CURRICULUM
OF
CIVIL ENGINEERING
FOR
BS
(Revised 2017)

HIGHER EDUCATION COMMISSION
ISLAMABAD
**CURRICULUM DIVISION, HEC**

<table>
<thead>
<tr>
<th>Name</th>
<th>Position</th>
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<tr>
<td>Prof. Dr. Mukhtar Ahmed</td>
<td>Chairman, HEC</td>
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<tr>
<td>Prof. Dr. Arshad Ali</td>
<td>Executive Director, HEC</td>
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<tr>
<td>Mr. Muhammad Raza Chohan</td>
<td>Director General (Academics)</td>
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<tr>
<td>Dr. Muhammad Idrees</td>
<td>Director (Curriculum)</td>
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<tr>
<td>Syeda Sanober Rizvi</td>
<td>Deputy Director (Curriculum)</td>
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<tr>
<td>Mr. Riaz-ul-Haque</td>
<td>Assistant Director (Curriculum)</td>
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<tr>
<td>Mr. Muhammad Faisal Khan</td>
<td>Assistant Director (Curriculum)</td>
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Composed by: Mr. Zulfiqar Ali, HEC, Islamabad
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

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### 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

1. Nominations from all Stakeholders
2. Selection of Relevant Members
3. Formulation of NCRC
4. Preliminary Meeting/ Preparation of Draft
5. Circulation of Draft for feedback (Local/ Foreign)
6. NCRC Convening of Final NCRC
7. Composing/ Printing
8. Dissemination (Website/ Hard copies)
9. Stakeholders (Website/ Hard copies)
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:

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<th>S. N</th>
<th>Name &amp; Institution</th>
<th>Position</th>
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| 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 |
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:-

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<tr>
<td>1</td>
<td>Engr. Dr. Mohammad Ashraf</td>
<td>Member, Associate Professor, Department of Civil Engineering, University of Engineering &amp; Technology, Peshawar.</td>
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<tr>
<td>2</td>
<td>Engr. Dr. Qaiser Iqbal</td>
<td>Member, Assistant Professor, Department of Civil Engineering, Sarhad University of Science &amp; Information Technology, Peshawar.</td>
</tr>
<tr>
<td>3</td>
<td>Engr. Zulfiqar Ali</td>
<td>Member, Assistant Professor, Department of Civil Engineering, Balochistan University of Engineering &amp; Technology, Khuzdar.</td>
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List of members who had not attended the preliminary meeting but attended final meeting is as below:-

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

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**SUMMARY-CIVIL ENGINEERING**

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**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

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| **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** |

<p>| <strong>SEMESTER-III</strong> | | | | | | |
| 12 | Computer Programing | Computing | Fundamentals | 1+2 | 1+6=7 | 3 |
| 13 | Civil Engg. Drawing &amp; 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 |
| | | | | | | <strong>8+6</strong> |
| | | | | | | <strong>8+18</strong> |
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<td>3+3=6</td>
<td>4</td>
</tr>
<tr>
<td>Social Science Elective</td>
<td>Humanities</td>
<td>Social Sciences</td>
<td>2+0</td>
<td>2+0=2</td>
<td>2</td>
</tr>
<tr>
<td>Civil Engineering Project</td>
<td>Civil Engineering Project</td>
<td>--</td>
<td>0+3</td>
<td>0+9=9</td>
<td>3</td>
</tr>
</tbody>
</table>

| 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
1. Title of the Course: CIVIL ENGINEERING MATERIALS

<table>
<thead>
<tr>
<th>Contact Hours</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory</td>
<td>Theory</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Practical</td>
<td>Practical</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>Total</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>CLOs</th>
<th>Learning Domain</th>
<th>Taxonomy level</th>
<th>PLO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>EXPLAIN various properties of construction materials.</td>
<td>Cognitive</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2.</td>
<td>SELECT appropriate constructional materials for various uses.</td>
<td>Cognitive</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>ANALYZE various material properties.</td>
<td>Cognitive</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

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:

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

**Contact Hours**  
Theory = 2  
Practical = 6  
Total = 8  

**Credit Hours**  
Theory = 2  
Practical = 2  
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:
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:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>CLO</th>
<th>Learning Domain</th>
<th>Taxonomy level</th>
<th>PLO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>EXPLAIN fundamental concepts of engineering drawing for simple objects/structures.</td>
<td>Cognitive</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2.</td>
<td>Manually DEVELOP drawings of simple objects/structures.</td>
<td>Psychomotor</td>
<td>4</td>
<td>10</td>
</tr>
</tbody>
</table>
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:

4. Title of the Course: FUNCTIONAL ENGLISH

<table>
<thead>
<tr>
<th>Contact Hours</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory</td>
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</tr>
<tr>
<td>Practical</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>2</td>
</tr>
</tbody>
</table>

| Theory        | 2            |
| Practical     | 0            |
| 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:**

3. The Functional Analysis of English, 3rd edition (2013), by Thmoas Bloor and Mariel Bloor
5. Title of the Course: APPLIED CALCULUS

<table>
<thead>
<tr>
<th>Contact Hour:</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory</td>
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<tr>
<td>Total</td>
<td>Total</td>
</tr>
<tr>
<td>Theory = 3</td>
<td>Theory = 3</td>
</tr>
<tr>
<td>Practical = 0</td>
<td>Practical = 0</td>
</tr>
<tr>
<td>Total = 3</td>
<td>Total = 3</td>
</tr>
</tbody>
</table>

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, Schaum’s series, (Latest Edition)

6. Title of the Course: PAKISTAN STUDIES

<table>
<thead>
<tr>
<th>Contact Hours</th>
<th>Credit Hours:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory = 1</td>
<td>Theory = 1</td>
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<tr>
<td>Practical = 0</td>
<td>Practical = 0</td>
</tr>
<tr>
<td>Total = 1</td>
<td>Total = 1</td>
</tr>
</tbody>
</table>

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:
   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:

7. Title of the Course: ENGINEERING SURVEYING

<table>
<thead>
<tr>
<th>Contact Hours</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory</td>
<td>Theory</td>
</tr>
<tr>
<td>= 2</td>
<td>= 2</td>
</tr>
<tr>
<td>Practical</td>
<td>Practical</td>
</tr>
<tr>
<td>= 3</td>
<td>= 1</td>
</tr>
<tr>
<td>Total</td>
<td>Total</td>
</tr>
<tr>
<td>= 5</td>
<td>= 3</td>
</tr>
</tbody>
</table>

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:

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

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:**
8. Title of the Course: ENGINEERING GEOLOGY

<table>
<thead>
<tr>
<th>Contact Hours</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory</td>
<td>Theory</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Practical</td>
<td>Practical</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>Total</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

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 glacialiations
   Dip, strike, folds, faults, joints, unconformities conformable and unconformable 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:**  
9. Title of the Course: ISLAMIC STUDIES

<table>
<thead>
<tr>
<th>Contact Hours</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory</td>
<td>Theory</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
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<td>2</td>
</tr>
</tbody>
</table>

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

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
2. Ahmad Hasan, “Principles of Islamic Jurisprudence” Islamic Research
   Institute, International Islamic University, Islamabad (1993)
   Islamic Book Service (1982)
   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:

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

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-planar 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:**
Title of the Course: APPLIED DIFFERENTIAL EQUATIONS

<table>
<thead>
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<th>Contact Hours</th>
<th>Credit Hours</th>
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<tbody>
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</table>

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:

12. Title of the Course: COMPUTER PROGRAMMING

<table>
<thead>
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<th>Credit Hours</th>
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<tbody>
<tr>
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<td>Practical</td>
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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
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:
5. Stephen J. Chapman , MATLAB Programming for Engineers (Latest Edition)
13. Title of the Course: CIVIL ENGINEERING DRAWING & GRAPHICS

<table>
<thead>
<tr>
<th>Contact Hours</th>
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<tbody>
<tr>
<td>Theory</td>
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<tr>
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<td>Total</td>
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<td>7</td>
<td>3</td>
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</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>CLOs</th>
<th>Learning Domain</th>
<th>Taxonomy level</th>
<th>PLO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>DESCRIBE different perspective (functions) of latest version of CAD.</td>
<td>Cognitive</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2.</td>
<td>PRODUCE Civil Engineering Drawings using CAD software.</td>
<td>Psychomotor</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Course Outline:
1. Introduction to Contour Plan, Infrastructure layout, and Site Plan
   - General notes
   - Contour plan
   - Infrastructure layout

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:

14. Title of the Course: ADVANCED ENGINEERING SURVEYING

<table>
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<th>Credit Hours</th>
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<td>Practical</td>
<td>Practical</td>
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<td>1</td>
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<td>Total</td>
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<td>3</td>
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</table>

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:

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

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:

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

Contact Hours

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<th>Practical</th>
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</tr>
<tr>
<td>Practical</td>
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Credit Hours

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<td>3</td>
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</tbody>
</table>

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:

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

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:

16. Title of the Course: ENGINEERING ECONOMICS

<table>
<thead>
<tr>
<th>Contact Hours</th>
<th>Credit Hours</th>
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<tbody>
<tr>
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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
   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:

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:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>CLOs</th>
<th>Learning Domain</th>
<th>Taxonomy level</th>
<th>PLO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>DEMONSTRATE knowledge of constructional aspects related to public infrastructure projects.</td>
<td>Cognitive</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>2.</td>
<td>ANALYZE the heavy construction equipment and operations for key</td>
<td>Cognitive</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>
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:

18. Title of the Course: STRUCTURAL ANALYSIS-I

<table>
<thead>
<tr>
<th>Contact Hours</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory = 3</td>
<td>Theory = 3</td>
</tr>
<tr>
<td>Practical = 0</td>
<td>Practical = 0</td>
</tr>
<tr>
<td>Total = 3</td>
<td>Total = 3</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>CLO</th>
<th>Learning Domain</th>
<th>Taxonomy Level</th>
<th>PLO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DESCRIBE various methods of analysis for determinate structures.</td>
<td>Cognitive</td>
<td>2</td>
<td>*</td>
</tr>
<tr>
<td>2</td>
<td>APPLY methods of analysis on determinate structures.</td>
<td>Cognitive</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>3</td>
<td>ANALYZE the beams and girders under the application of moving loads.</td>
<td>Cognitive</td>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>

*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:

19. Title of the Course: SOIL MECHANICS

<table>
<thead>
<tr>
<th>Contact Hours</th>
<th>Credit Hours</th>
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</thead>
<tbody>
<tr>
<td>Theory</td>
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<td>= 3</td>
</tr>
<tr>
<td>Practical</td>
<td>Practical</td>
</tr>
<tr>
<td>=3</td>
<td>= 1</td>
</tr>
<tr>
<td>Total</td>
<td>Total</td>
</tr>
<tr>
<td>=6</td>
<td>= 4</td>
</tr>
</tbody>
</table>

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:

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

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.

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:
2. An Introduction to Geotechnical Engineering by Holtz and Kovac.

20. Title of the Course: NUMERICAL ANALYSIS

<table>
<thead>
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<th>Contact Hours</th>
<th>Credit Hours</th>
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</thead>
<tbody>
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<td>Theory</td>
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<td>= 3</td>
<td>= 3</td>
</tr>
<tr>
<td>Practical</td>
<td>Practical</td>
</tr>
<tr>
<td>= 0</td>
<td>= 0</td>
</tr>
<tr>
<td>Total</td>
<td>Total</td>
</tr>
<tr>
<td>= 3</td>
<td>= 3</td>
</tr>
</tbody>
</table>

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
   - Mathematica

**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:**

21. **Title of the Course:** FLUID MECHANICS

**Contact Hours**

<table>
<thead>
<tr>
<th></th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory</td>
<td>= 3</td>
</tr>
<tr>
<td>Practical</td>
<td>= 3</td>
</tr>
<tr>
<td>Total</td>
<td>= 6</td>
</tr>
</tbody>
</table>

**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:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>CLO</th>
<th>Learning Domain</th>
<th>Taxonomy level</th>
<th>PLO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>DESCRIBE various basic terms related to fluid mechanics.</td>
<td>Cognitive</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2.</td>
<td>COMPUTE various basic parameters related to fluid mechanics.</td>
<td>Cognitive</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>3.</td>
<td>IMITATE various experiments on basic fluid mechanics equipment.</td>
<td>Psychomotor</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

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 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:

Title of the Course: PROBABILITY & STATISTICS

<table>
<thead>
<tr>
<th>Contact Hours</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory</td>
<td>Theory</td>
</tr>
<tr>
<td>= 2</td>
<td>= 2</td>
</tr>
<tr>
<td>Practical</td>
<td>Practical</td>
</tr>
<tr>
<td>= 3</td>
<td>= 1</td>
</tr>
<tr>
<td>Total</td>
<td>Total</td>
</tr>
<tr>
<td>= 5</td>
<td>= 3</td>
</tr>
</tbody>
</table>

