. H., Design of Prestressed concrete, John Wiley and Sons, Wiley, 1987
- Concrete Structures, Part-II, 3rd Edition by Zahid Ahmed Siddiqi, 2016

## **Geo-Technical & Foundation Engineering**

### **Course Outline**

#### **Earth Pressures**

- Definition, pressure at rest, active and passive earth pressures
- Coulomb's and Rankine's theories
- Bell's equation for cohesive frictional soils
- Earth pressure diagrams for different loading configurations

#### **Bearing Capacity of Soils**

- Definition of: gross, net, effective, and ultimate allowable bearing capacity
- Selection of bearing capacity type against particular loading
- Practical problems and solutions
- Presumptive values from codes, from plate load test
- Bearing capacity theories
- Bearing capacity from SPT and CPT data

#### **Geotechnical Investigation Report**

- Table of content
- Site introduction and site-specific requirement for geotechnical investigations
- Which geotechnical information is to be included in report and how?

#### **Slope Stability and Methods of Analysis**

- Types of slopes
- Factors affecting stability and remedies
- Types of failure
- Ordinary methods of slices
- Taylor's stability number method
- Swedish circle method

#### **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

## **Introduction to Deep Foundations**

- Types of piles, load carrying capacity of piles, group action, negative skin friction, pile load test

## **Soil Improvement**

- Basic principles,
- Objectives and methods

## **Soil Dynamics**

- Sources of dynamic loading, spring-mass-dashpot system
- Application to machine foundations, liquefaction

## **Software Application**

- Introduction to Rocscience

## **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:**

- Principles of Foundation Engineering by Baraja M. Das, (Latest Edition)
- Soil Mechanics by Jumikus, (Latest Edition)
- Soil Mechanics by Das, (Latest Edition)
- Advanced Soil Mechanics by Das, (Latest Edition)
- Foundation Analysis and Design by Bowles, (Latest Edition)
- Soil Engineering by Sprangler and Handy, (Latest Edition)
- Foundation Analysis by Teng, (Latest Edition)
- Foundation Design and Construction by Tomlism, (Latest Edition)
- Geotechnical Engineering – Principles and Practices by D.P. Coduto, (Latest Edition)
- Foundation Design – Principles and Practices by D.P. Coduto, (Latest Edition)
- Soil and Foundations by Liu & Evett (6th Edition)

## **Building Safety**

### **Course Outline**

#### **Introduction**

- Safety practices and procedures
- Commonly used building safety measures (national and international Codes and Standards – building, fire, electric, HVAC, site safety etc.)
- General Responsibilities
- Accident Prevention and Reporting
- Health & Welfare

#### **Technical Safety for Buildings and Installations**

- Ventilation systems and air conditioners
- Extinguishing systems
- Electrical systems
- Drinking water installations

#### **Testing and Commissioning**

- Time domain analysis: finite difference methods
- Fire testing
- Drive technology
- Air quality
- Cooling, Air Conditioning & Heating Technology
- Non-Destructive Testing and Destructive testing (through core sampling etc.)

#### **Personal Protection**

- Personal Protective Equipment
- Emergency Procedures and First Aid
- Safe Use of Hazardous Substances
- Safety Signs and Signals

#### **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:**

- Darryl C. Hill, 'Construction Safety Management and Engineering '

### **Integrated Building Design**

**Course Outline**

- Concept of integrated building design.
- Significance of building system integration at planning and design stage of an architectural project.
- Building management system. Sustainable architecture and its relevance to Pakistan.
- Critical review of the earlier architectural projects to understand the impacts of architectural design on energy consumption in buildings.
- Architectural design and planning of appropriate: Structural System, Mechanical System, Electrical Systems, Fire Safety Systems, Communication and Security systems, Lighting and Illumination Systems.
- Integration of renewable energy technologies with buildings.
- Introduction to 'Building Energy Performance Simulation' program and its integration into Architectural Design process
- Software Application: Introduction to Autodesk Green Building Studio

**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:**

- Joseph De Chiara, Time Saver Standards for Building Types, 2nd Edition

### **Architectural Design-III**

#### **Course Outline**

- Introduction to Building information modeling and usage of at least one of its tool
- Understanding of space utilization in hospital design and design of a Mosque.
- Field visits to local hospitals and mosques
- Design of a hospital building and mosque
- Software Application: Advanced Application of Autodesk Revit Architecture

#### **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:**

- Architectural Design with SketchUp: 3D Modeling, Extensions, BIM, Rendering, Making, and Scripting, 2015 by Alexander C. Schreyer
- BIM and Integrated Design: Strategies for Architectural Practice, 2011 by Randy Deutsch
- Time-savers standards for building types (Fourth Edition) by Joseph De Chira & Michael J. Crosbie



## **Depth Electives**

### **Steel Structure (Depth Elective – I)**

#### **Course Outline**

##### **Introduction**

- Use of steel as a structural material
- Mechanical properties
- Types and shapes of structural steel members
- Specifications and design codes
- Design philosophies, load and safety factors.

##### **Fundamentals of Working Stress Method**

- Overview of Allowable Stress Design (ASD)
- Service load and allowable stresses

##### **LRFD Method of Design**

- Factor of safety, loads and load combination.
- Concept of load and resistance factors
- Plastic design and limits on design
- Analysis and design of tension members
- Analysis and design of Compression Members.
- Local and overall stability
- Euler's buckling load in columns.
- Analysis and design of beams.
- Compact, non-compact and slender sections
- Bending strength
- Shear Strength
- Lateral torsional buckling.
- Biaxial Bending
- Purlins, sag rods
- Beam-column and axial-flexure interaction
- Second order effects
- Moment magnification.
- Plate girder proportioning and design.

