DETAIL OF COURSES

B.Sc CIVIL ENGINEERING PROGRAM

1. Title of the Course: ENGINEERING DRAWING (CE-101)

Credit Hours: 1+2 = 3

Specific Objectives of Course:

- To enable students to learn basics of general drawing and civil engineering drawing.
- To understand fundamentals of architectural, structural, plumbing, and electrical drawings.

Theory Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Describe** basics of engineering drawing.	PLO-1	C-1
CLO-2	**Explain** fundamentals of architectural, structural, plumbing, and electrical drawings.	PLO-1	C-2

Practical Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Perform** the tasks related to engineering drawing.	PLO-9	P-2
CLO-2	**Explain** basic concepts of engineering drawing.	PLO-2	C-2
CLO-3	**Justify** application of concepts related to engineering drawing.	PLO-10	A-3

Course Outlines:

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). Drawing types with respect to project execution (Proposals/PC-1

drawing, Submission /Tender drawing, Working /Construction drawing, Completion /As-built drawing).

Conceptual Drawings and Projection system:

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

Architectural Plan, Elevation, and Section of a Simple Building:

Architectural views (Plan, elevation, and section) of a simple building. General terminologies and symbols including schedule of opening. Architectural design of a house. Covered area specification of various development authorities. General notes.

Structural Details of a Simple Building:

Foundation plan. Plinth plan. Lintel plan. Slab plan. Cross-sectional details of foundation, columns, vertical stiffeners, plinth band, lintel band, lintels, beams and slabs. General notes

Architectural and Structural Details of Boundary Wall and Staircase:

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

Plumbing, sanitation, and Roof Drainage Plan of a Simple Building:

Typical water supply system. Water and waste water removal system. Roof drainage slopes. Standard Plumbing Symbols General notes. Electrical Drawings of a Simple Buildings. Typical layout of electrification. Symbols used for electrical layout. General notes.

Recommended Books:

1. Basics of the Engineering Drawing, Zahid Ahmed Siddiqi, 1st Edition
2. Horchsel R. P; Engineering Drawing and Geometry, John Willy & Sons, 2nd Edition, 2002.
3. Jensen C.H and Mason F. H. S “Drafting Fundamentals”, McGraw Hill, 5th Edition
4. A Course in Civil Engineering Drawing, V. B. Sikka, Latest Edition
5. Elementary Engineering Drawing (Plane and Solid Geometry), N. D. Bhatt, 50th Edition

2. Title of the Course: ENGINEERING MECHANICS (CE-102)

Credit Hours: 2+1 = 3

Specific Objectives of Course:

- To learn basic concepts and system of forces.
- To enable students to understand relationship of physical processes, kinetics, and kinematics.
- To develop skills to use the basic principles of mechanics in engineering applications.

Theory Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Describe** the basic concepts of equilibrium and explain their application in civil engineering.	PLO-1	C-2
CLO-2	**Apply** fundamental concepts of statics & kinematics for analyzing forces in statically determinate structures.	PLO-2	C-3

Practical Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Perform** the experiments related to engineering mechanics.	PLO-9	P-2
CLO-2	**Estimate** the physical parameters using experimental data.	PLO-2	C-2
CLO-3	**Justify** application of experiments related to engineering mechanics.	PLO-10	A-3
CLO-4	**Demonstrate** function of project, prepared on basic principles of engineering mechanics.	PLO-9	P-3

Course Outlines:

Basic Concepts

Concepts of space, time, mass, velocity, acceleration, and force. Scalar and vector quantities. Newton's law of motion. Law of gravitation

System of Forces

Resultant and resolution of co-planer forces using parallelogram, triangle & polygon law, and funicular polygon. Simple cases of resultant and resolution of forces in space. Conditions of equilibrium of co-planar forces, analytical and graphical formulations

Equilibrium of Rigid Bodies

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.

Kinematics

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.

Rigid Bodies

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

Friction

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

Application of Principles of Dynamics

Rectilinear and curvilinear motion. Newton’s equation of motion, dynamic equilibrium. Introduction to practical use of the above principles and properties.

Recommended Books:

1. Engineering Mechanics by R.C. Hibbeler, 10th Edition.
2. Engineering Mechanics Statics and Dynamics, J.L. Mariam & L.G. Kraige, 6th Edition.
3. Vector Mechanics for Engineers, Ferdinand P. Beer and E. Russel Johnston Jr, 7th Edition.

3. Title of the Course: ENGINEERING GEOLOGY (CE-103)

Credit Hours: 2+1 = 3

Specific Objectives of Course:

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

Theory Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Describe** basic concepts of geology, formation of rocks and structural features of strata	PLO-1	C-1
CLO-2	**Apply** knowledge of geology in civil engineering	PLO-1	C-3

Practical Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Perform** the experiments related to engineering geology	PLO-9	P-2
CLO-2	**Estimate** the physical parameters using experimental data	PLO-2	C-3
CLO-3	**Justify** application of experiments related to engineering geology	PLO-10	A-3

Course Outlines:

Introduction

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

Rocks and Minerals, Structural Features

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

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.

Landslides

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

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

Tunneling

Engineering geology of tunnels. Geological survey prior to tunnel. Lining of tunnels and their section. Selection of tunnel site and its requirements.

Geological Survey Maps

Physical method of subsurface mapping. Exploratory geological surveys at engineering sites.

Engineering Applications

Importance of geology for civil engineering projects. Important building stones and other construction materials. Geology of aquifers, wells, springs, streams and ground water conditions, hydrologic cycle. Role of geology in selection of sites for dams, reservoirs, and pertinent geological investigations. Geology of foundations, cutting tunnels, highways, airfields, and bridges.

Recommended Books:

1. A Geology for Engineers, by F.G.H. Blyth and M.H. De Freitas, 7th Edition
2. Principles of Physical, Geology, by Arthur Holmes, 4th Revised Edition
3. Geology for Civil Engineers, by Marcus Matthew and Noel Simon, 2nd Edition

4. Title of the Course: SURVEYING-I (CE-104)

Credit Hours: 2+2 = 4

Specific Objectives of Course:

- Can apply knowledge of mathematics, science, and engineering to understand the measurement techniques and equipment used in land surveying.
- 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.

Theory Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Explain** various principles and techniques of basic surveying	PLO-1	C-2
CLO-2	**Apply** various techniques to calculate parameters required for plotting survey maps	PLO-2	C-3

Practical Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Perform** the experiments related to basic surveying	PLO-9	P-2
CLO-2	**Plot** area maps using experimental data from modern tools	PLO-5	C-4
CLO-3	**Justify** application of experiments related to surveying	PLO-10	A-3

Course Outlines:

Introduction

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

Techniques

Distance measurement techniques. Theodolite and its types. Traversing and triangulation, bearings and meridians, plane table surveying. Plane Table Surveying. Computation of areas and volumes by various methods

Modern Methods in Surveying

Earthwork calculation. Digital Theodolite, field procedures for Digital Theodolite in topographic surveys. Construction layout using Digital Theodolite.

Leveling and Contouring

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

Recommended Books:

1. Surveying Theory and Practice, by R.E. Davis, 7th Edition.
2. Surveying and Leveling (Vol. I), by T.P Kanetkar and S.V Kulkarni.
3. Elementary Surveying-An introduction to Geometrics, by Wolf P.R. & Ghilani C.D, 11th Edition.
4. Surveying Principles and Application, by B. Kavanagh, 8th Edition.

5. Title of the Course: MATHEMATICS-I (MA-105)

Credit Hours: 3+0 = 3

Specific Objectives of Course:

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

Theory Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Acquire** knowledge related to basic concepts of calculus, statistics, and ODEs	PLO-1	C-2
CLO-2	**Apply** concepts for analysis and solution of engineering related problems	PLO-2	C-3

Course Outlines:

- Revision of elementary differentiation and integration
- Introduction to maxima and minima of a single function.
- Points of inflection and their physical significance, related Civil Engineering examples.
- Double and triple integral and their use in Civil Engineering.
- First order and special types of higher order differential equations of Civil Engineering Application and their solution.
- The role of statistics in Engineering
- Descriptive statistics
- Probability

Recommended Books:

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

6. Title of the Course: SURVEYING-II (CE-106)

Credit Hours: 2+2 = 4

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.

Theory Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Explain** principles and application of advanced surveying.	PLO-1	C-2
CLO-2	**Apply** various survey techniques for traversing and setting out of curves.	PLO-2	C-3

Practical Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Perform** and **Demonstrate** the experiments related to advanced surveying	PLO-9	P-3
CLO-2	**Execute** the plotting of area maps using modern tools based on experimental data	PLO-5	P-2
CLO-3	**Estimate** the physical parameters using experimental data	PLO-2	C-3

Course Outlines:

Surveying Drafting and Computations: General, Maps and Plans, Plotting, Contour Maps, Profiles, Cross- sections, End areas and Volumes, Primordial formula, Calculation of volumes, Area computations, Area by graphical analysis, Use of surveying software. Computation of area of traverse by independent coordinates and by DMD method.

Highway and Railway Curves: Route surveys, Circular curves, Deflections, and Chord calculations, Setting out circular curve by various methods, Compound curves, Reverse, Vertical, Parabolic curves, Computation of the high or low point on a vertical curve, Design considerations, Spiral curves, Spiral curve computations, Approximate solution for spiral problems, Superelevation.

Construction Surveys: Introduction, Horizontal and Vertical control, Buildings, Rail Road, Pipelines, and other construction surveys. Hydrographic Surveys: General, Objectives of hydrographic survey and electronic charting, Planning, Survey vessels, Vertical control, Depth and Tidal measurements, Position-fixing techniques, Sounding plan, Horizontal control, Processing, and Presentation of data.

Photogrammetry: Element of terrestrial and aerial Photogrammetry. Tunneling Surveying Operations involved in tunnels Introduction, Aerial photogrammetry and its applications, Flying heights, Flight planning, Relief displacement, Photograph overlap, Ground control for mapping, Mosaics, Stereoscopic viewing and parallax, Stereo plotting instruments, Analytical plotters, Orthophotos, Photogrammetric mapping.

Control Surveys: General, Geodesy Universal Transverse Mercator grid system, Modified Transverse Mercator grid system, State plane coordinate grid system, Lambert projection, Computations for the Lambert projection, Computations for the Transverse Mercator Secant Projection, Use of grid coordinates, Horizontal control techniques, Triangulation, Control survey markers, Direction of a line by observations on Polaris, Time and procedure for Observing Polaris, Computation technique for azimuth determination, Gyro theodolite.

Global Positioning System (GPS): Background information, Global positioning, Receivers, Satellites, Errors, GPS surveying techniques and applications, Survey planning, Initial ambiguity resolution, Vertical positioning.

Recommended Books:

1. Wolf P. R. & Ghilani C. D., Elementary Surveying – An introduction to Geomatics, 11th Edition, Prentice Hall, USA, 2004.
2. Thomas, M. Lillesand & Ralph W. Kiefer Remote Sensing and Images Interpretation, 5th Edition, John Wiley & Sons, Inc. (2005).
3. Kavanagh Barry, Surveying with Construction Applications, 7th Edition, Pearsons Education (2010)

7. Title of the Course: ENGINEERING MATERIALS (CE-107)

Credit Hours: 2+1 = 3

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.

Theory Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Discuss** basic properties of civil engineering materials for environmentally sustainable construction.	PLO-7	C-2
CLO-2	**Conduct** selection of materials according to various requirements.	PLO-4	C-3

Practical Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Perform** experiments related to engineering materials.	PLO-9	P-2
CLO-2	**Estimate** the physical parameters using experimental data.	PLO-2	C-3
CLO-3	**Clarify** application of experiments related to engineering materials.	PLO-6	A-2

Course Outlines:

Materials and properties: Introduction of materials, Construction materials, Physical properties, Mechanical properties, Chemical properties, Electrical & Thermal properties.

Stone: Introduction, Types, Applications, Characteristics of good building stones, Artificial stones.

Cement and Lime: Introduction and manufacture of Ordinary Portland cement, Constituents of cement, Types of cement, Cement hydration, Properties and field tests of cement, Special cements, Introduction, and manufacture of lime, Setting and hardening of lime, Applications of lime, Comparison of lime and cement.

