

**REVISED CURRICULUM
OF
CIVIL ENGINEERING**



**HIGHER EDUCATION COMMISSION
H-9, ISLAMABAD
2003**

CURRICULUM DIVISION, HEC

Prof. Dr. Altaf Ali G. Shaikh
Mr. Muhammad Younas
Malik Ghulam Abbas
Miss Ghayyur Fatima
Mr. M. Shabbir Baig
Mr. M. Tahir Ali Shah

Director General (Curriculum)
Director Curriculum
Deputy Director
Research Associate
Curriculum Officer
Assistant Director

*Composed by **Ghafoor Ahmad**, HEC, Regional Centre, Lahore*

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PREFACE

Curriculum of a subject is said to be the throbbing pulse of a nation. By looking at the curriculum of a subject, one can judge the state of intellectual development and the state of progress of a nation. The world has turned into a global village, new ideas and information are pouring in a constant stream. It is, therefore, imperative to update our curricula by introducing the recent developments in the relevant fields of knowledge.

In exercise of the powers conferred by Sub-section (1) of section 3 of the Federal Supervision of Curricula Textbooks and Maintenance of Standards of Education Act 1976, the Federal Government vide Notification No.D773/76-JEA (Cur.), dated December 4, 1976, appointed Higher Education Commission as the Competent Authority to look after the Curriculum Revision Work beyond Class XII at Bachelor level and onwards to all Degrees, Certificates and Diplomas awarded by Degree Colleges, Universities and other Institutions of higher education.

In pursuance of the above decisions and directives, the Commission is continually performing curriculum revision in collaboration with the Universities. According to the decision of the 44th Vice-Chancellors' Committee, curriculum of a subject must be reviewed after every 3 years. For the purpose, various Committees are constituted at the national level comprising senior teachers nominated by the Universities. Teachers from local degree colleges and experts from user organizations, where required, are also included in these Committees.

The National Curriculum Revision Committee on Civil Engineering in its meeting held in June 24-26, 2003 at the Higher Education Commission, Regional Centre, Lahore finalized the draft curriculum after due consideration of the comments and suggestions received from the Universities and Colleges where the subject under consideration is taught.

The Final draft prepared by the Curriculum Revision Committee duly approved by competent authority is being circulated for implementation by the Universities.

(PROF. DR. ALTAF ALI G. SHAIKH)
DIRECTOR GENERAL (CURRICULUM)

June, 2003

INTRODUCTION

The final meeting of National Curriculum Revision Committee in Civil Engineering was held from 24-26 June, 2003 to revise and update the draft curriculum developed in the first meeting held from 15-17th October, 2002 at the Higher Education Commission, Regional Centre, Lahore. The Following attended the meeting:

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1. Prof. Dr. Jahangir Durrani Convener
Deptt. of Civil Engineering,
NWFP University of Engg.& Tech. Peshawar.
2. Prof. Dr. Mahmood Memon, Member
Deptt. of Civil Engineering,
Quaid-e-Awam University
of Engg. Science & Technology, Nawabshah, Sindh.
3. Engr. Zubair M. Pirzada, Member
NESPAK, 1-C Block-N,
Moden Town Extension, Lahore
4. Mr. Muhammad Nadeem, Member
G.M. Civil,
POF Institute of Technology,
POF, Wah Cantt.
5. Prof. Dr. Abdul Sami Qureshi, Member
Deptt. of Civil Engineering,
Balochistan University of
Engg.& Tech. Khuzdar.
6. Dr. Farhat Javed, Member
Military College of Engg.,
Risalpur Cantonment.

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| 7. | Mr. Gul Hussain Memon,
Prof. Deptt. of Civil Engg.
Mehran University of Engg.& Tech.
Jamshoro | Member |
| 8. | Prof. Zia-u-Din Mian,
Deptt. of Civil Engineering,
University of Engg. & Tech.
Lahore. | Member |
| 9. | Dr. Mir Shabbar Ali,
Associate Prof.
Deptt. of Civil Engineering,
NED University of Engg. & Tech.,
Karachi. | Member/Secretary |

Meeting started with recitation from the Holy Quran by Dr. Mir Shabbar Ali.

Mr. Muhammad Riaz Cheema, Director, Higher Education Commission, Regional Centre, Lahore welcomed the participants of the meeting on behalf of the Chairman, Higher Education Commission. He briefed the participants of the legal obligations of the Commission in relation to review, revision and development of curricula. The Director further added that the objective is to train the students in engineering disciplines to meet the country needs. The finalized curricula would be referred to the universities/institutions of higher education as guidelines for adoption before start of the next academic session. The Director, HEC, Lahore assisted the committee as co-ordinator all the three days.

The Committee was also informed about the academic activities of HEC (defunct UGC) for improvement of education i.e. Pre-service & in-service teachers training courses; Exchange of teachers from University to University, University to R & D organization and University to Industry etc., writing of monographs on topics of syllabi. Since the main aim of the HEC (defunct UGC) is to develop the Higher Education in the Country therefore, the idea to get the

minimum benefit from the Commission's various schemes, was also taken into consideration by the Committee. The Director assured the committee of full cooperation and assistance and requested the members of NCRC to include latest books in the draft curriculum.

The Committee before taking up the regular agenda reaffirmed unanimously appointment of Prof. Dr. Jahangir Durrani, Deptt. of Civil Engineering, NWFP University of Engg.& Tech. Peshawar as its convenor and Dr. Mir Shabbar Ali, Associate Prof./Co-Chairman, Deptt. of Civil Engineering, NED University of Engg. & Tech.,Karachi as its Secretary.