- Simple welded and bolted connections
- Overview of moment and shear connections

### **BIM Model Applications in Steel Structure Design**

#### **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:**

- William Segui, Steel Design, CENGAGE Learning, 5th Edition (2013)
- Charles G. Salmon, John E. Johnson, Faris A. Malhas, Steel Structures: Design and Behavior, 5th Edition (2008), Prentice Hall.
- Gaylord, E.H. and C. N. Gaylord, Design of Steel Structures, McGraw-Hill Companies; (Latest-Edition)
- Spiegel & L. Burner. Applied Structural Steel Design, Prentice Hall, 2002
- Steel Structures by Zahid Ahmed Siddiqi, 4th Edition, 2017.

## **Structural Dynamics (Depth Elective – II)**

### **Course Outline**

#### **Introduction**

- Types of dynamic loads;
- Basic background of methods available and
- Motivation for structural dynamics.

#### **Dynamics of Single Degree-of-Freedom Structures**

- Dynamic equation of equilibrium;
- Free vibration of single degree of freedom systems
- Forced vibration: harmonic and periodic loadings
- Dynamic response functions, force transmission and vibration isolation

- SDOF response to arbitrary functions

### **Numerical Evaluation of Dynamic Response of SDOF Systems**

- Time domain analysis: finite difference methods
- Frequency domain analysis: basic methodology

### **Earthquake Response of SDOF System**

- Earthquake excitation, response history and construction of response spectra
- Response spectrum characteristics, tripartite plot, and design spectrum

### **Multi Degree of Freedom Systems - Basics**

- Dynamic equations of equilibrium, static condensation
- Symmetric plan and plan-asymmetric systems

### **Free Vibration Response of MDOF Systems**

- Undamped systems: natural modes and their properties
- Numerical solution for the eigenvalue problem
- Solution of free vibration response for undamped systems
- Free vibration analysis of systems with damping

### **Dynamic Analysis of Linear MDOF System**

- Introduction, modal analysis
- Response-history for earthquake excitations using modal analysis
- Response spectrum analysis for peak responses
- Concept of Caughey damping as a general type of proportional damping

### **Generalized Single Degree of Freedom Systems**

- Basic concepts, mass-spring system
- Lumped mass systems
- Systems with distributed mass and elasticity
- Rayleigh's method, shape function selection

### **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:**

- R.W. Clough, J. Penzien, Dynamics of Structures, McGraw Hill, 2nd ed. 1993.
- A.K. Chopra, Dynamics of Structures and Application to Earthquake Engineering, Pearson, 3rd Ed. 2005.

**Earthquake Engineering (Depth Elective – III)**

**Course Outline**

**Seismology**

- Earth's Interior and Plate Tectonics
- Causes of Earthquakes and Seismic Waves; Measurement of Earthquakes and Measurement parameters
- Modification of Earthquake due to the Nature of Soil
- Seismic Hazard Analysis I;
- Seismic Hazard Analysis II; Discussion on Tutorial Problems.

**Earthquake Inputs**

- Time History Records and Frequency Contents of Ground Motion
- Power Spectral Density Function of Ground Motion; Concept of Response Spectrums of Earthquake
- Combined DVA Spectrum and Construction of Design Spectrum; Site Specific, Probabilistic and Uniform Hazard Spectrums
- Predictive Relationships for earthquake parameters
- Discussion on Tutorial Problems.

**Dynamics for Earthquake Analysis**

- Equations of Motion for SDOF and MDOF Systems; Undamped Free Vibration of SDOF and MDOF Systems;
- Mode Shapes and Frequencies of MDOF System; Rayleigh Damping Matrix
- Direct Time Domain Analysis of MDOF System

- Direct Frequency Domain Analysis of MDOF System
- Modal Analysis in Time and Frequency Domain
- Discussion on Tutorial Problems

### **Response Analysis for Specific Ground Motion:**

- Equations of Motion for Single and Multi- Support Excitations and Solutions
- Equations of Motion in State Space and Solutions
- Computational Steps for the Solutions using MATLAB I
- Computational Steps for the Solutions using MATLAB II
- Time History Analysis of 3D Tall Buildings
- Discussion on Tutorial Problems

### **Response Spectrum Method of Analysis**

- Concept of Equivalent Lateral Force for Earthquake
- Modal Combination Rules
- Response Spectrum Method of Analysis of Structures and Codal Provisions
- Response Spectrum Method of Analysis for Torsionally Coupled Systems
- Response Spectrum Method of Analysis for
- Non Classically Damped Systems
- Discussion on Tutorial Problems

### **Seismic Soil - Structure Interaction**

- Fundamentals of Seismic Soil-Structure Interaction
- Direct Method of Analysis of Soil-Structure Interaction using FEM & Use of ABAQUS I
- Direct Method of Analysis of Soil-Structure Interaction using FEM and Use of ABAQUS II
- Sub structuring Method of Analysis of Soil-Structure Interaction Problem I
- Sub structuring Method of Analysis of Soil-Structure Interaction Problem II
- Discussion on Tutorial Problems

### **Inelastic Response of Structures for Earthquake Forces**

- Fundamental Concepts of Inelastic Response Analysis for Earthquake Forces
- Solutions of Incremental Equations of Motions for SDOF Systems
- Solutions of Incremental Equations of Motions for MDOF Systems

- Push over Analysis
- Concepts of Ductility and Inelastic Spectrum
- Discussion on Tutorial Problems

### **Base Isolation for Earthquake Resistant Design of Structures**

- Base isolation concept, isolation systems and their modeling
- Linear theory of base isolation;
- Stability of elastomeric bearings;
- Code provisions for seismic isolation, practical applications.

### **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:**

- David Key, 'Earthquake Design Practice for Buildings', Thomas Telford, London, 1988.
- Newmark N.M. and Rosenblueth E., 'Fundamentals of Earthquake Engg.', Prentice Hall, 1971.