Fine and coarse aggregates: Definition and Introduction of aggregates, Mechanical properties of aggregates, Physical properties of aggregates, Importance, and methods of grading of aggregates Cementitious materials: Introduction about mortars, Methods of preparation of mortars, Properties and application of mortars, Introduction about concrete, Components, and manufacture of concrete, Properties of concrete, Types of concrete, Effects of various chemicals on concrete.

Ceramics and Bricks: 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, Brick dimensions, Manufacture, and classification of bricks.

Plastics: Structure of plastics, Polymer technology, Types, Properties, Use of plastics as construction material.

Glass: Constituents of glass, Methods of manufacture, Types, Use and significance in civil engineering, Advantages, and drawbacks.

Wood: Structure of tree, General characteristics, Types, Seasoning of wood, Preservation of wood, Lamination of wood.

Paints: Objectives, Composition, Types, Consideration in choosing a paint, Introduction, objectives, and applications of varnish.

Metals: Introduction about metals, Non-ferrous metals: Aluminum, Copper, Zinc, Lead, Nickel, Ferrous metals: Iron, Cast iron and steel, Manufacture of steel, Types of steel, Heat treatment to steel, Hot and cold rolled steels, Stainless steel, Effect of various heat treatments on the properties of steel and its alloys. Important failures in steels. Structural failures, induced corrosion, brittle failures of steel. Methods of corrosion control, Properties of thermal insulation materials for use in buildings.

Thermometry and acoustics: Mode of Heat transfer in buildings, Thermal conductivity and diffusivity of building materials, Insulation in houses, Types of insulations, Acoustic insulation, Properties of good sound proof materials, Noise Reduction Coefficients of building materials.

Miscellaneous Construction Materials: Asbestos, Plaster of Paris, Abrasives, Rubber, Cork, Bitumen, Asphalt, Road metal.

Bulking of sand and Slaking of clay

Recommended Books:

1. Edward Allen, Joseph Iano; Fundamental of Building Construction Materials and Methods; John Wiley & Sons. NY 5th Edition 2008
2. William F., Smith, Principles of Materials Science & Engineering, McGraw Hill, 3rd Edition
3. Duggal, S. K., Building Materials, New Age International. 2010

8. Title of the Course: PROFESSIONAL ETHICS (CE-108)

Credit Hours: 2+0 = 2

Specific Objectives of course:

- This course will cover ethical issues regarding legal, privacy and intellectual property rights concerns and their application to information technology.
- It will give an overview of the subject aimed at raising students' awareness about ethics in Information Technology and in research.
- It will include case studies to target specific IT subfields such as ethics in business and in the workplace.

Theory Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Identify** the content of religious, national, or international law dealing with engineering ethics.	PLO-6	C-2
CLO-2	**Apply** the knowledge of ethics in their personal and professional life	PLO-8	C-3
CLO-2	Gain the ability to enhance key factors of interpersonal relations	PLO-12	A-2

Course Outline:

Understanding ethics in the helping professions: Business Ethics, Media Ethics, Police Ethics, Medical Ethics, Legal Ethics, and Research Ethics.

Accountability and confidentiality issues; Theoretical issues in understanding ethics; Resolving ethical dilemmas; Ethics and morals; The law and ethical practice; Ethical dimensions of E-professionalism; Professional responsibilities of practice; Developing ethical literacy and personal care.

Fulfilling Human Nature; Aristotle Nicomachean Ethics (selection); Kant Fundamental Principles of the Metaphysics of Morals (Selection); Turning Values of Upside Down; Hearing the Feminine Voice; Baier-What do Women Want in a Moral Theory (Selection).

Recommended Books:

1. Ethics for the Information Age, Michael J. Quinn, 6th edition, Addison-Wesley 2015.
2. Case Studies in Information Technology Ethics, Richard A. Spinello, 2nd Edition, Prentice Hall 2003.
3. How to be a gentleman: A timely guide to timeless manners. Thomson Nelson
4. Synder, C.R., & Lopez, S.J. (2007) Positive Psychology, USA, Sage Publications.
5. DuBrin, A. J. (2007). Human Relations: Interpersonal Job Oriented Skills. New York, Prentice Hall.

9. Title of the Course: MATHEMATICS-II (MA-109)

Credit Hours: 3+0 = 3

Specific Objectives of Course:

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

Theory Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Acquire** knowledge related to basic concepts of calculus, statistics, and ODEs	PLO-1	C-2
CLO-2	**Apply** concepts for analysis and solution of engineering related problems	PLO-2	C-3

Course Outlines:

Presentation of Data: Classification, tabulation, classes, graphical representation, histograms, frequency polygons, frequency curves and their types.

Measures of Central Tendency: Means: Arithmetic Mean (A.M), Geometric Mean (GM), Harmonic Mean (HM), and their properties, Weighted mean, median, quartiles, mode and their relations, Merits, and demerits of Averages.

Measures of Dispersion: Range, moments, skewness, quartile deviation, mean deviation, standard deviation, variance and its coefficients, kurtosis.

Curve Fitting: Goodness of fit, Fitting a straight line, parabola, circle.

Simple Regression: Scatter diagram, linear regression, and correlation.

Probability: Definitions, sample space, events. Laws of probability, conditional probability, Dependent and independent events

Random Variable: Introduction, distribution function, discrete random variable and its probability distribution, Continuous random variable, and its probability density function, Mathematical expectation of a random variable, Moment generating functions.

Probability Distribution: Binomial, Poisson, uniform, exponential, and normal distribution functions, and its approximation to Poisson distribution. Discrete random variables & probability distributions. Continuous random variables & probability distributions. Joint probability distribution. Sampling distributions & Point Estimation of parameters. Statistical interval for a single sample.

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.

Recommended Books:

1. Ervin Kreyszig. Advanced Engineering Mathematics, John Wiley and Sons, (10^{th} Edition), 2010.
2. Speigal M. R., Theory and Problems of Laplace Transforms, Schaum's Outline Series, 1992.

10. Title of the Course: PAKISTAN STUDIES (HU-110)

Credit Hours: 2+0 = 2

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.

Theory Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Describe** important historical event, geographical demarcation and to state deep understanding about past events and future learning.	PLO-12	C1
CLO-2	**Analyze** the revival of Islamic Society in the changing world Environment in context of political and constitutional history of Pakistan	PLO-6	C4
CLO-3	Gain basic understanding of contemporary socio-political and environmental structure of Pakistan and **compare** different social issues.	PLO-7	C4

Course Outlines:

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:

i. Indus Civilization
ii. Muslim advent
iii. Location and Geo-Physical features.

Government and Politics in Pakistan
Political and constitutional phases:
1947-58: 1958-71: 1971-77: 1977-88: 1988-99: 1999-2008: 2008-2013: 2013 - onwards

Contemporary Pakistan

a) Economic institutions and issues
b) Society and social structure
c) Ethnicity
d) Foreign policy of Pakistan and challenges
e) Futuristic outlook of Pakistan

f) Fundamental Human Rights per the U.N.O charter.
g) Fundamental Human Rights / Women Rights per Quran & Sunnah (Islamic point of view).
h) Natural Resources of Pakistan and utilization from them.
i) Atomic Energy Resources, Solar Energy Resources Other Resources, and utilization from them.
j) Pakistan and the Muslim World, Unity, Faith, Discipline.
k) World organization of the Muslim RGD, Rabita-Alam, Islamic Mutamir Alam, Islamic EGO, OIC.

Recommended Books:

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

11. Title of the Course: PROFESSIONAL ENGLISH (CE-111)

Credit Hours: 2+0 = 2

Specific Objectives of Course:

- To enhance English language skills.

Theory Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Apply** the acquire knowledge and skill of communication in their respective fields of engineering	PLO-9	C3
CLO-2	Consolidate and extend students' vocabulary and grammar, that will enable them to **present** and **contribute** towards drafting of text effectively	PLO-10	A2

Course Outlines:

- Consulting a dictionary for spelling, pronunciation, and meanings.
- Reading skills: skimming, scanning, intensive reading and improving reading speed.
- Library resources, listing books (bibliography).
- Sentence; subject and predicate, kinds, Types, and parts of speech, use of articles.
- Practice in writing a unified correct sentence.
- Punctuation and spellings.
- Analysis of sentence structure.
- Clauses, verbs (transitive and intransitive).
- Translation (Urdu into English).
- Paragraph writing.
- Practice in writing a good, unified, and coherent paragraph.
- Comprehension; answer to questions on a given text.
- Summary and précis making.

Recommended Books:

1. Shafi, S., Mansoor, S. and Irfan, H, 1994. Skill Worker: Student Activity Book: BA English for Paper B. 1st Ed. Caravan Book House Lahore, Pakistan.
2. Polymer English Grammar and Composition for BA/BSc1994. 1st Ed. Polymer Publication Lahore, Pakistan.

12. Title of the Course: FLUID MECHANICS-I (CE-201)

Credit Hours: 2+1 = 2

Specific Objectives of Course:

- To understand fundamentals of fluid mechanics.
- To enhance skills of utilizing fluid mechanics for civil engineering applications.

Theory Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Explain** the basic concepts of fluid at rest and motion.	PLO-1	C-2
CLO-2	**Apply** fundamental concepts for problem solving in fluid statics and kinematics.	PLO-2	C-3

Practical Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Perform** experiments related to basic fluid mechanics.	PLO-9	P-2
CLO-2	**Estimate** the hydraulic parameters using experimental data.	PLO-2	C-3
CLO-3	**Justify** experiments related to basic fluid mechanics.	PLO-10	A-3

Course Outlines:

Properties of Fluid Mechanics

Solids and fluids (liquids and gases), Units and dimensions, Introduction to Fluid Mechanics, Fluid Kinematics, Fluid Dynamics, Physical properties of fluids; density, specific weight, specific volume, specific gravity, surface tension, compressibility, Ideal and Real Fluids, Types of Fluids, Viscosity and its measurement, Newton's equation of viscosity, Hydrostatics, Kinematics, Hydrodynamics, Hydraulics.

Fluid Statics

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

Forces on Immersed Bodies

Forces on submerged planes & curved surfaces and their applications, Drag and lift forces, buoyancy and floatation, Equilibrium of floating and submerged bodies.

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.

Hydrodynamics / Energy Consideration in Steady Flow

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

Flow Measurement

Measurement of Static Pressure and Velocity, Measurement of Discharge, Orifices and mouthpieces, sharp-crested weirs and notches, Pitot tube and pitot static tube, Venturimeter, velocity methods.

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

Steady Flow in Open Channels

Chezy’s and Manning’s equations, Bazin’s and Kutter’s equations, Most economical rectangular and trapezoidal sections

Recommended Books:

1. Fluid Mechanics with Engineering Applications, Daugherty, R. L., J. B. Franzini and Fenimore, Latest Edition
2. Fundamentals of Fluid Mechanics, Monson Young, Latest Edition
3. Fluid Mechanics, Douglas, Latest Edition

13. Title of the Course: PROPERTIES OF CONCRETE (CE-202)

Credit Hours: 2+1 = 3

Specific Objectives of Course:

- To identify the engineering problems related to concrete construction reaching substantiated conclusions using engineering solutions.
- Design solutions for engineering processes that meet specified needs with appropriate consideration for public health and safety.

Theory Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Discuss** materials, activities and problems related to concrete.	PLO-1	C-2
CLO-2	**Implement** concrete mix designs considering various parameters using standard guidelines.	PLO-3	C-3

Practical Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Perform** experiments related to properties of concrete.	PLO-9	P-2
CLO-2	**Estimate** the physical parameters using experimental data.	PLO-2	C-3
CLO-3	**Justify** application of experiments related to properties of concrete.	PLO-10	A-3

Course Outlines:

- Introduction Batching, mixing, transporting, and placing, compaction and curing of concrete.
- Properties of fresh and hardened concrete.
- Determination of fundamental structural properties of concrete and non-destructive testing.
- Durability aspects and factors contributing towards durability.
- Use of additives and admixtures in concrete.
- Quality control at various stage of concrete construction.
- Design of concrete mixes.

- Concrete constituents and their mechanical properties.
- Creep and shrinkage of concrete.
- Air Entrainment, light weight, hot and cold weather concrete.
- Precast concrete with special reference to Cement concrete blocks.

Recommended Books:

1. Properties of Concrete by A.M.Nevelle
2. Handbook on Advanced Concrete Technology by N.V.Nayak & A.K.Jain

14. Title of the Course: ENGINEERING PRACTICE (CE-203)

Credit Hours: 2+1 = 3

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.