The Committee took up the agenda and deliberated on the comments as received from different universities / institutions on the revised draft. The draft scheme of studies, objectives of studies, model syllabus and its recommendations of NCRC are detailed below:-

OBJECTIVES OF TEACHING CIVIL ENGINEERING AT GRADUATE LEVEL

- To impart latest technical know how to the students in the field of Civil Engineering and produce competent civil engineers who will play vital role in the development of the nation and the country.
- To make them conscious of the high principles of Islamic Ideology and teaching.
- To inculcate in them the habit of hard work, sincerity and devotion towards their country in general and their profession in particular.
- To make them aware of the advancement of engineering knowledge in the developed countries so that they may keep themselves abreast with such developments.
- To impress upon them the spirit of discipline, teach them the code of ethics of the engineering profession and impress upon them to follow it during their practical life.

METHODS OF INSTRUCTIONS

This shall comprise the following

- Classroom lectures, duly supported by audio-visual aids, demonstrations and distribution of notes pertaining to the subject, whenever possible or wherever necessary.
- Laboratory experiments and design assignments.
- Instructional tours to appropriate establishments, concerns, construction sites, field stations, factories etc.
- Classroom discussions and lectures by renowned professionals.
- Enhanced use of modern computing facilities in the teaching-learning environment.

LEARNING SITUATION

Students participatory activities in the classrooms

The students are expected to attend the classroom lectures regularly so as to maintain continuity in the subject matter being taught by the teacher. They shall take proper notes and should have with them calculator and other such material which is needed for solving problems, doing design work etc.

Students' participation in the classroom activities must be duly recorded by the teacher in the form of attendance and in the form of the progress made by them in solving problems, assignments etc.

A question - answer session at the end of each lecture is always helpful and desirable:

FIELD WORK / PRACTICAL

Whatever has been stated above also applies here, in general. However the note books/field books/graphs and drawing sheets pertaining to the field work and practical should be completed within the allocated time and submitted to

the teacher before leaving. In case of field visit the students be required to write a visit report which shall be graded and grades be given consideration in viva.

EXPECTED OUTCOME

The schedule of course work is so designed that the students knowledge increases with the passage of time and at the end of their academic career they are mentally matured enough to take up the usual jobs pertaining to their field of studies. In the first year the subjects/ courses are of preliminary and basic nature with emphasis on theory and basic principles. The knowledge pertaining to a subject would grow as it is studied, sometime in more than one stage over different years.

EVALUATION AND ASSESSMENT.

Classroom Evaluation

1. The primary evaluation is to be on the basis of attendance of the students, as it would reflect the keenness and regularity of the students in pursuance of his studies.
2. The sessional marks are expected to discipline the students in the classroom activities and make them regular in attending the classes. Classroom attendance, question-answer session at the end of the lecture, occasional but regular class assignments,. class tests, homework assignment, quizzes etc., should be considered in the evaluation of sessional marks.

Evaluation for Promotion

The Academic pursuit and achievements of a student through- out an academic year are to be evaluated by holding an examination at the end. There should be both internal and external evaluation for each part of a subject offered in the year and one must pass each part separately. The minimum pass percentage in theory (Part- I) and practical (Part- II) may be 40 and 50 respectively.

In case of term/semester system, the performance shall be evaluated at the end of term/semester. The Universities following semester system may award grades from A to F in each subject on the basis of total marks obtained in the subject, including class tests, exams etc. The grading system, promotion/dismissal shall be in line with internationally accepted practice.

MASTER'S PROGRAMME

Depending upon facilities/expertise and local demand, individual universities may offer postgraduate courses as per their own choice and circumstances.

OPERATIONAL FRAMEWORK

The committee reviewed the existing curriculum in the light of observations of faculties of all Engineering Universities brought to the committee through their representatives in committee. The recommendations of the committee are given as under:

1. Every Engineering University in Pakistan covers different areas in respect of professional civil engineering applications, However objectives of Bachelor of Civil Engineering Courses are same. Considering this aspect the courses suggested are such that the civil engineering graduates from all universities be at par and at the same time be prepared to meet the local requirements.
2. Duration of the course should be of four academic years.
3. The minimum number of effective / teaching weeks per academic year should be 32.
4. Number of contact hours: The contact hours for study of courses are kept flexible for university to university, considering the variation in local requirements. The following limits have been proposed.

Minimum contact hours per week = 30

These above given contact hours cover theory lectures, design classes and practical periods.

5. Maximum Marks: Maximum marks to each course has been proposed in the scheme of studies. If needed a University may on its own change them within the limits proposed below:

First year to 3 rd Year every year	=1300 to 1500
Final Year	=1650
Aggregate total of 4 years	=5700

6. These courses form the core of the scheme and are required to be followed by each University as such. Taking into consideration the availability of faculties the course may be shifted among academic years but should not be deleted from syllabus.
7. Each student will have to attend a survey camp after completing the course of Surveying-II. If he fails to attend the camp he will not be awarded the degree/provisional certificate

Outlines of Courses

8. Outlines of the topics of each course are provided as guidelines to meet the requirement of uniformity. However the universities are at liberty to formulate sub headings / sub titles etc. Each course has been divided into two parts, Part-I means only theory classes and Part-II includes design classes, laboratory practicals, field surveys and viva-voce etc.