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

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:

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:

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

Course Outline:
1. Hydrodynamics Review
   Ideal and real fluid
   Differential equation of continuity
   Rotational and irrational flow
Stream function and velocity potential
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

24. Title of the Course: BUSINESS COMMUNICATION

<table>
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<th>Credit Hours</th>
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<td>Practical = 0</td>
<td>Practical = 0</td>
</tr>
<tr>
<td>Total = 2</td>
<td>Total = 2</td>
</tr>
</tbody>
</table>

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:
2. Hargie, O. (ed.) Handbook of Communications Skills, Routledge

25. Title of the Course: PROFESSIONAL ETHICS

<table>
<thead>
<tr>
<th>Contact Hours</th>
<th>Credit Hours</th>
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<tbody>
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</tr>
</tbody>
</table>

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.

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:
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

<table>
<thead>
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<th>Credit Hours</th>
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</thead>
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<td>Total = 6</td>
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</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>S.No</th>
<th>CLOs</th>
<th>Learning Domain</th>
<th>Taxonomy level</th>
<th>PLO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>ILLUSTRATE various properties of concrete.</td>
<td>Cognitive</td>
<td>3</td>
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</tr>
<tr>
<td>2.</td>
<td>DESIGN various structural reinforced concrete elements.</td>
<td>Cognitive</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>PRACTICE experiments on concrete for suitable use.</td>
<td>Psychomotor</td>
<td>3</td>
<td>2</td>
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</tbody>
</table>

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:

27. Title of the Course: QUANTITY & COST ESTIMATION

Contact Hours
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<th>Credit Hours:</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Practical</td>
<td>Practical = 1</td>
</tr>
<tr>
<td>Total</td>
<td>Total = 3</td>
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</tbody>
</table>

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:

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

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:
3. Standard Form of Bidding Documents by Pakistan Engineering Council

28. Title of the Course: CONSTRUCTION MANAGEMENT

<table>
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<th>Contact Hours</th>
<th>Credit Hours</th>
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</thead>
<tbody>
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<td>Total</td>
<td>Total</td>
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<tr>
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<td>= 3</td>
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</table>

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 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:
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

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

<table>
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<td>Practical = 3</td>
<td>Practical = 1</td>
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<tr>
<td>Total = 5</td>
<td>Total = 3</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>CLOs</th>
<th>Learning Domain</th>
<th>Taxonomy level</th>
<th>PLO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>ANALYZE beams subjected to unsymmetrical bending, curved beams and beams on elastic foundations.</td>
<td>Cognitive</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>2.</td>
<td>APPLY theory of elasticity under generalized loading.</td>
<td>Cognitive</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>3.</td>
<td>DISCUSS theory of plasticity and plastic analysis of beams and frames.</td>
<td>Cognitive</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>
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:

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

<table>
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<td>Practical = 1</td>
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<tr>
<td>Total = 6</td>
<td>Total = 4</td>
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</tbody>
</table>

Pre-requisites: Reinforced Concrete Design-I

Specific Objectives of course:
- To enable students to design various reinforced and prestressed structural elements using conventional and advanced design approaches.
Course Learning Outcomes (CLOs):
Upon successful completion of the course, the student will be able to:

<table>
<thead>
<tr>
<th>S.No</th>
<th>CLOs</th>
<th>Learning Domain</th>
<th>Taxonomy level</th>
<th>PLO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>DESIGN various structural reinforced concrete elements.</td>
<td>Cognitive</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>2.</td>
<td>DESIGN various reinforced concrete structural systems.</td>
<td>Cognitive</td>
<td>6</td>
<td>3</td>
</tr>
</tbody>
</table>

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:**
31. **Title of the Course:** TRANSPORTATION ENGINEERING-I

<table>
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<tr>
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</table>

**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:

<table>
<thead>
<tr>
<th>S.No</th>
<th>CLO</th>
<th>Learning Domain</th>
<th>Taxonomy level</th>
<th>PLO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>EXPLAIN concepts of transportation systems and its planning.</td>
<td>Cognitive</td>
<td>2</td>
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<tr>
<td>2.</td>
<td>CARRY OUT geometric design of transportation the external and internal port components based on best practices and guidelines.</td>
<td>Cognitive</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>CARRY OUT geometric design of transportation the external and internal port components based on best practices and guidelines.</td>
<td>Cognitive</td>
<td>6</td>
<td>3</td>
</tr>
</tbody>
</table>

