CURRICULUM

OF

CIVIL ENGINEERING

FOR

BACHELOR'S & MASTER'S DEGREE

(Revised 2017)

HIGHER EDUCATION COMMISSION
ISLAMABAD

CURRICULUM DIVISION, HEC

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Composed by: Mr. Zulfiqar Ali, HEC, Islamabad

PREFACE

The curriculum, with varying definitions, is said to be a plan of the teaching-learning process that students of an academic programme are required to undergo to achieve some specific objectives. It includes scheme of studies, objectives & learning outcomes, course contents, teaching methodologies and assessment/ evaluation. Since knowledge in all disciplines and fields is expanding at a fast pace and new disciplines are also emerging; it is imperative that curricula be developed and revised accordingly.

University Grants Commission (UGC) was designated as the competent 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).

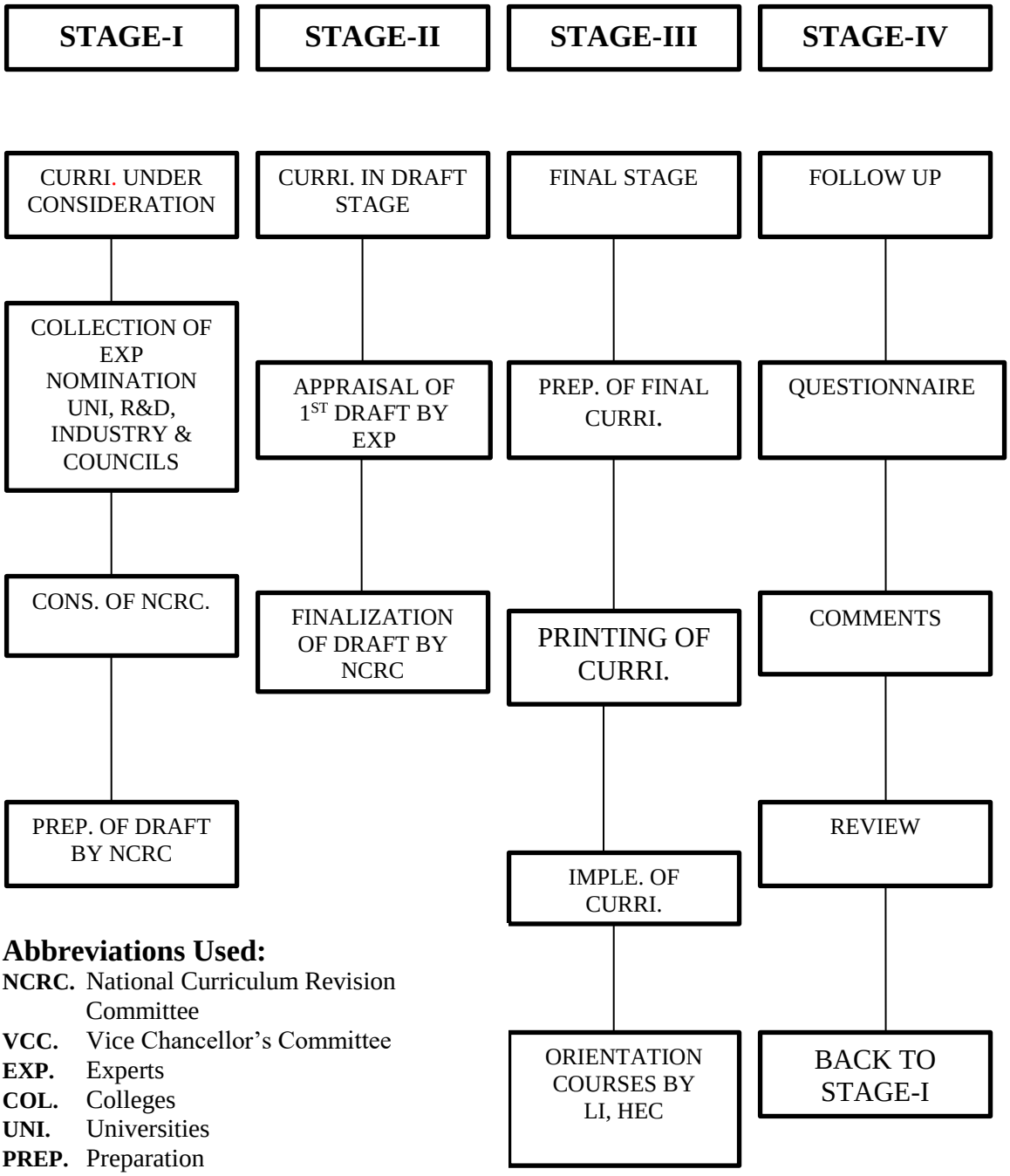
In compliance with the above provisions, the Curriculum Division of HEC undertakes the revision of curricula regularly through respective National Curriculum Revision Committees (NCRCs) which consist of eminent professors and researchers of relevant fields from public and private sector universities, R&D organizations, councils, industry and civil society by seeking nominations from their organizations.

In order to impart quality education which is at par with indigenous needs and international standards, HEC NCRCs have developed unified framework/ templates as guidelines for the development and revision of curricula in the disciplines of Basic Sciences, Applied Sciences, Social Sciences, Agriculture and Engineering.

It is hoped that this curriculum document, prepared by the respective NCRC’s, would serve the purpose of meeting our national, social and economic needs, and it would also provide the level of competency specified in Pakistan Qualification Framework to make it compatible with international educational standards. The curriculum is also placed on the website of HEC
http://hec.gov.pk/english/services/universities/RevisedCurricula/Pages/default.aspx

(Muhammad Raza Chohan)
Director General (Academics)

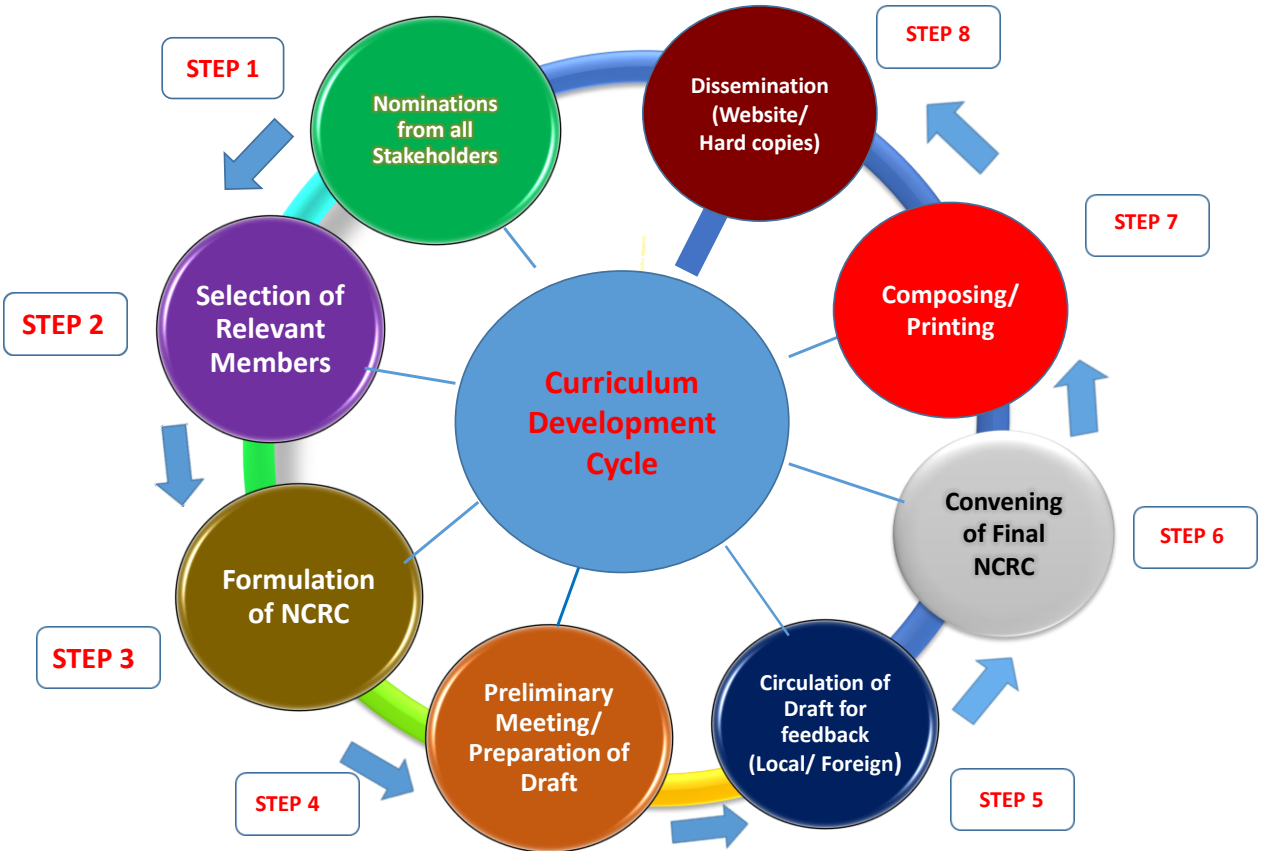
CURRICULUM DEVELOPMENT



Abbreviations Used:

NCRC. National Curriculum Revision Committee
VCC. Vice Chancellor's Committee
EXP. Experts
COL. Colleges
UNI. Universities
PREP. Preparation
REC. Recommendations
LI Learning Innovation
R&D Research & Development Organization
HEC Higher Education Commission
CONS: Constitution

CURRICULUM DEVELOPMENT CYCLE



MINUTES OF FINAL MEETING:

The final meeting of National Curriculum Revision Committee (NCRC) in the discipline of Civil Engineering (BS & MS Programmes) was held from 08-10 May, 2017 (03 days) at Higher Education Commission (HEC), Regional Centre, Lahore. Experts from academia and industry as well as entrepreneurs participated in the meeting. Dr. Muhammad Idrees (Director, Academics Division, HEC, Pakistan) coordinated the meeting. The list of the participants of final meeting is as below:

S. N	Name & Institution	Position
1	Prof. Engr.Dr. Hamza Farooq Gabriel **(Convener)** Professor / HoD, NUST Institute of Civil Engineering, National University of Sciences& Technology, H-12, Kashmir Highway, Islamabad.	Convener
2	Prof. Engr.Dr. Habib-ur-Rehman Mughal **(Secretary)** Professor,Department of Civil Engineering,University of Engineering & Technology, Lahore.	Secretary
3	Prof. Engr. Dr. Qaiser uz Zaman Khan Professor, Faculty of Civil & Environmental Engineering, Department of Civil Engineering, University of Engineering & Technology, Taxila.	Member
4	Prof. Engr. Dr. Abdul Jabbar Sangi, Professor, Department of Civil Engineering, NED University of Engineering & Technology, University Road, Karachi.	Member
5	Prof. Engr. Dr. M.A.Q Jahangir Durrani Dean, Iqra National University, Phase-II, Hayatabad, Peshawar	Member
6	Engr. Dr. Majid Ali, Associate Professor, Department of Civil Engineering, Capital University of Science & Technology, Kahuta Road, Zone-V, Islamabad.	Member
7	Engr. Dr. Shaukat Ali Khan Associate Professor, HoD, Department of Civil Engineering Abasyn University, Peshawar	Member
8	Engr. Dr. Rao Arsalan Khushnood, Assistant Professor, NUST Institute of Civil Engineering, National University of Science & Technology, H-12, Kashmir Highway, Islamabad.	Member
9	Engr. Dr. Farrukh Arif, Assistant Professor, Department of Civil Engineering, NED University of Engineering & Technology, University Road, Karachi.	Member

10	Engr. Dr. Muhammad Irfan ul Hassan Assistant Professor, Department of Civil Engineering, University of Engineering & Technology, Lahore.	Member
11	Engr. Abdul Qadeer General Manager NESPAK, Islamabad.	Member
12	Dr. Muhammad Idrees **(Coordinator)** Director Academic, Higher Education Commission, Islamabad	Coordinator

List of members who attended preliminary meeting held from November 30 to December 2 2016 (03 days) at HEC Regional Center, Peshawar but could not attend final meeting due to their personal engagements during these dates is as below:-

1	Engr. Dr. Mohammad Ashraf. Associate Professor, Department of Civil Engineering, University of Engineering & Technology, Peshawar.	Member
2	Engr. Dr. Qaiser Iqbal, Assistant Professor, Department of Civil Engineering, Sarhad University of Science & Information Technology, Peshawar.	Member
3	Engr. Zulfiqar Ali, Assistant Professor, Department of Civil Engineering, Balochistan University of Engineering & Technology, Khuzdar.	Member

List of members who had not attended the preliminary meeting but attended final meeting is as below:-

1	Prof. Engr. Dr. Abdul Sattar Shakir, Dean, Faculty of Civil Engineering, University of Engineering & Technology, Lahore.	Member
2	Prof. Engr. Dr. Khalid Farooq Director, Geotechnical Engineering Laboratory Department of Civil Engineering,University of Engineering & Technology, Lahore.	Member
3	Prof. Engr. Dr. Ammad Hassan Khan Chairman, Department of Transportation Engineering and Management, University of Engineering & Technology, Lahore.	Member

NCRC Agenda

The agenda of NCRC for Civil Engineering was as follows:

1. To revise/finalize the Civil Engineering curriculum (2012) for Bachelor's and Master's Programmes according to indigenous needs and to bring it at par with international standards.

2. To revise/finalize preface, mission, vision, preamble, and rationale of the subject.
3. To revise/finalize objectives/learning outcomes, list of contents and assessment criteria (formative & summative) and align these with undergraduate programmes (vertical approach) and other Master's programmes (horizontal approach).
4. To incorporate/finalize latest reading materials/references (local & international) for every course.
5. To revise/finalize course contents keeping in view the uniformity across other disciplines and avoiding overlapping.
6. To make recommendations for promotion/development of the discipline, keeping in view the futuristic needs of the society and international trends.

The meeting started with recitation from the Holy Quran. Dr. Muhammad Idrees, Director, Academics Division, HEC, Islamabad welcomed the participants. All the participants introduced themselves highlighting their qualification, experience and area of expertise within the discipline of Civil Engineering. Keeping with the tradition, Dr. Muhammad Idrees, Director Academics Division, HEC, Islamabad suggested the house to opt the Convener and Secretary of the preliminary NCRC for smooth functioning which was unanimously agreed.

Dr. Muhammad Idrees presented the agenda and objectives of the NCRC. He highlighted the importance of this meeting and emphasized for adaptation of general rules of curriculum development and revision like scope of the subject/programme, horizontal & vertical alignment, rule of flexibility and adaptability keeping in view the futuristic approach, market value/job market and societal needs. He also shared a template for revising/updating the curricula. The template was unanimously accepted to be followed.

In next session the house openly discussed the nomenclature of the discipline, preface, vision, mission, programme educational objectives (PEOs), programme learning outcomes (PLOs), course learning outcomes (CLOs), methods of instruction and learning environment, assessment and operational framework. After long deliberation, the committee finalized the above said segments of the curriculum. Similarly, framework/scheme of studies of undergraduate 4-years programme for Civil Engineering was discussed and finalized keeping in view the duration of the programme, number of semesters, number of weeks per semester, total number of credit hours, number of credit hours per semester, weightage of engineering and non- engineering courses and weightage of theory and practical. Furthermore, list of courses (core & elective) and semester wise breakup of courses were also discussed thoroughly and the same was unanimously finalized.

In the afternoon session, admission criteria/intake criteria was discussed and finalized. After that the list of courses was distributed among the committee members keeping in view the experience and expertise in the field for reviewing/finalizing course objectives, adding learning outcomes, updating list

of contents, adding teaching-learning methods and assessment, and updating bibliography/ references/ suggested books.

On second day, task assigned to the groups was displayed and discussed the addition/deletion and revising the courses. After through deliberation, draft curriculum of the Undergraduate/Bachelor's (BE/BSc./BS) (4-year) for Civil Engineering was finalized.

On third day, the courses of Postgraduate (ME/MSc/MS/MEM) programme of Civil Engineering was reviewed and after through discussion list of courses were finalized.

In the end, Dr. Idrees thanked the Convener, Secretary and all members of the Committee for sparing their time and for their contribution to prepare the final draft of the curriculum. The Convener of the NCRC also thanked the Secretary and members for their inputs in revising/updating the curriculum to make it more practical, competitive, efficient and realistic. The committee highly appreciated the efforts made by the officials of HEC Regional Centre, Lahore for making arrangements to facilitate the committee and their accommodation. The meeting ended with the vote of thanks to Dr. Muhammad Idrees and his team from HEC for providing this academic and professional opportunity for national cause.

RECOMMENDATIONS BY NCRC

Recommendations for Undergraduate Programme

1. To make better understanding of the students towards reinforced concrete, presently available 02 courses may be enhanced to 03 courses. One additional course of 'Concrete Technology' may be added. The other two subjects should be 'Reinforced Concrete Design-I' and 'Reinforced Concrete Design-II'. Currently, the course was not added due to limitation of total credit hours.

2. Course of 'Design of Structures' may be considered to be accommodated in the syllabus of civil engineering in forthcoming NCRC meeting.

3. For having expert opinion on courses of 'Islamic Studies' and 'Pakistan Studies', relevant experts may be invited in the next NCRC meeting.

4. More elective courses in core civil engineering streams may be incorporated.

5. Considering the global warming issue, topic of 'Climate Change' may be included in the existing 'Environmental Engineering-II' course.

RECOMMENDATIONS FOR POSTGRADUATE PROGRAMME

1. NCRC should also develop and update the curriculums (course outlines) for the postgraduate programmes, for which separate field of specialization based committees should be constituted.
2. Faculty involved in teaching the post graduate evening programmes should be furnished with separate reasonable financial incentives.
3. To promote research culture in the country, research based masters programs should also be encouraged.
4. Laboratory / Design work should be ensured in subjects where required.

General Recommendations for Civil Engineering Discipline

1. Bachelor programs which are off shoots of Civil Engineering should be included for Curriculum revision through NCRC meeting of Civil Engineering Program.
2. HEC may facilitate Continuous Professional Development (CPD) program in collaboration with institutions like; Pakistan Engineering Council (PEC), Institute of Engineers Pakistan (IEP), and Pakistan Engineering Congress (PEC).
3. The NCRC recommends that all new programmes may be regularized following the accrediting authority's requirements.
4. Every academic institution should have an Academic Calendar to be strictly followed throughout the academic year.
5. Use of available software(s) for engineering applications should be encouraged.
6. Internship / training of 4-6 weeks should be considered necessary.
7. HEC should facilitate for publication of textbooks for each course designed by National Curriculum Review Committee.
8. There should be Directorate of Industrial Liaison/Placement Bureau in every engineering institution/university working in coordination with HEC to promote, facilitate training/career opportunities for its students.
9. Renowned specialists from the academia/industries may be invited as guest speakers for extension lectures covering latest developments in the field.
10. Field visits to significant installations and infrastructure facilities should be arranged for students on regular basis.

Prof. Dr. Hamza Farooq Gabriel **(CONVENER)----------**

Prof. Dr. Habib-ur-Rehman Mughal **(SECRETARY)----------**

Dr. Muhammad Idrees **(COORDINATOR)----------**

VISION:

To strengthen teaching, research and innovation in Civil Engineering by producing human capital that delivers professional services and leadership contributing for sustainable development.

MISSION:

To impart high quality Civil Engineering education through modern teaching and tools for socioeconomic development so as to produce graduates who are prepared to lead and excel as professionals.

PREAMBLE:

The Civil Engineering programme provides the necessary technical skills in engineering design/analysis as well as mathematics and basic sciences consistent with Higher Education Commission (HEC) and Pakistan Engineering Council (PEC) accreditation standards and national development needs. A Civil Engineering graduate would be able to undertake planning, design, construction, operations and maintenance of urban and rural infrastructure by applying his/her knowledge in all stages of Civil Engineering and inter-disciplinary projects.

The curriculum design is a critical component and backbone of the educational structure in any nation. Curriculum is one of the key representative yardstick through which the stage and pace of socio-economic development of a nation can be assessed. The advent of new technology has turned the world into a global village. In view of tremendous research taking place world over new ideas and information is being added at a rapid pace making it imperative to update the curricula at regular intervals, for introducing latest development and innovation in the relevant field of knowledge.

RATIONALE

Considering the recent advancements in the science and technology and their impacts in the field of Civil Engineering, coupled with contemporary requirements of Outcome Based Education (OBE), there is a dire need to update the curriculum of BE/BSc/BS and ME/MSc/MS/MEM Civil Engineering programs.

SCOPE

The scope of the document is to provide minimum standards and guidelines for the development, delivery and assessment of the curriculum of Civil Engineering programs. The guideline areas include; Program Educational Objectives (PEOs), Program Learning Outcomes (PLOs), Course Objectives, Course Learning Outcomes (CLOs) of core courses, scheme of studies, course outlines, credit hours distribution, suggested assessment methods, and recommendations.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Following are the sample program educational objectives that are expected to be exhibited by the civil engineers after 3-5 years of their graduation.
Civil engineering professionals will:

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

Note: *Institutions are expected to customize their own PEOs for their respective program requirements.*

PROGRAM LEARNING OUTCOMES (PLOs)

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

The sample Program Learning Outcomes (PLOs) of Civil Engineering are based on graduate attributes of PEC Accreditation Manual 2014 and are given below:

- **PLO-01: Engineering Knowledge:** Ability to apply knowledge of mathematics, science and engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
- **PLO-02: Problem Analysis:** Ability to identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
- **PLO-03: Design/Development of Solutions:** Ability to design solutions for complex engineering problems and design systems, components, or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, and environmental considerations.
- **PLO-04: Investigation:** Ability to investigate complex engineering problems in a methodical way including literature survey, design and conduct of experiments, analysis and interpretation of experimental data, and synthesis of information to derive valid conclusions.
- **PLO-05: Modern Tool Usage:** Ability to create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modeling, to complex engineering activities, with an understanding of the limitations.

- **PLO-06: The Engineer and Society:** Ability to apply reasoning informed by contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice and solution to complex engineering problems.
- **PLO-07: Environment and Sustainability:** Ability to understand the impact of professional engineering solutions in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
- **PLO-08: Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.
- **PLO-09: Individual and Team Work:** Ability to work effectively, as an individual or in a team, on multifaceted and/or multidisciplinary settings.
- **PLO-10: Communication:** Ability to communicate effectively, orally as well as in writing on complex engineering activities with the engineering community and with society at large, such as being able to comprehend and write effective reports and design documentations, make effective presentations, and give and receive clear instructions.
- **PLO-11: Project Management:** Ability to demonstrate management skills and apply engineering principles to one's own work, as a member and/or leader in a team to manage projects in a multidisciplinary environment.
- **PLO-12: Lifelong Learning:** Ability to recognize importance of, and pursue lifelong learning in the broader context of innovation and technological developments.

COURSE LEARNING OUTCOMES (CLOs)

The course learning outcomes (CLOs) are linked to the PLOs and communicated by the given course content. CLOs are directly assessed from:

- ✓ One Hour Tests (OHTs) / Midterm Tests
- ✓ End Semester Exam (ESE)
- ✓ Lab Reports
- ✓ Complex Engineering Problems

Guidelines for CLOs' domain and levels are given in **Appendix-1**. For further details, please refer to PEC Accreditation Manual 2014.