## **Computer Aided Structural Analysis and Design (Depth Elective – IV)**

### **Course Outline**

#### **Background – Superstructure Design**

- Concepts of architectural dwgs; coordinate / grid system; structural layout; earthquake- resistant design; water tower; sloshing effect; code references.

### **SAP**

- SAP introduction; grids layout; material properties; member sizes, modifiers and other details; Geometry layout (beams, columns, shear walls, slabs); replication (linear, mirror, story); supports.

- Basic load cases (Dead, superimposed dead, live, roof live, soil (if any) and earthquake); mass-source
- Factored load combinations (considering eccentricities in all directions and using all code clauses)
- Applying basic loads (point, uniformly distributed, varying lateral and area loads)
- Checking model errors; analysis options; model analysis
- Evaluation of analysis; performing concrete design

### **Super Structure Detailing**

- Auto CAD introduction
- Structural drawings

### **Background – Foundation Design**

- Concepts of allowable bearing capacity (net, gross and effective) including design examples

### **SAFE**

- SAFE introduction; Exporting SAP file for SAFE foundation model; Importing SAP data/analysis; material and soil properties; foundation type and thickness; applying additional loads (if required); Preliminary foundation layout
- Service and Factored load combinations (considering eccentricities in all directions and using all code clauses)
- Evaluation of analysis and design; checking bearing pressures and satisfying foundation sizes

### **Sub Structure Detailing**

- Structural drawings

### **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:**

- Claudio Gianini, ' Computer Aided Structural Design '.

**Sustainable Building Materials (Depth Elective – V)**

**Course Outline**

**Introduction**

- Embodied energy
- Operational energy in Building and Life cycle energy
- Ecological foot print, Bio-capacity and calculation of planet equivalent

**Role of Material**

- Carbon from Cement
- Alternative cements and cementitious material, Alternative fuel for cements for reduction in carbon emission
- Sustainability issues for concrete

**Role of Quality**

- Minimization of natural resource utilization
- High volume fly ash concrete
- Geo-polymer concrete etc. concrete with alternative material for sustainability

**Use of Building**

- Integrated Photo Voltaic (BIPV) and other renewable energy in buildings
- Energy codes ECBC requirement, Concepts of OTTV etc.
- Basic concepts and efficiency

**Miscellaneous**

- Clay Bricks, Types kilns, Comparative energy performance emission performance and financial performance, Indoor air quality



- Paints, Adhesive and sealants for use in building, Volatile organic content (VOC) emission issues and indoor air quality for Sustainability and Health hazard

**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:**

- Charles J. Kibert, ' Sustainable Construction Green Building Design and Delivery ', 4th Edition.

**Green Composites (Depth Elective – VI)**

**Course Outline**

**Introduction**

- Green composite materials
- Renewable resources
- Bio-polymers
- Environmental aging

**Tribological Aspects of Natural Fiber Composites**

- Significance of tribology in development of materials
- Natural fiber composites
- Classification of natural fibers
- Classification of green composites

**Development and Characterization of Novel Fiber Reinforced Hybrid Friction Composites**

- Introduction
- Defects in drilling of NFRCs

- Delamination in NFRCs
- Geometrical errors
- Thermal damages

**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:**

- J. Paulo Davim, ' Green Composites: Materials, Manufacturing and Engineering ', De Gruyter, 2017.

**Smart Materials (Depth Elective - VII)**

**Course Outline**

**Introduction**

- Smart materials
- Properties
- Distribution by type
- The development of smart materials and structures
- Areas of application of intelligent systems

**Smart Materials**

- State-of-the-Art in Smart Materials & Structures (SM&S) Development
- Dynamics and Controls Related Knowledge
- Shape Memory Alloy Materials
- Shape Memory Alloy Actuators

**Types of Smart Material**

- pH-sensitive polymers
- Temperature-responsive polymers

- Self-healing materials

### **Applications of Smart Materials**

- Smart Materials in Engineering Applications
- Structural Application of Smart Materials
- Smart Materials in Aerospace

### **Intelligent Processing**

- Intelligent processing of materials
- Semiconductors and Metals
- Metallization techniques
- Ceramic materials, thin and thick layers.

### **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:**

- Mukesh V. Gandhi, ' Smart Materials and Structures ', CHAPMAN & HALL.

## **Value Engineering (Depth Elective – VIII)**

### **Course Outline**

#### **Introduction to Value Management**

- Definition of value management
- History of values analysis
- Value Analysis Verses Value Engineering
- Today's Opportunities
- Project selection
- Assembling the team

### **Information Gathering**

- Design documents - drawings, specifications, etc.
- Material / component cost
- Cost Models
- Annual Purchase Values and Quantities
- Commodity data
- Sample components
- Reject rates
- Warranty data
- Commercial consideration
- Supplier Suggestions/Supplier Walk-through

### **Analysis of Function-Cost Relationship**

- Define functions
- Analysis of Cost of Functions
- Select target function(s)

### **Idea Generation**

- Creativity
- Brainstorming Process
- Idea starters
- Idea forms

### **Evaluation of Ideas**

- Eliminate the Noise
- Estimate of Savings
- Cost to Implement
- Time to Implement
- Ranking of Ideas – A, B, C, D
- Evaluation Tools
- Selecting the Best Ideas

### **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:**

- R. Cooper and R. Slagmulder, 'Target Costing and Value Engineering '.