Theory Part

At the end of this course, students will be able to:			
No	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Describe** the knowledge about construction equipment, construction projects and methodologies	PLO-1	C-2
CLO-2	**Justify** the concepts of construction engineering in different situations	PLO-1	A-2
CLO-3	**Demonstrate** knowledge of construction engineering on civil engineering projects	PLO-11	C3

Practical Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Demonstrate** the construction activities of civil engineering projects	PLO-11	P-3
CLO-2	**Execute** the assigned task reliably independent of help	PLO-11	C-3
CLO-3	**Justify** advanced techniques and different latest equipment used in construction	PLO-5	A-3

Course Outlines:

Construction Equipment:

Earth moving, labour versus machinery. Factors affecting selection of construction equipment. Principle and use of common earth moving machinery required for different purposes (digging, hauling and compaction etc.)

Stone crushers, Machines for cleaning and grading of aggregates, Concrete mixers, vibrators and pneumatic tools, Introduction to tunneling, Piles and cofferdams, Form work and

shuttering. Defects and remedial measures in construction, Principal defects and diagnosis of causes.

Construction Methodologies:

Forms for Conc. structures, Form requirements, cost of forms, designing a project for form economy, materials for forms, size of form section, properties of lumber, Fundamental form design.

Foundation grouting: Need for grouting, exploring to determine the need for grouting, materials used for grout, drilling patterns, drilling injection holes, preparations for grouting, Washing the seams, grouting pressures, equipment for cement grouting, injecting cement grout, pressure grouting with asphalt, clay grouting, chemical grouting, determine the effectiveness of grouting.)

Construction Aspects of Engineering Projects

Introduction to work and tendering.

Recommended Books:

1. Fundamentals of Building Construction: Materials and Methods, 5th Edition. Edward Allen
2. Building Construction: Principles, Materials, and Systems 2009 Update. Medan Mehta, Walter Scarborough and Diane Armpriest.
3. Construction Methods and Management. Stephens W. Nunnally.
4. Huntington, W. C. Building Construction, John Wiley & Sons. (Latest Edition)
5. R. L. Peurifoy, W. B. Ledbetter, C. J. Schexnayder, Cliff J. Schexnayder. Construction Planning Equipment and Method. 5th Edition, McGraw-Hill Companies
6. Thompson J. F., Building Construction, Butterworld London.
7. Construction Equipment Management for Engineers, Estimators, and Owners, 1st Edition, Douglas D. Gransberg

15. Title of the Course:

NUMERICAL ANALYSIS AND COMPUTER PROGRAMING (MA-204)

Credit Hours: 2+1 = 3

Specific Objectives of Course:

- To introduce various techniques for solving linear, non-linear and difference equations using various numerical methods.
- To enable students to learn computer programing languages
- To develop skills of computer programming and its applications in elementary civil engineering problems.

Theory Part

At the end of this course, students will be able to:			
No	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Apply** numerical analysis techniques for simpler to complex problems of applied engineering.	PLO-2	C-3

Practical Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Apply** analytical tools in solving engineering as well as daily life problems.	PLO-5	C-6 P-4

Course Outlines:

Part (A)

Errors in Computation

Introduction, Error and their sources, Truncation Error, Absolute, relative and percentage error.

Eigenvalues and Eigenvectors of Matrices

Introduction, Eigenvalues, and eigenvectors. Interpolation with Unequally & Equally Space Date. Introduction, The` error of the interpolation polynomial, divided differences. The difference table, Newton's forward and backward difference formulae, Gauss formulae.

Nonlinear Equations:

Bisection method, the method of false position or regula falsi method, Secant method, Newton-Raphson method

Difference equations:

Solution of System:

Solution of System of Linear Equations (a) Direct Method - Introduction, Gauss's elimination method, LU decomposition, Cholesky's method. (b) Indirect Method - Iterative methods, Jacobi iterative method, Gauss seidel iterative method

Numerical Differentiation:

Introduction, Numerical differentiation formulae based on equally space data, Numerical differentiation formulae based on Newton's forward differences, Numerical differentiation formulae based on Newton's backward differences, Numerical differentiation formulae based on Lagrange's formula.

Numerical Integration:

Numerical Integration, The trapezoidal rule with error term, Simpson's 1/3 rule with error term, Simpson's 3/8 rule with error term.

Numerical Solution of Ordinary Differential Equations:

Euler's method, Modified Euler method, Runge-Kutta methods.

Recommended Books:

1. Gottfried, BS Programming with Structured Basics (Schaum Series), McGraw-Hill. (1st Edition)
2. Deitel & Deitel, T. R. Nieto, Visual C++ 6 (2nd Edition), 1992
3. Steven Holzner, Black Book of C++ (Latest Edition)
4. Evangelos Petroutsos, Mastering Visual Basic 6, Sybex Computer Books Inc. USA,1998.
5. Complex Variables by Murray R. Spiegel, Schaum Series
6. Numerical Analysis by Scheid, Schaum Series

Part (B)

C++ Programming Basics

Basic Programme Construction, Output using COUT, Directives, Comments, Integer Constants, Initialization, Input with cin, Floating point types, The SETW Manipulator, Arithmetic Operators, Library Functions. Loops, Decision, Logical Operators, Percentage Summary, Other control statement

Structures

Structures, Simple Structures, Declaring Structures, Defining a Structure Variable, Accessing Structure Features, A Measurement Example

Functions

Simple function, Passing Arguments to Functions, Returning Values from Functions.

Object and Classes

A simple class, C++ objects as data types, Constructors

Arrays and Strings

Array fundamentals, Array of Strings, The Standard C++ string class and Operator Overloading.

Recommended Books:

1. C++ Primer (5th Edition) by S. B. Lippman, J. Lajoie, B. E. Moo:
2. Accelerated C++ by Andrew Koenig and Barbara E. Moo
3. Effective C++ by Scott Meyers

16. Title of the Course: ISLAMIC STUDIES (HU-205)

Credit Hours: 2+0 = 2

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.

Theory Part

At the end of this course, students will be able to:			
No	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Discuss** fundamentals of Quran, Ahadees and their values in everyday life.	PLO-6	A-1
CLO-2	**Recognize** the importance of Islamic architecture in modern day engineering considering social and religious aspects/interests.	PLO-6	C-1
CLO-3	**Discuss** as well as interpret the social and religious aspects of Islamic ethics.	PLO-8	A-2

Course Outlines:

Introduction to Quranic Studies:

1. Basic Concepts of Quran
2. History of Quran
3. Uloom-ul -Quran

Study of Selected Text of Holly Quran:

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

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

1. Life of Muhammad Bin Abdullah (Before Prophet Hood)

2. Life of Holy Prophet (S.A.W) in Makkah
3. Important Lessons Derived from the life of Holy Prophet in Makkah
4. Life of Holy Prophet (S.A.W) in Madina
5. Important Events of Life Holy Prophet in Madina
6. Important Lessons Derived from the life of Holy Prophet in Madina

Introduction to Sunnah:

1. Basic Concepts of Hadith
2. History of Hadith
3. Kinds of Hadith
4. Uloom-ul-Hadith
5. Sunnah & Hadith
6. Legal Position of Sunnah

Introduction to Islamic Law & Jurisprudence:

1. Basic Concepts of Islamic Law & Jurisprudence
2. History & Importance of Islamic Law & Jurisprudence
3. Sources of Islamic Law & Jurisprudence
4. Nature of Differences in Islamic Law
5. Islam and Sectarianism

Islamic Culture & Civilization:

1. Basic Concepts of Islamic Culture & Civilization
2. Historical Development of Islamic Culture & Civilization
3. Characteristics of Islamic Culture & Civilization
4. Islamic Culture & Civilization and Contemporary Issues

Islam & Science:

1. Basic Concepts of Islam & Science
2. Contributions of Muslims in the Development of Science
3. Quran & Science

Islamic Economic System:

1. Basic Concepts of Islamic Economic System
2. Means of Distribution of wealth in Islamic Economics
3. System of Life Insurance and Islamic Concept of Riba
4. Islamic Ways of Trade & Commerce

Political System of Islam:

1. Basic Concepts of Islamic Political System
2. Islamic Concept of Sovereignty
3. Basic Institutions of Govt. in Islam

Islamic History:

1. Period of Khlaft-e-Rashida
2. Period of Ummayyads

3. Period of Abbasids

Social System of Islam:

1. Basic Concepts of Social System of Islam
2. Elements of Family
3. Ethical Values of Islam

Recommended Books:

1. Hameed ullah Muhammad, “Emergence of Islam”, IRI, Islamabad
2. Hameed ullah Muhammad, “Muslim Conduct of State”
3. Hameed ullah Muhammad, ‘Introduction to Islam
4. Mulana Muhammad Yousaf Islahi,”
5. Hussain Hamid Hassan, “An Introduction to the Study of Islamic Law” leaf Publication Islamabad, Pakistan.

17. Title of the Course: HAZARDS AND DISASTER MANAGEMENT (CE-212)

Credit Hours: 3+0 = 3

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.

Theory Part

At the end of this course, students will be able to:			
No	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Explain** hazards and disasters and use their management for different scenarios.	PLO-1	C-2
CLO-2	**Value** the different phases of disaster management.	PLO-2	C-4
CLO-3	**Debate** on sustainability after disaster occurrence.	PLO-7	A-3
CLO-4	**Develop** emergency preparedness plan for different disasters	PLO-12	A-4

Course Outline:

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

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

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

Recommended Books:

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

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

18. Title of the Course: THEORY OF STRUCTURES-I (CE-206)

Credit Hours: 3+1 = 4

Specific Objectives of Course:

- To enable students to learn basics of analysis of determinate structures.
- To enhance the skills of analyzing determinate structures under various loading conditions.

Theory Part

At the end of this course, students will be able to:			
No	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Discuss** basic concepts of Structural Analysis for statically determinate structures.	PLO-1	C-2
CLO-2	**Apply** Structural Analysis concepts to measure deflections and forces in different types of structures.	PLO-2	C-3

Practical Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Perform** experiments related to analysis of determinate structures	PLO-9	P-2
CLO-2	**Estimate** the physical parameters using experimental data	PLO-2	C-3
CLO-3	**Demonstrate** the ability to develop a physical model to **present** the concepts of analysis in structures	PLO-3	P-3, A-2

Course Outlines:

Introduction to structural analysis:

Definition, types of structures, structural idealization, loads. Determinacy, indeterminacy and stability of structures, analysis of determinate trusses, Common types of trusses, classification of coplanar trusses. Method of joints, Method of sections, Graphical method for analysis.

Analysis of Statically Determinate Rigid jointed plane frame:

Determinacy and stability of plane frames. Analysis, (sign convention etc.), Shear & bending moment diagrams of frames.

Deflection:

Deflection diagrams and elastic curves, Energy methods to compute deflections, Castiglioni's theorem for trusses, beams and frames, Principle of virtual work for trusses, beams and frames.

Moving Loads:

Influence lines for statically determinate beams and paneled girders. Influence lines for shear reaction and bending moment for beams and paneled girder, influence lines for axial forces in trusses. Calculation of Maximum stress functions i.e. reaction shear and bending moment in a simply supported beam due to series of moving loads, absolute maximum bending moment and its evaluation.

Arches, Cables, and suspension bridges:

Three hinged parabolic and circular arches, Influence line for 3-hinged arches, Introduction to cables and suspension bridges. Analysis of indeterminate beams by 3¬moment equation.

Recommended Books:

1. H. H. West, Fundamentals of Structural Analysis, John Willey-New York, 2nd Edition.
2. Alexender Chajes, Structural Analysis, N. J: Prentice Hall, 3rd Edition.
3. W. J. Spencer, Fundamental Structural Analysis, Palgrave Macmillon, 1988 New York, Inc.
4. R. C. Hibbler, Structural Analysis, Prentice Hall, 8th Edition,
5. K. M. LEET & Chia-Ming Uang, Fundamentals Structural Analysis Prentice Hall,7th Edition.
6. Wang, C. K., Indeterminate Structures Analysis, McGraw-Hill.

19. Title of the Course: STRENGTH OF MATERIALS-I (CE-207)

Credit Hours: 2+1 = 3

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.