METHODS OF INSTRUCTIONS AND LEARNING ENVIRONMENT

This shall comprise the following:-

- Classroom lectures, duly supported by audio-visual aids, demonstrations and relevant handouts
- Assignments and tutorials requiring use of reference materials and internet facility
- Homework load for the students should be rationalized considering the credit hours and nature of the course

- Semester projects and class presentations
- Laboratory experiments and design exercises
- Complex Engineering Problems as assignments (CEPs)
- Final year projects (FYPs)
- Field works such as survey camp, community services and internship
- Instructional visits to appropriate establishments, installations, construction sites, field stations, industries etc.
- Extension lectures and class room discussions by renowned professionals
- Enhanced use of modern computing facilities in the institutions
- The notebooks/field books/graphs and drawing sheets pertaining to the field work and practical should be completed within the allocated time and submitted to the teacher. In case of field visit, the students shall be required to write a visit report

ASSESSMENT

1. Classroom attendance, class assignments, class tests, homework assignments, quizzes, viva voce, presentations etc., should be considered for the award of sessional marks.

2. Structured rubrics are encouraged to be used for the assessment of Laboratory work, class performance, Complex Engineering Problems (CEPs), field survey, semester projects and Final Year Project (FYP).

3. The academic pursuit and achievements of a student in a semester/academic year are to be evaluated by holding semester examinations.
4. Final year courses may be evaluated by external/neutral examiners, in addition to internal examiner.
5. Final year projects shall preferably be evaluated by both external and internal examiners.

OPERATIONAL FRAMEWORK

1. Following the HEC guidelines, an operational framework is developed which includes both engineering and non-engineering courses as detailed in summary table titled "**BSc/BE/BS CIVIL ENGINEERING PROGRAMME".**

2. Every Engineering University in Pakistan covers different areas in respect of professional civil engineering applications. However, objectives of Bachelor of Civil Engineering Courses are same. Considering this aspect, the courses

suggested are such that the civil engineering graduates from all universities are at par and at the same time be prepared to meet the national and international requirements. The curriculum designed has the room for individual universities to adjust courses as per their local requirements.

3. **Number of contact hours:** The contact hours for study of courses are kept for university to university, considering the variation in local requirements. The following scheme is recommended:

    a. 1 credit hour of theory class = 1 contact hour
    b. 1 credit hour of lab / design class / practical = 3 contact hours

4. The evaluation of the students will be made on the basis of grading system in-line with the guidelines of the HEC.

5. **Course Contents:** Course contents of each course are being provided as guidelines to meet the requirement of uniformity. However, the universities are at liberty to formulate their respective course plans.

6. **Practical/Design Classes/Field Work:** The Laboratory Experiments/ Practical/Design Classes/Field Works shall be in conformance with the contents of the respective course.

FRAMEWORK FOR 4-YEAR IN
BSc/BS/BE CIVIL ENGINEERING PROGRAMME

Duration: 4 years
Number of Semesters 8
Number of weeks per semester: 18 (16 for teaching and 2 for examinations)
Total number of credit hours: 136
Number of credit hours per semester: 14-20
Engineering Courses: 70 per cent
Non-Engineering Courses: 30 per cent

Non-Engineering Domain							
Knowledge Area	**Sub Area**	**Name of Course**	**Lec CH**	**Lab CH**	**Credit Hours**	**Total Courses**	**Total Credit**
Humanities	English	Functional English	2	0	2	2	5
		Business Communication	2	1	3		
	Culture	Islamic Studies	2	0	2	2	3
		Pakistan Studies	1	0	1		
	Social Sciences &Ethics	Professional Ethics	2	0	2	2	5
		Social Science Elective	3	0	3		
Management Sciences	Professional Practice	Construction Management	2	1	3	3	8
		Engineering Economics	2	0	2		
		Management Science Elective Course	3	0	3		
Natural Sciences	Math	Applied Calculus/ Math-I	3	0	3	7	20
		Applied Differential Equations/Math-II	3	0	3		
		Numerical Analysis/Math-III	3	0	3		
		Probability & Statistics/Math-IV	2	1	3		
	Physics	Engineering Mechanics	3	1	4		
	Earth Sciences	Engineering Geology	2	0	2		
		Geo Informatics	1	1	2		
Total						16	41

Lec CH: Lecture Credit Hours Lab CH: Laboratory Credit Hours

Engineering Domain							
Knowledge Area	**Sub Area**	**Name of Course**	**Lec CH**	**Lab CH**	**Credit Hours**	**Total Courses**	**Total Credits**
Computing	Fundamentals	Computer Programming	1	2	3	3	9
	Estimation	Quantity & Cost Estimation	2	1	3		
	Design	Civil Engg. Drawing & Graphics	1	2	3		
Engineering Foundation	--	Civil Engg Materials	2	1	3	9	29
		Engineering Drawing	1	2	3		
		Engineering Surveying	2	1	3		
		Mechanics of Solids-I	2	1	3		
		Structural Analysis-I	3	0	3		
		Soil Mechanics	3	1	4		
		Fluid Mechanics	3	1	4		
		Construction Engineering	3	0	3		
		Engineering Hydrology	2	1	3		
Major Based Core (Breadth)	--	Advanced Engineering Surveying	2	1	3	6	20
		Advanced Fluid Mechanics	3	1	4		
		Reinforced Concrete Design-I	3	1	4		
		Environmental Engineering- I	2	1	3		
		Transportation Engineering-I	3	0	3		
		Structural Analysis-II	3	0	3		
Major Based Core (Depth)	--	Reinforced Concrete Design-II	3	1	4	7	24
		Mechanics of Solids-II	2	1	3		
		Geo Technical & Foundation Engineering	3	1	4		
		Transportation Engineering-II	3	1	4		
		Environmental Engineering-II	2	0	2		
		Steel Structures	3	0	3		

Knowledge Area	Sub Area	Name of Course	Lec CH	Lab CH	Credit Hours	Total Courses	Total Credits
		Hydraulics & Irrigation Engineering	3	1	4		
Inter-Disciplinary Engineering Breadth (Electives)	--	Basic Electro-Mechanical Engineering	2	2	4	2	7
		Architecture & Town Planning	3	0	3		
Civil Engineering Project	--	Civil Engineering Project	0	3	3	1	6
		Civil Engineering Project	0	3	3		
Total						28	95

SUMMARY-CIVIL ENGINEERING

Domain	Knowledge Area	Total Courses	Total Credit Hours	% Overall
Non-Engineering	Humanities	6	13	30
	Management Sciences	3	8	
	Natural Sciences	7	20	
	Sub Total	**16**	**41**	
Engineering	Computing	3	9	70
	Engineering Foundation	9	29	
	Major Based Core (Breadth)	6	20	
	Major Based Core (Depth)	7	24	
	Inter-Disciplinary Engineering Breadth (Electives)	2	7	
	Civil Engineering Project	1	6	
	Industrial Training/Internship (Summer)	0	0	
	Sub Total	**28**	**95**	
Total		**44**	**136**	100.00

Student Induction Criteria

HEC has set the following minimum requirements for admission in the program

- 60% marks in HSSC/FSc (Pre-Engineering) / Equivalent Qualification
- Qualifying the Entry Test

Institutions are expected to have well laid-out and transparent procedure to compute overall merit for admission in the program.

SCHEME OF STUDIES
OF CIVIL ENGINEERING FOR
BSc/BS/BE LEVEL

Course No	Course Outline	Knowledge Area	Sub Area	Credit Hours (Theory + Practical)	Contact Hours (Theory + Practical)	Total Credit Hours
SEMESTER-I						
1	Civil Engineering Materials	Engineering Foundation	F-I	2+1	2+3=5	3
2	Basic Electro-Mechanical Engineering	IDEE	IDEE-I	2+2	2+6=8	4
3	Engineering Drawing	Engineering Foundation	F – II	1+2	1+6=7	3
4	Functional English	Humanities	English-I	2+0	2+0=2	2
5	Applied Calculus / Maths-I	Natural Sciences	Math-I	3+0	3+0=3	3
6	Pakistan Studies	Humanities	Culture-I	1+0	1+0=1	1
				11+5	**11+15**	**16**
SEMESTER-II						
7	Engineering Surveying	Engineering Foundation	F – III	2+1	2+3=5	3
8	Engineering Geology	Natural Sciences-I	Elective-I	2+0	2+0=2	2
9	Islamic Studies	Humanities	Culture-II	2+0	2+0=2	2
10	Engineering Mechanics	Natural Sciences	Physics	3+1	3+3=6	4
11	Applied Differential Equations / Maths-II	Natural Sciences	Math-II	3+0	3+0=3	3
				12+2	**12+6**	**14**
SEMESTER-III						
12	Computer Programing	Computing	Fundamentals	1+2	1+6=7	3
13	Civil Engg. Drawing & Graphics	Computing	Design	1+2	1+6=7	3
14	Advanced Engineering Surveying	Breadth	B – I	2+1	2+3=5	3
15	Mechanics of Solids-I	Engineering Foundation	F – IV	2+1	2+3=5	3
16	Engineering Economics	Management Sciences	Management Science	2+0	2+0=2	2
				8+6	**8+18**	**14**

Course No	Course Outline	Knowledge Area	Sub Area	Credit Hours (Theory + Practical)	Contact Hours (Theory + Practical)	Total Credit Hours
SEMESTER-IV						
17	Construction Engineering	Engineering Foundation	F-VIII	3+0	3+0=3	3
18	Structural Analysis-I	Engineering Foundation	F – V	3+0	3+0=3	3
19	Soil Mechanics	Engineering Foundation	F – VI	3+1	3+3=6	4
20	Numerical Analysis / Maths-IV	Natural Sciences	Math – IV	3+0	3+0=3	3
21	Fluid Mechanics	Engineering Foundation	F – VII	3+1	3+3=6	4
				15+2	**15+6**	**17**
SEMESTER-V						
22	Probability & Statistics/ Math IV	Natural Sciences	Math-V	2+1	2+3=5	3
23	Advanced Fluid Mechanics	Breadth	B – II	3+1	3+3=6	4
24	Business Communication	Humanities	English-II	2+0	2+0=2	2
25	Professional Ethics	Humanities	Social Science	2+0	2+0=2	2
26	Reinforced Concrete Design-I	Breadth	B – III	3+1	3+3=6	4
27	Quantity & Cost Estimation	Computing	Estimation	2+1	2+3=5	3
				14+4	**14+12**	**18**
SEMESTER-VI						
28	Construction Management	Management Sciences	Professional Practice-I	2+1	2+3=5	3
29	Mechanics of Solid-II	Depth	D-I	2+1	2+3=5	3
30	Reinforced Concrete Design-II	Depth	D-II	3+1	3+3=6	4
31	Transportation Engineering-I	Breadth	B- IV	3+0	3+0=3	3
32	Engineering Hydrology	Engineering Foundation	F-IX	2+1	2+3=5	3
33	Structural Analysis-II	Breadth	B-V	3+0	3+0=3	3
				15+4	**15+12**	**19**

SEMESTER-VII						
34	Environmental Engineering-I	Breadth	B –VI	2+1	2+3=5	3
35	Management Science Elective	Management Sciences	Management	3+0	3+0=3	3
36	Architecture & Town Planning	IDEE	IDEE-II	3+0	3+0=3	3
37	Geotechnical & Foundation Engineering	Depth	D – III	3+1	3+3=6	4
38	Transportation Engineering-II	Depth	D – IV	3+1	3+3=6	4
(44)	Civil Engineering Project	Civil Engineering Project	--	0+3	0+9=9	3
				14+6	**14+18**	**20**

Course No	Course Outline	Knowledge Area	Sub Area	Credit Hours (Theory + Practical)	Contact Hours (Theory + Practical)	Total Credit Hours
SEMESTER-VIII						
39	Geo Informatics	Natural Science	Elective-II	1+1	1+3=4	2
40	Environmental Engineering-II	Depth	D – V	2+0	2+0=2	2
41	Steel Structures	Depth	D – VI	3+0	3+0=3	3
42	Hydraulics & Irrigation Engineering	Depth	D – VII	3+1	3+3=6	4
43	Social Science Elective	Humanities	Social Sciences	2+0	2+0=2	2
44	Civil Engineering Project	Civil Engineering Project	--	0+3	0+9=9	3
				11+5	**11+15**	**16**

Total Credit Hours = 136

Any one from the list at Annex "A"

Abbreviations used:

1. SS - Social Science
2. F - Foundations
3. NS - Natural Science
4. B - Breadth
5. IDEE - Inter-disciplinary Engineering Elective.
6. D - Depth

DETAIL OF COURSES

1. Title of the Course: CIVIL ENGINEERING MATERIALS

Contact Hours
Theory = 2
Practical = 3
Total = 5

Credit Hours
Theory = 2
Practical = 1
Total = 3

Pre-requisites: Nil

Specific Objectives of course:

- To familiarize students about the characteristics of construction materials used in civil engineering.
- To develop the skills for identification of suitable construction materials for civil engineering projects.

Course Learning Outcomes (CLOs):

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

S.No.	CLOs	Learning Domain	Taxonomy level	PLO
1.	EXPLAIN various properties of construction materials.	Cognitive	2	1
2.	SELECT appropriate constructional materials for various uses.	Cognitive	5	3
3.	ANALYZE various material properties.	Cognitive	4	2

Course Outline:

1. **Materials and their Properties**
   - Introduction of materials
   - Construction materials
   - Physical, mechanical and chemical properties
   - Electrical and thermal properties
2. **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
3. **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

4. **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
5. **Metals (Steel and Aluminum)**
   - Introduction to steel
   - Mechanical and physical properties of steel
   - Application of steel in civil engineering projects
   - Introduction to aluminum
   - Mechanical and physical properties of aluminum
   - Application of aluminum in civil engineering projects
6. **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
7. **Glass and Wood**
   - Constituents of glass and methods of manufacture.
   - Types, use and significance of glass in civil engineering
   - Advantages and drawbacks of glass
   - Structure of tree and general characteristics
   - Types, seasoning and preservation of wood
   - Lamination of wood
8. **Pavement Materials**
   - Bitumen
   - Asphalt
   - Road Metal
9. **Miscellaneous Construction Materials**
   - Asbestos, Plaster of Paris, Abrasives
   - Rubber, Cork, Plastics
   - Paint
   - Thermometry and acoustics
   - Bamboo
   - Natural, artificial and steel fibres
   - Modern Materials (Fiber reinforced polymer etc.)

Practical Work:

Following practicals may be carried out for the course.

- To determine consistency, initial and final setting time of various samples of cement and then to discuss the results.
- To determine the hydraulic properties of lime.
- To determine different densities of coarse aggregate.
- To carry out sieve analysis of various samples of coarse aggregates, draw gradation curves for those and to discuss its effects on the properties of concrete.
- To determine different densities of fine aggregate.
- To carry out sieve analysis of various samples of fine aggregates, draw gradation curves for those and to discuss its effects on the properties of concrete.
- To determine the compressive strength of mortar with various mix ratios.
- To determine water absorption of bricks and to discuss the results.
- To determine compressive strength of bricks and to discuss the results.
- To identify various types of wood samples by observation
- To determine flexural strength of provided samples of timber.

Suggested Teaching Methods

- Lecturing
- Laboratory Demonstration
- Written Assignments
- Guest Speaker
- Field Visits

Suggested Assessment Methods

Theoretical Work

- One hour test(s)/Mid-term
- Quiz tests, Assignments, Project Reports/Term Paper/Presentations
- Final Exam

Practical Work

- Laboratory Participation
- Laboratory Report/Manual
- Laboratory Quiz /Viva Voce

Text and Reference Books:

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

2. Title of the Course: BASIC ELECTRO-MECHANICAL ENGINEERING

Contact Hours		Credit Hours	
Theory	= 2	Theory	= 2
Practical	= 6	Practical	= 2
Total	= 8	Total	= 4

Pre-requisites: Nil

Specific Objectives of Course:

To enable students to acquire basic knowledge of electrical and mechanical engineering relevant to civil engineering.

Course Outline:

1. **Electrical Elements and Circuits**
   - Electric current, voltage, power and energy
   - Ohm's law, inductance, capacitance, Kirchhoff's laws
   - Introduction to node voltage and loop current methods
   - AC single and poly-phase system
   - DC machines, AC synchronous machines, AC induction machines, transformers converting machines
2. **Power Plant Installations and Distribution System**
   - Power systems layout
   - Generation, transmission, distribution and utilization of electric power
   - Introduction to domestic electrification
3. **Electronics**
   - Diode transistor and simple rectifier circuit.
   - Principles of house wiring and industrial wiring, illumination.
   - Electrical know how related to experimental design instrumentations like corrosion rate measurements, strain gauges, LDT's, LVDT's. etc.
4. **Basic Concepts**
   - Fundamentals of heat transfer, conduction, convection, radiation
   - Thermal conductivity, overall heat transfer coefficients
   - Practical equations
   - Laws of thermodynamics
5. **Heating Ventilation and Air Conditioning (HVAC)**
   - Introduction to HVAC components.
   - Heating and cooling load and its calculations;
   - Comfort charts;
   - Outline of A.C. Systems;
   - Consideration for air-conditioning in buildings;
   - Natural ventilations;
   - Insulating materials

Practical Work

The Design work and/or experiments related to above mentioned outline shall be covered in the Laboratory/Design class.

Suggested Teaching Methods

- Lecturing
- Laboratory Demonstration
- Written Assignments
- Guest Speaker
- Field Visits

Suggested Assessment Methods

Theoretical Work

- One hour test(s)/Mid-term
- Quiz tests, Assignments, Project Reports/Term Paper/Presentations
- Final Exam

Practical Work

- Laboratory Participation
- Laboratory Report/Manual
- Laboratory Quiz /Viva Voce

Recommended Books:

1. Basic Mechanical Engineering Elements by Griffith J. Paul (Latest Edition)
2. Basic Electrical Engineering by Del Toro, 2nd Edition, 2001, Prentice Hall.
3. Ryner Joel , Applied Thermodynamics, 5th Edition, 1996, Longman
4. T. D. & Mcconkey, Applied Thermodynamics, 5th Edition, 2004, Longman
5. Basic Electrical Technology by T.K. Nagasarkar & Suhkija, 2nd Edition, 2007
6. Theraja, B.L. Electrical Technology, S. Chand. 2008

3. Title of the Course: ENGINEERING DRAWING

Contact Hours		**Credit Hours**	
Theory	= 1	Theory	=1
Practical	= 6	Practical	=2
Total	= 7	Total	=3

Pre-requisites: Nil

Specific Objectives of course:

- To enable students to learn basics of engineering drawing.
- To develop the skills to understand fundamentals of structural drawings

Course Learning Outcomes (CLOs):

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

S.No.	CLO	Learning Domain	Taxonomy level	PLO
1.	EXPLAIN fundamental concepts of engineering drawing for simple objects/structures.	Cognitive	2	1
2.	Manually DEVELOP drawings of simple objects/structures.	Psychomotor	4	10

Course Outline:

1. **Introduction to Engineering Drawing and Types of Civil Engineering Drawings**
   - 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)
2. **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
3. **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

4. **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
5. **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
6. **Structural Details of Water Tank**
    - Base slab
    - Top slab
    - Section
    - Sump pit detail
    - Cover detail
    - General notes
7. **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
8. **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

Practical Work:

- Border line / margin, title box, gothic lettering, isometric views, orthographic views (first and third angles) and sections
- Architectural plan, elevation and section of a simple building
- Structural details of a simple building
- Architectural and structural details of a boundary wall
- Architectural and structural details of stair case
- Structural details of a water tank

- Plumbing, sanitation, and roof drainage plan of a simple building
- Electrical and HVAC drawings of a simple building

Suggested Teaching Methods

- Lecturing
- Laboratory Demonstration
- Written Assignments
- Guest Speaker
- Field Visits

Suggested Assessment Methods

Theoretical Work

- One hour test(s)/Mid-term
- Quiz tests, Assignments, Project Reports/Term Paper/Presentations
- Final Exam

Practical Work

- Laboratory Participation
- Laboratory Report/Manual
- Laboratory Quiz /Viva Voce

Recommended Books:

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

4. Title of the Course: FUNCTIONAL ENGLISH

Contact Hours		**Credit Hours**	
Theory	= 2	Theory	= 2
Practical	= 0	Practical	= 0
Total	= 2	Total	= 3

Pre-requisites: Nil

Specific Objectives of course:

To enhance English language skills.

Course Outline:

1. Speaking and Listening:

- Listening actively through the use of skills and sub skills, and in a variety of situations.
- Speaking: Fluency and confidence building through group discussions, role plays and public speaking.

2. **Vocabulary development:**
    - Tips / strategies in vocabulary enhancement, Practice in vocabulary development
3. **Reading:**
    - Reading skills, Sub skills, Reading strategies,
    - Reading practice through variety of reading texts and comprehension exercises
4. **Writing:**
    - Note taking: Techniques for taking notes from lectures, from books (integrated with listening & reading).
    - Process of Writing with practice in pre writing strategies, in revising, and in, editing for grammar.
    - Writing well- structured and effective paragraphs, essays and letters (routine communication) using proper writing mechanics.
    - Writing descriptions, narrations, cause and effect, compare and contrast etc.

Suggested Teaching Methods

- Lecturing
- Laboratory Demonstration
- Written Assignments
- Guest Speaker
- Field Visits

Suggested Assessment Methods

Theoretical Work

- One hour test(s)/Mid-term
- Quiz tests, Assignments, Project Reports/Term Paper/Presentations
- Final Exam

Practical Work

- Laboratory Participation
- Laboratory Report/Manual
- Laboratory Quiz /Viva Voce

Recommended Books:

1. Shafi, S., Mansoor, S. and Irfan, H, 1994. Skill Worker: Student Activity Book: BA English for Paper B. 1st Ed. Caravan Book House Lahore, Pakistan.
2. Polymer English Grammar and Composition for BA/BSc, 1994. 1st Ed. Polymer Publication Lahore, Pakistan.
3. The Functional Analysis of English, 3rd edition (2013), by Thmoas Bloor and Mariel Bloor

5. Title of the Course: APPLIED CALCULUS

Contact Hour:		**Credit Hours**	
Theory	= 3	Theory	= 3
Practical	= 0	Practical	= 0
Total	= 3	Total	= 3

Pre-requisites: Nil

Specific Objective of Course:

- To learn fundamentals of mathematics, calculus and analytical geometry.