* 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:

32. Title of the Course: ENGINEERING HYDROLOGY

Contact Hours

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Credit Hours:

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</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>S.No</th>
<th>CLOs</th>
<th>Learning Domain</th>
<th>Taxonomy level</th>
<th>PLO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>DEMONSTRATE the measurements of various meteorological parameters.</td>
<td>Cognitive</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>2.</td>
<td>CALCULATE various hydrological parameters.</td>
<td>Cognitive</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>3.</td>
<td>DESCRIBE various methods of flood estimation and flood routing.</td>
<td>Cognitive</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

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 assess 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:
4. Surface Water Hydrology by N.M. Awan (Vol. 1), National Book Foundation

33. Title of the Course: STRUCTURAL ANALYSIS-II

<table>
<thead>
<tr>
<th>Contact Hours</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory = 3</td>
<td>Theory = 3</td>
</tr>
<tr>
<td>Practical = 0</td>
<td>Practical = 0</td>
</tr>
<tr>
<td>Total = 3</td>
<td>Total = 3</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>S.No</th>
<th>CLOs</th>
<th>Learning Domain</th>
<th>Taxonomy level</th>
<th>PLO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>ANALYZE indeterminate structures using force and displacement methods</td>
<td>Cognitive</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>2.</td>
<td>ANALYZE indeterminate structures using matrix methods</td>
<td>Cognitive</td>
<td>4</td>
<td>2</td>
</tr>
</tbody>
</table>

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:
5. Alexander, Chajes, (1990), Structural Analysis

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:

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

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:
3. S. Peavy, D. R. Rowe, George Technologious, Environmental Engineering

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

<table>
<thead>
<tr>
<th>Contact Hours:</th>
<th>Credit Hours:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory</td>
<td>Theory</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Practical</td>
<td>Practical</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>Total</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

**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:

37. Title of the Course: GEOTECHNICAL & FOUNDATION ENGINEERING

Contact Hours

<table>
<thead>
<tr>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory</td>
</tr>
<tr>
<td>Practical</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

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:

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

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 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:
38. Title of the Course: TRANSPORTATION ENGINEERING-II

Contact Hours

<table>
<thead>
<tr>
<th></th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory</td>
<td>Theory</td>
</tr>
<tr>
<td>Practical</td>
<td>Practical</td>
</tr>
<tr>
<td>Total</td>
<td>Total</td>
</tr>
</tbody>
</table>

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:

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

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
- 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:
Title of the Course: GEO INFORMATICS

Contact Hours

<table>
<thead>
<tr>
<th></th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory</td>
<td>Theory</td>
</tr>
<tr>
<td>Practical</td>
<td>Practical</td>
</tr>
<tr>
<td>Total</td>
<td>Total</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>CLOs</th>
<th>Learning Domain</th>
<th>Taxonomy level</th>
<th>PLO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>EXPLAIN basic knowledge related to Geo-informatics.</td>
<td>Cognitive</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2.</td>
<td>APPLY GIS software for the map making.</td>
<td>Cognitive</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>3.</td>
<td>IMITATE use of GPS instruments for map making.</td>
<td>Psychomotor</td>
<td>3</td>
<td>5</td>
</tr>
</tbody>
</table>

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:

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:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>CLOs</th>
<th>Learning Domain</th>
<th>Taxonomy level</th>
<th>PLO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>DESCRIBE the fundamental components of water and wastewater treatment systems and solid waste management.</td>
<td>Cognitive</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2.</td>
<td>DESIGN domestic sewerage systems.</td>
<td>Cognitive</td>
<td>6</td>
<td>3</td>
</tr>
</tbody>
</table>

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:
5. UNESCO, Solid Waste Management for Developing Countries, (Latest Edition)
Title of the Course: STEEL STRUCTURES

Contact Hours
Theory = 3
Practical = 0
Total = 3

Credit Hours
Theory = 3
Practical = 0
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:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>CLOs</th>
<th>Domain</th>
<th>Taxonomy level</th>
<th>PLO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>DESCRIBE the theories and models suitable for the analysis and design of structural steel members.</td>
<td>Cognitive</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2.</td>
<td>DESIGN structural steel members under axial loads, flexure and shear.</td>
<td>Cognitive</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>3.</td>
<td>DESIGN connections in structural steel members.</td>
<td>Cognitive</td>
<td>6</td>
<td>3</td>
</tr>
</tbody>
</table>