Theory Part

At the end of this course, students will be able to:			
No	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Discuss** materials and their utilization in structures considering engineering properties	PLO-1	C-2
CLO-2	**Apply** fundamental concepts to analyze and design structural members subjected to various loadings	PLO-2	C-3
CLO-3	**Perform** safety analysis of structural members	PLO-2	C-3

Practical Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Perform** experiments related to mechanical properties of materials	PLO-9	P-2
CLO-2	**Estimate** the physical parameters using experimental data	PLO-2	C-3

Course Outlines:

Simple stress and strain

Types of stresses and strains, Statically determinate and indeterminate compatibility problems, Compound bars, Temperature stresses.

Analysis of Beams

Advanced cases of shearing forces and bending moment diagrams for determinate beams, Relationship between loads, shear force and bending moment, Theory of simple bending, Distribution of shear stresses in beams of symmetrical sections. Principle of superposition, Deflection of beams using double integration, moment area and conjugate beam methods.

Circular Shafts: Torsion of hollow and solid circular section.

Column and Struts

Columns, Types and different formulae for critical load like Euler's formula, and Empirical formula like Rankine Gordon Formula, initially imperfect columns, slenderness ratio.

Strain Energy: Strain energy due to direct load, shear bending and torsion, Impact loads.

Springs: Open coil springs, closed coil springs, leaf springs.

Introduction to Torsion of Thin Walled Tubes and Non-Circular Members

Thin, Thick and Compound Cylinders

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

Recommended Books:

1. Craig, R. R. (2011) Mechanics of Materials, 3rd Edition, John Wiley and Sons
2. Beer, F. P., E. R. Johnston, J. T. DeWolf, and D. F. Mazurek (2011) Mechanics of Materials, 6th Edition, McGraw Hill.
3. Hibbeler, R. C. (2011) Mechanics of Materials, 8th Edition, Prentice Hall.
4. Gere, J. M., and B. J. Goodno (2012) Mechanics of Materials, Brief edition, Cenage Learning.
5. Case, J., L. Chilver, and C. T. F. Ross (1999) Strength of Materials and Structures, 4th Edition, Edward Arnold.
6. Pytel, A., F. L. Singer (1987) Strength of Materials, 4th Edition, Harper International.
7. Warnock, F. V., P. P. Benham, and R.J. Crawford (1980) Mechanics of Engineering Materials, ELBS.

20. Title of the Course: SOIL MECHANICS-I (CE-208)

Credit Hours: 2+1 = 3

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.

Theory Part

At the end of this course, students will be able to:			
No	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Understand** the soil formation, its index, engineering properties and behavior	PLO-1	C-2
CLO-2	**Analyze** the effects of loads, additives and water on behavior and properties of soil	PLO-2	C-4
CLO-3	**Prepare** a soil investigation program and perform classification of soil	PLO-4	C-3

Practical Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Perform** experiments related to basic soil mechanics	PLO-9	P-2
CLO-2	**Estimate** the physical parameters using experimental data	PLO-2	C-3
CLO-3	**Justify** application of experiments related to soil mechanics	PLO-10	A-3

Course Outlines:

Soil and its constituents: Applications in engineering practice, soil formation: Weathering of rocks and types of soil, Types of soil deposits & their properties, soil structure and clay minerals. Physical properties, e.g., water content, void-ratio, porosity, degree of saturation, specific gravity, unit weight and their determination, Mass Volume relationships.

Soil Classification: Importance of soil classification, Atterberg limits, grain size distribution, sieve analysis, hydrometric analysis, Unified and AASHTO classification and description of their subgroups.

Soil Exploration: Purpose of soil exploration, phases and scope, soil exploration methods, probing test, trenches and pits, Auger boring, wash boring, Rotary drilling, Soil samples, Distributed and undistributed samples, Introduction to Geotechnical report writing.

Permeability and capillarity: Definition, Darcy's law, Factors affecting permeability, Laboratories and field determination of permeability, Capillarity and effects, frost heave and its prevention, Theory of flow nets. Estimation of seepage quantity and gradients. Permeability through stratified layer of soils, Quick sand conditions, Design of filters.

Compaction: Definition, Compaction fundamentals, Moisture density relationship, Compaction standards, Laboratory Tests, Factors affecting compaction, Field control and measurements of in-situ density, Effect of compaction on properties of soil. Field compaction equipments. Relative density, relative compaction & compaction specifications.

Soil Improvement: Basic principles and objectives. Various methods of soil improvement.

Recommended Books:

1. Donald P. Coduto Geotechnical Engineering (Principles and practices)
2. Whitlow, R., Basic Soil Mechanics, Longman Scientific & Technical
3. Smith, G. N. Elements of Soil Mechanics, Oxford BSP, Professional Books.
4. Smith, G. N. Elements of Foundation Design, Granada Publisher.
5. Braja M. Das, Principles of Geotechnical Engineering, 5th Edition, Thomson Engineering
6. J. E. Bowls, Physical and geotechnical properties of soils, McGraw-Hills Inc.
7. Lamb & Whitman, Soil Mechanics, John Willey
8. Advanced Soil Mechanics by B.M Das.
9. Foundation Analysis and Design by Bowles.
10. An Introduction to Geotechnical Engineering, Holtz and Kovacs
11. Principals of Foundation Engineering by B.M Das

21. Title of the Course: DRAWING, ESTIMATION & CONSTRUCTION (CE-209)

Credit Hours: 2+1 = 3

Specific Objectives of Course:

- To enable students to learn fundamentals of Architectural and Structural drawing.
- To learn broader aspect of civil engineering drawing & preparation of rough cost and detailed engineering estimates.
- Enable the student to visualize the basics of engineering design. It is intended for improving students approach towards conceptual design.
- To have skills to prepare architectural, structural, plumbing, electrical, hydraulic structures and highway/motorway drawings using manual drafting tools.

Theory Part

At the end of this course, students will be able to:			
No	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Estimate** the physical quantities related to construction works	PLO-2	C-3
CLO-2	**Discuss** architectural and legal aspects of construction projects	PLO-1	C-2

Practical Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Accomplish** tasks related to plotting of architectural and structural drawings	PLO-9	P-2
CLO-2	**Justify** the prepared bill of quantities	PLO-10	A-3

Course Outlines:

Introduction to Estimation:

Need for Estimation, Essential Qualities of a good Estimator, Site condition affecting Estimate.

Bill of Quantities (BOQ) & Measurement Book (MB): Types and methods of estimates, Rough Cost Estimate, Detailed Estimate, Engineer's Estimate, Contractor's Estimate, Progress Estimate, Separate/Individual Wall method, Units & Description of Common items of work in Building Construction, Detailed Estimation of some simple buildings.

Working out quantities, rates, and cost analysis of construction materials; Contents and preparation of bills of quantities for different projects like irrigation, roads, sanitary, building etc.

and maintaining of Measurement Books. Measurement, specification, and costing of site work, excavation, backfill, concrete, masonry, carpentry, and finishes works; Overview and discussion of estimating procedures and considerations for concrete retaining wall, steel truss, road, sewer, and water mains pipe works. Escalation, Contingency, Priced bill of quantity.

Construction:

Brick Masonry, Types & Sizes of bricks, Common Definitions regarding Brick Masonry, Bonds and its types, Stone Masonry, Rubble Masonry, Ashlar Masonry, Comparison of Stone and Brick Masonries, Pre-Construction Site Works, Site Survey, Profile Boards, Excavation, Safety in Excavation, Site Selection, Orientation of Buildings, Dampness, its causes, and remedies. Plastering and its types, Pointing, Joints in Buildings, Maintenance of Buildings. Doors and its types, Roofs and its types, Floors and its types, Stair-case, and its types.

Tendering: Preparation of civil engineering contracts and tender documents. Evaluation of proposals and contracts.

Overview of Contract Law and Dispute Resolution: Contract express and implied terms; breach of contract; liability for negligence; statutory and regulatory laws affecting construction; rights and liabilities of project key stakeholders. Overview of engineering and professional registration, contractor licensing, insurance and bonds. Liquidated damages and penalty/ bonus clauses. Delays; acceleration; suspension of work; termination. Changes, Claims, Alternate Dispute Resolutions Techniques.

Recommended Books:

1. S. Dutta, Estimating and Costing in Civil Engineering, 24th Ed. SOS Free Stock
2. D. D. Kohli, Estimating, Costing and Accounts, 9th Ed. S. Chand & Co. Pvt. Ltd.
3. Keith Collier, Fundamentals of construction. Estimating & Cost Accounting, Prentice Hall.
4. Jimmie Hinze, Construction Contracts, 3rd Edition, 2010, McGraw-Hill

22. Title of the Course: COMPUTER APPLICATIONS (HU-210)

Credit Hours: 2+1 = 3

Specific Objectives of Course:

- To acquaint the students with engineering applied nature computer softwares
- To enhance the ability of students in computer skills with focus on drafting of architectural and structural drawings using AUTOCAD and general engineering problem solutions using MATLAB and Ms Excel

Theory Part

At the end of this course, students will be able to:			
No	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Explain** tools and steps in AutoCAD Software for drafting engineering drawings	PLO-1	C-2
CLO-2	**Discuss** the use of Ms Excel & MATLAB tools to solve different problems	PLO-2	C-2
CLO-3	**Describe** different functions of latest version of both AutoCAD (in detail) and Ms Excel (in general) related to civil engineering domain.	PLO-12	C-1

Practical Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Demonstrate** skill of AutoCAD Software for drafting of simpler to complex engineering drawings	PLO-5	P-3
CLO-2	**Apply** the use of Ms-Excel & MATLAB tools to solve different engineering problems	PLO-5	C-3

Course Outlines:

Importance of software's in civil engineering:

Civil Engineering Drawing Software (AutoCAD)-Graphical user interface, different co-ordinate system, direct entry method, gaining drawing strategies, Layers, history of layers, assigning of layers, generating elevations and sections, working with hatches and fills, controlling text in the drawing, dimensioning and printing a drawing.

Microsoft Excel and MATLAB for solving numerical problems.

Recommended Books:

1. AutoCAD 2016: A Problem-Solving Approach.
2. Step by Step Microsoft Excel 2016 by Curtis D. Frye
3. Introduction To MATLAB® For Engineers, Third Edition by William J. Palm III

23. Title of the Course: COMMUNICATION SKILLS & TECHNICAL REPORT WRITING (CE-211)

Credit Hours: 1+1 = 2

Specific Objectives of Course:

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

Theory Part

At the end of this course, students will be able to:			
No	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Recognize** and comprehend organizational communication system for improved knowledge of technical writing skills needed professionally. Understanding of do's and don'ts of technical communication.	PLO-10	C-2
CLO-2	**Apply** of acquired understanding for communication in life-long learning.	PLO-12	C-3
CLO-3	**Review** correct use of English language in writing and speaking in response to real circumstances	PLO-10	C-2

Practical Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Implement** effective presentation and communication skills.	PLO-10	A-2
CLO-2	**Apply** the use of ethical values in personal and professional interactions.	PLO-8	C-3

Course Outlines:

Short Writings:

Paragraph writing. Practice in writing a good, unified, and coherent paragraph. Essay writing. Introduction to CV and job application. Translation skills Urdu to English. Study skills. Skimming and scanning, intensive and extensive, and speed reading, summary and précis writing and comprehension.

Proposals

Purposes, Kind and parts of proposals, Short and long proposals, Writing style and Appearance

Academic skills:

Letter / memo writing and minutes of the meeting, use of library and internet recourses**.** Presentation skills**.** Personality development (emphasis on content, style, and pronunciation). Strategies for successful speaking & successful listening. Strategies for improving oral presentation, strategies for reducing stage, freight, strategies for improving listing skills.

Electronic Communication:

E-mail, Online help, and Website

Engineering / Business Ethics:

Need and objectives for code of ethics and its importance, Types of ethics, involvement and impact in daily life, Problems / conflicts / dilemmas in application (case studies), Sexual Harassment / discrimination in the workplace: a) why it occurs, b) myths regarding sexual harassment, c) how to deal with it, d) gender equality e) respect etc. Codes of conduct: Code of Pakistan Engineering Council, Code for Gender Justice, Brief study of other codes of conduct.

Note: Documentaries to be shown for discussion and review and for practicing of listening and answering

Recommended Books:

1. Ellen, K. 2002. Maximize Your Presentation Skills: How to Speak, Look and Act on Your Way to the Top, Prima Lifestyles – 2005.
2. Hargie, O. (ed.) Handbook of Communications Skills, Routledge.
3. Mandel, S. 2000. Effective Presentation Skills: A Practical Guide Better Speaking, Crisp Publications.