Course Contents:

1. Complex Numbers:

- Basic Operations
- Graphical Representations
- Polar and Exponential Forms of Complex Numbers

2. Limits and Continuity

- Introduction to Limits
- Rates of Change
- Continuity

3. Differentiation

- Definition and Examples
- Relation Between Differentiability and Continuity
- Equations of tangents and normals
- Derivative as slope, as rate of change (graphical representation)
- Differentiation and successive differentiation and its application to rate, speed and acceleration
- Maxima and minima of function of one variable and its applications
- Convexity and concavity
- Points of inflexion

4. Integration

- Indefinite Integrals
- Definite Integrals
- Integration by substitution, by partial fractions and by parts
- Integration of trigonometric functions
- Riemann Sum, Fundamental Theorem of Calculus
- Area Under the Graph of a Nonnegative Function
- Area Between curves
- Improper Integrals

5. Transcendental Functions

- Inverse functions
- Hyperbolic and trigonometric identities and their relationship
- Logarithmic and Exponential Functions

6. **Vector Calculus**
    - Three Dimensional Geometry
    - Vectors in Spaces
    - Rectangular and polar co-ordinate systems in three dimensions
    - Direction cosines
    - Plane (straight line) and sphere.
    - Partial Derivatives
    - Partial differentiation with chain rule
    - Total derivative
    - Divergence, Curl of a Vector Field
7. **Analytical Geometry**
    - Arc-Length and Tangent Vector
    - Lengths of curves
    - Radius of gyration
    - Fubini's Theorem for Calculating Double Integrals
    - Areas Moments and Centers of Mass
    - Centroid of a plane figure
    - Centre of gravity of a solid of revolution
    - Moment of inertia
    - Second moment of area
    - Centers of pressure and depth of centre of pressure.
    - Triple Integrals, Volume of a Region in Space
    - Volumes of solids of revolution
    - Curvature, radius and centre of curvature

Suggested Teaching Methods

- Lecturing
- Laboratory Demonstration
- Written Assignments
- Guest Speaker
- Field Visits

Suggested Assessment Methods:

Theoretical Work

- One hour test(s)/Mid-term
- Quiz tests, Assignments, Project Reports/Term Paper/Presentations
- Final Exam

Practical Work

- Laboratory Participation
- Laboratory Report/Manual
- Laboratory Quiz /Viva Voce

Recommended Books:

1. Schaum's series, Calculus, Schaum's Series(Latest Edition)
2. Schaum's series, Complex, Variables Va Schaum's series, (Latest Edition)
3. Antom, H. Calculus and Analytic Geometry, John Wiley and Sons (Latest Edition)
4. Talpur, Calculus and Analytic Geometry, Ferozsons (Latest Edition)
5. Yousuf, S.M. Mathematical Methods, Ilmi Kutab Khana (Latest Edition)

6. Title of the Course: PAKISTAN STUDIES

Contact Hours		**Credit Hours:**	
Theory	= 1	Theory	= 1
Practical	= 0	Practical	= 0
Total	= 1	Total	= 1

Pre-requisites: Nil

Specific Objectives of course:

- To develop vision of Historical Perspective, Government, Politics, Contemporary Pakistan, ideology of Pakistan.
- To study the process of governance, national development, issues arising in the modern age and posing challenges to Pakistan.

Course Outline:

1. Historical Perspective

- Ideological rationale with special reference to Sir Syed Ahmed Khan, Allama Muhammad Iqbal and Quaid-e-Azam Muhammad Ali Jinnah.
- Factors leading to Muslim separatism
- People and Land
- Indus Civilization
- Muslim advent
- Location and Geo-Physical features.

2. Government and Politics in Pakistan

- Political and constitutional phases:
- 1947-58
- 1958-71
- 1971-77
- 1977-88
- 1988-99
- 1999-2008
- 2008-2013
- 2013 - onward

3. **Contemporary Pakistan**
    - Economic institutions and issues
    - Society and social structure
    - Ethnicity
    - Foreign policy of Pakistan and challenges
    - Futuristic outlook of Pakistan
4. **Socio-Economic International Relations**

Suggested Teaching Methods

- Lecturing
- Written Assignments
- Guest Speaker
- Field Visits

Suggested Assessment Methods

- One hour test(s)/Mid-term
- Quiz tests, Assignments, Project Reports/Term Paper/Presentations
- Final Exam

Recommended Books:

1. Burki, Shahid Javed. State & Society in Pakistan, The Macmillan Press Ltd 1980.
2. Akbar, S. Zaidi. Issue in Pakistan's Economy. Karachi: Oxford University Press, 2000.
3. Mehmood, Safdar. Pakistan Kayyun Toota, Lahore: Idara-e-Saqafat-e-Islamia, Club Road, Lahore.
4. Sayed, Khalid Bin. The Political System of Pakistan. Boston: Houghton Mifflin, 1967.
5. Haq, Noor ul. Making of Pakistan: The Military Perspective. Islamabad: National Commission on Historical and Cultural Research, 1993.
6. Pakistan Studies by Muhammad Raza Kazmi 2007 Oxford University Press

7. Title of the Course: ENGINEERING SURVEYING

Contact Hours		**Credit Hours**	
Theory	= 2	Theory	=2
Practical	= 3	Practical	= 1
Total	= 5	Total	= 3

Pre-requisites:Nil

Specific Objectives of Course:

- To enable students to understand theory and practice of land surveying.
- To enable students in reading and preparing surveying maps.
- To develop skills to use modern survey instruments.

Course Learning Outcomes (CLOs):

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

S.No.	CLOs	Learning Domain	Taxonomy level	PLO
1.	EXPLAIN basic surveying techniques used for surveying and levelling.	Cognitive	2	1
2.	PREPARE maps and plans, contour maps, profiles, cross-sections, etc. using surveying techniques.	Cognitive	3	2
3.	OPERATE various survey equipment for measurements with required accuracy.	Psychomotor	3	5

Course Outline:

1. **Introduction**
   - Introduction to land surveying
   - Definitions of basic surveying terms branches and their application
   - Instruments used
2. **Survey Techniques**
   - Distance measurement techniques
   - Compass survey
   - Traversing and triangulation
   - Plane table surveying
   - Computation of areas and volumes by various methods
   - Tacheometry
   - Theodolite survey
3. **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
4. **Leveling and Contouring**
   - Methods and types of levels, precise leveling
   - Methods and applications of contouring
5. **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

Practical Work:

Following practical work may be taken up for the course:

- Measuring of a building, by using Measuring Tape and Pacing.
- Measurement of distance by ranging and chaining
- Locating various objects by chain surveying and determine offsets

- Study of various parts and temporary adjustment of prismatic compass
- Measurement of bearings of sides of traverse with prismatic compass
- Measurement of bearings of sides of building by prismatic compass and computation of correct included angles
- Study and temporary adjustment of Plane table
- Locating given traverse by Plane Table surveying using Radiation Method (One Full size drawing sheet)
- Locating given traverse by Plane Table surveying using Intersection Method (One Full size drawing sheet)
- Locating given traverse by Plane Table surveying using Traverse Method (One Full size drawing sheet)
- Study of various parts of automatic level.
- Temporary adjustment of an automatic level
- Determine the height, distance and angle measurement of two points by using automatic level
- Determination of elevation of various points with automatic level by collimation plane method and rise & fall method

Suggested Teaching Methods

- Lecturing
- Laboratory Demonstration
- Written Assignments
- Guest Speaker
- Field Visits

Suggested Assessment Method

Theoretical Work

- One hour test(s)/Mid-term
- Quiz tests, Assignments, Project Reports/Term Paper/Presentations
- Final Exam

Practical Work

- Laboratory Participation
- Laboratory Report/Manual
- Laboratory Quiz /Viva Voce

Recommended Books:

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

8. Title of the Course: ENGINEERING GEOLOGY

Contact Hours		Credit Hours	
Theory	= 2	Theory	=2
Practical	= 0	Practical	=0
Total	= 2	Total	=2

Pre-requisites: Nil

Specific Objectives of course:

- To understand composition of various minerals, rocks and their properties.
- To develop a solid base for application of geology to engineering problems.

Course Outline:

1. Introduction

- Introduction to various branches of geology
- Origin and internal constitution of the earth.

2. Rocks and Minerals, Structural Features

- Main groups
- Igneous, sedimentary and metamorphic rocks
- Important minerals and ores
- Rock cycle.
- Glaciers and glaciations
- Dip, strike, folds, faults, joints, unconformities conformable and un conformable series of strata
- Effects of folding
- Faulting and jointing on civil engineering projects and their recognition in the field

3. Weathering and Erosion, Volcanoes

- Agents of weathering and erosion
- Weathering classification
- Cycle of erosion, normal, glacial and marine erosion
- Land forms
- Mass wasting
- Formation of meanders and ox-bow lakes
- Formation of volcanoes
- Causes of volcanoes
- Nature and types of volcanic eruptions
- Products of eruptions
- Types of volcanoes
- Geysers

4. Landslides

- Definition, causes of landslides
- Classification of landslides
- Preventive measures against landslides

5. **Earthquakes**
    - Definition and related technical terms
    - Causes of earthquake
    - Classification of earthquakes
    - Earthquake or seismic waves
    - Mechanism of earthquake
    - Measuring of earthquake intensity (modified mercali intensity scale)
    - Effects of earthquake and protective measures against earthquake
6. **Tunneling**
    - Engineering geology of tunnels
    - Geological survey prior to tunneling
    - Lining of tunnels and their section
    - Selection of tunnel site and its requirements.
7. **Geological Survey Maps**
    - Physical method of subsurface mapping
    - Exploratory geological surveys at engineering sites
8. **Engineering Applications**
    - Importance of geology for civil engineering projects,
    - Important building stones and other construction materials.
    - Role of geology in selection of sites for dams, reservoirs and pertinent geological investigations.
    - Geology of foundations, cutting tunnels, highways, airfields and bridges

Suggested Teaching Methods

- Lecturing
- Laboratory Demonstration
- Written Assignments
- Guest Speaker
- Field Visits

Suggested Assessment Method

Theoretical Work

- One hour test(s)/Mid-term
- Quiz tests, Assignments, Project Reports/Term Paper/Presentations
- Final Exam

Practical Work

- Laboratory Participation
- Laboratory Report/Manual
- Laboratory Quiz /Viva Voce

Recommended Books:

1. Blyth, F.G.H. A Geology for Engineers, Butterworth-Heinemann, 7th Edition, 1984
2. Bell, Engineering Geology, Butterworth-Heinemann, 2nd Edition, 2006
3. Dimitri PL Krynine, Principles of Engineering Geology & Geotechnics, McGraw-Hills Inc. 1957

4. Ali H Kazmi and M. Qasim Jan, Geology and tectonics of Pakistan, Graphic Publishers, 1997

9. Title of the Course: ISLAMIC STUDIES

Contact Hours		Credit Hours	
Theory	= 2	Theory	=2
Practical	= 0	Practical	=0
Total	= 2	Total	=2

Pre-requisites: Nil

Specific Objectives of course:

- To provide Basic information about Islamic Studies
- To enhance understanding of the students regarding Islamic Civilization
- To improve Students skill to perform prayers and other worships
- To enhance the skill of the students for understanding of issues related to faith and religious life**.**

Course Outline:

1. Introduction to Quranic Studies

- Basic Concepts of Quran
- History of Quran
- Uloom-ul -Quran

2. Study of Selected Text of Holy Quran

- Verses of Surah Al-Baqra Related to Faith(Verse No-284-286)
- Verses of Surah Al-Hujrat Related to Adab Al-Nabi(Verse No-1-18)
- Verses of Surah Al-Mumanoon Related to Characteristics of faithful (Verse No-1-11)
- Verses of Surah al-Furqan Related to Social Ethics (Verse No.63-77)
- Verses of Surah Al-Inam Related to Ihkam(Verse No-152-154)
- Verses of Surah Al-Ihzab Related to Adab al-Nabi (Verse No.6,21,40,56,57,58.)
- Verses of Surah Al-Hashar (18,19,20) Related to thinking, Day of Judgment
- Verses of Surah Al-Saf Related to Tafakar,Tadabar (Verse No-1,14)

3. Seerat of Holy Prophet (S.A.W)

- Life of Muhammad Bin Abdullah (Before Prophet Hood)
- Life of Holy Prophet (S.A.W) in Makkah
- Important Lessons Derived from the life of Holy Prophet in Makkah

4. **Seerat of Holy Prophet (S.A.W)**
    - Life of Holy Prophet (S.A.W) in Madina
    - Important Events of Life Holy Prophet in Madina
    - Important Lessons Derived from the life of Holy Prophet in Madina
5. **Introduction to Sunnah**
    - Basic Concepts of Hadith
    - History of Hadith
    - Kinds of Hadith
    - Uloom-ul-Hadith
    - Sunnah & Hadith
    - Legal Position of Sunnah
6. **Selected Study from Text of Hadith**
7. **Introduction to Islamic Law & Jurisprudence**
    - Basic Concepts of Islamic Law & Jurisprudence
    - History & Importance of Islamic Law & Jurisprudence
    - Sources of Islamic Law & Jurisprudence
    - Nature of Differences in Islamic Law
    - Islam and Sectarianism
8. **Islamic Culture & Civilization**
    - Basic Concepts of Islamic Culture & Civilization
    - Historical Development of Islamic Culture & Civilization
    - Characteristics of Islamic Culture & Civilization
    - Islamic Culture & Civilization and Contemporary Issues
9. **ISLAM & Science**
    - Basic Concepts of Islam & Science
    - Contributions of Muslims in the Development of Science
    - Quran & Science
10. **Islamic Economic System**
    - Basic Concepts of Islamic Economic System
    - Means of Distribution of wealth in Islamic Economics
    - Islamic Concept of Riba
    - Islamic Ways of Trade & Commerce
11. **Political System of Islam**
    - Basic Concepts of Islamic Political System
    - Islamic Concept of Sovereignty
    - Basic Institutions of Govt. in Islam
12. **Islamic History**
    - Period of Khlaft-e-Rashida
    - Period of Ummayyads
    - Period of Abbasids

13. Social System of Islam

- Basic Concepts of Social System Of Islam
- Elements of Family
- Ethical Values of Islam

Suggested Teaching Methods

- Lecturing
- Written Assignments
- Guest Speaker
- Field Visits

Suggested Assessment Methods

- One hour test(s)/Mid-term
- Quiz tests, Assignments, Project Reports/Term Paper/Presentations
- Final Exam

Recommended Books:

1. Hussain Hamid Hassan, “An Introduction to the Study of Islamic Law” leaf Publication Islamabad, Pakistan, (Latest Edition).
2. Ahmad Hasan, “Principles of Islamic Jurisprudence” Islamic Research Institute, International Islamic University, Islamabad (1993)
3. Mir Waliullah, “Muslim Jurisprudence and the Quranic Law of Crimes” Islamic Book Service (1982)
4. H.S. Bhatia, “Studies in Islamic Law, Religion and Society” Deep & Deep Publications New Delhi (1989)
5. Dr. Muhammad Zia-ul-Haq, “Introduction to Al Sharia Al Islamia” Allama Iqbal Open University, Islamabad (2001)

10. Title of the Course **ENGINEERING MECHANICS**

Contact Hours		**Credit Hours**	
Theory	= 3	Theory	= 3
Practical	= 3	Practical	= 1
Total	= 6	Total	= 4

Pre-requisites: Nil

Specific Objectives of course:

- To become familiar with all relevant physical properties and fundamental laws governing the behavior of materials and structures
- To enable students to understand relationships of physical processes, kinetics and kinematics.To develop skills to use the basic principles of mechanics in engineering applications.

Course Learning Outcomes (CLOs):

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

Sr. No.	CLOs	Learning Domain	Taxonomy Level	PLO
1	CARRY OUT analysis for the two-dimensional force system and equilibrium.	Cognitive	3	2
2	CALCULATE important geometrical properties of plane areas.	Cognitive	3	1
3	CONDUCT various experiments on force system and equilibrium.	Psychomotor	4	1

Course Outline:

1. **Basic Concepts:**
   - Concepts of space, time, mass, velocity, acceleration and force.
   - Scalar and vector quantities,
   - Newton's laws of motion, Law of gravitation.
2. **System of Forces:**
   - Force System, Resultant, and resolution of co-planer forces using parallelogram, triangle & polygon law and funicular polygon.
   - Simple cases of resultant and resolution of forces in space.
3. **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 especially of civil engineering importance, Equilibrium of two-force and three-force bodies.
4. **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.
5. **Friction:**
   - Coulomb's theory of friction.
   - Problems involving friction on flat and curved surfaces.
6. **Kinematics:**
   - Rectilinear and curvilinear motion.
   - Dynamic equilibrium
7. **Kinetics:**
   - Work, energy and power.
   - Virtual work formulation of equilibrium of coplanar force.
   - Potential energy, energy criterion for equilibrium, stability of equilibrium, application to simple cases.

- Newton's equation of motion

Practical Work:

The Design work and/or experiments to be performed in the laboratory in the following topics;

- To determine the reaction of the simply supported beam under various loadings.
- To determine the center of mass of various figures, cut out the wooden plank by experiment & calculations.
- To find the tension in various parts of a Hanging rope loaded at various points.
- To determine the force acting in the tie and jib of a simple jib crane (Wall Crane).
- To verify the principle of moment.
- To verify law of friction between solid bodies and to find the coefficient of friction between wood and other materials.

Suggested Teaching Methods:

- Lecturing
- Laboratory Demonstration
- Written Assignments
- Guest Speaker
- Field Visits

Suggested Assessment Methods

Theoretical Work

- One hour test(s)/Mid-term
- Quiz tests, Assignments, Project Reports/Term Paper/Presentations
- Final Exam

Practical Work

- Laboratory Participation
- Laboratory Report/Manual
- Laboratory Quiz /Viva Voce

Recommended Books:

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

11. Title of the Course: APPLIED DIFFERENTIAL EQUATIONS

Contact Hours		Credit Hours	
Theory	= 3	Theory	= 3
Practical	= 0	Practical	= 0
Total	= 3	Total	= 3

Pre-requisites: Applied Calculus

Specific Objectives of course:

- To introduce basic techniques pertaining to matrices
- To learn formulation/solution of differential equations and Fourier series.

Course Outline:

1. Introduction to Differential Equations

- Introduction
- Definitions and terminology
- Formulations, order, degree and the linearity of differential equation
- Initial-value problems

2. First Order Differential Equations

- Variables separable forms,
- Homogenous equations,
- Non-homogenous equations,
- Exact equations,
- Linear equations,
- Solution by substitutions,

3. Applications of First Order DEs

- Modeling with the first order differential equations
- Orthogonal trajectories
- Population dynamics

4. Higher Order Linear Differential Equations

- Introduction and preliminary theory,
- Initial-value and boundary-value problems,
- Introduction to Complex numbers
- Homogenous and non-homogenous equations,
- Method of undetermined coefficients,
- Method of variation of parameters,
- Power series solution

5. Applications of the Second Order Differential Equations

- Spring mass problems,
- RLC circuits
- Simple pendulum

6. **Partial Differential Equations**
    - Basic concepts
    - Vibrating string
    - Wave equation
    - Heat equation

7. **Fourier Series:**
    - Periodic functions and expansion of periodic functions in Fourier series and Fourier coefficients.
    - Expansion of functions with arbitrary periods, Odd and even functions and their Fourier series,
    - Half range expansions of Fourier series.

Suggested Teaching Methods

- Lecturing
- Written Assignments
- Guest Speaker

Suggested Assessment Methods

Theoretical Work

- One hour test(s)/Mid-term
- Quiz tests, Assignments, Project Reports/Term Paper/Presentations
- Final Exam

Recommended Books:

1. Ervin Kreyszig. Advanced Engineering Mathematics, John Wiley and Sons, (10^{th} Edition), 2010.
2. Speigal M. R., Theory and Problems of Laplace Transforms, Schaum's Outline Series, (Latest Edition).

12. Title of the Course: COMPUTER PROGRAMMING

Contact Hours		**Credit Hours**	
Theory	= 1	Theory	= 1
Practical	= 6	Practical	= 2
Total	= 7	Total	= 3

Pre-requisites: Nil

Specific Objectives of Course:

- To enable students to learn computer languages and Microsoft Office.
- To develop skills of computer programming and its applications in elementary civil engineering problems.

Course Outline:

1. **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

2. **The Loop Control Structure**
   - The for loop, Nesting of loops
   - Multiple initializations in the for loop
   - The while loop
   - The break statement
   - The continue statement
   - The do-while loop

3. **The Case Control Structure**
   - Decisions using switch
   - Switch versus if-else ladder
   - The go to keyword

4. **Functions**
   - Function definition
   - Passing values between functions
   - Functions declaration and prototypes

5. **Arrays and Strings**
   - Introduction to arrays and strings
   - 2D arrays

6. **Programming Languages**

7. **Programming of Civil Engineering Problems**
   Programming of simple and elementary civil engineering problems

8. **Miscellaneous**
   - Introduction to pointers
   - File handling
   - Structures

9. **Introduction to MS Office with advanced applications of MS Excel**

10. **Use of MATLAB**

Practical Work:

- Introduction (Computer hardware and components, Numbers System, Conversion between bases)
- Introduction (Integers, Unsigned Integers, Signed Integers, Number Representations and Ranges, ASCII Codes, Algorithms and Flowcharts)
- Introduction to Programming Language C++ / VB & Input/output, Operators, Selection
- Loop (For, while and do-while loops)
- Functions in Programming Language C++ / VB

Suggested Teaching Methods:

- Lecturing
- Laboratory Demonstration
- Written Assignments
- Guest Speaker

Suggested Assessment Method:

Theoretical Work

- One hour test(s)/Mid-term
- Quiz tests, Assignments, Project Reports/Term Paper/Presentations
- Final Exam

Practical Work:

- Laboratory Participation
- Laboratory Report/Manual
- Laboratory Quiz /Viva Voce

Recommended Books:

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

13. Title of the Course: CIVIL ENGINEERING DRAWING & GRAPHICS

Contact Hours		**Credit Hours**	
Theory	= 1	Theory	= 1
Practical	= 6	Practical	= 2
Total	= 7	Total	= 3

Pre-requisites: Engineering Drawing

Specific Objectives of course:

- To enable students to prepare and understand architectural and structural drawings.
- To have sufficient knowledge of working drawings related to civil engineering projects.

Course Learning Outcomes (CLOs):

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

S.No.	CLOs	Learning Domain	Taxonomy level	PLO
1.	DESCRIBE different perspective (functions) of latest version of CAD.	Cognitive	2	1
2.	PRODUCE Civil Engineering Drawings using CAD software.	Psychomotor	4	5

Course Outline:

1. **Introduction to Contour Plan, Infrastructure layout, and Site Plan**
   - General notes
   - Contour plan
   - Infrastructure layout
   - Site plan
2. **Architectural Details of a Simple Two Storied Building**
   - Broad prospective about architectural details
   - General notes
   - Ground floor plan
   - First floor plan
   - Roof and mumty plan
   - Elevations
   - Longitudinal and transverse sections
3. **Structural Details of a Simple Two Storied Framed RCC Building**
   - Broad prospective about structural RCC details
   - General notes
   - Foundation plan and related details
   - Framing of plinth beams and related details
   - Framing of floor beams and related details

- Framing of roof and mumty beams and related details
- Slab reinforcement layout
- Misc. details (stair case and water tank)
- Structural details of boundary wall

4. **Plumbing and Electrical Details of a Simple Two Storied Building**
   - Broad prospective about plumbing and electrical details
   - General notes for plumbing details
   - External water supply and sewerage layout
   - Internal water supply and sewerage layout (all plans)
   - General notes for electrical details
   - Electrification for all plans
5. **Structural Details of Steel Roof Truss**
   - Broad prospective about structural steel details
   - General notes
   - Framing plan
   - Truss elevation
   - Member cross-sections and connection details
6. **Drawings and Detailing of Hydraulic and Drainage Structures**
   - Broad prospective about hydraulic and drainage structural details
   - General notes
   - Layout plan
   - Sectional details
7. **Drawings and Detailing of Highway and Motor way**
   - Broad prospective about highway and motorway structural details
   - General notes
   - Layout plan
   - Sectional details
8. **Computer Aided Drawing and Modeling**
   - Use of 2D CAD softwares
   - Introduction to 3D CAD softwares
   - Introduction to Building Information Modeling (BIM)

Practical Work:

- Introduction to Auto Cad, Auto Cad practice, and Contour Plan, Infrastructure layout, and Site Plan
- Architectural Details of a Simple Two Storied Building
- Structural Details of a Simple Two Storied Framed RCC Building
- Plumbing and Electrical Details of a Simple Two Storied Building
- Structural Details of Steel Roof Truss
- Drawings of Hydraulic and Drainage Structures
- Drawings of Highway and Motor way
- Simple Drawing in BIM

Suggested Teaching Methods

- Lecturing
- Laboratory Demonstration
- Written Assignments
- Guest Speaker
- Field Visits

Suggested Assessment Methods

Theoretical Work

- One hour test(s)/Mid-term
- Quiz tests, Assignments, Project Reports/Term Paper/Presentations
- Final Exam

Practical Work

- Laboratory Participation
- Laboratory Report/Manual/Drawings
- Laboratory Quiz /Viva Voce

Recommended Books:

1. M. Chakarborti, Civil Engineering Drawing, UBS Publications, (Latest Edition).
2. Gurcharan Singh, Civil Engineering Drawing, (Latest Edition). Malik Book Dept., Lahore
3. Mastering AutoCAD 2017 and AutoCAD LT 2017 by George Omura with Brian Benton, (latest edition), 2016.
4. Boughton, B. Reinforced Concrete Detailer's Manual (Reference Book), HarperCollins, Publishers Ltd. London

14. Title of the Course: ADVANCED ENGINEERING SURVEYING

Contact Hours		**Credit Hours**	
Theory	= 2	Theory	= 2
Practical	= 3	Practical	= 1
Total	= 5	Total	= 3

Pre-requisites: Engineering Surveying

Specific Objectives of course:

- To acquire knowledge of control surveys and their use in advanced branches of surveying.
- To apply principles of surveying and modern tools in related field problems.