SCHEME OF STUDIES

1st YEAR CIVIL ENGINEERING

	Course Title	Marks	
		Part-I	Part-II
1.	Engineering Mechanics	100	50
2.	Civil Engineering Materials	100	50
3.	Surveying-I	100	50
4.	Introduction to Computer Programming for Civil Engineering	50	50
5.	Engineering Drawing	50	100
6.	Mathematics-I/Applied Calculus	100	-
7.	Mathematics-II/Differential Equations	100	-
8.	Writing & Communication Skills	100	50
9.	Islamiat & Pak.Studies	100	-
10.	Basic Electrical and Mechanical Engineering	100	50
		900	400

TOTAL:1300

2ND YEAR CIVIL ENGINEERING

	Course Title	Marks	
		Part-I	Part-II
1.	Strength of Materials-I/ Mechanics of Solids-I	100	50
2.	Fluid Mechanics-I	100	50
3.	Theory of Structures-I/ Analysis of Structures-I/ Elementary Structural Analysis	100	50
4.	Surveying-II	100	50
5.	Construction Engineering	100	-
6.	Civil Engineering Drawing	100	50
7.	Engineering Geology	100	50
8.	Mathematics-III / Complex Analysis, Statistical Methods & Probability	100	-
9.	Architecture & Town Planning	100	-
10.	Quantity Surveying & Estimation for Civil Works	100	50
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		1000	350

TOTAL:1350

3RD YEAR CIVIL ENGINEERING

	Course Title	Marks	
		Part-I	Part-II
1.	Plain and Reinforced Concrete-I	100	50
2.	Transportation Engineering -I	100	50
3.	Soil Mechanics	100	50
4.	Hydrology, Water Resources & Drainage Engg.	100	50
5.	Strength of Materials-II/ Mechanics of Solids-II/ Structural Mechanics	100	50
6.	Fluid Mechanics-II	100	50
7.	Theory of Structures-II/ Analysis of Structures-II/ Structural Analysis	100	50
8.	Linear Algebra and Numerical Methods	100	-
9.	Steel Structures	100	50
10.	Environmental Engineering-I / Environmental and Water Supply Engineering	100	50
		----- 1000	----- 450

TOTAL:1450

4TH YEAR CIVIL ENGINEERING

	Course Title	Marks	
		Part-I	Part-II
1.	Plain and Reinforced Concrete -II	100	50
2.	Structural Design and Drawing	100	50
3.	Environmental Engineering –II / Environmental and Sanitary Engg.	100	50
4.	Transportation Engineering -II	100	50
5.	Construction Planning, Project Management and Economics	100	-
6.	Modern Methods of Structural Analysis	100	50
7.	Foundation Engineering	100	50
8.	Irrigation Engineering	100	50
9.	Civil Engineering Project	-	200
10.	Geotechnical Engineering	100	50
11.	Hydraulic Engineering	100	50
		----- 1000	----- 600

TOTAL:1600

OUTLINE OF COURSES

FIRST YEAR

ENGINEERING MECHANICS

Statics

Concept and units of measurement of mass, force, time and space. General principles of statics. Vector addition, subtraction and products.

General conditions of equilibrium of co-planer forces. Laws of triangle, parallelogram and polygon of forces. Funicular polygon.

Dynamics

Rectilinear and curvilinear motions. Tangential and normal components of acceleration. Simple harmonic motion.

Geometrical properties of plane areas.

Work, energy, power, impulse, momentum, conservation of momentum and energy. Problems involving Friction on flat and curved surfaces.

Books Recommended

Hibler, R.C. Engineering Mechanics, Prentice Hall.

CIVIL ENGINEERING MATERIALS

Cements, ceramics and refractories

Manufacture, properties and application of lime, cement, ceramics and bricks. Mortars and concretes. Pozzolanic materials. Effects of various chemicals on cement and concrete. Methods of protection. Strength and tests of building stone. Quarrying and dressing of stone.

Timber

Varieties and uses of important timbers. Methods of seasoning and sawing. Decay, seasoning and preservation of timber. Laminated materials.

Glass and Plastics

Composition, varieties, properties and uses of glass, plastics, laminates and adhesives. Properties and uses of asphalt, bitumen, rubber and asbestos.

Metals

Composition and properties of ferrous and non-ferrous metals used in Civil Engineering. Effect of various heat treatments on the properties of steel and its alloys. Corrosion and methods of corrosion control. Properties of thermal insulation materials for use in buildings.

Paints and Varnishes

Composition, preparation, properties, tests and uses of paints, plasters, varnishes and distempers.

Other materials

Bituminous materials, apoxies, acoustical materials and geo-textiles.

Books Recommended

Neville, A. Properties of Concrete, English Language Book Society.
Smith, R.C. Material of Construction, McGraw Hill.

SURVEYING-I

General introduction

Small instruments used in surveying; chain surveying. Use of tapes and steel bands. Methods of chain surveying and errors involved.

Levelling

General principle. Types of levels and their temporary and permanent adjustments. Methods of levelling. Reduction of levels, procedures for precise levelling and accuracy expected.

Theodolite. Types, construction and use of theodolite. Temporary and permanent adjustments. Measurement of bearings, horizontal and vertical angles.

Plane Table Surveying

Parts and accessories. Methods of surveying. Two-point and three-point problems.

Traversing

Traversing with prismatic compass, theodolite and plane table, computations and adjustments of traverse.

Calculation of Areas and Volumes

Earth work calculations. D.M.D. method, Simpson rule and trapezoidal rule.

Modes and Methods of Surveying

Electronic surveying. Surveying drafting and computations.

Books Recommended

1. Kavanash, B. Surveying principles and Application, Prentice Hall
2. Irvine, W. Surveying for Construction, McGraw Hill.
3. Davis, R.E. Surveying Theory and Practice, McGraw Hill.

INTRODUCTION TO COMPUTER PROGRAMMING FOR CIVIL ENGINEERING

Operating Systems

Introduction to computer set up. Basic principles of digital computer programming. Programme structure and Flow Charts. DOS and Windows Operating Systems. M. S. Office.

Programming

Introduction to a programming language, Arithmetic Operations and Functions, Input output statements, Decision making statements., Loop, Functions and Subroutines, Arrays and Subscripts representation, Data and Data files, Output files.

Civil Engg. Computations

Introduction to use of packages for Civil Engg. Computations.