24. Title of the Course: THEORY OF STRUCTURES-II (CE-301)

Credit Hours: 3+1 = 4

Specific Objectives of Course:

- 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.

Theory Part

At the end of this course, students will be able to:			
No	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Analyze** different types of indeterminate structures using force based methods.	PLO-2	C-3
CLO-2	**Analyze** different types of indeterminate structures using displacement based methods.	PLO-2	C-3

Practical Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Perform** experiments related to analysis of indeterminate structures	PLO-9	P-2
CLO-2	**Estimate** the physical parameters using experimental data	PLO-2	C-3
CLO-3	**Justify** application of experiments related to indeterminate structures	PLO-10	A-3

Course Outlines:

Introduction

Statically indeterminate structures, determination of degree of instability and stability of structures.

Force Method

Methods of least work and consistent deformation, application to statically indeterminate beams, frames, trusses and two hinged arches.

Displacement Method

Slope deflection method, moment distribution method, application to indeterminate beams and frames.

Introduction to Plastic Analysis of Structures

Influence Line Diagram (ILD) for Indeterminate Members

Clark Maxwell and Betty's theorems, influence lines for moment and reaction in propped cantilever, fixed ended and two and three span continuous beams. ILD for shear force and bending moment at any section in an indeterminate beam.

Moment Distribution Method

Concept, distribution and carry over factors. Analysis of continuous beams and frames with and without yielding of supports. Solution of frames involving side sway.

Analysis of indeterminate trusses Application of virtual work (Unit load method) to deflection of trusses, external and internal indeterminacy. Analysis of trusses with redundant support reactions.

Analysis of two-hinged arches

Analysis of two-hinged circular and parabolic arches having supports at same and at different levels.

Deformed Shapes of the Structures

Deflection, Slope & introduction to Elastic Limit. Rules for Sketching Deformed Shapes of the Structures. Qualitative deformed shape of braced & unbraced frames.

Recommended Books:

1. Structural Analysis. Hibbeler, R. C., 8th Edition.
2. Structural Analysis. Aslam Kassimali., 2nd Edition.
3. Analysis of Structures. West, H. H: An Integration of Classical and Modern Methods. John Wiley and Sons Ltd; 2nd Edition.

25. Title of the Course: STRENGTH OF MATERIALS-II (CE-302)

Credit Hours: 3+1 = 4

Specific Objectives of Course:

- To provide the student/engineer with methods of analyzing various structural members in terms of determination of stresses and strains so that a given structure can be safely designed and/or analyzed under the applied loading conditions.

Theory Part

At the end of this course, students will be able to:			
No	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Apply** concepts of stress and strain transformation in structural members.	PLO-1	C-3
CLO-2	**Analyze** structural members under various loading conditions.	PLO-2	C-4

Practical Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Perform** experiments related to advanced mechanics of materials	PLO-9	P-2
CLO-2	**Estimate** the physical parameters using experimental data	PLO-2	C-3
CLO-3	**Justify** application of experiments related to advanced mechanics of materials	PLO-10	A-3

Course Outlines:

Stress and strain analysis (Analytical solutions): Analysis of Stress and strain at a point due to combined effect of axial force, shear force and bending moment.

Graphical solution of stress and strain analysis: Mohr's circle for stress and strain analysis.

Theory of Yielding/Failure: Theories of failure for ductile and brittle materials.

Shear stresses in thin walled open section beams: Shear stress distribution in thin walled open beams.

Flat Plates: Introduction to bending and buckling of plates.

Columns: Eccentrically loaded columns.

Introduction to Theory of Elasticity: Stress tensor, Plane stress and plane strain problems, Stress and strain transformations, Principal stresses, strains and planes.

Curved Beams: Introduction to circumferential and radial stresses in curved beams.

Strain: Electrical resistance strain measurements, Strain rosette analytical solution, Relationships between elastic constants and between stress and strain, Kern of a section, Stress trajectories. Prager's pole technique, Strain rosette solution. Yielding loci and envelope.

Unsymmetrical bending of beams of symmetrical and unsymmetrical sections, Geometrical properties of symmetrical and unsymmetrical- sections, Principal axes.

Shear flow and **shear center** of thin walled open section beams.

Recommended Books:

1. Craig, R. R. (2011) Mechanics of Materials, 3rd Edition, John Wiley and Sons
2. Beer, F. P., E. R. Johnston, J. T. DeWolf, and D. F. Mazurek (2011) Mechanics of Materials, 6th Edition, McGraw Hill.
3. Hibbeler, R. C. (2011) Mechanics of Materials, 8th Edition, Prentice Hall.
4. Gere, J. M., and B. J. Goodno (2012) Mechanics of Materials, Brief edition, Cenage Learning.
5. Case, J., L. Chilver, and C. T. F. Ross (1999) Strength of Materials and Structures, 4th Edition, Edward Arnold.
6. Pytel, A., F. L. Singer (1987) Strength of Materials, 4th Edition, Harper International.
7. Warnock, F. V., P. P. Benham, and R.J. Crawford (1980) Mechanics of Engineering Materials, ELBS.

26. Title of the Course: SOIL MECHANICS-II (CE-303)

Credit Hours: 3+1 = 4

Specific Objectives of Course:

- To provide the students with an in-depth knowledge and understanding of stresses in soil, vertical and lateral earth pressures
- Determining bearing capacity of soil.
- To inculcate the knowledge of consolidation and permeability of soil;
- Parameters for design of foundation/footing. Settlement and time rate of settlement.

Theory Part

At the end of this course, students will be able to:			
No	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Discuss** the engineering properties of soil, stress distribution, concepts of slope failure and dynamic loading	PLO-1	C-2
CLO-2	**Analyze** the engineering behavior of soil and stability of slopes	PLO-2	C-4
CLO-3	**Evaluate** design of various geotechnical structures	PLO-3	C-5

Practical Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Perform** experiments related to engineering properties of soil	PLO-9	P-2
CLO-2	**Estimate** the physical parameters using experimental data	PLO-2	C-3
CLO-3	**Justify** experiments related to engineering properties of soil	PLO-10	A-3
CLO-4	**Applying** modern tools to predict the soil behavior under different loading conditions	PLO-5	P-3

Course Outlines:

Shear Strength: Concept, Shear strength parameters, Coulomb's law, shear strength of cohesive and non- cohesive soils, Factors affecting shear strength of sot and its applications in engineering. Simple laboratory and field tests for determination of shear strength.

Stress Distribution: Geo-static stresses, total stress and pore pressure, effective stress capillarity and its effects. Westergard and Boussineq's theories. Pressure bulb, stress distribution diagram on horizontal and vertical planes. Stress at a point outside the loaded area. New mark's influence charts. Vertical stresses due to a line and strip loads. Fadum's charts, approximate method.

Earth Pressures: Definition, Active and passive earth pressure. Pressure at rest. Coulomb's and Rankine's theories. Bell's equation for cohesive frictional soils. Earth pressure diagrams for different loading configurations.

Stability of Slopes: Types of slopes, Factors affecting stability, Types of failure and remedial measurements. Method of stability analysis.

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.

Soil Dynamics: Sources of dynamic loading, spring mass-dashpot system, application to machine
foundations, liquefaction. Introduction to Geotechnical Computer Software

Recommended Books:

1. Advanced Soil Mechanics by B.M Das.
2. Foundation Analysis and Design by Bowles.
3. Geotechnical Engineering by Codout
4. An Introduction to Geotechnical Engineering, Holtz and Kovacs
5. Principals of Foundation Engineering by B.M Das

27. Title of the Course: CONSTRUCTION, PLANNING & MANAGEMENT (CE-304)

Credit Hours: 2+1 = 3

Specific Objectives of Course:

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

Theory Part

At the end of this course, students will be able to:			
No	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Define** basics of project management related to the civil engineering projects.	PLO-11	C-1
CLO-2	**Apply** different techniques of project management for planning and scheduling to control and facilitate project execution.	PLO-2	C-3
CLO-3	**Define** principles of economics related to engineering projects.	PLO-1	C-1

Practical Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Plan** various activities to monitor physical and financial progress of a project	PLO-11	C-6
CLO-2	**Discuss** application of Primavera software in planning of projects	PLO-5	C-2

Course Outlines:

Planning & Scheduling:

Network Techniques, Arrow Diagram, Node Diagram, Critical Path, Types of Floats, CPM Calculations, Bar Chart, Time Scaled Diagrams, Resource Leveling, Resource Allocation, Network Compression, Types of Costs, PERT. Cost Load Schedule, Cash Flow, Beta Curve and Center Limit Theorem.

Management:

Project, Management, Qualities of a good Manager, Scope Triangle, Types of Management Creeps, S-Curve and its types, Project Failures, Techniques of Construction Planning, Pre-tender, Planning, Pre-construction, Planning, Method Statements.

Economics:

Definitions of Engineering Economics, Sole Proprietorship, Partnership, Joint Stock Companies, Fund-raising for Joint Stock Companies, Types of Banks, and Site Selection for Factories, Types of Markets, Value, Utility, Competition and its types, Monopoly and its types, Supply Schedule, Demand Schedule, and Forecasting Techniques.

Introduction to use of computer software in project planning and management:

Civil Engineering management software (MS Project) or Primavera P6 - Definition of project, planning of project activities, create phases and sub-phases in a project, milestones, Work breakdown structure codes, structuring tasks into a logical outline, identifying resource requirements and set working times, set resource costs & managing progress of the project.

Recommended Books:

1. Techniques for Construction Network Scheduling, by James D. Stevens, McGRAW-HILL Publishing Company
2. Managing the construction process: estimating scheduling, and project control, by Frederick E. Gould, Pearson Prentice Hall 2010.
3. Construction Planning and Scheduling, by Jimmie W. Hinze, 3rd Edition.
4. Construction Jobsite, by William R. Mincks, Hal Johnston, Management, 3rd Edition.
5. Construction Contracts, by Jimmie Hinze, 3rd Edition 2010.

28. Title of the Course: HYDROLOGY AND WATER RESOURCES (CE-305)

Credit Hours: 2+1 = 3

Specific Objectives of Course:

- Solve and demonstrate the basic problems and principles of hydrology
- Communicate the concepts of hydrology both in technical as well as non-technical language to convey the knowledge to the public
- Measure different hydrological quantities/components such as stream flows, relative humidity, temperatures and using the modern tools as well.

Theory Part

At the end of this course, students will be able to:			
No	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Discuss** basic concepts of hydrology & water resources	PLO-1	C-2
CLO-2	**Measure** various hydrological parameters using different techniques	PLO-2	C-4

Practical Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Perform** experiments related to hydrology	PLO-9	P-2
CLO-2	**Estimate** the physical parameters using experimental data	PLO-2	C-3
CLO-3	**Justify** experiments related to hydrology & water resources	PLO-10	A-3

Course Outlines:

Introduction: Water resources in Pakistan. Hydrologic cycle and equation of continuity. Water budget. Assessment of groundwater resources. Introduction of dams and barrages.

Precipitation: Types of precipitation. Factors necessary for the formation of precipitation, Measurement of precipitation. Interpretation of precipitation data.

Evaporation and Transpiration: Factors affecting evaporation. Measurement of Evaporation. Potential evapotranspiration.

Stream Flow: Water stage and its measurement. Selection of site for stage record. Selection of control and metering section. Methods of measurement of stream flow. Interpretation of stream flow data.

Runoff: Factors affecting runoff. Estimating the volume of storm runoff.

Hydrographs: Characteristics of hydro graphs. Components of a hydro graph. Hydrograph separation. Estimating the volume of direct run off. Introduction to unit hydro graph concept.

Steam flow routing: Introduction to flood, frequency and duration analysis. Introduction to Ground Water Flow Sources and discharge of ground water. Water table and artesian aquifer, The Thiem formula and its application to aquifer tests.

Introduction to hydrologic modeling: Physical models. Analogue models. Numerical models. Introduction to GIS with its application in Hydrology and Water Resources: Introduction to related software(s) like QGIS & HEC HMS for rainfall runoff modeling.