**Construction and Safety Management (Depth Elective – IX)**

**Course Outline**

**Types of Safety Practices**

- Green Composites from Natural Resources
- Types of Practices Used to Promote Safety on Projects
- Implementing New Safety Practices
- Level of Integration of Safety Policies and Programs
- Aspects of a World-Class Safety Program

**Impact of Safety Practices/Programs on Business**

- Impact of Safety Practices on the Success of Projects
- Impact of Safety Practices on Project Schedule
- Impact of Safety Practices on Project Budget
- Impact of Safety Practices on Project ROI
- Impact of Safety Practices on Injury Rates

**Influence Factors**

- Factors Driving Adoption of Current Safety Management Practices
- Factors Encouraging Future Investment in More Extensive Safety Management Practices
- Factors Discouraging Investment in More Extensive Safety Management Practices
- Top Influential People Impacting Improvement of Safety Management Practices

### **Communication and Education**

- Impact of Safety Training and Orientation on Construction Firm Employees
- Entities that Conduct Safety Training for Jobsite Workers
- Safety Training Conducted Online
- Requiring OSHA 10 and OSHA 30 Training
- Types of Safety Training and Orientation for Jobsite Workers
- Types of Safety Training and Orientation for Foremen and Supervisors

### **Technology and Safety Management**

- Impact of Building Information Modeling (BIM) on Site Safety
- Top BIM Functions for Improving Safety
- Stages in BIM Process at Which Safety Personnel Get Involved
- Use of Mobile Devices on the Jobsite
- Staff Using Mobile Devices
- Impact of Mobile Devices on Safety

### **Building Processes and Safety Management**

- Impact of the Use of Prefabrication and Modularization on Safety
- Aspects of the Use of Prefabrication and Modularization That Contribute to Project Safety
- Specific Safety Training for Green Technologies, Practices or Products

### **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:**

- Darryl C. Hill, ' Construction Safety Management and Engineering '.

## **Sustainability in Construction Projects (Depth Elective - X)**

### **Course Outline**

#### **Fundamentals of Sustainable Building and Design**

- Definition of value management
- The “case” or rationale for green building
- A view of the current state of green building in the
- Region and nationally
- The principles of sustainable design
- An introduction to the practicum project

#### **The Importance of Place: Site, Transportation and Land Use Issues**

- An introduction to sustainable site design
- An understanding of the site planning process
- Sustainable site analysis and conduct a site assessment
- Importance of transportation planning, siting, relationship to sustainability
- Strategies to achieve sustainable transportation patterns and site development

#### **Energy Efficient Design**

- How the design of building energy systems impacts the human experience and the global environment
- The value of contextual, holistic approach to building energy system design
- How a building dynamically interacts with its occupants and the local climate, including renewable energy flows
- Fundamental building energy systems, including
- HVAC and lighting

#### **“Green” Materials Selection**

- Factors in material selection and the issue of trade-offs
- Resources to assist in determining materials appropriateness
- Analytical process to evaluate materials for a project
- Material considerations when using the LEED rating program
- Material considerations when designing a green home

### **Indoor Environmental Quality & Health**

- Benefits of improving indoor environmental quality
- Common indoor air pollutants
- Barriers and solutions to achieving good indoor air
- Implementation issues to help achieve good quality indoor air
- Ventilation system design strategies
- Linkages between health, well-being and productivity
- Physical, psychological and financial benefits of daylight and view

### **Water and Site Design**

- Benefits of adopting a natural systems-based
- Approach
- Sustainable site development patterns
- Impact reduction through landscape layout, plant
- Selection and placement
- Outdoor water conservation strategies and practices
- On-site management methods for storm water and
- Wastewater
- Indoor water conservation

### **Sustainable Job Site Operations**

- Construction waste management, site protection and
- IAQ protection
- Incorporating green building materials
- Planning and practices for sustainable construction
- Building Operations and Maintenance

### **Facility management (FM) functions, duties of FM**

- Department, FM professionals, and FM position in
- Sustainability
- Building Commission (Cx), what it is, how it is
- Accomplished, and its critical importance to the
- Performance of a building
- Effective operations and maintenance
- Effective training programs within a building



**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:**

- J. K. Yates, Daniel Castro-Lacouture, ' Sustainability in Engineering Design and Construction ' .1st Edition

**Green Buildings (Depth Elective - XI)**

**Course Outline**

**Introduction and Overview**

- Shifting Landscape for High-Performance Buildings
- Sustainable Development and Sustainable Construction
- The Vocabulary of Sustainable Development and Sustainable Construction
- Sustainable Design, Ecological Design, and Green Design
- Green Building Progress and Obstacles

**Green Building Foundations**

- Ethics and Sustainability
- Basic Concepts and Vocabulary
- Major Environmental and Resource Concerns
- The Green Building Movement

**Sustainable Design and Green Building**

- Sustainable Design Practices
- Benefits of Sustainably Designed Projects
- Designing High Efficiency Buildings
- Reduce, Reuse, Recycle Building Materials and Natural Resources
- Green Building Practices

## **Ecological Design**

- Design versus Ecological Design
- Historical Perspective
- Contemporary Ecological Design
- Key Green Building Publications: Early 1990s
- Key Thinking about Ecological Design
- Evolving the Concept of Ecological Design

## **Green Building Assessment**

- Major Green Building Assessment Systems Used in the United States
- International Building Assessment Systems

## **The US Green Building Council LEED Building Rating System**

- Brief History of LEED
- Structure of the LEED Suite of Building Assessment Systems
- LEED Credentials
- LEED v4 Structure and Process

## **The Green Globes Building Assessment System**

- Green Globes Building Rating Tools
- Structure of Green Globes for New Construction
- The Green Globes Assessment and Certification Process
- Green Globes Professional Credentials

## **The Green Building Design Process**

- Conventional versus Green Building Delivery Systems
- Executing the Green Building Project
- The Integrated Design Process
- Role of the Charrette in the Design Process

## **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:**

Charles J. Kibert, ' Sustainable Construction Green Building Design and Delivery ', 4th Edition.