Methods of analysis of simple elementary Civil Engineering Problems and preparation of computer programmes.

Books Recommended

Mayo, W.E. & C. Martin, Programming with Fortran 77 (Schaum Series), McGraw Hill.

Gottfried, B.S. Programming with Structured Basics (Schaum Series), McGraw Hill.

ENGINEERING DRAWING

Introduction

Drawing instruments and their use. Types of lines, lettering, dimensioning, and planning of a drawing sheet. Principal requirements of a working drawing.

Projections

Orthographic projection of points, lines and plane figures. Traces. Use of auxiliary planes. Isometric and pictorial projections of solid figures. Preparation of free hand sketches from solid objects and from orthographic projections. Plane curves, cycloids, hypo cycloids, involutes and shadows etc.

Drawing Exercises

Preparation of Drawings in first and third angles of orthographic projection of parts as detailed below:

Nuts and bolts, keys and cotters, screw thread systems, couplings, simple bearings, and pipe connections.

Preparation of simple assembly drawings. Architectural Symbols and Architectural Scales. Preparation of plan, elevation and section for simple buildings.

Books Recommended

Parkinson, A.C. A First Year Engineering Drawing. English language Book Society.

Boughton, B. Reinforced Concrete Details' Manual (Reference Book), Crossby Lockwood Staples Granda Publishing London.

MATHEMATICS-I / APPLIED CALCULUS

Revision of elementary differentiation. Cartesian and polar coordinate systems. Hyperbolic functions. Catenaries, Exponential function.

Application of derivatives. Rate, speed, acceleration. Tangents and normals. Maclaurin's and Taylor's series. Maxima and minima of a function of single variable. Convexity and concavity (points of inflexion) and errors due to small increments. Curvature and radius of curvature. Partial differential co-efficient. Partial differentiation of an implicit function. Total differential and its application to small errors. Statement of Taylor's theorem. Maxima and minima of function of two independent variables.

Introduction to integration. Integration by substitution and by parts. Definite integral. Double and triple integral and their use in determining area, volume, centroid and moment of inertia.

Application of integral. Area under a curve. Mean and root mean square values. Length of an arc.

Areas of surfaces and volumes of solids of revolution. Theorems of Pappus and Gladius. Approximate integration for areas and volumes. Prismoidal rule for volumes of irregular solids, tanks, cuttings and embankments.

Graphical differentiation and integration with examples of Civil Engineering application.

Books Recommended

Talpur, Calculus and Analytic Geometry, Ferozsons

Yousuf, S.m. Mathematical Methods, Ilimi Kutab Khana

Schum's series, Calculus, Schum's Series

Schum's series, Complex, Schum's series,

Antom, H. Calculus and Analytic Geometry, Johny Wiley and Sons.

MATHEMATICS-II / DIFFERENTIAL EQUATIONS

Differential equations: First order and special types of higher order differential equations of engineering application. The D-operator, complementary function and particular integral. Simultaneous differential equations. Solution of differential equations in series.

Fourier Series: Fourier theorem and coefficient in Fourier series.

Even and odd functions.

Laplace Transforms: Laplace transform of some elementary functions; Laplace transform theorems. Inverse Laplace transforms. Application to solution of ordinary differential equations.

Partial Differential Equations: Solution of simple types of differential equations. Partial differential equations in cylindrical and spherical co-ordinates.

Books Recommended

Kreysziz, E. Advanced Engineering Mathematics, Wayne and Erson.

WRITING AND COMMUNICATION SKILLS

Writing formal and business letters and memos. Drafting notices and minutes. Theoretical knowledge and comprehension of contracts and agreements. Preparing proposals and conducting and writing research project reports. Participating in seminars and interviews. Writing and presenting Conference papers.

ISLAMIAT AND PAKISTAN STUDIES

***** As prescribed by HEC *****

BASIC ELECTRICAL AND MECHANICAL ENGINEERING

Introduction

Power Systems layout, generation, transmission, distribution and utilization of electric power.

Electrical Elements and Circuits

Electric current, voltage, power and energy, Ohm's law, inductance, capacitance, Kirchoff's laws. Introduction to node voltage and loop current methods.

Electronics

Diode. Transistor and simple rectifier circuit.

Principles of House wiring and Industrial wiring, Illumination. Electrical know how related to experimental design instrumentations like corrosion rate measurements, strain guages, LDT's, LVDT's. etc.

Internal combustion Engines

Introduction to Air-Conditioning and Refrigeration

Introduction to Heating, Ventilation and Air-Conditioning (HVAC). Heating and cooling load and its calculations; Comfort charts; Outline of A.C. systems; Consideration for air-conditioning in buildings; natural Ventilations; Insulating materials.

Books Recommended

Theraja, B.L. Electrical Technology, S. Chand.

SECOND YEAR

STRENGTH OF MATERIALS-I / MECHANICS OF SOLIDS-I

Simple Stress and Strain

Kinds of stresses and strains. Load extension diagrams for different materials. Hook's Law. Moduli of elasticity. Lateral strain. Volumetric strain. Poisson's Ratio. Temperature stresses and compound bars. Shear force and bending moment diagrams for statically determinate beams.

Stresses in Beams

Theory of simple bending: Moment of resistance and section modulus. Application of Flexure formula, Shear stresses in beams.

Columns and Struts

Axially loaded columns. Euler's treatment, Rankine Gordon formula for short and intermediate columns. Slenderness ratio.

Circular Shafts

Theory of torsion of solid and hollow circular shafts.

Springs

Open coil springs, Closed coil springs, Leaf springs.

Strain Energy

Strain Energy due to direct loads, force, bending moment and torque. Stresses due to impact loads.

Books Recommended

Pytel, A. & F.L.Singer, Strength of Material, Harper & row Publishers, New York.