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:**

**42. Title of the Course:** HYDRAULICS & IRRIGATION ENGINEERING

<table>
<thead>
<tr>
<th>Contact Hours</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory  = 3</td>
<td>Theory  = 3</td>
</tr>
<tr>
<td>Practical = 3</td>
<td>Practical = 1</td>
</tr>
<tr>
<td>Total = 6</td>
<td>Total = 4</td>
</tr>
</tbody>
</table>

**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:

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

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:**
4. Robert, L. D, Fluid Mechanics with Engineering Applications

**43. Social Science Elective**

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

Final Year Project
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 subordinates 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:

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 Taxonomy
   - Evolution of Growth and Culture
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:**

**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:

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:

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:

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)
       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:

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

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:
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

**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:**
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
Specific Objectives of course:
To familiarize students with the concepts of construction contract preparation and management.
To provide students an 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.


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.


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

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:**

**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; Conflict Management; Management by Wandering Around; Ethics; Improving Personal Productivity; etc., Developing the Skills Needed to be an Effective Project Manager.

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; Legal 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.


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.
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)**

<table>
<thead>
<tr>
<th>Perception</th>
<th>Set</th>
<th>Guided Response</th>
<th>Complete Overt Response</th>
<th>Adaption</th>
<th>Organization</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Definition:</strong> Senses cues that guide motor activity.</td>
<td><strong>Definition:</strong> Imitates and practices skills, often in discrete steps.</td>
<td><strong>Definition:</strong> Performs acts with increasing efficiency, confidence, and proficiency.</td>
<td><strong>Definition:</strong> Adapts skill sets to meet a problem situation.</td>
<td><strong>Definition:</strong> Creates new patterns for specific situations.</td>
<td><strong>Sample Verbs:</strong></td>
</tr>
<tr>
<td><strong>Sample Verbs:</strong></td>
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<td><strong>Sample Verbs:</strong></td>
<td><strong>Sample Verbs:</strong></td>
</tr>
<tr>
<td>detect</td>
<td>copy</td>
<td>complete with confidence</td>
<td>adopts</td>
<td>designs</td>
<td></td>
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<tr>
<td>hear</td>
<td>duplicate</td>
<td>conduct</td>
<td>reorganizes</td>
<td>originates</td>
<td></td>
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<tr>
<td>listen</td>
<td>imitate</td>
<td>demonstrate</td>
<td>combines</td>
<td>combines</td>
<td></td>
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<tr>
<td>observe</td>
<td>manipulate with guidance</td>
<td>execute</td>
<td>compiles</td>
<td>compiles</td>
<td></td>
</tr>
<tr>
<td>perceive</td>
<td>operate under supervision</td>
<td>improve efficiency</td>
<td>constructs</td>
<td>combines</td>
<td></td>
</tr>
<tr>
<td>recognize</td>
<td>practice</td>
<td>increase speed</td>
<td>constructs</td>
<td>constructs</td>
<td></td>
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<tr>
<td>see</td>
<td>repeat</td>
<td>make</td>
<td>constructs</td>
<td>constructs</td>
<td></td>
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<tr>
<td>sense</td>
<td>try</td>
<td>pace</td>
<td>constructs</td>
<td>constructs</td>
<td></td>
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<tr>
<td>smell</td>
<td></td>
<td>produce</td>
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<tr>
<td>taste</td>
<td></td>
<td>show dexterity</td>
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<tr>
<td>view</td>
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<tr>
<td>watch</td>
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</tbody>
</table>

## Adaption

**Definition:** Creates new patterns for specific situations.

**Sample Verbs:**
- designs
- originates
- combines
- compiles
- constructs

## Complete Overt Response

**Definition:** Adapts skill sets to meet a problem situation.

**Sample Verbs:**
- adopts
- reorganizes
- alters
- revises
- changes

## Guided Response

**Definition:** Performs acts with increasing efficiency, confidence, and proficiency.

**Sample Verbs:**
- complete with confidence
- conduct
- demonstrate
- execute
- improve efficiency
- increase speed
- make
- pace
- produce
- show dexterity