Course Learning Outcomes (CLOs):

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

S.No.	CLOs	Learning Domain	Taxonomy level	PLO
1.	CALCULATE various types of curves	Cognitive	3	1
2.	CARRY OUT construction, control hydrographic surveys, field astronomy, photogrammetry and GPS surveys	Cognitive	3	2
3.	COMMIT to individual or group survey task as a leader or member expressing team spirit and inspiring conduct	Affective	3	5

Course Outline:

1. **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

2. **Construction Surveys**
   - Introduction, horizontal and vertical control
   - Buildings, rail roads, Route surveys
   - Pipeline and other construction surveys

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

4. **Control Surveys**
   - Geodesy universal transverse mercator grid system,
   - Modified transverse mercator grid system
   - Lambert projection
   - Computations for lambert projection

5. **Field Astronomy**
   - Solar and stellar observations for position and azimuth determination

6. **Photogrammetry**
   - Introduction
   - Application of aerial and terrestrial photogrammetry

- Stereoscopy

7. **GPS surveying techniques and applications**
   - Survey planning, initial ambiguity resolution
   - Vertical positioning
8. **Tunnel Surveying**
   - Introduction
   - Use of gyroscope

Practical Work:

Following design exercises may be taken up for the course.

- Carrying out of a road alignment project (Determination of NSL of road cross sections)
- Carrying out of a road alignment project (Plotting of NSL and design levels in field book)
- Carrying out of a road alignment project (Layout of design levels of road cross sections)
- Study the different parts and temporary adjustment of theodolite
- To measure the horizontal angle by using theodolite
- To plot an open traverse (Direct Angles) using theodolite
- To plot a closed traverse using theodolite
- To set out a simple curve by Rankine's method of Deflection angle
- using Theodolite
- Find out distances in height on an uneven ground by using tacheometry method
- To draw contours on Plane Table sheet to show by direct method
- To find the Co-ordinates and Elevation of a Point with GPS
- Field work with Total Station

Suggested Teaching Methods

- Lecturing
- Laboratory Demonstration
- Written Assignments
- Guest Speaker
- Field Visits

Suggested Assessment Methods

Theoretical Work

- One hour test(s)/Mid-term
- Quiz tests, Assignments, Project Reports/Term Paper/Presentations
- Final Exam

Practical Work

- Laboratory Participation
- Laboratory Report/Manual
- Laboratory Quiz /Viva Voce

Recommended Books:

1. Wolf P. R. & Ghilani C. D., (2012), Elementary Surveying – An introduction to Geomatics, 13th Edition, Prentice Hall, USA.
2. Thomas, M. Lillesand & Ralph W. Kiefer, (2005), Remote Sensing and Images Interpretation, 5th edition, John Wiley & Sons, Inc.
3. Kavanagh Barry, (2010), Surveying with Construction Applications, 7th Edition, Pearsons Education.

15. Title of the Course: MECHANICS OF SOLIDS-I

Contact Hours		**Credit Hours**	
Theory	= 2	Theory	= 2
Practical	= 3	Practical	= 1
Total	= 5	Total	= 3

Pre-requisites: Engineering Mechanics

Specific Objectives of course:

- To enable students to learn fundamentals regarding strength of materials.
- To enhance skills of utilizing material of appropriate strength for Civil Engineering application.

Course Learning Outcomes (CLOs):

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

S.No.	CLOs	Learning Domain	Taxonomy level	PLO
1.	DISCUSS the behavior of members (bars, beams) subjected to different sets of loading and states of stresses.	Cognitive	2	1
2.	SOLVE problems related to biaxial state of stresses.	Cognitive	3	2
3.	PRACTICE experiments to study the material response under different sets of loadings.	Psychomotor	3	1

Course Outline:

1. 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

2. Bending Theory

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

3. Deflections of Beams

- Curvature, slope and deflection of beams using integration methods

4. Theory of Torsion

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

5. 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

Practical Work:

Following practical exercises may be taken up for the course.

- Determination of the compressive strength of cement.
- Determination of tensile strength of cement.
- Determination of yield strength, ultimate strength, rupture strength and percentage elongation of mild steel bar.
- To perform the Izod Impact Test for the given metals.
- Determination of the modulus of elasticity of the material of the given rectangular beam.
- Determination of the modulus of rigidity of the material of the given specimen with circular cross-section.

Suggested Teaching Methods

- Lecturing
- Laboratory Demonstration
- Written Assignments
- Guest Speaker
- Field Visits

Suggested Assessment Methods

Theoretical Work

- One hour test(s)/Mid-term
- Quiz tests, Assignments, Project Reports/Term Paper/Presentations
- Final Exam

Practical Work

- Laboratory Participation
- Laboratory Report/Manual
- Laboratory Quiz /Viva Voce

Recommended Books:

1. Pytel, A. & F. L.Singer, Strength of Material, Harper & Row Publishers, New York.
2. Hibbler, R. C., Mechanics of Materials, Prentice Hall, 6th Edition, 2004.
3. Warnock, F. V., Benham, P. P., Mechanics of Solids and Strength of Materials, Pitman Publishing, 1970.
4. James M. Gere & Barry. J. Goodno, Mechanics of Materials, 7th Edition, 2008, CL Engineering
5. James M. Gere & Stephen P. Timoshenko, Mechanics of Materials, 4th Edition, 1997, PWS Pub Co.

16. Title of the Course: ENGINEERING ECONOMICS

Contact Hours		Credit Hours	
Theory	= 2	Theory	= 2
Practical	= 0	Practical	= 0
Total	= 2	Total	= 2

Pre-requisites: Nil

Specific Objectives of course:

- To introduce the fundamentals of engineering economics.
- To enable students to perform economic analysis of different projects.

Course Outline:

1. Fundamentals of Engineering Economics

- Basic concepts and principles of
- Economics
- Micro-economics theory
- The problems of financial scarcity
- Basic concept of Engineering Economy
- Consumer and Producer goods, Goods and services
- Price-supply-demand-relationship

- Equilibrium, Elasticity of demand &supply
- Measures of economic worth, Non-monitory values
- Theory of pricing
- Theory of production
- Laws of return

2. **Capital Financing and Allocation**
   - Funding, funding agencies and planning commission
   - Capital Budgeting, allocation of capital among independent projects
   - Financing with debt capital
   - Financing with equity capital
   - Trading on equity
   - Financial leveraging
3. **Business Organization and Industrial Relationship**
   - Types of ownership
   - Types of stocks, partnership and joint companies
   - Banking and Specialized credit institution
   - Labour problems, labour organization, prevention and settlement of disputes, Markets, competition and monopoly.
4. **Linear Programming**
   - Mathematical statement of linear programming problems
   - Graphic solution simplex procedure,
   - Duality problem
5. **Depreciation and Taxes**
   - Depreciation concept
   - Economic life
   - Methods of depreciation
   - Profit and returns on capital, productivity of capital
   - Gain (loss) on the disposal of an asset
   - Depreciation as a tax shield
6. **Selection between Alternatives**
   - Time value of money and financial rate of return, present value, future value and annuities
   - Rate of Return Analysis
   - Incremental analysis
   - Cost-benefit analysis
   - Payback period
   - Sensitivity and breakeven analysis,
   - Alternatives having different lives, making of buy decisions and replacement decisions

Suggested Teaching Methods

- Lecturing
- Laboratory Demonstration
- Written Assignments
- Guest Speaker
- Field Visits

Suggested Assessment Methods

Theoretical Work

- One hour test(s)/Mid-term
- Quiz tests, Assignments, Project Reports/Term Paper/Presentations
- Final Exam

Practical Work

- Laboratory Participation
- Laboratory Report/Manual
- Laboratory Quiz /Viva Voce

Recommended Books:

1. Fundamentals of Engineering Economics, 3rd ed., by Chan S. Park, Published by Pearson Education (2012)
2. Engineering Economy. Macmillan Publishing Company, New York .DeGarmo, E. Paul; Sullivan, G. William and Bontadelli, A. James, 6th Edition (1979).
3. Engineering Economic and Cost Analysis. Harper & Row, Publishers, New York. Collier, A. Courtland and Ledbetter, B. William (1982).
4. Principles of Engineering Economic Analysis. John Wiley &Sons.White, A. John; Agee H. Marvin and Case, E. Kenneth, 2nd Edition (1984).
5. Engineering Economy by Leland T. Blank, Anthony J. Tarquinii **7TH** edition

17. Title of the Course: CONSTRUCTION ENGINEERING

Contact Hours		**Credit Hours**	
Theory	= 3	Theory	= 3
Practical	= 0	Practical	= 0
Total	= 3	Total	= 3

Pre-requisites: Nil

Specific Objectives of course:

- To familiarize students about different construction methodologies and equipment to be used in carrying out a construction project.
- To develop ability of students to carry out the construction projects according to drawings and specifications.

Course Learning Outcomes (CLOs):

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

S.No.	CLOs	Learning Domain	Taxonomy level	PLO
1.	DEMONSTRATE knowledge of constructional aspects related to public infrastructure projects.	Cognitive	3	1
2.	ANALYZE the heavy construction equipment and operations for key	Cognitive	4	2

	project planning and management inputs.			
3.	APPLY knowledge regarding building construction methodologies.	Cognitive	3	1

Course Outline:

1. **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
2. **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
3. **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
4. **Overview of Construction Aspects of Infrastructure Engineering Projects**
   - Retaining structures, hydraulic structures, underwater concreting and pavements.

5. Developments in Construction Technology

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

Suggested Teaching Methods

- Lecturing
- Written Assignments
- Guest Speaker
- Field Visits

Suggested Assessment Methods

- One hour test(s)/Mid-term
- Quiz tests, Assignments, Project Reports/Term Paper/Presentations
- Final Exam

Recommended Books:

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

18. Title of the Course: STRUCTURAL ANALYSIS-I

Contact Hours		**Credit Hours**	
Theory	= 3	Theory	= 3
Practical	= 0	Practical	= 0
Total	= 3	Total	= 3

Pre-requisites: Engineering Mechanics

Specific Objectives of course:

- To understand the principles of structural analysis and its role in design process.
- To analyse determinate structural members under static and moving loads.

Course Learning Outcomes (CLOs):

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

S. No.	CLO	Learning Domain	Taxonomy Level	PLO
1	DESCRIBE various methods of analysis for determinate structures.	Cognitive	2	*
2	APPLY methods of analysis on determinate structures.	Cognitive	3	3
3	ANALYZE the beams and girders under the application of moving loads.	Cognitive	4	3

*This CLO is intentionally not mapped with the PLO as an option.

Course Outline:

1. **Introduction to Structural Analysis**
   - Types of structures
   - Structural idealization and loads
   - Redundancy and stability of structures

2. **Analysis of Determinate Pin Jointed Structures**
   - Method of joints
   - Method of sections
   - Method of moments and shears
   - Graphical method

3. **Analysis of Statically Determinate Rigid Jointed Plane Frames**
   - Axial force diagrams
   - Shear force diagrams
   - Bending moment diagrams

4. **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

5. **Three Hinged Arches, Cables and Suspension Bridges**
   - Basic considerations in analysis and design
   - Moving loads on three hinged arches and suspension bridge

6. **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

Suggested Teaching Methods

- Lecturing
- Written Assignments
- Guest Speaker
- Field Visits

Suggested Assessment Methods

- One hour test(s)/Mid-term
- Quiz tests, Assignments, Project Reports/Term Paper/Presentations
- Final Exam

Recommended Books:

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

19. Title of the Course: SOIL MECHANICS

Contact Hours		**Credit Hours**	
Theory	=3	Theory	= 3
Practical	=3	Practical	= 1
Total	=6	Total	= 4

Pre-requisites: Nil

Specific Objectives of course:

- To enable students to learn soil properties and its behaviour under loading.
- To apply the laws of mechanics to soils so that the engineers can design and construct safe structures on or with soil.

Course Learning Outcomes (CLOs):

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

S.No.	CLO	Learning Domain	Taxonomy level	PLO
1.	CARRY OUT classification of soils.	Cognitive	3	1
2.	ANALYSE soil mass for stress, seepage and settlement.	Cognitive	4	2
3.	PRACTICE laboratory and field tests to characterize various soil parameters.	Psychomotor	3	4

Course outline:

1. **Introduction**
   - Applications of soil mechanics in engineering practice
   - Types of soils and their properties
   - Formation of soils
2. **Index Properties of Soil**
   - Weight-volume relationships
   - Plasticity of soil
   - Structure of soil
3. **Engineering Classification of Soil**
   - Important classification of soil
   - Grain size distribution by sieve analysis
   - Hydrometric analysis
   - Atterberg's limits
   - Classification systems
4. **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
5. **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
6. **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.

7. Soil Compaction

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

Practical Work:

- Sieve analysis.
- Hydrometer analysis.
- Specific gravity.
- Moisture content determination.
- Atterberg limits.
- Field identification tests.
- Permeability by constant and variable head.
- AASHO and modified AASHO test.
- Density in situ by sand replacement and rubber balloon method.
- Relative density

Suggested Teaching Methods

- Lecturing
- Laboratory Demonstration
- Written Assignments
- Guest Speaker
- Field Visits

Suggested Assessment Methods

Theoretical Work

- One hour test(s)/Mid-term
- Quiz tests, Assignments, Project Reports/Term Paper/Presentations
- Final Exam

Practical Work

- Laboratory Participation
- Laboratory Report/Manual
- Laboratory Quiz /Viva Voce

Recommended Books:

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

20. Title of the Course: **NUMERICAL ANALYSIS**

Contact Hours		**Credit Hours**	
Theory	= 3	Theory	= 3
Practical	= 0	Practical	= 0
Total	= 3	Total	= 3

Pre-requisites: Nil

Specific Objectives of course:

- To introduce various techniques for solving linear, non-linear and difference equations using various numerical methods.

Course Outline:

1. Solution of Non-Linear Equations

- Bisection method
- Newton's method
- Secant method
- Method of false position
- Method of successive approximation

2. Interpolation

- Basic idea
- Taylor’s polynomial
- Lagrange's formula of interpolation

3. Numerical Differentiation and Integration

- Numerical differentiation
- Review of integration concept and their physical significance for Engineering
- Trapezoidal and Simpson's rule numerical integration techniques

4. Solution of Linear Simultaneous Equations

- Gaus Elimination and Gaus-Jordan methods
- Numerical solution of differential equations
- Euler and modified Euler methods
- Runge-Kutta methods

5. Complex Numbers

- Basic operations
- Graphical representations
- Polar and exponential forms of complex numbers
- De'Moivre's theorem with applications

6. Complex Variables

- Limit, continuity, zeros and poles
- Cauchy-Reimann Equations

7. Use of Softwares

- Matlab
- Mathmatica

Suggested Teaching Methods

- Lecturing
- Written Assignments
- Guest Speaker
- Field Visits

Suggested Assessment Methods

- One hour test(s)/Mid-term
- Quiz tests, Assignments, Project Reports/Term Paper/Presentations
- Final Exam

Recommended Books:

1. Complex Variables by Murray R. Spiegel, Schaum Series, (Latest Edition)
2. Numerical Analysis by Scheid, Schaum Series, (Latest Edition)

21. Title of the Course: FLUID MECHANICS

Contact Hours		**Credit Hours**	
Theory	= 3	Theory	= 3
Practical	= 3	Practical	=1
Total	= 6	Total	= 4

Pre-requisites: Nil

Specific Objectives of course:

- To enable students to learn basics of fluid mechanics for civil engineering applications.

Course Learning Outcomes (CLOs):

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

S.No.	CLO	Learning Domain	Taxonomy level	PLO
1.	DESCRIBE various basic terms related to fluid mechanics.	Cognitive	2	1
2.	COMPUTE various basic parameters related to fluid mechanics.	Cognitive	3	2
3.	IMITATE various experiments on basic fluid mechanics equipment.	Psychomotor	3	1

Course Outline:

1. 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

2. 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

3. Forces on Immersed Bodies

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

4. Fluid Kinematics

- Steady and unsteady flow
- Laminar and turbulent flow
- Uniform and non-uniform flow
- Pathline streamlines and stream tubes
- Velocity and discharge
- Control volume

- Equation of continuity for compressible and incompressible fluids

5. 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

6. Flow Measurement

- Orifices and mouthpieces, sharp-crested weirs and notches
- Pitot tube and pitot static tube
- Venturimeter, orificemeter

7. 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

8. Uniform Flow in Open Channels

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

Practical Work:

Following practical/experiments may be taken up for the course.

- To determine physical properties of a fluid.
- To determine the metacentric height and locate the positions of various important points of a floating body.
- To determine hydrostatic force on a submerged plane surface and depth of centre of pressure.
- To verify the Bernoulli's theorem for steady flow of water.
- To determine the hydraulic coefficients of an orifice.
- To determine the coefficient of discharges for rectangular and triangular notches.

Suggested Teaching Methods

- Lecturing
- Laboratory Demonstration
- Written Assignments
- Guest Speaker
- Field Visits

Suggested Assessment Method

Theoretical Work

- One hour test(s)/Mid-term
- Quiz tests, Assignments, Project Reports/Term Paper/Presentations
- Final Exam

Practical Work

- Laboratory Participation
- Laboratory Report/Manual
- Laboratory Quiz /Viva Voce

Recommended Books:

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

22. Title of the Course: PROBABILITY & STATISTICS

Contact Hours		**Credit Hours**	
Theory	= 2	Theory	= 2
Practical	= 3	Practical	= 1
Total	= 5	Total	= 3

Pre-requisites: Nil

Specific Objectives of course:

To learn techniques of probability and statistical analysis of the data.

Course Outline:

1. Presentation of Data and Measures of Central Tendency

- Classification, tabulation, classes, graphical representation, histograms, frequency polygons, frequency curves and their types
- Means: Arithmetic Mean (A.M), Geometric Mean (GM), Weighted mean, median, quartiles, mode and their relations, Merits and demerits of Averages

2. Measures of Dispersion

- Range, moments, skewness, quartile deviation
- Mean deviation
- Standard deviation
- Variance and its coefficients

3. **Curve Fitting and Regression**
   - Goodness of fit
   - Scatter diagram
   - Fitting a straight line
   - Linear regression and correlation
   - Multiple regression

4. **Probability and Random Variable**
   - Definitions, sample space, events.
   - Laws of probability, conditional probability
   - Dependent and independent events

5. **Probability Distribution**
   - Introduction, distribution function
   - Discrete random variable and its probability distribution (Binomial, Poisson)
   - Continuous random variable and its probability density function, uniform, and normal distribution functions
   - Mathematical expectation of a random variable

6. **Introduction to Soft wares**
   - Microsoft Excel
   - Matlab
   - SPSS

Practical Work:

- Introduction to Matlab including syntax
- Simple program in Matlab
- Solving CE problem using Matlab
- Introduction to SPSS
- Simple program in SPSS
- Solving CE problem using SPSS
- Simple program in Excel
- Solving CE problem using MS Excel

Suggested Teaching Methods

- Lecturing
- Laboratory Demonstration
- Written Assignments
- Guest Speaker
- Field Visits

Suggested Assessment Methods

Theoretical Work

- One hour test(s)/Mid-term
- Quiz tests, Assignments, Project Reports/Term Paper/Presentations
- Final Exam

Practical Work

- Laboratory Participation
- Laboratory Report/Manual
- Laboratory Quiz /Viva Voce

Recommended Books:

1. Statistical methods for engineers by McCuen, Richard Prentice Hall, (Latest Edition)
2. Basic Statistics for Business & Economics by Doughlas A Lind, Irwin Publishers,(Latest Edition)

23. Title of the Course: ADVANCED FLUID MECHANICS

Contact Hours		**Credit Hours**	
Theory	= 3	Theory	= 3
Practical	= 3	Practical	=1
Total	= 6	Total	= 4

Pre-requisites: Fluid Mechanics

Specific Objectives of course:

- To enable students to learn advanced principles of fluid mechanics for broader application to civil engineering projects.

Course Learning Outcomes (CLOs):

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

S.No.	CLOs	Learning Domain	Taxonomy level	PLO
1.	ANALYZE pipes flow and open channel flow.	Cognitive	4	2
2.	APPLY basic principles of fluid mechanics for computations.	Cognitive	3	3
3.	IMITATE various experiments on the advanced equipment related to fluid mechanics.	Psychomotor	3	1

Course Outline:

1. Hydrodynamics Review

- Ideal and real fluid
- Differential equation of continuity
- Rotational and irrational flow

- Stream function and velocity potential function
- Brief description of flow fields
- Orthogonality of stream lines and equipotential lines
- Flow net and its limitations
- Different methods of drawing flow net.

2. Steady Flow through Pipes

- Laminar and turbulent flow in circular pipes, semi empirical theories of turbulence
- General equation for friction
- Velocity profile in circular pipes, pipe roughness
- Nukuradse's experiments
- Darcy-Weisbach Equation
- Implicit and Explicit Equations for Pipe Friction Factor
- Moody's diagrams
- Pipe flow problems
- Minor losses
- Branching pipes

3. Flow around immersed bodies

- Lift and drag force
- Boundary layer along smooth flat plate
- Thickness of boundary layer, shear stresses and velocity distributions
- Types of boundary layers (laminar, turbulent and laminar and turbulent)
- Friction drag coefficient

4. Impact of Jets

- Impulse momentum principle
- Force of jet on stationary flat and curved plates
- Force of jet on moving flat and curved plates
- Forces of plumbing fittings

5. Water Turbines

- Types, impulse and reaction turbines
- Momentum equation applied to turbines
- Specific speed, Turbine characteristic curves

6. Centrifugal Pumps

- Types
- Classifications
- Construction features, operation and efficiencies
- Specific speed and characteristic curves

7. Reciprocating Pumps

- Types

- Maximum suction lift, construction features, specific speed, cavitation and operation

8. Introduction to related software

Practical Work:

Following practical/experiments may be taken up for the course.