FLUID MECHANICS-I

Units and Dimensions

Physical properties of fluids. Density, specific weight, specific volume, specific gravity, surface tension, compressibility.

Viscosity, units of viscosity, measurement of viscosity, Newton's equation. Pressure intensity and pressure head. Measurement of pressure. Forces on submerged plane and curved surfaces. Buoyancy and flotation. Equilibrium of floating and submerged bodies.

Steady and unsteady flow

Uniform and non-uniform flow. Laminar and turbulent flow. Bernoulli's equation and energy equation. Velocity and acceleration. Orifice meter. Notches and weirs. Venturimeter.

Steady flow through pipes. Darcy Weisbach equation. Losses in pipelines. Hydraulic and energy grade lines. Pipes in series and in parallel. Energy transmission through pipes.

Books Recommended

Daugherty, R.L. & J.B. Franzini, Fluid Mechanics with Engineering Application, Harper & Row Publishers, New York.

**THEORY OF STRUCTURES-I/ANALYSIS OF STRUCTURES-I /
ELEMENTARY STRUCTURAL ANALYSIS**

Introduction to Structural Analysis

Definition; Types of Structures; Structural Idealization; Loads; Types of beams, supports and loads. Simple cases of axial force. Relationship between load, shear force and bending moment. Shear force and bending moment diagrams.

Determinacy, Indeterminacy and Stability of Structures

Analysis of Determinate trusses

Common types of trusses; Classification of coplaner trusses; Method of joints; Method of sections; Graphical method for analysis.

Analysis of Statically determinate Rigid jointed plane Frames

Determinacy & stability of plane frames; Analysis, Shear & bending moment diagrams of frames

Rotation and Deflection

Deflection diagrams & elastic curves; Double integration, moment area and conjugate beam methods; Energy methods to compute deflections; Castigliano's theorem for trusses. Beams & frames, Unit Load Method; Principle of virtual work for trusses, beams & frames.

Moving Loads

Influence lines for statically determinate beams and panelled girders; Influence lines for shear, reaction, and bending moment for beams and panelled girder; Influence lines for axial forces in trusses; Calculation of Maximum stress function 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 & Suspension Bridges.

Three hinged parabolic and circular arches; Influence line for 3-hinged arches; Introduction to cables & suspension bridges

SURVEYING-II

Introduction to plain and geodetic survey

Triangulation

Classification of triangulation. Operations in triangulation. Intervisibility of station points. Strength of figure, quality of observations, weighted observations. Distribution and adjustment of errors. Computation and plotting.

Curves

Simple circular curves, compound curves, transition curves, vertical curves, reverse curves. Computations and setting out by different methods.

Tacheometry

Principles of tangential and stadia methods. Field observations and calculations for measurement of horizontal distance and height.

Field Astronomy

Introduction of geographical and Astronomical terms. Determination of true meridian, latitude, longitude and time from astronomical observations.

Photogrammetry

Elements of terrestrial and aerial photogrammetry. Aerial surveying. Flight planning and computations.

Tunnel Surveying

Surveying operations involved in tunnels.

Hydrographic Surveying

Taking Soundings, Gauges and meters. Measurement of velocity and discharge. Introduction to EDM, Triliteration. Contouring, Map reading.

Introduction to modern positioning systems, use of GPS and Satellite imagery, use of computer and AutoCad plotting.

Survey Camp for Two Weeks

Books Recommended

Russel, P.W. & C Brinker. Elementary Surveying, Harper Collins.

CONSTRUCTION ENGINEERING

Construction Aspects of Engineering Projects.

An over view of construction aspects for different types of engineering projects, e.g., buildings, retaining structures, bridges, pavements and special structures; General consideration common to all projects with special reference to building structures.

Layout techniques

Layout techniques with special reference to buildings. Excavation in different types of soils, solution of particular problems arising out of condition of sub - soil at site e.g., de-watering, shoring, bracing, underpinning sheet piling etc.

Concreting

Methods of preparation, pouring, placement and curing of concrete in foundations. Construction joints, Plinth joints in raft foundations, mass concreting; Plinth beams and plinth protection, damp proof course.

Construction Methodologies

Sub structure construction methodologies pertaining to in situ and precast construction for moderate to high rise buildings; Mechanized construction techniques e.g., lift slabs etc; Form work for general in situ construction and a comparison with precast construction; General Principles of designing props, bracing and horizontal shuttering platforms; Alignments, plumbs, leveling and cambering; Methods of concreting vertical and horizontal members, including mechanized placement, ready mix concrete etc.

Slab on grade, plain cement concrete floors, floor finishing; Construction methodologies for planar and non-planar roofing systems, finishes and water proofing.

Non structural elements, specially masonry and brickwork with sufficient details related to constructional aspects; Doors, windows alignment, plumb and fixation; Construction aspects related to services.

Books Recommended

Huntington, W.C. Building Construction, John Wiley & Sons.

Mitchell. Elementary Building Construction, B.T.Batsford Ltd.

CIVIL ENGINEERING DRAWING

Introduction

Need and requirement of drawings for Civil Engineering projects. General nature of drawings, components, symbols and nomenclature needed for specific drawings such as architectural, structural, plumbing, electrical, air-conditioning, roads and earth work.

General description of drawings related to Civil Engineering projects.

Drawings at different stages of projects. Elements of perspective drawing.

Architectural Drawings

Elements of architectural planning and design. Schematic and working drawings and details of residential, commercial, religious, recreational, industrial, clinical, hospital and educational buildings; Details of doors, windows and staircases.

Structural Drawings

Elements of structural drawing and detailing, preparation of foundation plan, structural framing, slab details, staircase details, water tanks, beam and column elevations and sections mostly pertaining to reinforced concrete structures. Details of steel roof truss, connection details and fabrication drawings.