**Zero Energy Buildings (Depth Elective - XII)**

**Course Outline**

**Introduction**

- Zero-Energy Buildings
- Boundary Definitions and Energy Flows
- Grid Connections
- Net Zero Site Energy
- Net Zero Source Energy
- Net Zero Energy Costs
- Net Zero Energy Emissions

**Analysis of Zero Energy Building**

- An introduction to sustainable site design
- Analyze the energy uses of a building
- Analyze the local climate and select appropriate measures

**Development of Zero Energy Building**

- Develop an integrated net-zero-energy concept for the building
- Apply a stepped approach to find energy reducing measure
- Example of zero energy buildings from real life

**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:**

- Shady Attia, ' Net Zero Energy Buildings '. 2018.

**Building Maintenance (Depth Elective - XIII)**

**Course Outline**

**Introduction and Safety Procedures in Building Maintenance**

- Building maintenance job skills and employment opportunities
- Identification and proper use of hand and power tools
- Safety instructions, rules and regulations, and safety gears

**General Mathematics for Building Maintenance**

- Mathematical procedures including computations using fractions, decimals, and percentages

**Blueprint Reading**

- The use of blueprints showing building stages from excavation to completion
- Plans, interpret symbols, and identify standard dimensions

**Carpentry**

- Types of construction lumber, installation of studding and joists, and installation and repair of drywall
- Practical applications of carpentry taught include identification of moldings; cutting, mitering, and nailing of finished carpentry projects; installation of interior doors, and sub-flooring

**Painting, Papering, Tiling and Floor Care**

- Classification of paints, preparation of walls and woodwork, and application of paint to these surfaces
- Classification and application of wall coverings and methods of repairing them

## **Electricity**

- Introduction to electrical theory and fundamentals of electrical wiring and repairs approach
- Install light switches, receptacles, doorbells, and light fixtures connect circuits to panel boxes and 220/240-volt lines for large appliances
- Importance of preventive maintenance and how it affects energy consumption and appliance function

## **Plumbing and Pipe Fitting**

- Installation and repair of plumbing fixtures and garbage disposals
- Install pipes and fittings. Cold water supply systems and sewage systems
- Install devices and fixtures that reduce water consumption

## **Air Conditioning**

- Basic air conditioning cycle and how to service window units
- Importance of preventive maintenance and how it directly involves energy saving
- Charge, evacuate, and reclaim refrigerants of window units

## **Heating**

- Function, maintenance, and troubleshooting of heating systems
- Warm air and hot water heating systems
- Importance of energy conservation and green technology as it applies to heating

## **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:**

- Brian Wood, ' Building Maintenance '. Wiley – Blackwell, 2009

## **Multidisciplinary Engineering Courses**

### **Electrical Systems for Buildings**

#### **Course Outline**

- Over view of Electrical system: Electrical system and basic components of Electrical System, Basic Electrical formulas and calculations, Single phase and three phase electrical system.
- Major electrical components for buildings: Wire and types of wires, Cable and types of cables, cable trays/ raceways and their types, Boxes & Panels, Switches, Receptacles, Bus ways, Electrical protection equipment including fuses, Circuits breakers and relays.
- Interior wiring system: Electrical Load Calculations for buildings, Preliminary Work: Planning Your Project, Highlights of the National Electrical Code, Wiring project, Circuit Maps: Common Household Circuits.
- Communication and security systems: Communication spaces and pathways, Design considerations for communications, types of communications cable pathways, Design considerations for communication spaces, Grounding system, Communication cabling system: Types of communication cabling, Design considerations for communications, Material and installation standards, Cable hierarchy, Voice and data communication system: Types of voice communications, Types of data communications system: Terminal-host systems, Local area network (LANs): other data communication systems, video communications systems. Electronic security systems:
- Levels of security, Types of security technologies, Access control/ card entry, Design considerations for card entry systems: Biometric Access control technologies. Intrusion detection, Design considerations for intrusion detection, Closed circuit television.

#### **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:**

- Richard J. Flower Electricity Principles and Application, 7th Edition

**Mechanical Systems for Buildings**

**Course Outline**

- Building Air Systems: Theory, design and application of air transportation systems used in heating, ventilation and air conditioning.
- Building Hydraulic Systems: Theory, design and application of water transportation systems used in building, heating and cooling systems.
- Building Thermal Systems: Theory and application of the thermal energy flow in buildings and building systems (theory of conduction, convection and radiation used in evaluating building thermal energy system).
- HVAC System: Basic components of HVAC systems, Basic HVAC system types, HVAC systems for specific building applications, Space planning considerations, Equipment descriptions.
- Energy conservation Factors. Vertical and Horizontal Transportation; Escalators, Lifts etc.

**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:**

- McConkey, Applied Thermodynamics, 5th edition
- Tao Janis, Mechanical and Electrical Systems in Buildings, 2nd edition

## **Energy Efficient Buildings**

### **Course Outline**

- Energy context
- Physical principles
- Building envelope
- Building services
- Energy Performance Certificate
- Energy Auditing
- Building design best practice
- Compliance and regulation
- Energy Savings Opportunities Scheme (ESOS)
- Software Application: Application of Autodesk Green Building Studio

### **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:**

- Handbook of Energy Efficiency in Buildings, 1st Edition, A Life Cycle Approach by Umberto Desideri Francesco Asdrubal

## **Town Planning**

### **Course Outline**

#### **Town Planning**

- Definitions
- Trends in Urban growth
- Objectives of town planning
- Modern planning in Pakistan and abroad



### **Preliminary Studies**

- Study of natural resources, economic resources, legal and administrative problems
- Civic surveys
- Preparation of relevant maps

### **Land Use Patterns & Street Patterns**

- Various theories of land use pattern
- Location of Parks and recreation facilities
- Public and semi-public buildings
- Civic centers, commercial centers, local shopping centers
- Public schools, industry & residential areas
- Layout of street, road crossing & lighting
- Community planning