- To observe laminar and turbulent flows using Reynold's Apparatus.
- To measure head loss in a pipe line of constant diameter.
- To verify the Impulse Momentum Principle by using various deflectors.
- To perform experiment on Pelton wheel to plot its characteristics curves.
- To make the study of Francis Turbine.
- To perform experiment on Francis Turbine to plot its characteristics curves.
- To perform experiment on Centrifugal Pump to plot its characteristics curves.
- To perform experiment on Double Acting Reciprocating Pump to determine the coefficient of discharge and slip of the pump.

Teaching Methodology

- Lecturing
- Written Assignments
- Guest Speaker
- Report Writing

Suggested Teaching Methods

- Lecturing
- Laboratory Demonstration
- Written Assignments
- Guest Speaker
- Field Visits

Suggested Assessment Methods

Theoretical Work

- One hour test(s)/Mid-term
- Quiz tests, Assignments, Project Reports/Term Paper/Presentations
- Final Exam

Practical Work

- Laboratory Participation
- Laboratory Report/Manual
- Laboratory Quiz /Viva Voce

Recommended Books

1. Daugherty, R. L. Franzini B. & Finnemore E. J., Fluid Mechanics, McGraw Hill Book Co. (Latest Edition)
2. Douglus, Fluid Mechanics, McGraw-Hill Inc. (Latest Edition)
3. Jack P., Fundamentals of Fluid Mechanics , McGraw-Hill Inc. (Latest Edition)
4. Merle Potter, Mechanics of Fluid, CL- Engineering (2011)

24. Title of the Course: BUSINESS COMMUNICATION

Contact Hours		Credit Hours	
Theory	= 2	Theory	= 2
Practical	= 0	Practical	= 0
Total	= 2	Total	= 2

Pre-requisites: Functional English

Specific Objectives of course:

- To inculcate in students the skills of organizing material, writing a report, and presenting their work for business communication

Course Outline:

1. Foundations of Business Communication

- Definitions; communication, organization
- Understanding the need and scope of business
- Professional and organizational communication,
- Conditions, properties, process, tools, modes, levels, types of communication.
- Principles of Effective Communication & Building goodwill (You-attitude, positive emphasis and unbiased language).
- Listening, non-verbal communication.
- Communication dilemmas and problems .
- Feedback and its types.
- Audience Analysis

2. Oral Communication:

- Group Discussions and interpersonal skills,
- Meetings,
- Interviews,
- Making presentations

3. Business & Technical Writing

- Types of messages: Formats (Letter and memorandum)
- Three Types of Business Messages (routine, negative and persuasive communications).

- Organizational Plans: Direct, Indirect & AIDA approach. Writing business messages (e-mails, inquiries, requests, replies, regrets,] declining offers, letters, routine messages, etc.).
- Meetings: notice, \ agenda and minutes. Job applications and resumes. Research / scientific reports (structure, layout, writing process)

Suggested Teaching Methods

- Lecturing
- Written Assignments
- Guest Speaker
- Field Visits

Suggested Assessment Method

- One hour test(s)/Mid-term
- Quiz tests, Assignments, Project Reports/Term Paper/Presentations
- Final Exam

Recommended Books:

1. Ellen, K. 2002. Maximize Your Presentation Skills: How to Speak, Look and Act on Your Way to the Top, Prima Lifestyles - 2005
2. Hargie, O. (ed.) Handbbook of Communications Skills, Routledge
3. Mandel, S. 2000. Effective Presentation Skills: A Practical Guide Better Speaking, Crisp Publications
4. Mark, P. 1996. Presenting in English. Hove: Language Teaching Publications.
5. David F. Beer, David A. 2014. McMurrey, A Guide to Writing as an Engineer, 4th Edition
6. Phillip A. Laplante, 2011. Technical Writing: A Practical Guide for Engineers and Scientists

25. Title of the Course: PROFESSIONAL ETHICS

Contact Hours		**Credit Hours**	
Theory	= 2	Theory	= 2
Practical	= 0	Practical	=0
Total	= 2	Total	= 2

Pre-requisites: Nil

Specific Objectives of Course:

- To grasp ideals and principles as they have been spelled out in a variety of traditional ethical systems
- To apply ethical concepts and guidelines in solving major problems and dilemmas of civil engineering practices in a corporate culture.

Course Outline:

1. Introduction to Professional & Engineering Ethics:

- Definitions - Ethics,
- Professional Ethics,
- Engineering Ethics,
- Business Ethics;Ethics & Professionalism.
- Need and scope of Engineering and Professional Ethics through Case Studies. Development of Engineering Ethics & Major issues in Engineering & Professional Ethics

2. Moral Reasoning &Ethical Frameworks:

- Ethical Dilemma: Resolving Ethical dilemmas and making Moral Choices.
- Codes of Ethics (of local and international professional bodies).
- Moral Theories: Utilitarianism, Rights Ethics and Duty Ethics, Virtue Ethics Self-Realization &Self Interest.
- Ethical Problem Solving Techniques: Line drawing, flow Charting, Conflict Problems.
- Case Studies and applications.

3. Contemporary Professional Ethics

- Professional Responsibilities.
- Risk and Safety as an Ethical Concern for Engineers Workplace Responsibilities and Ethics: Teamwork, confidentiality and conflicts of interest, Whistle blowing, Bribe and gift, risk and cost - benefit analyses, gender discrimination and sexual harassment.
- Environmental Ethics.
- Computer Ethics &the Internet.
- Honesty: Truthfulness, trustworthiness, academic and research integrity, critique codes of ethics

Suggested Teaching Methods

- Lecturing
- Written Assignments
- Guest Speaker
- Field Visits

Suggested Assessment Methods

- One hour test(s)/Mid-term
- Quiz tests, Assignments, Project Reports/Term Paper/Presentations
- Final Exam

Recommended Books:

1. "Ethics in Engineering" 4th edition, by Mike W. Martin, Roland Schinzinger, McGraw-Hill, New York, 2005
2. "Engineering Ethics: Concepts and Cases", 4th edition, by Charles E. Harris, Michael S. Pritchard, Michael J. Rabins, Wadsworth, 2008.
3. The Seven Habits of Highly effective people by Stephan r. Covey
4. Principle Centered Leadership Stephan r. Covey

26. Title of the Course: REINFORCED CONCRETE DESIGN-I

Contact Hours		**Credit Hours**	
Theory	= 3	Theory	= 3
Practical	= 3	Practical	= 1
Total	= 6	Total	= 4

Pre-requisites: Nil

Specific Objectives of course:

- To familiarize the students with the fundamental properties of concrete.
- To enable students to design various structural concrete members

Course Learning Outcomes (CLOs):

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

S.No	CLOs	Learning Domain	Taxonomy level	PLO
1.	ILLUSTRATE various properties of concrete.	Cognitive	3	3
2.	DESIGN various structural reinforced concrete elements. .	Cognitive	6	3
3.	PRACTICE experiments on concrete for suitable use.	Psychomotor	3	2

Course Outline:

1. 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)

2. 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

3. 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

4. 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

5. 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

6. Columns

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

7. Footings

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

8. Concrete Detailing (Bond, Anchorage & Development Length)

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

Practical Work:

Following practical may be carried out for the course.

- To study the compressive strength of concrete using cube and cylinder
- To prepare mix design for various strengths of concrete
- To find workability of concrete using slump cone method, compacting factor method, VeBe time method
- To study the effect of w/c ratio on the strength of concrete
- To study effect of aggregate/cement ratio of workability and compressive strength of concrete.
- To determine the strength of concrete using core extraction and to discuss the results from control cylindrical samples
- To study the ultrasonic pulse velocity test and Schmidt hammer test on hardened concrete
- To study the behaviour of balanced reinforced, under-reinforced and over-reinforced concrete flexural members
- To study the behaviour of shear deficient flexural members
- To study the permeability of concrete samples with various mix ratio

Suggested Teaching Methods

- Lecturing
- Laboratory Demonstration
- Written Assignments
- Guest Speaker
- Field Visits

Suggested Assessment Methods

Theoretical Work

- One hour test(s)/Mid-term
- Quiz tests, Assignments, Project Reports/Term Paper/Presentations
- Final Exam

Practical Work

- Laboratory Participation
- Laboratory Report/Manual
- Laboratory Quiz /Viva Voce

Recommended Books:

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

27. Title of the Course: QUANTITY & COST ESTIMATION

Contact Hours		**Credit Hours:**	
Theory	= 2	Theory	= 2
Practical	= 3	Practical	= 1
Total	= 5	Total	= 3

Pre-requisites: Nil

Specific Objectives of course:

- To enhance the ability of students to learn the various principles of computations related to quantity surveying.
- To enhance skill of students in preparing detail estimates and bill of quantities for various civil engineering projects.
- To familiarize students with tender and contract documents.

Course Learning Outcomes (CLOs):

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

S.No.	CLOs	Learning Domain	Taxonomy level	PLO
1.	APPLY concept and skills for quantity take-off for different civil engineering works.	Cognitive	3	1
2.	CARRY OUT rate analysis, productivity and pricing.	Cognitive	3	2
3.	DISCUSS concepts related to legal and contractual aspects of cost of construction projects	Cognitive	2	11

Course Outline:

1. 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

2. 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

3. Contractual Aspects Related to Bidding

- Specifications and their types for various items of construction projects
- Overview of payment schemes in construction projects
- Preparation of Civil Engineering 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.

Practical Work:

Following design exercises may be taken up for the course.

- Use of spreadsheets for rate analysis, bid preparation etc.
- Use of Quantity take-off software.

Suggested Teaching Methods

- Lecturing
- Written Assignments
- Guest Speaker
- Field Visits

Suggested Assessment Methods

- One hour test(s)/Mid-term
- Quiz tests, Assignments, Project Reports/Term Paper/Presentations
- Final Exam

Recommended Books:

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

28. Title of the Course: CONSTRUCTION MANAGEMENT

Contact Hours		**Credit Hours**	
Theory	= 2	Theory	= 2
Practical	= 3	Practical	=1
Total	= 5	Total	= 3

Pre-requisites: Nil

Specific Objectives of course:

- To develop ability of students in planning and management techniques for various construction projects.

Course Outline:

1. Introduction:

- Construction challenges, key players in construction projects
- Management issues and need for improved organization and management structures with particular reference to local construction industry
- Project management objectives
- Processes and responsibilities
- Project Life Cycle (PLC)
- Value engineering
- Normal track versus Fast track construction

2. **Project Scoping, Bidding and Preconstruction Planning:**

- Defining project scope
- Pre-Qualification process
- Bidding process
- Overview of preconstruction planning aspects including area and site investigation, constructability review
- Site layout planning
- Contractor's site (team) organization chart
- Preliminary schedules
- Mobilization plan

3. **Project Planning, Scheduling and Controlling by Deterministic Models:**
    - Work Breakdown Structure
    - Project activities and their types
    - Estimating activity durations,
    - Establishing activity sequencing; Arrow Diagramming Method (ADM) overview
    - Precedence Diagramming Method (PDM)
    - Scheduling using Rectangular bar chart
    - CPM Scheduling
        - Determining the minimum total cost of a project
        - Resource scheduling and leveling
        - Cost loaded schedule
        - S-curve
        - Cash flow analysis
        - Overview of Project control during construction
        - Record keeping
        - Project supervision

4. **Project Planning, Scheduling and Controlling by Probabilistic Models:**
    - Program Evaluation & Review Technique (PERT)
    - Statistical tools including mean, variance and standard Deviation, Probability distribution, Beta curves and center limit theorem.

Practical work

- Development of Construction Project Schedule using Scheduling Softwares. The task may include (as per requirement);
- Creating Projects.
- Defining Project Calendar.
- Defining Activities (including activity codes, names, duration etc.)
- Defining activity relationships.
- Performing Scheduling.
- Defining Work Breakdown Structure.
- Defining Constraints.
- Defining Applying Grouping & Filtering.
- Introductory tasks related to Resource Pool.

Suggested Teaching Method

- Lecturing
- Laboratory Demonstration
- Written Assignments
- Guest Speaker
- Field Visits

Suggested Assessment Methods

Theoretical Work

- One hour test(s)/Mid-term
- Quiz tests, Assignments, Project Reports/Term Paper/Presentations
- Final Exam

Practical Work

- Laboratory Participation
- Laboratory Report/Manual
- Laboratory Quiz /Viva Voce

Recommended Books:

1. Saleh Mubarak 2015 Construction Project Scheduling and Control 3rd Edition, Wiley
2. Frederick E. Gould, Managing the construction process: estimating, scheduling, and project control, Pearson Prentice Hall 2010
3. Jimmie W. Hinze, Construction Planning and Scheduling, 3rd Edition
4. William R. Mincks, Hal Johnston, Construction Jobsite Management, 3rd Edition.

29. Title of the Course: MECHANICS OF SOLIDS-II

Contact Hours		**Credit Hours**	
Theory	= 2	Theory	= 2
Practical	= 3	Practical	= 1
Total	= 5	Total	= 3

Pre-requisites: Mechanics of Solids-I

Specific Objectives of course:

- To develop ability of students to carry out analysis of complex state of stress.
- To familiarize students about the stability, analysis and failure modes of structure elements.

Course Learning Outcomes (CLOs):

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

S.No.	CLOs	Learning Domain	Taxonomy level	PLO
1.	ANALYZE beams subjected to unsymmetrical bending, curved beams and beams on elastic foundations.	Cognitive	4	2
2.	APPLY theory of elasticity under generalized loading.	Cognitive	3	2
3.	DISCUSS theory of plasticity and plastic analysis of beams and frames.	Cognitive	2	2

Course Outline:

1. **Enhanced Topics Related to Beam Bending and Shear**
   - Unsymmetrical bending
   - Shear flow, shear center
   - Analysis of curved beams
   - Beams on elastic foundations.

2. **Theory of Elasticity**
   - Analysis of stresses and strains due to combined effect of axial, bending and twisting forces/moments
   - Elementary theory of elasticity
   - Equilibrium and compatibility equations
   - Stress and deformation relationships
   - Stress transformation
   - Theories of failure

3. **Torsion of Thin Tubes and Open Sections**
   - Torsion of non-circular shafts
   - Membrane analogy
   - Torsion in thin tubes and open sections.

4. **Cylinders**
   - Analysis of thin and thick cylinders.

5. **Theory of Plasticity**
   - Elementary theory of plasticity
   - Plastic hinges
   - Shape factor
   - Collapse mechanism.

6. **Energy Methods**
   - Energy methods-General area of application and its usefulness.

7. **Stability**
   - Struts and columns
   - Euler, Rankine and other formulas for buckling load of columns
   - Stability analysis of columns under eccentric loading.

8. **Fatigue:**
   - Fatigue due to cyclic loading
   - Discontinuities and Stress Concentration,
   - Corrosion Fatigue,
   - Low Cyclic Fatigue
   - ε-N relations.

Practical Work

- Determination of torsion of bars with open and closed cross sections.
- Determination of the buckling load under different conditions.
- Verification of the Euler's theory of buckling.
- Bending of symmetrical and unsymmetrical cross-sections.
- Elastic deformation of curved beams
- Determination of stresses under combined bending and torsion
- Stresses in thin and thick wall cylinders

Suggested Teaching Methods

- Lecturing
- Written Assignments
- Guest Speaker
- Field Visits

Suggested Assessment Methods

- One hour test(s)/Mid-term
- Quiz tests, Assignments, Project Reports/Term Paper/Presentations
- Final Exam

Recommended Books:

1. Arthur P. Boresi. & Richard J. Schmidt, Advanced Mechanics of Materials, John Wiley; 6th Edition (2002)
2. Pytel, A. & Ferdinand L. Singer, Strength of Material, Harper and Row Harper Collins College Div; 4th Sub Edition (1987)
3. R.C. Hibbeler, Mechanics of Materials, Prentice Hall; 8th edition (2010)
4. James M. Gere & Barry. J. Goodno, Mechanics of Materials, 7th Edition, 2008, CL Engineering
5. James M. Gere & Stephen P. Timoshenko, Mechanics of Materials, 4th Edition, 1997, PWS Pub Co.
6. Mechanics of Materials by Zahid Ahmed Siddiqi, 2015

30. Title of the Course: REINFORCED CONCRETE DESIGN-II

Contact Hours		**Credit Hours**	
Theory	= 3	Theory	= 3
Practical	= 3	Practical	= 1
Total	= 6	Total	= 4

Pre-requisites: Reinforced Concrete Design-I

Specific Objectives of course:

- To enable students to design various reinforced and pre-stressed structural elements using conventional and advanced design approaches.

Course Learning Outcomes (CLOs):

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

S.No	CLOs	Learning Domain	Taxonomy level	PLO
1.	DESIGN various structural reinforced concrete elements.	Cognitive	6	3
2.	DESIGN various reinforced concrete structural systems.	Cognitive	6	3

Course Outline:

1. **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.
2. **Design for Torsion**
3. **Slender Columns:**
   - Analysis and design of slender columns subjected to combined flexure and axial loading,
   - Guidelines for design of shear walls-an over view.
4. **Design of Different Types of Foundations:**
   - Analysis and design of eccentric, strap, strip and mat footings
   - Pile caps.
5. **Stairs, Water tanks, Reservoirs:**
   - Analysis and Design of Various Types of Stairs and Staircases,
   - Analysis and Design of water tanks and reservoirs.
6. **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.
7. **Introduction to earthquake resistant design of structures.**

8. **Design of gravity and cantilever retaining walls.**
9. **Introduction to computer aided analysis and design**

Practical Work:

Following practical may be carried out for the course;

- To design various structures manually and to draw its structural drawings
- To model, analyze and design various types of structures using FE based softwares

Suggested Teaching Methods

- Lecturing
- Laboratory Demonstration
- Written Assignments
- Guest Speaker
- Field Visits

Suggested Assessment Methods

Theoretical Work

- One hour test(s)/Mid-term
- Quiz tests, Assignments, Project Reports/Term Paper/Presentations
- Final Exam

Practical Work

- Laboratory Participation
- Laboratory Report/Manual
- Laboratory Quiz /Viva Voce

Recommended Books:

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

31. Title of the Course: TRANSPORTATION ENGINEERING-I

Contact Hours		Credit Hours	
Theory	=3.	Theory	= 3
Practical	= 0	Practical	= 0
Total	= 3.	Total	= 3

Pre-requisites: Nil

Specific Objectives of course:

- To provide background knowledge of transportation engineering with detailed and thorough understanding of framework of various transportation systems

Course Learning Outcomes (CLOs):

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

S.No	CLO	Learning Domain	Taxonomy level	PLO
1.	EXPLAIN concepts of transportation systems and its planning.	Cognitive	2	*
2.	CARRY OUT geometric design of transportation the external and internal port components based on best practices and guidelines.	Cognitive	6	3
3.	CARRY OUT geometric design of transportation the external and internal port components based on best practices and guidelines.	Cognitive	6	3

* This CLO is interionally not mapped with the PLO s an option.

Course outline:

1. Introduction to Transportation Systems and Planning

- Modes of transportation, need and scope of comprehensive plan
- Phases of planning
- Principles of planning
- Communication (road network, rail-road network & airport), port and harbor facilities
- Introduction to design aspects
- Overview of Mass Transit Systems

2. Railway Engineering

- Elements of track
- Types of gauges
- Types of rail sections, Rail joints, Creep and wear of rail, Fish Plate bearing plates and check rails

- Types of sleepers, their merits and demerits, Sleeper density spacing and stiffness of track
- Types of ballast, Requirements for good ballast, Renewal of ballast
- Formation of single and double track
- Formation failures, Selection of site for a railway station
- Layout of stations and yards
- Modern methods for construction of tracks
- Maintenance, tools and organization
- Introduction to design aspect
- Points and crossings
- Signalization and navigation

3. Airport Engineering

- Type &elements of Airport planning
- Factors affecting Airport Site Selection
- Airport Classification
- Airport Drainage Systems
- Various Runway Configurations
- Introduction to design aspect
- Instrument Landing Systems (ILS)

4. Ports and Harbour Engineering

- Classification of harbours
- Ports and harbours of Pakistan
- Design principles and requirements of harbours
- Wharves and jetties
- Breakwaters and groynes
- Channel regulation and demarcation
- Types of docks and their construction
- Transit sheds and warehouses

Suggested Teaching Methods

- Lecturing
- Written Assignments
- Guest Speaker
- Field Visits

Suggested Assessment Methods

- One hour test(s)/Mid-term
- Quiz tests, Assignments, Project Reports/Term Paper/Presentations
- Final Exam

Recommended Books:

1. Jason C. Yu, Transportation Engineering Introduction to Planning, Design and Operations, Elsevier Science Ltd. (June 1982).
2. Horonjeff, R. Planning and Design of Airports, McGraw-Hill Professional; 4th Edition (December 1, 1993).
3. Gregory P. Tsinker, Port Engineering Planning Construction Maintenance and Security, John Wiley, 2004.
4. William Walter Hey, Railway Engineering, Wiley; 2nd Edition (June 16, 1982)

32. Title of the Course: ENGINEERING HYDROLOGY

Contact Hours		**Credit Hours:**	
Theory	= 2	Theory	= 2
Practical	= 3	Practical	= 1
Total	= 5	Total	= 3

Pre-requisites: Nil

Specific Objectives of course:

- To enable students to learn broad areas of hydrological engineering and principles of water management particularly in irrigated agriculture.

Course Learning Outcomes (CLOs):

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

S.No	CLOs	Learning Domain	Taxonomy level	PLO
1.	DEMONSTRATE the measurements of various meteorological parameters.	Cognitive	3	1
2.	CALCULATE various hydrological parameters.	Cognitive	3	2
3.	DESCRIBE various methods of flood estimation and flood routing.	Cognitive	2	2

Course Outline:

1. Introduction

- Hydrology
- Hydrologic cycle and the water balance equation
- Practical uses of hydrology
- Importance of hydrology

2. Water Resources

- Planning and development of water resources projects
- Domestic
- Industrial

- Agricultural and other water usages
- Water resources in Pakistan

3. Water Management

- Water management practices at basin level, canal level and farm level

4. Meteorology

- The atmosphere and its composition, dew point and its measurement devices
- Saturation deficit
- The general circulation of wind system, the monsoons and western disturbances
- Measurement of air temperature, relative humidity, radiation, sunshine, atmospheric pressure and wind velocity & direction

5. Precipitation

- Forms and types of precipitation
- Factors necessary for the formation of precipitation
- Measurement of precipitation
- Interpretation of precipitation data
- Computation of average rainfall over a basin

6. Evaporation and Transpiration

- Factors affecting evaporation
- Measurement of evaporation
- Evapo-transpiration

7. Stream Flow

- Water Stage and its measurement
- Stage Gauges and its types
- Selection of control and metering section
- Methods of measurement of stream flow
- Current meter
- Interpretation of stream flow data
-

8. Runoff & Hydrographs

- Factors affecting runoff
- Estimating the volume of storm runoff
- Characteristics of Hydrograph
- Components of a hydrograph
- Hydrograph separation
- Estimating the volume of direct runoff
- Introduction to unit hydrograph concept
- S-curve
- Application of probability in determining maxima/minima of discharge

9. Floods and their estimates

- Introduction to floods and its causes
- Methods to estimate floods
- Return period and its estimation
- Flood Frequency analysis

10. Stream Flow Routing

- Reservoir routing
- Channel routing
- Flood Control
- Introduction to Hydrological Modeling

11. Groundwater

- Introduction
- Sources and discharge of ground water
- Water table and artesian aquifer
- Ground water hydraulics
- Pumping test
- Tube well technology

12. Computer Application

- Development of design worksheets and use of software (if any).