Plumbing and Electrical Work

Plumbing and electrical detailing pertaining to small residential units.

Computer Aided Drawing (AutoCAD)

General and basic know how related to computer aided drafting, e.g., co-ordinate system, drawing setup procedure, basic draw commands, basic edit commands; Layers, creating test and defining styles options, block and drawing import/export options; Cross hatching, save and plot (2D) and isometric drawings.

ENGINEERING GEOLOGY

Introduction to Geology

Internal constitution of the earth; Importance of Geology for Civil Engineering Projects; Geological Process (External & Internal), Rock cycle, Volcanoes; Physical Properties of common Rock forming minerals

Geological Material (Rock, soil and subsurface water)

Types of rocks and their formation process. Common rock forming minerals; Types of soil and their formation process. Common soil forming minerals; Geology of Aquifers (wells, springs, streams and ground water conditions)

Rock Classification

Visual classification; Discontinuity classification; Color of Grain Size; Hardness Classification; Geological Classification; Classification by Field Measurement & Strength Tests; Classification by Rock Quality Designation; Classification by Velocity Index; Classification by Uniaxial Compression Strength and Modulus Ratio; Classification by Durability

Durability of rocks

Drying and wetting test, Slake durability test, Soundness test.

Engineering and Physical properties of rocks

Specific gravity and absorption, unit weight, uniaxial compression strength and moisture content etc.

Geological structure and Plate tectonics.

Brief Introduction to structural geology and plate tectonics with respect to global application

Earthquakes

Causes and effects of earthquakes, index for earthquake. Prediction of earthquake and Protective measures against earthquake, Sequence and principles of stratigraphy, Earthquake zoning for Pakistan. Brief description of Seismic Network of Pakistan.

Applied Geology

Role of geology in selection of sites for dams, reservoirs and pertinent geological investigations; Geology of foundations, highways, airfields and bridges; Engineering geology of tunnels, geological survey prior to tunneling, lining of tunnels and their section. Selection of tunnel site and its requirements, case histories; Land Slides; Introduction to blasting.

Glaciers and Glaciation

Brief Introduction of local geology. Geological map reading, bore log interpretation.

Books Recommended

Blyth, F.G.H. Geology for Engineers, English Language Book Society (ELBS)
Edward Arnold Ltd.

MATHEMATICS-III / COMPLEX ANALYSIS, STATISTICAL METHODS & PROBABILITY.

Binary arithmetic. Representation of numbers in computer. Errors in arithmetic operations. Errors in computational methods.

Complex numbers and their graphical representation. De Moivre's Theorem. The roots of any real or complex number. Functions of a complex variable. Limits and continuity.

Statistics and probability

Classification, tabulation, classes, graphical representation, histograms, frequency polygons, frequency curves and their types.

Means: A.M., G.M., H.M., and their properties; Weighted mean, median, quartiles, mode and their relations; Merits and demerits of averages.

Range, moments, skewness, quartile deviation, mean deviation, standard deviation, variance and its coefficients, kurtosis.

Goodness of fit; Fitting a straight line, parabola, circle.

Scatter diagram, linear regression and correlation.

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

Binomial, Poisson, uniform, exponential and normal distribution functions and its approximation to Poisson distribution.

Books Recommended

Blind, D. A. & R. D. Mason, Basic Statistics for Business & Economics, Irwin Publishers

ARCHITECTURE & TOWN PLANNING

Architecture

Historical Development

General introduction to history of architecture; Emergence / Development of Islamic Architecture.

Influences

Geographical, climatic, religious, social, historical.

Principles

Truth or purpose & beauty.

Qualities

Strength, vitality, grace, breadth and scale.

Factors

Proportion, colour and balance.

Use of Materials

Stone, wood, metals, concrete, composites, ceramics.

General Treatment to Plan of Buildings

Walls and their construction; Openings and their position, character and shape; Roofs and their development and employment; Columns and their position, form and decoration; Moulding and their form decoration; Ornament as applied to any buildings.

Town Planning

Definitions

Trends in Urban growth; Objectives of town planning; Modern planning in Pakistan and abroad.

Preliminary Studies

Study of natural resources, economic resources, legal and administrative problems, civic surveys and preparation of relevant maps.

Land Use Patterns

Various theories of land use pattern. Location of Parks and recreation facilities, public and semi-public buildings, civic centres, commercial centres, local shopping centres, public schools, industry & residential areas.

Street Patterns

Lay out of street, road crossing & lighting; Community planning.

City Extensions

Sub Urban development, Neighbourhood Units, Satellite Towns and Garden City

Urban Planning

Issues related to inner city urban design and emergence / upgradation of squatter settlements.

Introduction to Urban & Regional Planning using GIS

Books Recommended

Brodbent, G, J.C. Anthony, Emerging Concept in Urban Space Design, Van Nostrand Reinhold Co. Ltd.

Snyter, J.C. Introduction to Urban Planning, Milwaukee McGraw Hill Book Co.

Fletcher, S.B. A History of Architecture, The Athlone Press

QUANTITY SURVEYING AND ESTIMATION FOR CIVIL WORKS

Scope

Scope of civil engineering works; General practice in government departments for schedule of rates and specifications; Rate analysis; Specifications for various items of construction.

B.O.Q & M.B.

Working out quantities, rates and cost analysis of construction materials; Valuation, depreciation and sinking fund.

Contents and preparation of bills of quantities for a project and maintaining of Measurement Books.

Measurement, specification and costing of excavation and back filling, mass concrete retaining walls, beams, concrete piles, steel or wooden truss or steel framed gantry, estate road, sewer and water main pipe works.

Tendering

Preparation of civil engineering contracts and tender documents.