### **City Extensions and Urban Planning**

- Sub Urban development
- Neighborhood Units
- Satellite Towns and Garden City
- Issues related to inner city urban design and emergence/upgradation of squatter settlements

### **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:**

- Dan Cruickshank, Sir Banister Fletcher's A History of Architecture, Architectural Press; 20th Edition (September 25, 1996)
- Leonard Benevolo; Origins of Modern Town Planning, MIT Press, 15-Aug-1971

- Sir Rymond Unwin, Town Planning in Practice, FQ Legacy Books (December 31, 2010)

## **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:

- Identify hazards in the home, laboratory and workplace that pose a danger or threat to their safety or health, or that of others.
- Control unsafe or unhealthy hazards and propose methods to eliminate the hazard.
- 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.
- Demonstrate a comprehension of the changes created by WHMIS and OSHA legislation in everyday life.

### **Course Outline:**

#### **Health and Safety Foundations**

- Nature and scope of health and safety
- Reasons/benefits and barriers for good practices of health and safety
- Legal frame work and OHS Management System

#### **Fostering a Safety Culture**

- Four principles of safety- RAMP (Recognize, Assess, Minimize, Prepare)
- Re-thinking safety-learning from incidents
- Safety ethics and rules
- Roles and responsibilities towards safety

- Building positive attitude towards safety
- Safety cultures in academic institutions

### **Recognizing and Communicating Hazards**

- Hazards and Risk
- 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.
- Learning the language of safety: Signs, symbols and labels

### **Finding Hazard Information**

- Material safety data sheets
- Safety data sheets and the GHS (Globally Harmonized Systems)

### **Accidents & Their Effect on Industry**

- Costs of accidents
- Time lost
- Work injuries, parts of the body injured on the job
- Chemical burn injuries
- Construction injuries
- Fire injuries

### **Assessing and Minimizing the Risks from Hazards**

- Risk Concept and Terminology
- Risk assessment procedure
- Risk Metric's
- Risk Estimation and Acceptability Criteria
- Principles of risk prevention
- Selection and implementation of appropriate Risk controls
- Hierarchy of controls

### **Preparing for Emergency Response Procedures**

- Fire
- Chemical Spill
- First Aid
- Safety Drills / Trainings:

- Firefighting
- Evacuation in case of emergency

### **Stress and Safety at Work environment**

- Workplace stress and sources
- Human reaction to workplace stress
- Measurement of workplace stress
- Shift work, stress and safety
- Improving safety by reducing stress
- Stress in safety managers
- Stress and workers compensation

### **Incident Investigation**

- Importance of investigation
- Recording and reporting
- Techniques of investigation
- Monitoring
- Review
- 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**

### **Fine Arts**

#### **Course Outline**

- Study of Basic concept of Fine Arts, the basic visual elements such as line, shape form etc., that together create visual image.
- Study of principles of Art, Unity Balance Harmony etc.
- Division of lines in different equal proportion and mean proportion, implementation of lines.
- Study of composition /importance of composition, Composition or Layout through the arrangements of the various elements of art.
- Study of perspective one /two
- Study of shading with concept of Light and Dark
- Study of basic concept of colors, how to handle textural tonal /color qualities
- Introduce the Material /Medium, Pastels and Water color.

#### **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:**

- The Story of Art by E.H. Gombrich
- Art through ages, 15th Edition by Helen Gardner

## **History of Building Technology**

### **Course Outline**

- A history of development of various cultures and civilizations from the pre-historic to the present-day world with emphasis on building types Egyptian Architecture: Persian empire, Origins and development of Persian art and architecture, example of architecture (Palaces, Temples, Tombs) and city planning Mesopotamian Architecture: Characteristics of the valley of the river Tigris and Euphrates, people and their culture, Influences on the art and architecture of Mesopotamia. Examples of Architecture (palaces, temples and ziggurats) and city planning.
- Indus Valley Civilization: Its location, influences on art and architecture, examples of the Indus valley architecture and city planning.
- European Civilization & its Buildings: Greek Period: Greek civilization, location and influences on its architecture, Hellenic and Hellenistic Greece, Example of Greek architecture.
- Roman Period: Roman civilization and empire, Influences on its art and architecture, Examples of Roman architecture. Roman architecture and its unity in the Empire. Romanesque and Gothic period: Medieval period in Europe, Feudal system, Dominance of clergy, Church and Monarch. Renaissance Period: Renaissance and the emergence of mercantile society in Italy, City states, Guilds, The influence of Islam through Spain, Developments in art and architecture during this period. Examples of architecture and city planning development of Romanesque architecture in Europe. Industrial revolution in Europe; Rise of Europeans as world leaders and colonization of the countries of the Islamic world.
- Muslim Civilization: location and influences on its architecture, Building types, A brief survey of architectural developments during Umayyad, Abassid, Fatmid, Spanish, Ottoman, Persian and Mughal dynasties.
- Modern Civilization: Developments in architecture Colonial period in Colonies and their impact on Traditional architecture. Examples of colonial architecture from North Africa and Indian sub-continent Modern Movement in Architecture, Post Modern Architecture, Deconstruction

**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:**

- Owen Hopkin, Architectural styles a visual guide, 2014

## **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 Outline**

- 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:

1. The students will be able to write technically correct statements, assignments, final year project report, project proposal, short report and research paper
2. The students would be able to their write CV, cover letter and business/ professional Correspondence meeting all criteria
3. 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:

1. To comprehend basic concepts of Linear Algebra and optimization
2. 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**

- 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
- 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**

- 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
- 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**

- Formulation of a single RLC circuit, Spring mass systems, Earthquake model of a single story building



- Bungee Jumper model, Bridge collapse problem etc.