Recommended Books:

1. Engineering Hydrology An Introduction by Dr. Abdul Razzak Ghumman
2. Introduction to Hydrology by Warren Viessman, Jr. Gary L. Lewis
3. Concise Hydrology by Dawei Han
4. Fundamentals of Hydrology by Tim Davie
5. Applied Hydrology by Ven Tee Chow, David Maidment and Larry W. Mays

29. Title of the Course: ENVIRONMENTAL ENGINEERING-I (CE-306)

Credit Hours: 2+1 = 3

Specific Objectives of Course:

- To introduce the concept of environmental pollution, contamination, and its sources particularly in context to water.
- Provide an overview of key topics and relevant field issues in environmental engineering.
- Gain an understanding of the underlying scientific, engineering, and regulatory concepts in each topical area.
- Learn several quantitative approaches for environmental assessment and problem solving.
- To learn principles of environmental engineering applied to the design and implementation of water supply schemes.

Theory Part

At the end of this course, students will be able to:			
No	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Discuss** water and waste water systems	PLO-1	C-2
CLO-2	**Apply** knowledge of environmental engineering to solve basic and complex issues	PLO-2	C-3
CLO-3	**Discuss** environmental issues and solutions through environmental assessment reports	PLO-7	C-2

Practical Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Perform** experiments related to environmental engineering	PLO-9	P-2
CLO-2	**Estimate** the physical parameters using experimental data	PLO-2	C-3
CLO-3	**Justify** concepts related to hydrology & water resources and its impact on the society	PLO-6	A-3

Course Outlines:

- Introduction to the Environmental Engineering.
- Water survey: Tracing leakages. Relationship of sewerage and water supply system. System sewerage. Quantity and quality of sanitary sewage.
- Principles of waste water treatment: screening: grit removal sedimentation, standard and high rate biological filtration: activated sludge process: mechanical and diffused aeration: Oxidation ponds: aerated lagoons, sludge digestion and drying. In half and septic tank.
- Water pollution (Water chemistry and characteristics, sources of pollution, factors affecting water quality, water quality control and management)
- Introduction to Water quality and treatment: Impurities in drinking water, impacts of untreated water on community health, WHO guide lines, water sampling techniques, physical, chemical and biological parameters, water borne diseases.
- Advance water treatment techniques
- Introduction to Water supply systems: Population forecasting techniques, water uses and consumption, factors affecting per capita consumption, water demands, fire demands.
- Introduction to:
    a) Wastewater collection systems
    b) Wastewater treatment
    c) Air pollution control
    d) Solid waste management
    e) Hazardous and industrial waste management
    f) Water quality modeling
    g) Noise pollution control

Recommended Books:

1. Introduction to Environmental Engineering Third Edition by Davi & Cornwell, McGraw Hill
2. Water Supply & Sewerage by E.W Steel and McGhee 6th Edition
3. Environmental Engineering Laboratory, by Dr. Khurshid Ahmad
4. Waste Water Engineering, Treatment, disposal, Reuse by Metcalf and Eddy, 3rd Edition.
5. Environmental Assessment in Practice by D. Owen Harrop & J. Ashley Nixon
6. Integrated Solid Waste Management by George Techobanoglous, Hilary Theisen & Samuel A. Vigil
7. Elements of public health engineering by K.N Duggal
8. Water and Waste Water Engineering by Fair & Gayer
9. Water and Wastewater Technology by Mark J, Hammer

30. Title of the Course: REINFORCED CONCRETE-I (CE-307)

Credit Hours: 3+1 = 4

Specific Objectives of Course:

- Know the basic concept of reinforced concrete
- Gain Ability to design singly reinforced and Doubly reinforced beams by working stress method and ultimate strength design method.
- Gain ability to analyze and design one-way, Two-way slabs and continuous slabs by USD
- Know the basic concept of safety and serviceability provisions in design

Theory Part

At the end of this course, students will be able to:			
No	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Discuss** concepts of reinforced concrete structural members as per design provisions	PLO-1	C-2
CLO-2	**Perform** analysis of reinforced concrete members for various loading conditions	PLO-2	C-3
CLO-3	**Apply** working stress and ultimate strength methods in design of reinforced concrete members	PLO-3	C-3

Practical Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Perform** experiments to conduct quality evaluation of existing structures and hardened concrete.	PLO-9	P-2
CLO-2	**Estimate** the physical parameters using experimental data	PLO-2	C-3

Course Outlines:

Mechanics of reinforced concrete:

Basic Principles of reinforced concrete design and associated assumptions, Behavior of reinforced concrete members in flexure.

Introduction to Design Philosophy: Design philosophy, Design Codes, Factor of Safety and Load factors, and Prevailing methods of design of reinforced concrete members.

Working stress method:

Introduction and Application of WSD in simple structural members

Ultimate Strength Method:

a) Balanced Sections, Tension- Controlled Sections, and Compression- Controlled or Brittle Sections.
b) Strength Reduction or ϕ Factors, Minimum Percentage of Steel, Balanced Steel Percentage.
c) Analysis and Design of prismatic and non-prismatic sections in flexure.
d) Compatibility based analysis of sections and code requirements for flexure.
e) Analysis and Design of one-way solid slab.
f) Analysis and Design of two-way solid slabs with general discussion on other slab systems.

Analysis and Design:

a) Beams
b) Slabs
   One-way
   Two-way
c) Columns

Analysis and design of T beam, doubly reinforced beam and continuous beam by ultimate strength design method (USD)

Analysis of T-Beams, Alternate Method for Analyzing T-Beams, Design of-T Beams Design of T Beams for Negative Moments, L-Shaped Beams, Compression Steel, Design of Doubly Reinforced Beams, Design of Continuous beams

Serviceability:

Introduction Limit state design, Importance of Deflections, Control of Deflections, Calculation of Deflections, Effective Moments of Inertia, Long-Term Deflections, Simple-Beam Deflections, Types of Cracks, Control of Flexural Cracks, ACI Code Provisions Concerning Cracks.

Shear Strength in beams and design of shear reinforcement:

Shear Stresses in Concrete Beams, Shear Strength of Concrete, Shear Cracking of Reinforced Concrete Beams, Web Reinforcement, Behavior of Beams with Web Reinforcement, Design for Shear, ACI Code Requirements, Cutting Off or Bending Bars.

Bond in concrete and development length:

Bond Stresses, Development Lengths for Tension Reinforcing, Development Lengths for Bundled Bars, Hooks.

Design of Short Columns: Types of Columns, Axial Load Capacity of Columns, Failure of Tied and Spiral Columns, Code Requirements for Cast-in- Place Columns, Safety Provisions for Columns, Design Formulas, Comments on Economical Column Design, Design of Axially Loaded Columns, Axial Load and Bending, The Plastic Centroid, Development of Interaction Diagrams, Use of Interaction Diagrams, Code Modifications of Column, Interaction Diagrams,

Design and Analysis of Eccentrically Loaded Columns (uni-axially loaded) Using Interaction Diagrams

Torsion:

Introduction to Compatibility and Equilibrium Torsion.

Analysis and Design of Footings by USD Method:

Strip footing for walls, Spread / Isolated footing for Columns, and Combined Footings.

Recommended Books:

1. Design of Reinforced Concrete, 9th Ed - Jack C. McCormac
2. Design of Concrete Structures. By Nilson A. H., David D., Charles W. D, McGraw-Hill (Latest Edition)
3. Design of Reinforced Concrete Structures, by Mg Gragor (Latest Edition)

31. Title of the Course: DESIGN OF STEEL STRUCTURES (CE-308)

Credit Hours: 2+1 = 3

Specific Objectives of Course:

- To introduce students to the fundamental design process of steel as a structural member. The emphasis is on the general theory and performance of structural steel, as well as design and analysis of structural members subjected to various loading conditions based on the current Load and Resistance Factor Design (LRFD) code.

Theory Part

At the end of this course, students will be able to:			
No	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Explain** specifications and design philosophy of structural steel members.	PLO-1	C-2
CLO-2	**Analyze** structural steel members under various loading conditions.	PLO-2	C-4
CLO-3	**Apply** design procedures for structural steel members and their connections.	PLO-3	C-3

Practical Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Accomplish** the tasks of Analyzing steel roof truss under gravity and wind load and **interpret** the analysis results.	PLO-9	C-4, A-2
CLO-2	**Design** components of steel roof truss and **develop** shop drawing according to the latest LRFD code.	PLO-3	C-6, P-3

Course Outlines:

Introduction to steel as a structural material, hot rolled, cold formed and built up sections; objectives of designer and selection design criteria; introduction to various methods of design,

Fundamentals of allowable stress design: Strength analysis and design of simple tension, compression, flexural members.

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, calculation of net area; Analysis and design of columns, lacing and stay plates, residual stresses, local and overall stability, Euler's buckling load in columns; analysis and design of beams, compact, non-compact and slender sections, lateral torsional buckling, beam-

column and axial-flexure interaction, second order effects, moment magnification; plate girder proportioning and stiffener including drawings; welded, bolted and riveted truss connections, brackets, moment and shear connections; design and drawing of a truss, purlin, roof sheet, end bearing plate, uplift of truss due to wind.

Recommended Books:

1. Siddiqi, Z.A., (2012) Steel Structures, 3rd edition, Help Civil Publishers, Lahore, ISBN 978-969-8633-09-7
2. Siddiqi, Z.A., (2012) LRFD Steel Design Aids- based on AISC 2010 LRFD and AASHTO LRFD Bridge Design Specifications, 4th edition, Help Civil Publishers, Lahore, ISBN 978-969-8633-08-0
3. McCormac, J.C. and S. F. Csernak, (2012) Structural Steel Design LRFD Method, 5th edition, Prentice Hall, ISBN 978-0-13-607948-4
4. Segui, W. T., (2013) Steel Design, 5th edition, Cengage Learning, ISBN 978-1-111-57600-4
5. AISC Committee, (2011) Steel Construction Manual, 14th edition, The American Institute of Steel Construction, ISBN 1-56424-060-6
6. ANSI/AISC 360-10, (2010) Specifications for Structural Steel Buildings, The American Institute of Steel Construction.
7. Salmon, C.G., J. E. Johnson, and F. A. Malhas, (2009) Steel Structures Design & Behaviour, 5th edition, Pearson-Prentice Hall, ISBN 978-0-13-188556-1

32. Title of the Course: FLUID MECHANICS-II (CE-309)

Credit Hours: 2+1 = 3

Specific Objectives of Course:

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

Theory Part

At the end of this course, students will be able to:			
No	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Explain** dimensional analysis and concepts of hydraulic machinery	PLO-1	C-2
CLO-2	**Analyze** flow through pipes and its characteristics	PLO-2	C-4

Practical Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Discuss** the components of hydraulic machinery	PLO-2	C-2
CLO-2	**Perform** experiments related to hydraulic machinery	PLO-9	P-2
CLO-3	**Justify** experiments related to hydraulic machinery	PLO-10	A-3

Course Outlines:

Fluid flow in pipes:
Reynold's number and its significance. Instability of viscous flow. Viscous flow through circular pipes. Turbulence flow through circular pipes. Semi-empirical theories of turbulence. Velocity profile in turbulent flow. Pipe roughness. Nikurades's experiments. Moody's diagrams, Introduction to pipe networks.

Dimensional Analysis:

Rayleigh and Buckingham's Pi-theorem and their applications.

Elementary Hydro-dynamics:
Ideal and real fluid. Differential equation of continuity. Rotational and irrotational flow. Stream function and velocity potential function. Circulation and vorticity. Orthogonality of streamlines

and equipotential lines. Brief description of flow fields. Flow net and its limitations. Different methods of drawing a flow net.

Forces on Immersed Bodies:

Theoretical concept of boundary layers. Development of boundary layer on immersed bodies. Separation of boundary layer.

Forces on Vanes and Turbo machinery:

Impulse momentum equation. Forces on moving flat and curved vanes. Definition, similarity laws and factors for turbomachines.

Types of Turbines:

Impulse turbine: Construction, features and operations, specific speed. Reaction Turbine, Types, construction, features and operation, specific speed. Cavitation. Draft tube.

Governing of turbines:

Centrifugal Pumps: Classification. Construction features and operations, Specific speed, Cavitation. Reciprocating Pumps. Single acting and double acting pumps. Acceleration head. Maximum suction lift. Use of air vessels.