Evaluation of proposals and contracts.

THIRD YEAR

PLAIN AND REINFORCED CONCRETE-I

Concrete Technology

Constituent materials of concrete & their properties; Hydration, setting & hardening of cement; Testing of cement & aggregates; Types of concrete & their properties; Batching, mixing, transportation & placing of concrete; Properties of fresh and hardened concrete as well as factors affecting them; Testing of concrete for various properties including physical & strength tests.

Introduction to RCC

Basic principles of reinforced concrete design and associated assumptions; Behaviour of reinforced concrete members in flexure; Design philosophy, design codes, factor of safety and load factors; Prevailing methods of design of reinforced concrete members.

Working stress method

Serviceability criteria and checks for deflection, crack width and crack spacing; Importance of working stress method related to prestress.

Ultimate strength method

Analysis and Design of prismatic and non-prismatic sections in flexure, compatibility based analysis of sections and code requirements for flexure; Analysis of one-way and two-way solid slabs with general discussion on other slab systems; Design for flexure.

Shear stress in reinforced concrete sections, models and analogies towards solution of diagonal tension problem; Design for diagonal tension.

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

Books Recommended

Hassoun, M.N. Design of Reinforced Concrete Structures, PWS Engineering
Wang, C.K. & Charles G.S. Reinforced Concrete Design, Harper and Row.

TRANSPORTATION ENGINEERING-I

Introduction to Transportation Systems

Modes of transportation; Need and scope of comprehensive plan; Phases of planning, Principles of planning; Communication (rail-road network & airport), port and harbour facilities, street traffic and design.

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 a good ballast, Renewal of a ballast. Formation of single and double track. Formation failures; Selection of site for a railway station. Layout of stations and yards; Modern methods for construction of tracks. Maintenance, tools and organization.

Airport Engineering

Type & elements of Airport planning, Factors affecting Airport Site Selection; Airport Classification; Airport Drainage Systems; Various Runway Configurations.

Coastal Engineering:

Classification of harbours; Ports and harbours of Pakistan; Design principles and requirements of harbours; Wharves and jetties; Breakwaters and groynes; Channel regulation and demarkation; Classification of docks and their construction; Transit sheds and warehouses.

Books Recommended

Yu. J.C. Transportation Engineering Introduction to Planning, Design and Operations, Elsevier

SOIL MECHANICS

Soil Formation

Soil and its constituents, Weathering of rocks and types of soils.

Physical Properties

Water content, void ratio, porosity, degree of saturation, specific gravity, unit weight and their determination , Atterberg limits, sieve analysis , hydrometer and Pipette analysis, Stoke's law , grain size distribution.

Soil Classification, Importance of soil classification. M.I.T., Unified , AASHTO and ASTM Classification systems.

Water in Soil: Occurrence and effects

Occurrence of ground water , water table or phreatic surface , capillarity and capillary water, soil suction , pore pressure and effective stress , frost heave , swelling and collapsible soils.

Permeability and Seepage

Definition , Hydraulic gradient , Darcy's Law , Factors affecting permeability , Permeability of stratified soils , Laboratory and field determination of coefficient of permeability.

Compaction

Definition , Compaction fundamentals , Moisture density relationships , Standard Proctor test and modified AASHO test for compaction , Factors affecting compaction , Compaction equipment , properties and structure of compacted soils, Specifications , field control and measurement of in-situ density , CBR test.

Shear Strength

Concept of shear strength , Normal and shear stresses along a plane , analysis of stress using Mohr circle, Pole method of finding stress along a plane , Shear strength parameters , Coulomb's Law, Mohr- Coulomb failure criterion, Shear strength of cohesive and non-cohesive soils, Effect of stress and strain on shear strength , Laboratory and field tests including unconfined compression, direct shear test and triaxial test.

Books Recommended

Whitlow, R., Basic Soil Mechanics, Longman Scientific & Technical
Smith, G.N. Elements of Soil Mechanics, Oxford BSP, Professional Books.
Smith, G.N. Elements of Foundation Design, Granada Publisher.

HYDROLOGY, WATER RESOURCES AND DRAINAGE ENGINEERING

Surface Water Hydrology

Introduction, Hydrologic cycle, Precipitation, Measurement of rainfall, Computation of average rainfall over a basin, Runoff, Factors affecting runoff, Computation of runoff, Estimation of maximum rate of runoff or flood discharge, Hydrograph analysis, Unit Hydrograph.

Ground Water Hydrology

Interstices, Porosity, Co-efficient of storage, permeability & Transmissibility, water-yielding properties, Ground water reservoir, Aquifer. Aquifer as reservoir, Aquifer as conduit, Ground water in motion.

Quality of Water

Quality of water, Methods of indicating quality, Salt concentration and its limits for irrigation water, Quality of water in the Indus plain.

Basic Principles and Equations

Darcy's law, Volume elasticity of aquifer, Differential equation governing ground water flow, hydraulic boundaries, Flow from and to stream, Flow net, numerical analysis of water levels.

Waterlogging and Salinity

Definition of waterlogging, Salinity, Environmental impact of waterlogging, Mechanism of soil destruction, remedial measures.

Drainage

Purpose of drainage, Drainage needs, Water table, Water movements in subsoil, permeability, Methods of permeability determination.

Design of Drainage Systems

Surface drainage, Design of open ditches, Maintenance of alignment Drainage, Open drains, Methods of construction, Subsurface drainage, Tile drains, Mole drains, Determining depth and spacing of drains. Drainage co-

efficient, Size of the tile drain, Outlets for drains, Envelop material, Installation and maintenance of Tile Drains.

Well Irrigation

Aquifers, Types of aquifers, Storage co-efficient, Well- hydraulics, Well losses, Capacity of well, Interference among wells and tube well types and its construction.