Practical Work:

Following design exercises/practical work may be taken up for the course.

- To plot saturation curve and to find the saturation deficit, relative humidity and dew point temperature.
- To examine the consistency of precipitation data record at a station and to adjust it.
- To estimate the average rainfall over the basin area by using various methods.
- To extend the rating curve by two methods.
- To derive the ordinates of a unit hydrograph for the catchment.
- To covert duration of a unit hydrograph from one to another.
- To explore rainfall-runoff relationships using basic hydrology system
- To asses hydraulic parameters for a confined aquifer using Theis method.

Suggested Teaching Methods

- Lecturing
- Laboratory Demonstration
- Written Assignments
- Guest Speaker
- Field Visits

Suggested Assessment Methods

Theoretical Work

- One hour test(s)/Mid-term
- Quiz tests, Assignments, Project Reports/Term Paper/Presentations
- Final Exam

Practical Work

- Laboratory Participation
- Laboratory Report/Manual
- Laboratory Quiz /Viva Voce

Recommended Books:

1. Warren Viessman, Jr. and Gary L. Lewis, Introduction to Hydrology, 5th Edition Prentice Hall
2. R. K. Linsley, Max A. Kohler, and Joseph L. Paulhus, Hydrology for Engineers, McGraw-Hill Education (ISE Editions); International 2 Revised edition (June 1, 1982)
3. Linsley, R. K., J. Franzini, Water Resources Engineering, McGraw Hill; 4th Edition (June 1, 1992).
4. Surface Water Hydrology by N.M. Awan (Vol. 1), National Book Foundation
5. Engineering Hydrology An Introduction by Abdul Razzaq Ghumman, Prosperous Pakistan Publishers, Lahore, 2006.

33. Title of the Course: STRUCTURAL ANALYSIS-II

Contact Hours		**Credit Hours**	
Theory	= 3	Theory	= 3
Practical	= 0	Practical	= 0
Total	= 3	Total	= 3

Pre-requisites: Structural Analysis-I

Specific Objectives of course:

- To learn and understand the classical methods of analysis for indeterminate structures under static and moving loads.
- To familiarize students with various methods of analysis of indeterminate structures.
- To develop the skills for using the state-of-the-art methods of structural analysis.

Course Learning Outcomes (CLOs):

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

S.No	CLOs	Learning Domain	Taxonomy level	PLO
1.	ANALYZE indeterminate structures using force and displacement methods	Cognitive	4	2
2.	ANALYZE indeterminate structures using matrix methods	Cognitive	4	2

Course Outline:

1. **Analysis of Indeterminate Structures Using Force Approach**
   - Compatibility methods for beams and frames with and without support settlement

2. **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

3. **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

4. **Finite Element Method:**
   - Introduction to finite elements
   - Shape functions for bar element

Suggested Teaching Methods

- Lecturing
- Written Assignments
- Guest Speaker
- Field Visits

Suggested Assessment Methods

- One hour test(s)/Mid-term
- Quiz tests, Assignments, Project Reports/Term Paper/Presentations
- Final Exam

Recommended Books:

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

34. Title of the Course: ENVIRONMENTAL ENGINEERING-I

Contact Hours		**Credit Hours**	
Theory	=2	Theory	= 2
Practical	= 3	Practical	= 1
Total	= 5	Total	= 3

Pre-requisites: Nil

Specific Objectives of course:

- To introduce the concept of environmental pollution, contamination and its sources particularly in context to water.
- To learn principles of environmental engineering applied to the design and implementation of water supply schemes.

Course Learning Outcomes (CLOs):

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

S. No.	CLOs	Learning Domain	Taxonomy level	PLO
1.	DESCRIBE the demand and services for water supply.	Cognitive	2	1
2.	DESIGN water distribution networks and treatment systems.	Cognitive	6	3
3.	REPEAT experiments related to various parameters for water quality.	Psychomotor	3	7

Course Outline:

1. Introduction

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

2. Water Pollution

- Water chemistry and characteristics

- Introduction to sources of pollution
- Effects on water quality
- Control parameters

3. **Water Demand and Supply**
   - Population forecast
   - Water uses & consumption
   - Types and variations in demand
   - Maximum demand & fire demand

4. **Water Quality**
   - Water impurities & their health significance
   - Water quality guidelines/standards (US., WHO and NSDW Pakistan etc)
   - Water quality monitoring

5. **Water Sampling and Testing**
   - Sampling techniques and examination of water (physical, chemical and microbiological parameters)
   - Water borne diseases

6. **Water Treatment**
   - Treatment of surface & ground water
   - Screening, (types of settling), coagulation and flocculation
   - Filtration
   - Design aspects of slow sand and rapid sand filters and their operations
   - Pressure filters
   - Membrane Technology (Reverse Osmosis, Ultrafiltration)

7. **Miscellaneous Water Treatment Techniques**
   - Fluoridation, Iron & Manganese removal
   - Water softening methods
   - Water disinfection and chemicals
   - Chlorination
   - Emergency treatment methods
   - Ozone
   - Ultraviolet

8. **Water Distribution**
   - Layout and design of water transmission works and distribution networks (Hardy Cross and Equivalent Pipe method)
   - Service reservoirs
   - Fixtures and their installation
   - Tapping of water mains
   - Urban and Rural Water Supply

9. Use of relevant software in design

Practical Work:

Following experiments may be taken up for the course.

- To determine optimum dosage for turbid water by jar test.
- To determine Dissolved Oxygen of a given water sample.
- To determine Biological Oxygen Demand (BOD) of a given sample.
- To determine the Chemical Oxygen Demand (COD) of a given sample.
- Determination of Coliform bacteria of a given water sample by Multiple Tube Fermentation method.
- To determine the amount of nitrogen in a given sample.
- Study of single beam Spectrophotometer.

Suggested Teaching Methods

- Lecturing
- Laboratory Demonstration
- Written Assignments
- Guest Speaker
- Field Visits

Suggested Assessment Methods

Theoretical Work

- One hour test(s)/Mid-term
- Quiz tests, Assignments, Project Reports/Term Paper/Presentations
- Final Exam

Practical Work

- Laboratory Participation
- Laboratory Report/Manual
- Laboratory Quiz /Viva Voce

Recommended Books:

1. Mackenzie L. Davis, David A. Cornwell, Introduction to Environmental Engineering, 4th Edition, 2008
2. McGraw-Hill Science/Engineering/Math; 4th Edition (October 3, 2006)
3. S. Peavy, D. R. Rowe, George Technologious, Environmental Engineering8oiupulkj
4. Terence J. McGhee, Water Supply and Sewerage, 6th Edition, McGraw Hill
5. Howard McGraw-Hill Publishing Company; 7th Edition (March 1987)

35. Title of the Course: Management Science Elective

Refer to Annexure B for the course outlines of Management Sciences Electives

36. Title of the Course: ARCHITECTURE & TOWN PLANNING

Contact Hours:		**Credit Hours:**	
Theory	= 3	Theory	= 3
Practical	= 0	Practical	= 0
Total	= 3	Total	= 3

Pre-requisites: Nil

Specific Objectives of course:

- To understand ancient and modern form of living.
- To impart knowledge related to planning and development of inhabitant areas.

Course Outline:

1. **Architecture**
   - Historical Development
   - General introduction to history of architecture
   - Emergence/Development of Islamic Architecture
   - Geographical, climatic, religious, social and historical influences
   - Architectural beauty
2. **Qualities, Factors and Use of Materials**
   - Strength, vitality, grace, breadth and scale
   - Proportion, colour and balance
   - Stone, wood, metals, concrete, composites, ceramics
3. **Architectural Aspects of Building Planning**
   - Walls and their construction
   - Openings and their position, character and shape
   - Roofs and their development and employment
   - Columns and their position, form and decoration
   - Moulding and their form decoration
   - Ornament as applied to any buildings
4. **Town Planning**
   - Definitions
   - Trends in Urban growth
   - Objectives of town planning
   - Modern planning in Pakistan and abroad
5. **Preliminary Studies**
   - Study of natural resources, economic resources, legal and administrative problems
   - Civic surveys
   - Preparation of relevant maps
6. **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

7. 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

Suggested Teaching Method

- Lecturing
- Written Assignments
- Guest Speaker
- Field Visits

Suggested Assessment Method

- One hour test(s)/Mid-term
- Quiz tests, Assignments, Project Reports/Term Paper/Presentations
- Final Exam

Recommended Books:

1. Dan Cruickshank, Sir Banister Fletcher's A History of Architecture, Architectural Press; 20th Edition (September 25, 1996)
2. Leonard Benevolo; Origins of Modern Town Planning, MIT Press, 15-Aug-1971
3. Sir Rymond Unwin, Town Planning in Practice, FQ Legacy Books (December 31, 2010)

37. Title of the Course: GEOTECHNICAL & FOUNDATION ENGINEERING

Contact Hours		**Credit Hours**	
Theory	=3	Theory	= 3
Practical	= 3	Practical	= 1
Total	= 6	Total	= 4

Pre-requisites: Soil Mechanics

Specific Objectives of course:

- To enhance the skills related to baring capacity and settlement evaluation of soils.
- To apply principles of soil mechanics to engineering problems pertaining to retaining structures, foundations and embankments.

Course Learning Outcomes (CLOs):

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

S.No.	CLOs	Learning Domain	Taxonomy level	PLO
1.	ANALYZE earth pressures, bearing capacity and stability of slopes.	Cognitive	4	2
2.	DEVELOP geotechnical design of shallow and deep foundations.	Cognitive	6	3
3.	PRACTICE field and laboratory testing to characterize subsoils.	Psychomotor	3	4

Course Outline:

1. **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

2. **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

3. **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?

4. **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

5. **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

6. **Introduction to deep foundations**
    - Types of piles, load carrying capacity of piles, group action, negative skin friction, pile load test

7. **Soil Improvement**
    - Basic principles,
    - Objectives and methods

8. **Soil Dynamics**
    - Sources of dynamic loading, spring-mass-dashpot system
    - Application to machine foundations, liquefaction

Practical Work:

- Direct shear test
- Unconfined compression test
- Triaxial compression test
- Standard proctor test SPT
- Plate load test
- Consolidation test
- Electrical Resistivity

Suggested Teaching Methods

- Lecturing
- Laboratory Demonstration
- Written Assignments
- Guest Speaker
- Field Visits

Suggested Assessment Methods

Theoretical Work

- One hour test(s)/Mid-term
- Quiz tests, Assignments, Project Reports/Term Paper/Presentations
- Final Exam

Practical Work

- Laboratory Participation
- Laboratory Report/Manual
- Laboratory Quiz /Viva Voce

Recommended Books:

1. Principles of Foundation Engineering by Baraja M. Das, (Latest Edition)
2. Soil Mechanics by Jumikus, (Latest Edition)
3. Soil Mechanics by Das, (Latest Edition)
4. Advanced Soil Mechanics by Das, (Latest Edition)

5. Foundation Analysis and Design by Bowles, (Latest Edition)
6. Soil Engineering by Sprangler and Handy, (Latest Edition)
7. Foundation Analysis by Teng, (Latest Edition)
8. Foundation Design and Construction by Tomlism, (Latest Edition)
9. Geotechnical Engineering – Principles and Practices by D.P. Coduto, (Latest Edition)
10. Foundation Design – Principles and Practices by D.P. Coduto, (Latest Edition)
11. Soil and Foundations by Liu & Evett (6th Edition)

38. Title of the Course: TRANSPORTATION ENGINEERING-II

Contact Hours		**Credit Hours**	
Theory	= 3	Theory	= 3
Practical	= 3	Practical	= 1
Total	= 6	Total	= 4

Pre-requisites: Transportation Engineering-I

Specific Objectives of course:

- To equip students with knowledge related to highway design, construction, maintenance and traffic operations

Course Learning Outcomes (CLOs):

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

S.No	CLOs	Learning Domain	Taxonomy level	PLO
1.	APPLY the basics of traffic engineering for effective traffic management	Cognitive	3	*
2.	DESIGN rigid and flexible pavements	Cognitive	6	3
3.	PRACTICE to investigate properties and quality of asphalt mix	Psychomotor	3	4

Course Outline:

1. Introduction to Road Systems

- Location Survey in Rural and Urban Areas
- Urban Location Controls
- Highway Planning
- Roads in Hilly Areas

2. Highway Engineering

- Highway Components
- Elements of a typical cross-section of road
- Types of cross-section

3. **Classification of Highways**
    - Highway Materials
    - Types & Characteristics
    - Specifications & Tests
    - Introduction to resilient behavior

4. **Geometric Design**
    - Design controls and criteria
    - Sight distance requirements
    - Horizontal curves
    - Super elevation
    - Transition curve
    - Curve widening
    - Grade line
    - Vertical curves

5. **Pavement Design**
    - Types of pavements
    - Wheel loads
    - Equivalent single axle load
    - Repetition and impact factors
    - Load distribution characteristics
    - Design of flexible and rigid pavements
    - Highway drainage
    - Pavement failures
    - Introduction to non-destructive testing
    - Pavement evaluation
    - Construction, Maintenance and rehabilitation

6. **Traffic Engineering**
    - Operating and design speeds
    - Traffic flow parameters, their relationships and data collection methodologies
    - Traffic Survey, O & D Survey
    - Traffic Safety
    - At-grade and grade-separated intersections
    - Traffic control devices
    - Capacity analysis
    - Traffic management, Level of service and signal timing for an intersection

7. **Introduction to relevant computer software**
    - Highway infrastructure design

Practical Work:

- Aggregate Gradation Test
- Impact Value of Aggregates
- Los Angles Abrasion Test
- S G & Absorption Test of Coarse Aggregates
- Shape Test of Aggregates
- Lab CBR Test
- Penetration test of bitumen
- Ductility test of bitumen
- Softening point test of bitumen
- Flash and fire point test of bitumen.
- Viscosity test for bituminous materials
- Marshall Stability and flow test

Suggested Teaching Method

- Lecturing
- Laboratory Demonstration
- Written Assignments
- Guest Speaker
- Field Visits

Suggested Assessment Method

Theoretical Work

- One hour test(s)/Mid-term
- Quiz tests, Assignments, Project Reports/Term Paper/Presentations
- Final Exam

Practical Work

- Laboratory Participation
- Laboratory Report/Manual
- Laboratory Quiz /Viva Voce

Recommended Books:

1. Jason C. Yu, Transportation Engineering Introduction to Planning, Design and Operations, Elsevier Science Ltd (June 1982)
2. Croney D., The Design and Performance of Road Pavements, 3rd Edition McGraw-Hill Professional (September 4, 2008)
3. Salter R. J., Highway Traffic Analysis and Design, Palgrave Macmillan; 3rd Edition (September 1996).
4. Fred L. Mannering, Scott S. Washburn, Walter P. Kilareski Principles of Highway Engineering and Traffic Analysis, Wiley; 4th Edition (September 9, 2008).

39. Title of the Course: GEO INFORMATICS

Contact Hours		Credit Hours	
Theory	= 1	Theory	= 1
Practical	= 3	Practical	= 1
Total	= 4	Total	= 2

Pre-requisites: Advanced Engineering Survey

Specific Objectives of course:

- To acquaint with state-of-the-art Geo-informatics and its diverse applications in engineering.

Course Learning Outcomes (CLOs):

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

S.No.	CLOs	Learning Domain	Taxonomy level	PLO
1.	EXPLAIN basic knowledge related to Geo-informatics.	Cognitive	2	1
2.	APPLY GIS software for the map making.	Cognitive	3	5
3.	IMITATE use of GPS instruments for map making.	Psychomotor	3	5

Course Outline:

1. Introduction to Geo Informatics and Resources of information

- Photogrammetric surveying
- Satellite System
- Aerial and Satellite photogrammetry
- Google Earth

2. Geographic Information System (GIS)

- Fundamentals of GIS
- Spatial Data types and acquiring consideration
- Data models and structures
- Coordinate Systems
- Datums and map projections and their transformation
- Attribute-based operation
- Introduction to Spatial Analysis

3. Remote Sensing (RS)

- Basic Concepts
- Physicals basis of Remote Sensing
- Earth Resources Satellites / Platforms
- Sensors

- Types of Resolutions
- Geo-referencing
- Image Processing Techniques and Classification
- Global Positioning System (GPS)
- Navigational Satellites
- Positioning Systems (GLONASS, GPS & Galileo)
- Fundamentals and Elements of GPS
- System Operation & Characteristics
- Errors and Atmospheric effects
- Differential GPS (DGPS)

4. Field and Laboratory Work with Software

- Training on GPS instruments based surveys
- Integration GPS data in GIS
- Exercises on Image processing software and recent GIS software
- Demonstration on RS/GIS applications in engineering disciplines

Practical Work:

Following practical may be taken up for the course;

- To locate the features on the ground, measure lengths and areas of the objects using Google earth.
- To covert coordinate system of a map using GIS software.
- To covert projection of a map using GIS software.
- To generate a point coverage showing the meteorological station map.
- To find the coordinates of a point on ground using GPS.
- To use Differential GPS to carry out the topographic survey of the area.
- Image processing using any Remote Sensing Software.

Suggested Teaching Method

- Lecturing
- Written Assignments
- Guest Speaker
- Field Visits

Suggested Assessment Method

Theoretical Work

- One hour test(s)/Mid-term
- Quiz tests, Assignments, Project Reports/Term Paper/Presentations
- Final Exam

Practical Work

- Laboratory Participation
- Laboratory Report/Manual
- Laboratory Quiz /Viva Voce

Recommended Books:

1. Michael Kennedy (2002), The Global Positioning System and GIS: An introduction 2nd Edition, Taylor & Frances, New York, ISBN-0-415-28608-5
2. Thomas, M. Lillesand & Ralph W. Kiefer (2005), Remote Sensing and Image Interpretation, 5th edition, John Wiley & Sons, Inc.
3. Clarke, K. (2004) Getting Started with Geographic Information System, Prentices Hall, New York, 2nd Edition ISBN-1879102897
4. Chang, K. T., Introduction to Geographic Information Systems, 3rd Ed. McGraw-Hill Higher Education.

40. Title of the Course: ENVIRONMENTAL ENGINEERING-II

Contact Hours		**Credit Hours**	
Theory	=2	Theory	= 2
Practical	= 0	Practical	= 0
Total	= 2	Total	= 2

Pre-requisites: Environmental Engineering-I

Specific Objectives of course:

- To introduce knowledge of Environmental laws and regulations, required in context to pollution control and impact assessment requirement.
- Introduction to Impact Assessment concept and techniques
- To provide know-how to students to plan, design wastewater collection & treatment systems.
- To introduce the definitions and characteristics of solid wastes, concept of waste management and methods of safe disposal.

Course Learning Outcomes (CLOs):

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

S.No.	CLOs	Learning Domain	Taxonomy level	PLO
1.	DESCRIBE the fundamental components of water and wastewater treatment systems and solid waste management.	Cognitive	2	1
2.	DESIGN domestic sewerage systems.	Cognitive	6	3

Course Outline:

1. Introduction to Environmental Legislation and Regulations

- Basic definitions and differences in terms
- International Acts, Treaties, Agendas and Accords
- Environmental Protection Agency

- Pakistan Environmental Protection Act 1997
- National Environmental Quality Standards (NEQS) and International Standards

2. Introduction to Environmental Impact Assessment

- Definitions, activity, consequence, effect-impact, relationship, magnitude, duration and significance.
- Assessment types
- IEE & EIA in context to PEPA applicable to development projects
- EIA process
- EIA Study
- EIA Analysis
- EIA Techniques
- Environmental & Monitoring Plan

3. 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.

4. 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

5. Sewer System

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

6. Sewage Treatment and Disposal: Primary, secondary & tertiary treatment

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

7. **Sewage Disposal**
    - Receiving body assimilation capacity
    - Stream pollution and self-recovery, sludge handling, treatment & disposal
    - Effluent re-use

8. **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

9. **Solid waste management**
    - Types, characteristics, sources and quantities of solid waste
    - Collection, disposal (Landfill, composting, incineration, RDF, waste to energy) and recycling

10. **Software applications**

Suggested Teaching Method

- Lecturing
- Written Assignments
- Guest Speaker
- Field Visits

Suggested Assessment Method

- One hour test(s)/Mid-term
- Quiz tests, Assignments, Project Reports/Term Paper/Presentations
- Final Exam

Recommended Books:

1. Gerard Kiely, Environmental Engineering, McGraw-Hill International Edition, (1997)
2. Integrated Solid Waste Management, by George Tchobanoglous, International Edition, McGraw-Hill (January 1, 1993)
3. Wood, C, Environmental Impact Assessment (A Comparative Review). Longman Scientific and Technical. Longman House Burnt Hill, Harlow Essex. UK, (1995)
4. Petts, J. and Eduljee, G., Environmental Impact Assessment for Waste Treatment and Disposal Facilities. John Willey & Sons Inc. UK. (1994)
5. UNESCO, Solid Waste Management for Developing Countries, (Latest Edition)
6. Standard Handbook of Environmental Engineering by Corbitt, R.A., 2nd Edition, 1999.

41. Title of the Course: STEEL STRUCTURES

Contact Hours		Credit Hours	
Theory	= 3	Theory	= 3
Practical	= 0	Practical	= 0
Total	= 3	Total	= 3

Pre-requisites: Nil

Specific Objectives of course:

- To acquaint students with use of steel as a structural component and develop their ability to design steel structures.

Course Learning Outcomes (CLOs):

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

S.No.	CLOs	Domain	Taxonomy level	PLO
1.	DESCRIBE the theories and models suitable for the analysis and design of structural steel members.	Cognitive	2	1
2.	DESIGN structural steel members under axial loads, flexure and shear.	Cognitive	6	3
3.	DESIGN connections in structural steel members.	Cognitive	6	3

Course Outline:

1. **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.

2. **Fundamentals of Working Stress Method**
   - Overview of Allowable Stress Design (ASD)
   - Service load and allowable stresses

3. **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

Suggested Teaching Methods

- Lecturing
- Written Assignments
- Guest Speaker
- Field Visits

Suggested Assessment Methods

- One hour test(s)/Mid-term
- Quiz tests, Assignments, Project Reports/Term Paper/Presentations
- Final Exam

Recommended Books:

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

42. Title of the Course: HYDRAULICS & IRRIGATION ENGINEERING

Contact Hours		Credit Hours	
Theory	= 3	Theory	= 3
Practical	= 3	Practical	= 1
Total	= 6	Total	= 4

Pre-requisites: Fluid Mechanics & Advanced Fluid Mechanics

Specific Objectives of course:

- To enable students to learn fundamentals of hydraulic engineering, particularly related to open channel flow, flow through pipes, dam and river engineering.
- To enhance the capabilities of students related to irrigation engineering and canal network.