Recommended Books:

1. Fluid Mechanics with Engineering Applications by E. John Finnemore and Joseph B. Franzini
2. Fluid Mechanics Including Hydraulic Machines by Dr. A. K. Jain
3. Hydraulics Machinery by S. S. Rattan
4. Hydraulic Engineering by Henderson

33. Title of the Course: TRANSPORTATION ENGINEERING-I (CE-310)

Credit Hours: 2+1 = 3

Specific Objectives of Course:

- Obtain an understanding of the fundamentals of Transportation Engineering.
- Learn both quantitative and computerized techniques for solving problems related to geometric design of a roadway.
- Apply principles of Traffic Engineering and Railway Engineering for evaluation and analysis of relevant characteristics and parameters in both the fields.
- Demonstrate the capability to write a technical report and communicate the results to other Engineering professionals.

Theory Part

At the end of this course, students will be able to:			
No	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Explain** the fundamentals of transportation engineering	PLO-1	C-2
CLO-2	**Apply** principles of transportation engineering in geometric design using various parameters	PLO-2	C-3

Practical Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Perform** experiments related to pavement materials	PLO-9	P-2
CLO-2	**Estimate** the physical parameters using experimental data	PLO-2	C-3
CLO-3	**Argue** the use of sustainable materials in pavement construction	PLO-7	A-3

Course Outlines:

Introduction:

Highway Planning. An Approach to Urban Highway Planning. Location Survey in Rural & Urban Areas, Location Controls Elements of a Typical Cross Section of Road. Types of Cross-Section. Classification of Highways. Highway Materials, Types & Characteristics, Specification & tests. Highway Drainage. Geometric Design. Horizontal Curves. Vertical Curves. Grade Line. Super Elevation. Transition Curve. Curve Widening. Sight Distance Requirements.

Traffic Engineering:

Design Speed. Traffic Estimates. Traffic Lane Capacity. Traffic Survey. Road Signs & Signals. Channelization. Design of Intersection at Grade & Grade Separated Intersections. Drivers Characteristics. Traffic Control devices. Parking and Accident Studies. Traffic Management. Highway Safety.

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. Selection of Site for a Railway Station. Layout of Stations and Yards. Points and Crossings. Various Layouts for Signaling and Inter-Locking. Modem Methods for Construction of Tracks. Maintenance, Tools and Organization.

Recommended Books:

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

34. Title of the Course: ENVIRONMENTAL ENGINEERING-II (CE-401)

Credit Hours: 2+1 = 3

Specific Objectives of Course:

- Provide an overview of key topics in environmental science and engineering
- Gain an understanding of the underlying scientific, engineering, and regulatory concepts in each topical area
- Learn several quantitative approaches for environmental assessment and problem solving
- To get understanding to solve environmental issues in field like sewer design, water supply design, solid waste management, preparation of EIA, management of air quality, noise control etc.

Theory Part

At the end of this course, students will be able to:			
No	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Solve** basic and complex issues in the field of environmental engineering	PLO-2	C-3
CLO-2	**Design** water supply and sanitation systems	PLO-3	C-6

Practical Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Perform** experiments related to environmental engineering	PLO-9	P-2
CLO-2	**Estimate** the physical parameters using experimental data	PLO-2	C-3
CLO-3	**Justify** experiments related to hydrology & water resources	PLO-10	A-3

Course Outlines:

Water Consumption, Variation in water demands, Design Period, Population Forecasting, Design Area, Pressure Zoning, Water Distribution Techniques, Types of Water Supply Pipes, Valves, Dead-end system, Grid iron system, Design of water supply scheme by Hardy Gross method, Leakage Test, Equivalent Pipes.

Types of Sewers, Separate Sewerage System, Combined System, Estimation of discharge for Storm Sewerage, Invert Levels, Types of Sewerage Pipes, Defects in Concrete Pipes, Bedding, Jointing, Manhole, Drop Manhole, Pumping Station, Design of Wet Well, BOD, COD, BOD Tests, Physical Properties of Sewage, Population Equivalent.

Sampling and Analysis of Air and Water Pollutants.

Solid Waste Management, Characteristics, Collection, Processing, and Disposal of Solid Wastes.

Introduction to Environmental legislation and regulations, NEQS, EPAs, International protocols

Design criteria of water supply and water treatment.

Water Treatment and Water Supply Networks. Surface & Groundwater Treatment. Water and wastewater disinfection.

Design criteria of wastewater collection and treatment.

Sewage characterization (Physical, Chemical & biological Properties, Definitions of Some Terms in Sewage Characterization, Derivation of BOD Equation, Population Equivalent, Sewage Treatment, Primary Sedimentation Tank (Primary Clarifier), Secondary Treatment, Suspended Growth Process, Trickling Filters, Waste Water Stabilization Ponds (WSP), Sludge Digestion, Disposal of Wastewater on Land and Water Bodies

Storm drainage, road and building drainage systems.

Design criteria of solid waste collection systems.

Solid waste engineering and management (Types of Solid Wastes with Physical, Chemical & Biological Properties, Types of Solid Waste Collection System, The Detail Comparison of Haul Container System and Stationary Container System, Types of Stationary Container System, Solid Waste Systems in Pakistan, Transfer Stations, Composting, Worm Composting, Sanitary Landfill

Environmental Impact Assessment (Introduction, Terminologies, Definitions, EIA Methods & Techniques, EIA Procedure)

Recommended Books:

1. Introduction to Environmental Engineering Third Edition by Davi & Cornwell, McGraw Hill
2. Water Supply & Sewerage by E.W Steel and McGhee 6th Edition
3. Environmental Engineering Laboratory, by Dr. Khurshid Ahmad
4. Waste Water Engineering, Treatment, disposal, Reuse by Metcalf and Eddy, 3rd Edition.
5. Environmental Assessment in Practice by D. Owen Harrop & J. Ashley Nixon
6. Integrated Solid Waste Management by George Techobanoglous, Hilary Theisen & Samuel A. Vigil
7. Elements of public health engineering by K.N Duggal
8. Water and Waste Water Engineering by Fair & Gayer
9. Water and Wastewater Technology by Mark J, Hammer

35. Title of the Course: REINFORCED CONCRETE-II (CE-402)

Credit Hours: 3+1 = 4

Specific Objectives of Course:

- To understand the mechanics of design of various structural elements present in reinforced concrete structures under gravity loading
- To comprehend the basics of earthquake resistant design of reinforced concrete structural elements.

Theory Part

At the end of this course, students will be able to:			
No	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Explain** concepts of analysis and design for reinforced concrete members	PLO-1	C-2
CLO-2	**Analyze** different reinforced concrete members	PLO-2	C-4
CLO-3	**Apply** various design approaches for reinforced concrete members	PLO-3	C-3

Practical Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Perform** experiments related to reinforced concrete members	PLO-9	P-2
CLO-2	**Estimate** the physical parameters using experimental data	PLO-2	C-3
CLO-3	**Justify** experiments related to reinforced concrete members	PLO-10	A-3

Course Outlines:

Introduction to Limit State: One-way Joist or Ribbed Slab

Analysis and Design of Column Supported Slab by DDM: Flat Plate, Flat Slab and Waffle Slabs.

Analysis and Design of Wall: Retaining Wall, Shear walls, Load Bearing Walls.

Introduction to design of miscellaneous Structures: Staircase and Water tanks.

Design of Long Columns: Biaxial Columns, Columns subjected to Flexural and Axial Loading in Braced & unbraced frames.

Design of Footings: Eccentric Footings, Strap Footings, Mat or Raft Footings, Buoyant Footings, Introduction to Design of Piles and Pile Caps.

Introduction to Seismic Design of Structural Members:

Static Lateral Force Procedure Method, Base Shear, Seismic Zones, Soil Types, Response Modification Factor, Time Period, Seismic Weight, Seismic service and factored load combinations, Dynamic Bearing Capacity, Seismic Detailing for Structural Members like beams, columns and joints

Design philosophy of unconfined/ confined masonry with specifications and codes of practice given in PBC.

Recommended Books:

1. Design of Concrete Structures 4th Edition by H.Nilson David D., Charles W.D.
2. Building code of Pakistan, 2007
3. ACI Code
4. ACI Detailing Manual
5. Structural Concrete Theory and Design by M. Nadim Hussain 5th Edition
6. Reinforced Concrete Design, Wang C.K., Charles G. S., Harper
7. Reinforced Concrete: Mechanics and Design by James James G. MacGregor
8. Reinforced Concrete: A Fundamental Approach, 5th Edition Edward G. Nawy, Prentice Hall, 2005.
9. Design of Reinforced Concrete by Jack C. McCormac
10. Reinforced Concrete Design by Kenneth M.Leet
11. Handbook of Concrete Engineering by Mark Fintel

36. Title of the Course: HYDRAULIC ENGINEERING (CE-403)

Credit Hours: 2+1 = 3

Specific Objectives of Course:

- Understanding mechanics of flowing water and thus become an engineer capable of controlling damage caused by flooding
- Analyzing different hydraulic structures such as dams, barrages, culverts, weirs, notches etc.
- Understanding complicated hydraulic phenomena such as hydraulic jump, conjugate depths, specific energy etc.
- Application of the fluid mechanics principals to open channel flow

Theory Part

At the end of this course, students will be able to:			
No	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Discuss** hydraulic similitude and sediment transport	PLO-1	C-2
CLO-2	**Apply** principles of hydraulic engineering to open channel flow	PLO-2	C-3
CLO-3	**Analyze** various hydraulic structures	PLO-2	C-4

Practical Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Perform** experiments related to flow and sediment transport through open channel	PLO-9	P-2
CLO-2	**Estimate** the hydraulic parameters using experimental data	PLO-2	C-3
CLO-3	**Justify** experiments related to Hydraulics Engineering	PLO-10	A-3

Course Outlines:

Steady flow in open channels:

Specific energy: Specific energy under different conditions, Flow over humps and through contractions, relationships for specific energy for rectangular, triangular, semi-circular and trapezoidal section channels, Calculation of critical depth for channels of varying sections

Uniform Flow: Various relationships for uniform flow calculations, Manning,s formula and its importance, factors affecting Manning,s Formula, , most efficient section in an open channel, Uniform flow calculations in open channels, calculations of normal depth in open channels of different shapes and lined channels

Gradually varying flow: Basic differential equation of GVF and its different forms, Description of various water surface profiles, calculation of back water curves in channels of uniform section, control sections, various characteristics of GVF profiles.

Rapidly varying flow: Basic governing equation of Hydraulic Jump. Hydraulic jump and its different forms. Hydraulic jump in a rectangular and non-rectangular section, sequent depth ratios, energy loss in a jump, Hydraulic jump on a sloping bed. Practical applications of hydraulic jump. Critical depth meters, Broad crested weir, sharp crested weirs and their forms, Venturi-flume.

Unsteady Flow: Discharge through orifices and over weirs under varying heads. Unsteady flow through pipelines. Water hammer Instantaneous and slow closure of valves. Surges in open channels.

Spatially Varying Flow:

Basic relation for spatially increasing and decreasing discharge flows, Side weirs and flow relationship for side weirs, bottom racks

Dams: Brief description of various types of storage dams. Forces on gravity dams and its design.

Hydraulics Similitude: Similitude in hydraulic model testing. Similitude requirements: Geometric, kinematic and dynamic similarity. Various dimensionless numbers and their significance. Model technique and analysis.

Sediment Transport in Open Channels: Properties of individual particles. Fall velocity**.** Movement of bed and suspended load. Collection and analysis of field data

Water Power Engineering: Selection of waterpower sites, Components and layout of a waterpower scheme, types of hydropower schemes based upon available head, location, capacity etc.