### **Analytical Methods of Solution for Second-order ODEs**

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

### **Series Solution for Second-order ODEs**

- Series solution of ODEs and convergence tests
- Series solution of Legendre equation, Frobenius method of solution for Bessel equation and related applications

### **Laplace Transform**

- Laplace Transform, Derivation of Basic formulae, Inverse Laplace Transform, First shift theorem
- 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
- Application of Laplace transform to a system of ODEs and related applications

### **Partial Differential Equations**

- Partial Differential Equations and their types, Applications of partial differential equations in Engineering
- Method of Separation of Variables Method (MSVM) and solution of wave equation by the MSVM
- 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**

- 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
- 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**

- 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
- 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**

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

### **Iterative Methods for Linear and Nonlinear Equations**

- Numerical Solution of nonlinear equations: Bisection method, Newton's method, Secant method, Convergence analysis of these methods
- Newton's method for system of nonlinear equations
- 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**

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

### **Numerical Methods for Computing Eigenvalues**

- Eigenvalues and Eigenvectors of matrix: power method,
- Inverse power method, Shifted inverse power method.

- Applications of eigenvalues in engineering disciplines.

### **Numerical Optimization**

- Unconstrained Optimization,
- Golden search ratio, Lagrange Multipliers,
- Method of steepest descent
- 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**

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

### **Data Presentation**

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

### **Measure of Central Tendency**

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

### **Measure of Dispersion**

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

### **Simple Regression, Correlation and Curve Fitting**

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

### **Probability and Random Variables**

- Probability review, Laws of probability, Conditional probability, Bayesian theorem, independent, dependent events.
- Random variables, Discrete and Continuous random variables, Probability mass and density functions, Distribution functions, Mathematical expectation,

- Variance of random variable, Bivariate distribution, Joint probability distribution, Moment generating function

### **Probability Distributions**

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

### **Sampling and Sampling Distributions**

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

### **Statistical Inference and Testing of Hypothesis**

- Introduction to inferential statistics, Estimation, hypothesis testing of population mean, proportion,
- 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:**

- Review of complex numbers, Complex valued functions, Elementary functions (exponential and logarithmic functions, Trigonometric and hyperbolic functions and their inverses),
- Limits and continuity,
- Applications in Engineering

#### **Complex Differentiation and Integration:**

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

#### **Power Series:**

- Taylor Series, Laurent Series, Singularities, Zeros and poles, Residue integration method, Residue theorem,
- Conformal mapping

**Laplace Transformation:**

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

**Special functions and Fourier Transforms:**

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

**Z-Transformation:**

- Z-transform, Properties of Z-transform, linearity and scaling, Standard Z-transform, Inverse Z-transform,
- Inverse Z- transform by using residue, convolution theorem of Z-transform,
- 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. Jewett, Jr. Physics for Scientists and Engineers with modern Physics, 9th 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, chemical reaction types, precipitation, acid-base, oxidation state; molarity, limiting reactants, and product yields.

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

**Suggested Books:**

- Chemistry, The Molecular Nature of Matter and Change with Advanced Topics Martin S. Silberberg and Patricia G. Amateis, McGraw-Hill Education, 8th Edition (2017)
- Chemistry, The Central Science, Theodore L. Brown et al. 13th Edition (2014)
- Applied Chemistry: A textbook for Engineers and Technologists by Roussak and Gesser (2013)
- General Chemistry by Donald A. McQuarrie et al , 4th ed. (2011)

- Water Chemistry, Stanley E. Manahan, CRC Press (2011)
- Environmental Chemistry, Colin Baird and Michael Cann, 3rd Edition (2005)
- General Chemistry, Kenneth W. Whitten et al. 6th Edition (2000)
- Chemistry: The Molecular science, Olmsted and William (1994)
- Engineering Materials 1: An Introduction to Properties, Applications and Design, Fifth Edition, David R. H. Jones and Michael F. Ashby (2018)
- Engineering Materials 2: An Introduction to Microstructures and Processing, Fourth Edition, Michael F. Ashby and David R. H. Jones (2013)

## **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**

- Extent to which development intends to sensitize societal and under-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, I., and Houkes, W. latest edition. A Philosophy of Technology: From Technical 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 edition.

## **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:**

- Fincham, 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 Verses 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 دروس قرآن 52 (Karachi: Islamic Research Academy, 7<sup>th</sup> ed., 2017).
- Sayyid Hasan-uddin Ahmad, تعلیمات قرآنی 2-vols., (Karachi: Jasarat Publications, 1998).
- Muhammad Shafī' معارف القرآن (Karachi: Dar-ul-Isha'at, 2000).
- Sayyid Abu'l A'la Mawdūdī, تفہیم القرآن 6vols., (Lahore: Islamic Publications, 1998). [Preambles of all (114) chapters.]
- Amin Ahsan Islahi, تدبر القرآن (Lahore: Farān Publications, 2005).
- Khawaja Abdul Waheed, موضوعات قرآن و انسانی زندگی (Islamabad: Islamic Research Institute, 3<sup>rd</sup> ed., 1997).
- Khurram Murad, رب کا پیغام (Lahore: Manshūrat, Mansoor, 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](http://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 Perspectives**

### **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**

#### **1. 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

#### **2. 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

#### **3. 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

#### **4. 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

**5. 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

**6. 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

**7. 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](http://www.pc.gov.web/sdg/sdgpak)
- Economic Survey of Pakistan- [http://finance.gov.pk/survey\\_1617.html](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](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 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. The management of engineering. New York: Wiley.
- Cleland, David. Field guide to project management. New York: Wiley.
- Eisner, H. Essentials of project management and systems engineering management. New York: Wiley.
- Frame, J. D. Managing projects in organizations. San Francisco: Jossey-Bass
- Goldratt, Eliyahu. Critical chain. North River Press.
- Haynes, M.E. Project management: From idea to implementation. Los Altos, CA: Crisp Publications.
- Lewis, James, Project planning, scheduling & control. New York: McGraw-Hill
- Lewis, James, P. Mastering project management. New York: McGraw-Hill
- Lientz, Bennet & Rea, Kathryn. Project management for the 21st century. San Diego: Academic Press.