Course Learning Outcomes (CLOs):

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

S.No.	CLOs	Learning Domain	Taxonomy level	PLO
1.	ANALYSE the 'State of Flow' in open channels.	Cognitive	4	2
2.	DESIGN gravity irrigation system with unlined canals.	Cognitive	6	3
3.	EXECUTE the experimentation to verify the theoretical principles of hydraulic engineering.	Psychomotor	2	2

Course Outline:

1. Steady Flow in Open Channel

- Specific energy and critical depth
- Dynamic equation of gradually varied flow, surface profiles and back water curves
- Humps and constrictions
- Hydraulic jump
- Broad crested weirs, venturi flume and critical depth meters

2. Unsteady Flow

- Flow through pipes, orifices and over weirs under varying heads
- Unsteady flow through pipe lines, water hammer, instantaneous and slow closure of valves
- Surges in open channel

3. Dimensional Analysis and Similitude

- Similitude in hydraulic models, similitude requirements, geometric, kinematics and dynamics similarities, dimensionless numbers and their significance
- Releigh's method
- Buckingham's PI-theorem and its application, physical models, techniques and analysis
- Introduction to numerical models

4. Dams and Hydro Power Engineering

- Selection of hydropower sites

- Components and layout of hydropower schemes
- Types of storage dams, forces on dams, design of gravity dams
- Reservoir engineering, operation and regulation of storage reservoirs
- Sediment Transport in Channels
- Sedimentation Problems in Reservoirs

5. Canal Irrigation

- Elementary concept about canal head works, selection of their site and layout, weirs and barrages, various components and functions
- Canal Head Regulator
- Measures adopted to control silt entry into canals, silt ejectors and excluders
- Design of weirs on permeable foundations, sheet piles and cut off walls
- Design of irrigation channels (Lined/Unlined)
- Kennedy's and Lacey's Theories
- Rational methods for design of irrigation channels
- Comparison of various methods
- Canal lining: advantages and types
- Maintenance of irrigation canals

6. Hydraulic Structures

- Canal Falls, flumes, canal outlets
- Cross drainage works: types and functions

7. Water logging and salinity

- Causes and effects of water logging, reclamation of water logged soils
- Drains and tube wells
- Causes and effects of salinity and alkalinity of lands in Pakistan
- Reclamation methods
- Drainage network in irrigated areas

8. Drainage

- Definition, Land reclamation
- Surface Drainage
- Subsurface Drainage
- Estimation of discharge capacity of Cross-drainage structures
- Disposal of drainage effluents

9. Design using Software

- Computer aided design of irrigation channels

Practical Work:

Following practical/experiments may be taken up for the course.

- To perform experiment on flume to plot E~y diagram and q~y diagram for uniform flow.
- To produce a hydraulic jump in tilting flume.

- To analyze water hammer phenomena through water hammer apparatus.
- To measure discharge on Ordinary Depth Flume.
- To measure discharge on Critical Depth Flume.
- Layout and design of an irrigation scheme.
- Design of a typical outlet.
- Design of a barrage.

Suggested Teaching Methods

- Lecturing
- Laboratory Demonstration
- Written Assignments
- Guest Speaker
- Field Visits

Suggested Assessment Methods

Theoretical Work

- One hour test(s)/Mid-term
- Quiz tests, Assignments, Project Reports/Term Paper/Presentations
- Final Exam

Practical Work

- Laboratory Participation
- Laboratory Report/Manual
- Laboratory Quiz /Viva Voce

Recommended Books:

1. Linsley, R. K., J. Franzini, Water Resources Engineering, McGraw-Hill; 4th Edition (June 1, 1992).
2. David, A. Chin, Water Resources Engineering, Prentice Hall; 2nd Edition (April 13, 2006).
3. Linslay, R. K. and Joseph, B. F. Water Resources Engineering, McGraw-Hill, Inc.
4. Robert, L. D, Fluid Mechanics with Engineering Applications
5. Hanif, C, Open Channel Hydraulics, 2nd Edition (2008)
6. Iqbal, A, Irrigation and Hydraulic Structures, Theory, Design and Practice, 3rd Edition, 2007

43. Social Science Elective

Refer to Annexure A for the course outlines of Social Sciences Electives

44. Civil Engineering Project

Final Year Project

List of Courses for MSc/MS/ME/MEM in Civil Engineering

MS Induction criteria

Admission criteria to MS/MSc/ME/MEM programs shall be as per HEC guidelines.

The courses given in the following sections are provided for different fields of specializations. The programs may include customized courses based on the specific requirements.

MSc/MS/ME in Structural Engineering

1.	Advanced Structural Analysis
2.	Advanced Reinforced Concrete
3.	Properties of Structural Materials
4.	Prestressed Concrete
5.	Advanced Steel Structures
6.	Non Linear Structural Analysis
7.	Finite Element Method
8.	Reliability Based Structural Design
9.	Advanced Mechanics of Solids
10.	Fiber Reinforced Polymers
11.	Structural Fire Engineering
12.	Design of Masonry Structures
13.	Seismic Analysis and Design
14.	Bridge Engineering
15.	Design of Special Structures
16.	Theory of Plates and Shells
17.	Stability of Structures
18.	Structural Dynamics
19.	Repair, Maintenance and strengthening of Structures
20.	Structural Optimization
21.	Durability of Concrete Structures
22.	Design of Tall Structures
23.	Serviceability of Concrete Structures
24.	Seismology and Earthquake Engineering
25.	Structural Assessment and Rehabilitation
26.	Computational Modeling of Materials and Structures
27.	Advanced Concrete Technology
28.	Fracture Mechanics
29.	Fiber Reinforced Composites

30.	Performance Based Seismic Design
31.	Computer Methods in Structural Analysis
32.	Nanotechnology in Concrete
33.	Wind Engineering in Structures
34.	Research Methods in Engineering
35.	Probability and Statistics

MS/ME in Hydraulics & Irrigation Engineering, Water Resources Engineering and Management, Water Resources Engineering, Water Resources and Irrigation Engineering or any other relevant specialization in water resource engineering

1.	Hydraulic Structures
2.	Advanced Fluvial Hydraulics
3.	Hydropower Engineering
4.	Irrigation Engineering & Practices
5.	Applied Hydrology
6.	Sediment Transport
7.	Advanced Fluid Mechanics
8.	Drainage Engineering
9.	Computer Aided Design of Hydraulic Structures
10.	River Engineering and Flood Management
11.	Application of RS & GIS
12.	Soil Erosion & watershed Management
13.	Hydrological Systems Modeling
14.	Water Resources Economics, Planning & Management
15.	Ground Water Engineering
16.	Advanced Open Channel Hydraulics
17.	Computational Hydraulics
18.	Hydrodynamics
19.	River Flood Modelling
20.	Urban Flood Management
21.	Dam Engineering
22.	Water Supply and Sewer System Design
23.	Irrigation System Design and Management
24.	Data Driven Modelling and Real Time Control of Water Systems
25.	Modelling Theory and Information Management
26.	Design and Construction of Earthen Dam
27.	Coastal Engineering
28.	River Basin Modelling
29.	Climate Change and Hydrological Cycle
30.	Water Law and Policy
31.	Planning, Development, and Management of Hydropower Systems

32.	Design of Hydropower Plants
33.	Hydrometeorology
34.	Water management Computations
35.	Watershed Management
36.	Legal and Financial Aspects of Water Resources
37.	Sustainable Water Resource Management
38.	Reservoir Operation
39.	Groundwater Resource Management
40.	Water Quality Management
41.	Research Methods in Engineering
42.	Probability and Statistics

MSc/MS/ME in Geo-Technical Engineering

1.	Advanced Soil Mechanics
2.	Foundation Engineering
3.	Deep Foundations
4.	Dam Engineering
5.	Geotechnical Investigation
6.	Soil Improvement Techniques
7.	Rock Engineering
8.	Environmental Geo-techniques
9.	Soil Dynamics
10.	Bridge and Tunnel Engineering
11.	Soil Erosion & Watershed Management
12.	Ground Water Engineering
13.	Engineering Properties of Soil
14.	Earth Reinforcement
15.	Earth Retaining Structures
16.	Pavement Analysis and Design
17.	Soil Structure Interaction
18.	Slope Stability
19.	Advanced Geotechnical Design
20.	Design and Construction of Earthen Dam
21.	Rock Mechanics
22.	Geo Environmental Engineering
23.	Numerical Methods in Geotechnical Engineering
24.	Research Methods in Engineering
25.	Probability and Statistics

MSc/MS/ME in Transportation Engineering

1.	Transportation Planning and Engineering
2.	Geometric Design and Highway Safety
3.	Pavement Analysis and Design
4.	Traffic Engineering and Management
5.	Airport Planning and Design
6.	Railway Engineering
7.	Pavement Evaluation and Rehabilitation
8.	Planning for Traffic Safety and Injury Prevention
9.	Pavement Management Systems
10.	Highway construction Materials & Equipment
11.	Harbor and Dock Engineering
12.	Bridge and Tunnel Engineering
13.	Asphalt Mix Design and Construction
14.	Pavement Distress identification and Preservation
15.	Advanced Probability and Statistics for Transportation Engineering
16.	Application of RS & GIS
17.	Transportation Infrastructure Asset Management
18.	Urban Transport System Evaluation
19.	Public Transportation system
20.	Traffic Management Analysis
21.	Traffic Impact and Safety Studies
22.	Geotechnical Aspects of Highways
23.	Traffic Flow Theory
24.	Intelligent Transportation System (ITS)
25.	Transportation Economics
26.	Waterways Transportation
27.	Travel Demand Forecasting
28.	Research Methods in Engineering
29.	Probability and Statistics

MSc/MS/MEM in Construction Engineering and Management

1.	Construction Project Administration
2.	Construction Planning, Scheduling and Control
3.	Safety Management in Construction
4.	Contract Management
5.	Cost Engineering and Control
6.	Economic Decision Analysis in Construction
7.	Leadership in Construction Management
8.	Construction Equipment Management
9.	Value Engineering in Construction
10.	Human Resource Management in Construction Industry
11.	Supply Chain Management in Construction Industry
12.	Decision Making and Risk Management in Construction
13.	Construction Operations and Development of Technologies
14.	Entrepreneurship in Construction Industry
15.	Construction Claim Management
16.	Regional Development Planning
17.	Social Engineering for Sustainable Development
18.	Public Infrastructure Management
19.	Planning and Management of Housing
20.	Energy Management in Buildings
21.	Sustainable Development and Construction
22.	Environmental Impact Assessment
23.	Fundamentals of Disaster Management
24.	Policies, Planning and Strategies for Disaster Management
25.	Community Based Disaster Risk Management
26.	Vulnerability Analysis and Hazard Mitigation
27.	Real Estate Management
28.	Occupational Health and Safety in Construction
29.	Total Quality Management (TQM)
30.	Project Evaluation and Feasibility Analysis
31.	Project Management Framework and Tools
32.	Advanced Bidding and Estimating
33.	Constructional Failure Analysis
34.	Research Methods in Engineering
35.	Probability and Statistics

MSc/MS/ME in Coastal Engineering

1.	Introduction to Ocean and Coastal Engineering
2.	Applied Hydrology
3.	Marine Pollution and Control
4.	Coastal Processes
5.	Coastal Management
6.	Port Planning and Design
7.	Soil Mechanics in Coastal Engineering
8.	Marine Geology
9.	Marine Dredging
10.	Off-shore Engineering Analysis
11.	Computational Hydraulics
12.	Design of Marine Structures
13.	Tsunami Inundation Modelling
14.	Sea Water Intrusion
15.	RS and GIS Applications
16.	Mathematical Methods for Engineers
17.	Research Methods in Engineering
18.	Probability and Statistics

MSc/MS/ME in Earthquake Engineering

1.	Structural Dynamics
2.	Fundamental of Earthquake Engineering
3.	Seismic Design of Structures
4.	Advanced Structural Analysis
5.	Fundamentals of Earthquake Engineering
6.	Displacement Based Seismic Design
7.	Performance Based Seismic Design
8.	Seismic Design of Steel and Composite Structures
9.	Seismic Design of Masonry Structures
10.	Loss Estimation and Hazard Mitigation
11.	Engineering Seismology
12.	Dynamic Soil Structure Interaction
13.	Seismic Risk Reduction
14.	Policies, Planning and Strategies for Disaster Management
15.	Seismic Design of Life-Line Structures
16.	Seismic Assessment and Rehabilitation of Structures
17.	Structural Reliability Analysis
18.	Vibration Control and Dissipation Mechanisms
19.	Seismic Design of Shell Structures
20.	Research Methods in Engineering
21.	Probability and Statistics
22.	Structural Dynamics
23.	Fundamental of Earthquake Engineering
24.	Seismic Design of Structures
25.	Advanced Structural Analysis

26.	Fundamentals of Earthquake Engineering
27.	Displacement Based Seismic Design
28.	Performance Based Seismic Design
29.	Seismic Design of Steel and Composite Structures
30.	Seismic Design of Masonry Structures
31.	Loss Estimation and Hazard Mitigation
32.	Engineering Seismology
33.	Dynamic Soil Structure Interaction
34.	Seismic Risk Reduction
35.	Policies, Planning and Strategies for Disaster Management
36.	Seismic Design of Life-Line Structures
37.	Seismic Assessment and Rehabilitation of Structures
38.	Structural Reliability Analysis
39.	Seismic Design of Shell Structures

Annex "A"

List of Social Science Courses (Electives)

Universities may opt courses according to their requirement and facilities:

1) Sociology (Sociology and Development)
2) Social Anthropology
3) Psychology
4) Critical thinking
5) Introduction to Philosophy
6) Organizational Behaviour

SOCIOLOGY
Sociology and Development

Objectives: The main objective of this course is to apprise potential engineers about social factors that contribute towards enhancing their professional performance for the good of society and the country. This course is culture specific and has to be taught within the context of local and national socio-economic environment. The engineers are expected to supervise several people in different capacities and their understanding about human behaviour is critical for their optimum performance. Modification of human behaviour or getting work done from sub-ordinates and seniors remain a major challenge for all the professional engineers. This course will enhance understanding about the determinants of human behaviour, which ultimately will result in improved individual efficiency.

1. Introduction to Sociology

- What is sociology?
- Nature, Scope, and Importance of Sociology
- Social Interactions
- Social Groups
- Social Institutions

2. Culture and Related Concepts

- Definition of Culture
- Types of Culture
- Elements of Culture
- Role of Culture in Organization
- Socialization and Personality

3. Interpersonal Relations

- Interpersonal Behaviour
- Formation of Personal Attitudes
- Language and Communication
- Motivations and Emotions
- Public Opinion

4. **Social Stratification**
    - Factors of Social Stratification
    - Caste and class
    - Power, Prestige, and Authority
    - Social Mobility
    - Migration

5. **Human Ecology**
    - Ecological Processes
    - Ecosystem and energy
    - Ecosystem and Physical Environment
    - Solid Waste Disposal
    - Pollution

6. **Population Dynamics**
    - World Population Growth and Distribution
    - Population Dynamics in Pakistan
    - Causes and Consequences of Urbanization
    - Population Policy in Pakistan
    - Population and Development

7. **Community Development**
    - Meaning, Scope, and Subject Matter of Community Development
    - Processes of Community Development
    - Community Development Programs in Pakistan
    - Community Organization and Related Services
    - Cooperation and Conflict in Community Development

8. **Deviance and Crime**
    - Crime as a Social and Cultural Phenomenon
    - Crime and Social Organization
    - Organized Crime
    - Culture Based Crime
    - Economics of Crime

9. **Sociology of Change and Development**
    - What is Social Change and Development?
    - Dynamics of Social Change
    - Role of NGOs in Development
    - World System and Development
    - Gender and Development

Recommended Books:

1. Allport, G. W. (1985). The Historical Background of Modern Social Psychology. New York, Random House.
2. Bernard, A. and T. Burgess (2004). Sociology, Cambridge University Press.
3. DuBrin, A. J. (2007). Human Relations: Interpersonal Job Oriented Skills. New York, Prentice Hall.
4. Gardezi, H. N., Ed. (1991). Understanding Pakistan: The Colonial Factor in Societal Development. Lahore, Maktaba Fikr-o-Danish.
5. Hafeez, S. (1991). Changing Pakistan Society. Karachi, Royal Book Company. Gardezi, H. N., Ed. (1991).
6. Jones, G. W. (2005). "Why are Population and Development Issues not Given Priority?" Asia-Pasific Population Journal 20(1).
7. Macionis, J. J. (1999). Sociology 7th Edition, National Book Foundation, Islamabad
8. Maser, C. (1997). Sustainable Community Development: Principles and Concepts. Plorida St. Lucie Press.
9. Nelson, N. and S. Wright (1995). Power and Participatory Development: Theory and Practice. London, Intermediate Technology Publications.
10. Syed, S. H. (2003). The State of Migration and Multiculturalism in Pakistan: The Need for Policy and Strategy. Islamabad, UNESCO: 1-30.
11. Utton, A. E. (1976). Human Ecology, West View Press.
12. Webster, A. (1990). Introduction to Sociology of Development. London, Nacmillan Education Ltd.
13. Weiss, A. M. (2001). Power and civil society in Pakistan, Oxford University press.

SOCIAL ANTHROPOLOGY

Objectives: The students are expected to learn anthropological skills for application by professional engineers and other related practitioners. Societal growth needs are to be understood within our own cultural environment. Such a body of applied knowledge will result in improving the professional performance of would-be engineers. As culture and society play an important role towards all human activities, this course will help students relate technical skills to the societal needs and requirements.

1. Introduction

- Anthropology and Social Anthropology
- Fields of Anthropology
- Anthropological Research Methods
- Social Anthropology and other Social Sciences
- Significance of Social Anthropology

2. Culture

- Definition, Properties and Taxomony
- Evolution of Growth and Culture

- Evolution of Man: Religious and Modern Perspectives
- Evolution of Culture
- Culture and Personality

3. Evolution and Growth of Culture

- Evolution of Man
- Schools of Thought in Cultural Anthropology
- Acculturation
- Enculturation
- Ethnocentrism and Xenocentrism

4. Language and Culture

- Communication
- Structural Linguistics
- Historical Linguistics
- Relationship between Language and Culture
- Ethnography

5. Economic System

- Global Economic System
- The Allocation of Resources
- The Conversion of Resources
- The Distribution of Goods and Services
- Poverty and Inequality

6. Marriage and Family

- Marriage and Mate Selection
- The Family: Types and Functions
- Kinship System
- Structure and Function of Family
- Gender Relations

7. Political Organization

- Political Sociology
- Origin of Political Organization and Organizational System
- Types of Political Organizations
- Power Politics and Factionalism in Pakistan
- Resolution of Conflict

8. Religion and Magic

- The Universality of Religion
- Comparative Religions
- Religion and Society
- Religious Beliefs and Practices
- Witchcraft and Sorcery

9. **Culture Change**
    - Forms of Art
    - Expressive Culture
    - Process of Cultural Change
    - Cultural Change in the Modern World
    - Cultural Change in Pakistani society

Recommended Books:

1. Ahmad, Akbar S. 1990. Pakistani Society, Karachi, Royal Books Co.
2. Bernard, H. Russel. 1994. Research Methods in Anthropology, Qualitative and Quantitative Approaches. London: Sage Publications
3. Bodley, John H. 1994. Cultural Anthropology, California: Mayfield Publishing Co.
4. Brogger, Jan. 1993. Social Anthropology and the Lonely Crowd. New Delhi: Reliance Publishing
5. Ember, Carol R. & Ember Melvin. 2005. Anthropology, 11th ed. Englewood Cliffs: Prentice Hall, Ince. Harper and Row
6. Harris Marvin. 1987. Cultural Anthropology. New York: Harper and Row
7. Harris Marvin. 1985. Culture, People, nature; An Introduction to General Anthropology London: Harper and Row
8. Haviland, W. A. (2005). Anthropology: The Human Challenge. New York, Thomson Learning Inc.
9. Hertzler J. O. 1981. The Social Structure of Islam. Cambridge: CambridgeUniversity Press.
10. Keesing, Roger m. 1998. Cultural Anthropology: A contemporary perspective. 3rd ed. New York: HarcourtBraceCollege Publishers.
11. Kottak, Conard Phillip. 2002. Anthropology: The Exploration of Human Diversity. 9th ed. Boston: McGraw Hill Higher Education.
12. Kennedy, Charles H. 1992. PakistanLondon: Westview Press,.
13. Marron, Stanley. 1057. Pakistani Society and Culture. New Heaven
14. Wilson, Richard A. 1996. Human Rights, Culture and Context: Anthropological Perspective. London: Pluto Press.

PSYCHOLOGY

Understanding Psychology and Human Behaviour

1. **What is Psychology?**
2. **Nature, Scope and Application with Special Reference to Pakistan**
3. **Different Schools of Psychology**
4. **Methods of Psychology**
5. **Learning**
6. **Intelligence and Artificial Intelligence**
7. **Personality and its Assessment**
8. **Understanding Maladjustive Behaviour**
9. **Positive Emotional States and Processes**
10. **Stress Management and Anger Management**

Recommended Books:

1. Atkinson R.C., & Smith E.E. (2000), Introduction to Psychology (13thEd.), HarcourtBraceCollege Publishers.
2. Fernald, L.D., & Fernald, P.S. (2005), Introduction to Psychology, USA: WMC Brown Publishers.
3. Hergenhahn, B.R. (2001). An Introduction to the History of Psychology, New York: Wadsworth.
4. Goodwin, C.J, (2000) Research in Psychology: Methods and Design, (3rdEd.), New York: John Wiley & Sons.
5. Synder, C.R., & Lopez, S.J. (2007) Positive Psychology, USA, Sage Publications.
6. Allen, B.P. (1997), Personality Theories: Development, Growth and Diversity, (2nd Ed.), Boston: Allyn & Bacon.
7. Cohen, R.J., &Swerdlik, M.E. (2005) Psychological Testing & Assessment (6thEd.), New York: McGraw-Hill.
8. Corcini, R., (2000). Current Psychotherapies. London: Thompson & Co Publishers.
9. Comer, R.J. (2004). Abnormal Psychology, USA: Freeman & Company.
10. Schwartz, B., Wassernman, E., & Robbins, S. (2002), Psychology of Learning and Behaviour, 5th Ed. Norton and Company.

PROFESSIONAL PSYCHOLOGY

1. **Introduction to Professional Psychology**
2. **Psychological Testing**
3. **Educational Psychology**
4. **Industrial/Organizational Psychology**
5. **Social Psychology**
6. **Health Psychology**
7. **Clinical Psychology**
8. **Positive Psychology**
9. **Legal, Ethical, and Professional Issues.**

Recommended Books:

1. Crow, L., & Crow, A. (2000) Educational Psychology, New Delhi: Eurosia Publishing House Ltd.
2. Spiegel, P.K., & Koocher, G.P. (1998), Ethics in Psychology, New York: OxfordUniversity Press
3. Snyder, C.R., & Lopes, S.J. (2000), Handbook of Positive Psychology, New York: OxfordUniversity Press.
4. Compton, W.C. (2005), Introduction to Positive Psychology, USA, Thomson Wadsworth.
5. Debra, L.N. & James Compbell Quick, (2000) Organizational Behaviour (3rdEd), Cincinnat: South Western.
6. Fred Luthans, Alexander, D.S. & Edwin, A. Locke (2000) (Eds), Handbook of Principles of Organizational Behaviour, London: Blackwell.