Recommended Books:

Text Books

1. Elementary Hydraulics by Cruise, V.P. Singh
2. Open Channel Hydraulics (2009 ed.) by V. Chow

Reference Books

1. Open Channel Hydraulics by French
2. Irrigation Engineering and Hydraulic structures by Santosh Kumar Garg
3. Open Channel Flow by Subramanya

37. Title of the Course: TRANSPORTATION ENGINEERING-II (CE-404)

Credit Hours: 2+1 = 3

Specific Objectives of Course:

- Obtain an understanding of the fundamentals of Pavement Engineering.
- Learn both quantitative and computerized technique for solving problems related to Highway and Runway Engineering.
- Apply principles of Pavement Engineering to evaluate, analyze and design asphalt mix and asphalt pavement.
- Demonstrate the capability to write a technical report and communicate the results to other Engineering professionals

Theory Part

At the end of this course, students will be able to:			
No	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Explain** fundamentals of pavement and airport engineering.	PLO-1	C-2
CLO-2	**Apply** principles of pavement engineering to analyze and design of pavements.	PLO-2	C-3

Practical Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Perform** experiments related to pavement materials	PLO-9	P-2
CLO-2	**Implement** asphalt mix design considering various parameters using standard guidelines.	PLO-3	C-3
CLO-3	**Justify** experiments related to material properties and design	PLO-10	A-3

Course Outlines:

Highway Engineering:

The Pavement, Types of Pavement, The Principal of Pavement Design, Two Approaches to Pavement Design. Pavement Design standards, Axle loads, Equivalent Single Axle load, Classification of Commercial vehicles, Axle Loading of Commercial Vehicles, The Influence of Axle Configuration, and Loading on the Damaging Effect. Contact area between the tyre and the Road. Repetition and Impact Factors. Load distribution characteristics. Methods of

pavement design. AASHTO pavement design method. Group index method. C.B.R. Method. Westergard method, Resilient behavior of unbound granular materials. Pavement failures, construction, and maintenance. Pavement evaluation and rehabilitation. Introduction to non-destructive testing.

Runway Engineering:

Airport Planning, Type & elements of Airport planning, Factors affecting airport site selection Runway lighting. Airport drainage systems. Air-characteristics. Characteristics of transport category aircraft. The effect of aircraft performance on runway Length. Various runway, configuration. Comparison of Highway and airport pavements.

Introduction to Pavements for Ports and Harbors.

Recommended Books:

1. Principles of Highway Engineering and Traffic Analysis by Fred L. Mannering.
2. Pavement Analysis and Design by Yang H. Huang.
3. Airport Planning and Management by Alexander T. Wells.
4. Fundamentals of Transportation Engineering: A Multimodal Systems Approach by Jon D. Fricker, Robert K. Whitford.
5. Planning and Design of Airports by Robert Horonjeff, Francis McKelvey, William Sproule, Seth Young.

38. Title of the Course: FOUNDATION ENGINEERING (CE-405)

Credit Hours: 2+1 = 3

Specific Objectives of Course:

- Learn to select and design the type of foundations according to field conditions.
- Can calculate the settlements in the soils under the applied loading of various types of structures.
- To handle various types of geotechnical problems at site such as high moisture content, applying drainage around and under the structure foundation, preventing foundation from corrosion and excessive settlements due to capillary rise of moisture.

Theory Part

At the end of this course, students will be able to:			
No	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Analyze** various design options for foundations according to field conditions.	PLO-3	C-4
CLO-2	**Perform** bearing capacity and settlement analysis of foundations for different types of soils	PLO-2	C-3
CLO-3	**Evaluate** foundations considering various geotechnical parameters	PLO-4	C-5

Practical Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Perform** experiments related to foundation design	PLO-9	P-2
CLO-2	**Estimate** the physical parameters using experimental data	PLO-2	C-3
CLO-3	**Justify** experiments related to foundation design	PLO-10	A-3

Course Outlines:

Introduction to foundations: Definition, Purpose of foundation and their types, General requirements of foundations, Selection of foundation type.

Bearing Capacity of Soils: Definition of: gross, net, ultimate, safe and allowable bearing capacity. Methods of obtaining bearing capacity: Presumptive values from codes, from plate

load test. Bearing capacity theories, i.e. Terzaghi's theory and Hanson's theory, effect of water table. Bearing capacity from SPT and CPT data.

Consolidation: Mechanics of consolidation, theory of one dimensional consolidation, assumptions and validity, Primary and secondary consolidation settlements, Normally and pre-consolidated clays, Oedometer test, Determination of compression index and coefficient of consolidation. Determination of pre-consolidation pressure. Time-settlement diagrams.

Settlement Analysis: Definition, total settlement, differential settlement, angular distortion, immediate settlement, magnitude and time rate of consolidation settlement. Causes of settlement and methods of controlling settlement. Allowable total and differential settlement, Settlement analysis.

Shallow Foundations: Design aspects of foundations, proportioning of foundation for a given settlement, dewatering of foundation trenches.

Deep foundations: Types of piles, load carrying capacity of piles, group action, negative skin friction, pile load test.

Recommended Books:

1. Foundation Engineering and Design by Joseph E. Bowles 5th Edition
2. Soil Mechanics and Foundation Engineering by V. N. S. Murthy
3. Principles of Foundation Engineering by Braja M. Das
4. Foundation Design by Donald P. Coduto 2nd Edition

39. Title of the Course: STRUCTURAL ENGINEERING (CE-407)

Credit Hours: 2+1 = 3

Specific Objectives of Course:

- To familiarize students with advanced method of analysis of structures.
- To develop the skills for using the state-of-the-art methods of structural Analysis.

Theory Part

At the end of this course, students will be able to:			
No	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Apply** matrix based methods for analysis of various structural components	PLO-2	C-3
CLO-2	**Design** pre-stressed concrete members, and bridge decks	PLO-3	C-6
CLO-3	**Discuss** SDOF system for free and forced vibration with and without viscous damping	PLO-1	C-2

Practical Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Perform** experiments related to structural analysis	PLO-9	P-2
CLO-2	**Estimate** the physical parameters using experimental data	PLO-2	C-3

Course Outlines:

Prestressed Concrete:

Prestressed vs Reinforced concrete. Types of Prestressing. Losses in Prestressing. Analysis and design of simple Prestressed concrete members. Introduction to various Prestressing systems.

Bridge Engineering:

Types of bridges. Site selection. Bridge loadings. Load distribution on bridge deck. Introduction to design of deck for a simple concrete bridge.

Advanced Structural Analysis:

Definition of matrices and determinants. Stiffness method. Truss element, Beam clement, Plantation of stiffness sub matrices of multiple ended members.

Flexibility method.

Introduction to structural dynamics: Introduction, vibrations of lumped mass SDOF system, damped and undamped system, Natural vibration of SDOF systems, free and forced vibration with and without viscous damping, response of SDOF system.

Introduction to Finite Element Analysis: Definition, Types of Elements, Methods of Finite Element Analysis.

Recommended Books:

1. Analysis of Structures and Stiffness Methods by Dr. Saeed Ahmad, Publication of HEC
2. Structural Analysis by Alexander Chajes
3. Structural Analysis by Hibbeler, R. C.
4. Analysis of Structures by William and Todd
5. Design of Concrete Structures by Nilson and Darwin

40. Title of the Course: IRRIGATION ENGINEERING (CE-408)

Credit Hours: 2+1 = 3

Specific Objectives of Course:

- To enable students to learn fundamentals of dam and river engineering.
- To enhance the capabilities of students related to irrigation engineering and canal network.

Theory Part

At the end of this course, students will be able to:			
No	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Explain** basic concepts of irrigation engineering	PLO-1	C-2
CLO-2	**Analyze** irrigation structures	PLO-2	C-4
CLO-3	**Design** irrigation canals and barrages	PLO-3	C-6

Practical Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Design** barrages and cross drainage works for simple conditions.	PLO-3	C-6
CLO-2	**Sketch** the design of barrage and cross drainage works	PLO-9	P-1
CLO-3	**Justify** assigned design for a specific project and its effect on the society	PLO-6	A-3

Course Outlines:

Introduction:

Definition and Type of Irrigation. Water resources for irrigation; ground water, surface water. Irrigation system of Pakistan.

Canal Irrigation:

Canal lining; advantages, Types and Maintenance of irrigation canals. Monitoring of flows-telemetry system. Design of irrigation channel. Kennedy's and Lacy's theories. Rational

methods for design of irrigation channels, Comparison of various methods, Computer aided design of irrigation channels.

Irrigation Works:

Canal head regulators, meter flumes, outlets and cross drainage works; their types and function, Elementary concept about canal head works, selection of their site and layout. Weirs and barrages; various components and functions. Design of weirs on permeable foundations, sheet piles and well foundation, cut off walls. Measures adopted to control silt entry into canals; silt ejectors and silt excluders.

Irrigated Agriculture:

Water requirements of crops. Duty of irrigation water. Delta of crops. Consumptive use, and common formula for its determination.

Irrigation methods and practice: Soil survey and land classification.

Reservoirs: Brief description of various types of storage reservoir and their site selection.

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.

Drainage:

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

Recommended Books:

Text Books

1. Irrigation Engineering and Hydraulic structures by Santosh Kumar Garg
2. Irrigation and Hydraulic Structures, Theory, Design and Practice by Iqbal Ali
3. Irrigation Engineering by Reddy

Reference Books

1. Irrigation and Water Power Engineering by B.C. Punmia and Pande Lal
2. Irrigation and Drainage Engineering by Iqtidar H. Siddique

41. Title of the Course: DESIGN OF STRUCTURES (CE-409)

Credit Hours: 2+2 = 4

Specific Objectives of Course:

- Students will be able to understand and apply the standard codes of practice and specifications in their design.
- Students will be able to use already learned basic design concepts to design simple and complex RC structures.
- Student will be able to produce working structural drawings.
- Students will understand earthquake-resistant design of structures.

Theory Part

At the end of this course, students will be able to:			
No	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Justify** selection of structural systems for various functions	PLO-2	C-5
CLO-2	**Design** complete RC structures of various natures and importance in compliance with the standard codes of practices	PLO-3	C-6
CLO-3	**Discuss** earthquake engineering concepts from design point of view	PLO-1	C-2

Practical Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Design** complete RC structures of various natures with the standard codes of practices	PLO-3	C-6
CLO-2	**Sketch** the detail structural working drawings	PLO-9	P-2
CLO-3	**Defend** the selection of structural system in a given scenario	PLO-10	A-4

Course Outlines:

Specifications codes and Practice:

a) ACI-318-14
b) ASCE-07
c) Pakistan Building Codes (PBC)

d) UBC97

Choice and forms of Structures for various conditions.

Drawing office Practice for preparation of detailed working drawing.

Analysis design and preparation of working drawings of steel and concrete structures.

Introduction to basics of earthquake resistant design.

Recommended Books:

1. Design of structures by R.H Nilson
2. ACI-318-14
3. ASCE-07

42. Title of the Course: COMPUTER AIDED DESIGN (CE-410)

Credit Hours: 1+2 = 3

Specific Objectives of Course:

- To use industry standard softwares in a proficient manner in addition to knowing the theoretical concepts of structural analysis and design
- To understand the finite element modeling, specification of loads and boundary conditions, performing analysis and interpretation of results for final analysis and design using commercial softwares.

Theory Part

At the end of this course, students will be able to:			
No	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Discuss** finite element modeling of civil engineering structures.	PLO-1	C-2
CLO-2	**Produce** input files for analysis and design of real 3D structures using the latest commercial softwares.	PLO-3	C-3

Practical Part

At the end of this course, students will be able to:			
No.	**CLO Statement**	**PLO**	**Bloom's**
CLO-1	**Demonstrate** skill of commercial softwares for analysis and design of civil engineering structures	PLO-5	P-3
CLO-2	**Discuss** use of latest codes and softwares for analysis and design of civil engineering structures	PLO-2	C-2

Course Outlines:

- Introduction to Finite Element Analysis
- Modeling of plane frame
- Modeling of floor structures subjected to area loads
- Modeling of portal frame, steel structures with concrete footing
- Modeling of load dependent structures where structural condition changes for different load cases
- Application of support displacement load on spaced frame structure
- Modeling of pre-stress loading in a plane frame structure
- Modeling of structures with offset connection
- Concrete analysis and design of space frame structures
- Analysis and design of space frame with floor

- Flat plats and shear wall using finite elements
- Analysis and design of water retaining structures
- Dynamic analysis (Response spectrum and time history)
- Analysis of space frame for seismic loads
- Analysis of space frame for wind
- Modeling of space frame using mesh generation command,
- Modeling of space structures subjected to moving loads
- Analysis and design of space frame structures sitting on all types of foundations
- Modeling of domed cylindrical structures
- Analysis of bridge with moving loads
- Frame shear wall interaction
- Barrel vaulted structures
- Beam and slabs on elastic foundations
- Wall resisting hydrostatic pressures.

Recommended Books:

1. ETABS Manual
2. SAP Manual
3. SAFE Manual
4. STAAD PROV Manual
5. The Finite Element Method A Practical Course by G.R.LIU and S.S. QUEK