- Miller, Roger & Lessard, Donald. The strategic management of large engineering projects. Cambridge, MA: MIT Press.
- Nicholas, J.M. Managing business & engineering projects. Englewood Cliffs, NJ: Prentice Hall.
- Shtub, Avraham, Bard, Jonathan, & Globerson, Shlomo. Project management: Engineering, technology, and implementation. Englewood Cliffs, Prentice-Hall.
- Project Management by Adrienne Watt
- J.R. Meredith and S.J. Mantel. Project Management: A Managerial Approach. John Wiley and Sons. New York. (Reference).

## **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 2010
- William D. Bygrave and Andrew Zacharak, Entrepreneurship 2nd Edition, Wiley, 2012.
- Entrepreneurship by Hisrich, McGraw- Hill, 2009
- Principles of Marketing, Cotrell McGraw- Hill 2012
- Paul Burns and Jim Dew Hurst: Small Business and Entrepreneurship
- P.N. Singh: Entrepreneurship for Economic Growth
- Peter F. Drucker: Innovation and Entrepreneurship Peter F. Drucker
- John B. Miner: Entrepreneurial Success
- "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
- "Entrepreneurial Marketing," Lessons from Wharton's Pioneering MBA Course, Morgan, H. L., A. Kallianpur, and L. M. Lodish, John Wiley & Sons, 2001

## **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 Odonnell 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:**

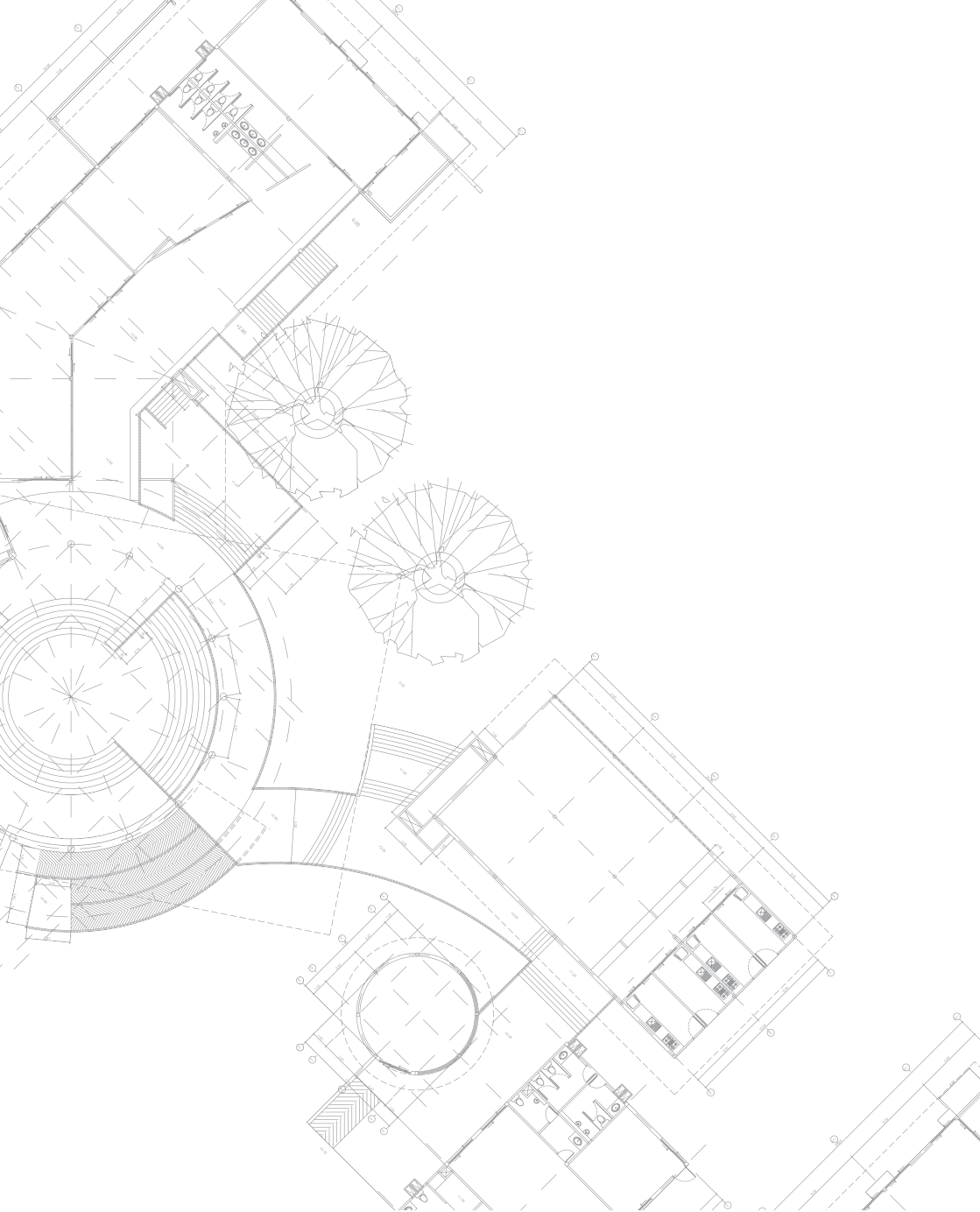
Mid Term, Report writing/ Presentation, Assignments, Project Report, Quizzes, Final Term

### **Suggested Books:**

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







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