7. Brannon, L.& Reist, J. (2000), Health Psychology: An Introduction to Behaviour and Health (4th ed.), USAWadsworth.
8. Donohue, W. & Ferguson, K. (Eds), (2003), Handbook of Professional Ethics for Psychologists; Issues, Questions and Controversies, London: Sage Publications.
9. Meyers, D. (2005), Social Psychology, 8th Ed. McGraw Hill Inc.
10. Cooper, J. & Hogg, M. (2003) Handbook of Social Psychology, Sage Publications
11. Halgin, R.P., Whitbourne, S.K., & Halgin, R. (2004), Abnormal Psychology: Clinical Perspectives on Psychological Disorders, New York: McGraw Hill.
12. Thorndike R.L., & Hage, E.P. (1995), Measurement and Evaluation in Psychology and Education (4th Ed), New York, MacMillan.

CRITICAL THINKING

1. **The Power of Critical Thinking**
   - Claims and Reasons
   - Reasons and Arguments
   - Arguments in the Rough

2. **The Environment of Critical Thinking**
   - Perils of Haunted Mind
   - Self and the Power of the Group
   - Subjective and Social Relativism
   - Skepticism

3. **Making Sense of Arguments**
   - Arguments Basics
   - Patterns
   - Diagramming Arguments
   - Assessing Long Arguments

4. **Reasons for Belief and Doubt**
   - Conflict Experts and Evidence
   - Personal Experience
   - Fooling Ourselves
   - Claims in the News

5. **Faulty Reasoning**
   - Irrelevant Premises
   - Genetic Fallacy, Composition, Division
   - Appeal to the Person, Equivocation, Appeal to Popularity
   - Appeal to Tradition, Appeal to Ignorance, Appeal to Emotion
   - Red Herring, Straw Man

6. **Unacceptable Premises**
   - Begging the Question, False Dilemma
   - Slippery Slope, Hasty Generalization
   - Faulty Analogy

7. **Deductive Reasoning: Propositional Logic**
   - Connectives and Truth Values
   - Conjunction, Disjunction, Negation
   - Conditional, Checking for Validity
   - Simple Arguments, Tricky Arguments
   - Streamlined Evaluation

8. **Deductive Reasoning: Categorical Logic**
   - Statements and Classes
   - Translations and Standard Form
   - Terms, Quantifiers
   - Diagramming Categorical Statements
   - Sizing up Categorical Syllogisms

9. **Inductive Reasons**
   - Enumerative Induction
   - Sample Size, Representativeness, Opinion Polls
   - Analogical Induction
   - Casual Arguments, Testing for Causes
   - Casual Confusions

10. **Inference to the Best Explanation**
    - Explanations and Inference
    - Theories and Consistency
    - Theories and Criteria
    - Testability, Fruitfulness, Scope, Simplicity
    - Conservatism

11. **Judging Scientific Theories**
    - Science and Not Science
    - The Scientific method, Testing Scientific Theories
    - Judging Scientific Theories
    - Copernicus versus Ptolemy, Evolution Versus Creationism
    - Science and Weird Theories
    - Making Weird Mistakes
    - Leaping to the Weirdest Theory, Mixing What Seems with What is
    - Misunderstanding the Possibilities
    - Judging Weird Theories
    - Crop Circles, Talking with the Dead

Recommended Books:

1. Vaughn Lewis, 2005, The Power of Critical Thinking, OxfordUniversity Press.
2. Paulsen David W., Cederblom Jerry:2000, Critical Reasoning, Wadsworth
3. Restall Greg. 2005, Logic: An Introduction, Routledge

INTRODUCTION TO PHILOSOPHY

1. **Definition and Nature of Philosophy**
2. **Theory of Knowledge**
   - Opinion and Knowledge
   - Plato, the Republic Selection
   - Knowledge through Reason
   - Descartes Meditation on First Philosophy
   - Knowledge through Experience
   - Hume an Inquiry concerning Human Understanding (Selection)
   - Experience Structured by the Mind
   - Kant Critique of Pure Reason (Selection
   - Knowing and Doing
   - James Pragmatism (Selection)
   - Knowledge and Emotion
   - Jaggar Love and Knowledge (Selection)

3. **Philosophy of Religion**
   - Proving that Existence of God
   - Anselm, Aquinas, Paley, Dawkins (Selection)
   - Justifying Religious Beliefs
   - Pascal Pensees (Selection)
   - James The will to Believe Selection
   - Freud the Future of An Illusion (Selection)
   - Confronting the Problems of Evil
   - Mackie Evil and Omnipotence (Complete)
   - Hick Philosophy of Religion (Selection)

4. **Metaphysics**
   - Idealism and Materialism
   - Berkeley Three Dialogues Between Hylas and Pholonous (Selection)
   - Armstrong Naturalism, Materialism and First Philosophy (Selection)
   - The Mid-Body Problem
   - Descartes Meditations on First Philosophy (Selection)
   - O'Hear Introduction to the Philosophy of Science (Selection)
   - Dennett The Origins of Selves (Complete)
   - Pali Canon (Selection)
   - Penelhum Religion and Rationality (Selection)

5. **Freedom to Choose**
    - Libertarianism
    - James The Dilemma of Determinism (Selection)
    - Taylor Metaphysics (Selection)
    - Determinism
    - Hospers Meaning and Free Will (Selection)
    - Skinner Walden Two (Selection)
    - Compatibilism
    - Stace Religion and the Modern Mind (Selection)
    - Radhakrishnan Indian Philosophy (Selection)

6. **Ethics**
    - Fulfilling Human Nature
    - Aristotle Nicomachean Ethics (selection)
    - Loving God
    - Augustine The Morals of the Catholic Church and the City of God (Selection)
    - Following Natural Law
    - Aquinas Summa Theologiae (Selection)
    - Doing One's Duty
    - Kant Fundamental Principles of the Metaphysics of Morals (Selection)
    - Maximizing Utility
    - Mill Utilitarianism (Selection)
    - Turning Values of Upside Down
    - Nietzsche Human, All too Human and Beyond Good and Evil (Selection)
    - Creating Ourselves
    - Sartre Existentialism is a Humanism (Selection)
    - Hearing the Feminine Voice
    - Gilligan In a Different Voice (Selection)
    - Baier What do Women Want in a Moral Theory (Selection)

7. **Political and Social Philosophy**
    - The State as Natural
    - Plato the Republic (Selection)
    - Aristotle Politics (Selection)
    - The State as a Social Contract
    - Hobbes Philosophical Rudiments Concerning Government and Society (Selection)
    - Locke the Second Treatise of Government (Selection)
    - Liberty of the Individual
    - Mill On Liberty (Selection)
    - Alienation in Capitalism
    - Marx Economic and Philosophic Manuscripts of 1844 (Selection)

- Justice and Social Trust
- Rawls A Theory of Justice (Selection)
- Nozick Anarchy, State, and Utopia (Selection)
- Held Rights and Goods (Selection)
- Women in Society
- Wollstonecraft A Vindication of the Rights of Women (Selection)
- De Behaviour The Second Sex (Selection)
- The Value of Philosophy
- Russel The Problems of Philosophy (Selection)
- Midgley Philosophical Plumbing (Selection)

Recommended Books:

1. Abel Donald C., Stumpf Samuel Enoch, 2002. Elements of Philosophy: An Introduction, 4th Ed. McGraw Hill.
2. Scruton Roger, 2001. A short History of Modern Philosophy, 2ndEd. Routledge.

ORGANIZATIONAL BEHAVIOUR

1. **Introduction to Organizational Behaviour**
   - Organizational Disciplines and topics
   - Psychological Perspective
   - Social-Psychological Perspectives

2. **Structure and Control in Organization**
   - Introduction
   - Bureaucracy
   - Managerial Work
   - Contingency theory
   - Organizational Design

3. **Individual and Work Learning**
   - Learning Theories
   - Learning and Work

4. **Stress**
   - Types of Stress and Work
   - Occupational Stress Management

5. **Individual Differences**
   - Personality and its factors
   - Personality dimensions and social learning
   - Intelligence

6. **Motivation and Job Satisfaction**
   - Needs at Work

- Theories of Motivation and job satisfaction
- Correlates of Job satisfaction
- Correlates of Job satisfaction

7. Group and Work

- Social Interaction
- Dramaturgy and impression Management
- Social Skill

8. Group and Inter group Behaviour

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

9. Leadership

- Leadership as an attribute
- Leadership Style

10. Patterns of Work

- Work-the classical approach
- Marx, Weber, & The critique of labour
- Foucault & Disciplinary Power

11. Conflict and Consent in Work

- The labor Process debate
- Work place control and resistance
- Industrial conflict and industrial relations

12. Organizational culture

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

Recommended Books:

1. Finchan, R., & Rhodes, P. (2003), Principles of Organizational Behaviour, 3rd Oxford.
2. Noe, R., Hollenbeck, J. Gerhart, B., & Wright, P. (2006), Human Resource Management, 5th Ed., McGraw Hill.
3. Newstrom John W. (2007), Organizational Behaviour, (12th Ed), McGraw Hill.
4. Luthan Fred, (2005), Organizational Behaviour, McGraw-Hill Inc.
5. Robins, Stephen, (2005), Organizational Behaviour, McGraw-Hill Inc.

Annex "B"

List of Management Science Courses

Universities may opt courses according to their requirement and facilities, or may design and include relevant management science course related to Civil Engineering:

1. Entrepreneurship
2. Hazard and Disaster Management
3. Construction Contract Management
4. Modern Aspects Of Construction Project Management

ENTREPRENEURSHIP

Objective:

Entrepreneurship is an important component in the process of economic development. The purpose of this course is to analyse the theories of entrepreneurship and to go for case studies of successful entrepreneurs.

Course Contents:

1. **Introduction:**The concept of entrepreneurship, the economist view of entrepreneurship, The sociologist view, Behavioural approach, Entrepreneurship and Management

2. **The Practice of Entrepreneurship**: The process of entrepreneurship, Entrepreneurial Management, The entrepreneurial business, Entrepreneurship in service institutions, The new venture

3. **Entrepreneurship and Innovation:** The innovation concepts, Importance of innovation for entrepreneurship, Sources of innovative opportunities, The innovation process, Risks involved in innovation

4. **Developing Entrepreneur:**Entrepreneurial profile, Trait approach to understanding entrepreneurship, Factors influencing entrepreneurship, The environment, Socio cultural factors, Support systems

5. **Entrepreneurship Organization:** Team work, Networking organization, Motivation and compensation, Value system

6. **Entrepreneurship and SMES**: Defining SMEs, Scope of SMEs, Entrepreneurial, managers of SME, Financial and marketing problems of SMEs

7. **Entrepreneurial Marketing:** Framework for developing entrepreneurial marketing, Devising entrepreneurial marketing plan, Entrepreneurial marketing strategies, Product quality and design

8. **Entrepreneurship and Economic Development:** Role of entrepreneur in the economic development generation of services, Employment creation and training, Ideas, knowledge and skill development, The Japanese experience

Case Studies of Successful Entrepreneurs

Text Books:

1. Paul Burns and Jim Dew Hurst: Small Business and Entrepreneurship
2. P.N. Singh: Entrepreneurship for Economic Growth
3. Peter F. Drucker: Innovation and Entrepreneurship Peter F. Drucker
4. John B. Miner: Entrepreneurial Success.

HAZARDS AND DISASTER MANAGEMENT

Specific Objectives of course:

- To familiarize students with the basic concepts of natural and human induced hazards
- To enable students to learn the techniques for pre and post-disaster management.

Course Outline:

Introduction to Hazards and Disasters (earthquakes, floods, droughts, landslides, cyclones, etc.), Social & Economic Aspects of Natural and human induced hazards, Hazard and Disaster Investigation,

Disaster Management, Pre-Disaster Phase (Prevention, Mitigation & Preparedness), Disaster Phase (Response, relief and recovery), Post-Disaster Phase (Rehabilitation, Development), Damage assessment, Disaster management policies and institutional infrastructure from national to local level

Monitoring of Infra-structure facilities; strategies for protection against possible damages; maintenance for different infrastructure facilities. Rehabilitation and repair strategies, Predictions and preparedness strategies for natural disasters such as Earthquakes etc; Emergency management; Awareness Programs; Follow-on Disasters; Recovery plans; Strategies for protection, Risk and Vulnerability Analysis; Disaster Mitigation

Recommended Books:

1. Thomas D. Schneid, Disaster Management and preparedness, CRC Press; 1st Edition (November 22, 2000)
2. David Alexander, Principles of Emergency planning and Management, Published in the United State of America by Oxford University Press Inc. 1998 Madison Avenue, New York 10016

3. Timothy Beatley, Philip Berke, David J. Brower 1999 Natural Hazard Mitigation: Recasting Disaster Policy and Planning Island Press ISBN: 1559636025
4. Charlotte Benson, Edward J. Clay (2004) Understanding the Economic and Financial Impacts of Natural Disasters World Bank Publications ISBN: 0821356852
5. The primer on Disaster Risk management in Asia
6. Mr. Aloysius J. Rego Director of Knowledge Sharing and partnerships and Co-Team Leader of Disaster management System team Asian Disaster preparedness Center (ADPC) 2003.

CONSTRUCTION CONTRACT MANAGEMENT

Specific Objectives of course:

- To familiarize students with the concepts of construction contract preparation and management.
- To provide students overview of the regulatory environment in the construction industry with special reference to contracts

COURSE OUTLINE:

1. **Introduction to Contracts**:General Description, Construction Contracts,Elements, Form, Intent, Privity, Format and Major Components, Key Drafting Considerations.

2. **Contract Award Mechanisms**: Open vs. Sealed Bids, Bids vs. Negotiated Best Value Awards, General Considerations in Bids for Public Projects, Overview of PPRA Bidding Rules, Responsible and Responsive Bidder, Lowest Cost Bidding, Multi-Parameter Bidding, General Considerations in Bids for Private Projects, Bid Bonds, Bidding Advantages and Disadvantages, Bid Issues.

3. **The Bidding Process:** Bid Advertisement, Prequalification, Bid Decision, Bidding Period, Bid Package, Accuracy of Bidding Information, Instructions to Bidders, Addenda, Alternates, Modification and Withdrawal of Bids, Award, Mistakes in Bids, Bid Qualification.

4. **Subcontractors & Subcontracts:** GC-Sub and Owner-Sub Relationships, Subcontractor Bidding and Selection Process, Bid Shopping, Advantages and Disadvantages. of Subcontracting, Insurance and Bonding Requirements, Subcontract Agreement and Terms, Subcontract Management: Contract Provisions; Flow-Down Clauses; Back charges; Changes; Extra Work; Delays; Safety and Waste Management, Supplier Contracts.

5. **Contract Conditions:** General and Supplementary Conditions of Contract, Overview and Discussion on Use of Standard Contracts in Construction – PEC, AIA, FIDIC, etc.

6. **Contract Interpretations:** Interpreting Contract Documents, Common Rules of Contract Interpretation, Modifications: Contract Modifications, Substitutions, Feedback.

7. **Overview of regulatory environment:** Overview of engineering and professional registration, contractor licensing, insurance and bonds.

8. **Overview of Claims and Dispute Resolution:**Project Delays, Changes, Claims, Alternate Dispute Resolutions Techniques.

Recommended Books:

1. Jimmie Hinze Construction Contracts 3rd Edition, McGraw-Hill Education.
2. Will Hughes, John Murdoch, Construction Contracts: Law and Management 4th Edition, Taylor and Francis

ADVANCED TOPICS IN CONSTRUCTION PROJECT MANAGEMENT

Credit Hours: 3+0 = 3

Prerequisites: None

Specific Objectives of course:

- To familiarize students with advanced aspects of construction project management

Course Outline:

1. **The Art of Project Key Project Management Competencies and Skills** - Leadership; Developing Management: People; Communication; Interpersonal; Stress Handling; Problem-Solving; Time Management; Delegation; Motivation; Change Management; ConflictManagement; Management by Wandering Around; Ethics; Improving PersonalProductivity; etc., Developing the Skills Needed to be an Effective ProjectManager.

2. **Project Delivery Systems** Project Delivery System – DBB; DB; BOT; CM@Risk; Integrated Project Delivery (IPD)

3. **Jobsite Management:** Site organization; Staffing; Subcontracting; Job Commencement; Construction Operations; Procurement; Jobsite Management; Documentation and Record Keeping on Jobsite; Submittals; Samples; Shop Drawings; Jobsite Layout and Control.

4. **Construction Quality Management:** Concepts, Principles, Views, Relationship with Value and Organizational Excellence, Quality and Global Competitiveness, Quality Management, Four Stages of Quality Management, Inspection, Quality Control, Quality Established by the Contract, Quality Control in Subcontract Work, Quality Assurance, Overview of ISO, Total Quality Management, From QA to TQM, Cost of Quality, TQM Implementation in Construction Industry, Establishing and Maintaining a Total Quality Culture, ISO 9000 and TQM,

5. **Construction Health, Safety and Environment:** Need for Safe Practices; Humanitarian Concerns; Economic Costs and Benefits; **l**egal and Regulatory Considerations, Roles of Construction Personnel in Safety,
   Overview of Accident Causation Theories, Safety Record Keeping, Safety Management System, Safety Program; Policies and Rules; PPE; Hazard Analysis;
   HSE Communications; Accident Investigation and Reporting; Training; Safety
   Committees; Recording Injuries and Illnesses; Emergency Response, Overview of OSHA and OHSAS Safety Regulations, Incident and Injury Free Environment (IIF); Concept; Employee and Management Participation in Promoting Safety;

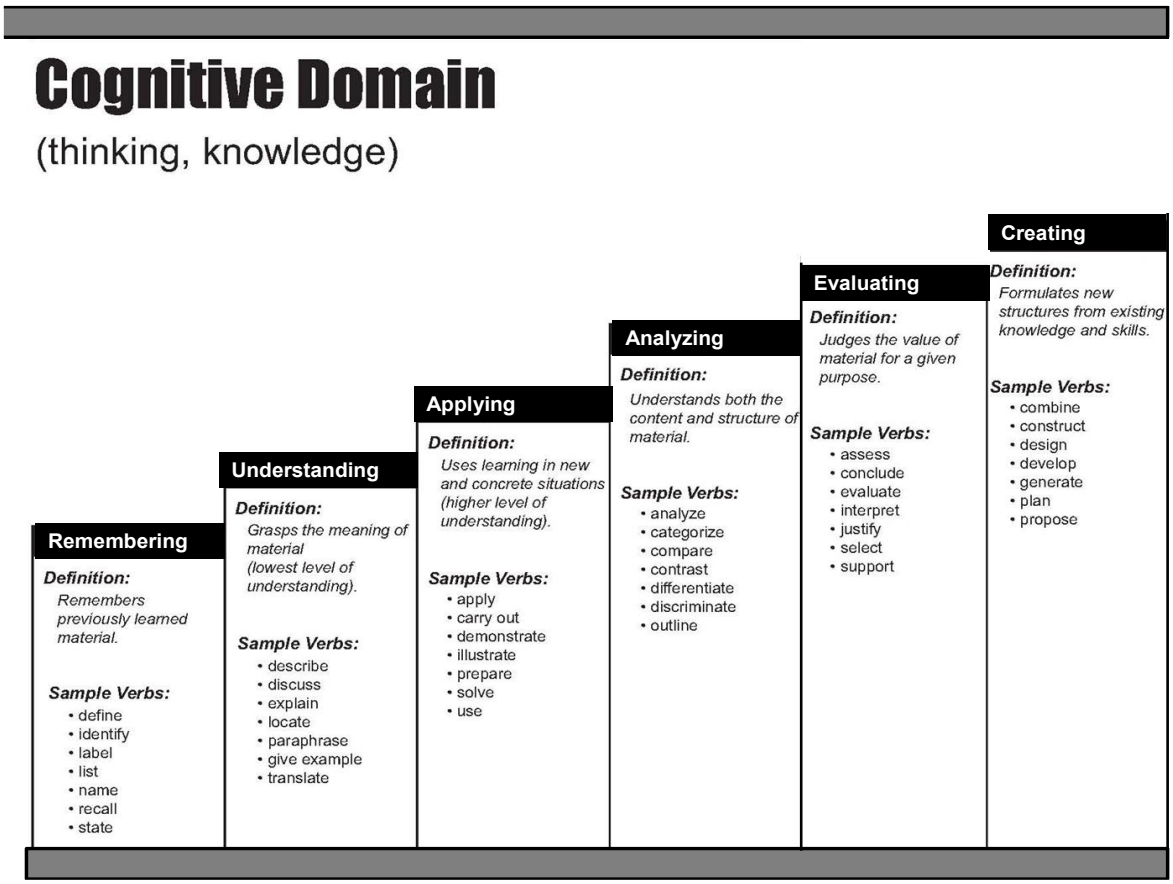
   Incentives; Teamwork Approach in Promoting Safety; Establishing a Safety-First Corporate Culture; IF Pathway; IIF Techniques, Total Safety and Its Components, Continuous Safety Improvement.

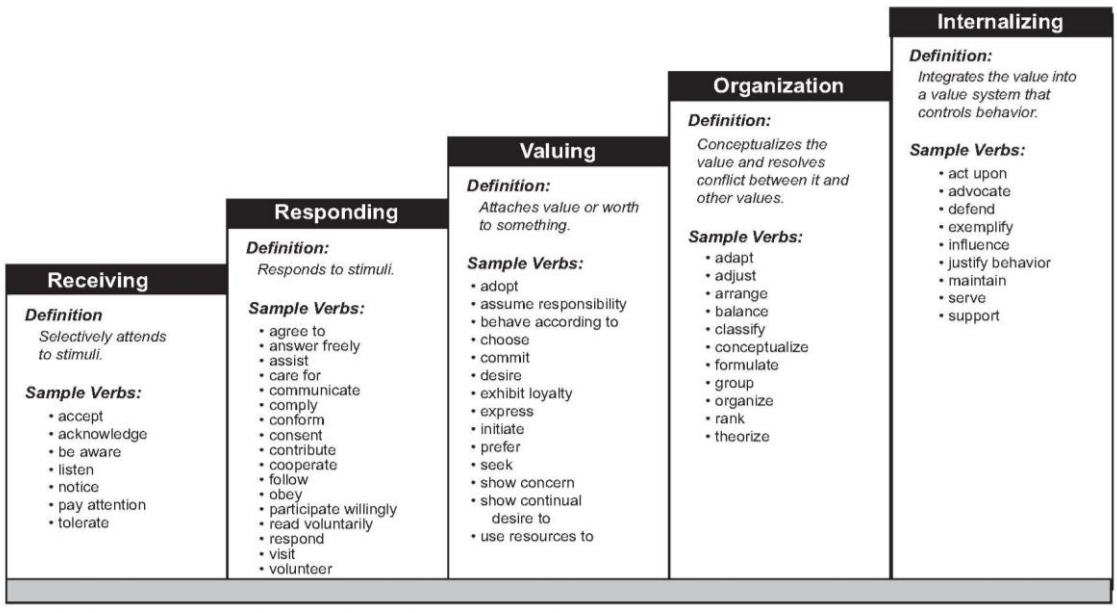
6. **Foundations of Construction Sustainability:** Defining Sustainable Construction, Whole Systems Thinking, Collaboration as Sustainability in Action, Key Features of Sustainable Construction, The Green Construction Movement, Emerging Directions.

7. **Construction Risk Management**: Introduction to concepts of risk and uncertainty, risk management process, types of construction risk, overview of essential components of risk management plan.

Appendix-1

There are many versions of Taxonomy available in literature. Therefore, the used Taxonomy of cognitive, affective and psychomotor nature is attached herewith. However, universities are at liberty to use any Taxonomy.





Psychomotor Domain

(doing, skills)