Canal Lining

Lining and its types, Financial justification and economics of canal lining, Design of lined irrigation channels, Permissible velocities in lined channels, Construction of various types of lining.

Introduction to relevant software packages

STRENGTH OF MATERIALS- II / MECHANICS OF SOLIDS-II / STRUCTURAL MECHANICS.

Stress Analysis

Analysis of stresses and strains at a point due to combined effect of axial force, shear force and bending moment. Mohr's circle for stresses and strains. Relationships between elastic constants; Introduction to complex stress contours

Theories of failure.

Unsymmetrical bending.

Shear stress distribution in unsymmetrical beams.

Thin and thick cylinders.

Analysis of curved beams and beams on elastic foundation.

Eccentrically loaded columns

Introduction to bending and buckling of plates.

Experimental stress analysis.

Use of strain gauges and strain rosette.

Introduction to relevant software packages.

Books Recommended

Pytel, A. & Ferdinand L. Singer, Strength of Material, Harper and Row

Boreise, A.P. & O. M. Sidebottom, Advanced Mechanics of Materials, John Wiley & Sons.

FLUID MECHANICS-II

Fluid Flow in Pipes

Reynold's number and its significance, Instability of viscous flow. Viscous flow through circular pipes. Turbulent flow through circular pipes. Semi-empirical theories of turbulence. Velocity profile in turbulent flow. Pipe roughness, Nukuradse's experiments. Moody's diagrams.

Elementary Hydro-Dynamics

Ideal and real fluids. Differential equation of continuity. Rotational and irrotational flow. Stream function and velocity potential function. Circulation and vorticity. Orthogonality of stream lines and equipotential lines. Brief description of flow fields. Flow net and its limitations. Different methods of drawing a flow net.

Forces on Immersed Bodies

Development of boundary layer on immersed Bodies. Elementary theory of surface drag and form drag. Simple lift and drag equations and their applications to simple engineering problems. Separation of boundary layer.

Forces on Vanes and Turbo Machinery

Impulse momentum equation. Forces on moving flat and curved vanes. Impulse turbine, construction features and operations, Specific speed. Reaction turbine, types, construction features and operation, specific speed, cavitation, draft tube.

Centrifugal pumps.

Classification, construction features and operation, specific speed, cavitation.

Reciprocating Pumps

Single acting and double acting pumps, acceleration head, maximum suction lift. Use of air vessels.

Introduction to relevant software packages

Books Recommended

Dagherty, R.L. B.F. Joseph & E.J.Finnemore. McGraw Hill Book Co.

THEORY OF STRUCTURES-II / ANALYSIS OF STRUCTURES-II/STRUCTURAL ANALYSIS.

Method of Consistent Deformation/Force Method

Analysis of statically indeterminate beams, frames and trusses. Castigliano's second theorem (Method of least work).

Slope Deflection Method

Derivation of equation, Analysis of continuous beams and portal frames without joint movement. Analysis of continuous beams and portal frames due to yielding of supports. Analysis of portal frames with joint movement. Analysis of closed frames and multistorey portal frames.

Moment Distribution Method

Concept, Distribution and carry over factors, Analysis of continuous beams and portal frames without joint movement. Analysis of continuous beams and portal frames due to yielding of supports. Analysis of continuous beams and portal frames with joint movement. Analysis of multistorey portal frames.

Analysis of Arches

Analysis of two hinged circular and parabolic arches, supports at different levels.

Influence Lines for Indeterminate Beams

Use of Clark Maxwell and Betti's Theorem, Law of Reciprocal Deflections, Influence lines for moment and reactions in proposed cantilevers. Influence lines for support reaction of two and three span continuous beams. Influence lines for Shear Force and Bending Moment at any section of the beam.

Introduction to Plastic Analysis

Approximate analysis of Indeterminate Structures

Three Moment Equation.

Analysis of indeterminate beams.

Books Recommended

Wang, C.K. Intermediate Structural Analysis, McGraw Hill.

West, H.H. Analysis of Structures, John Wiley & Sons.

Hibbeler, R.C. Structural Analysis, Prentice Hall.

LINEAR ALGEBRA AND NUMERICAL METHODS

Algebra of matrices and determinants and their use in solving simultaneous equations.

Solution of Non-linear Equations

Simple iteration. Bisection method. Newton's method. Secant method. Method of false position. Comparison of these methods.

Finite Differences

Difference operators and Table. Differences of polynomials. Newton's and Gauss interpolating techniques for equally spaced data. Simple theorems on divided differences. Newton's formula for unequal intervals. Lagrange's formula of interpolation. Curve fittings by the method of least squares. Numerical differentiation and integration.

Solution of Linear Simultaneous Equations

Partial Differential Equations:

Solution of simple types of differential equations. Partial differential equations in cylindrical and spherical co-ordinates.

Gauss-elimination method. Jacobi's method. Gauss-Seddel method. Sparse matrices. Solution of ordinary differential equations. Initial value problems. Euler and modified Euler methods. Runge Kutta and Kutta Merson methods.

Eigen values and Eigen vectors

Interactive and transformation methods. Eigenvalues of tridiagonal matrix.

Solution of Polynomial Equations

Polynomial arithmetic. Finding initial approximations and complete solution of a polynomial.

Development of simple computer programmes and applications.

Book Recommended

Schum's Series, Numerical Analysis, McGraw Hill.

STEEL STRUCTURES

Introduction to structural design, design loads, safety factors and load factors. Specifications and codes of practice.

Introduction to ASD (Alternate Stress Design) and LRFD (Load and Resistance Factor Design) methods.

Fabrication and erection methods of steel structures; Design of members in tension, compression and flexure; Riveted, welded and bolted connections; Design of roof truss and plate girder.

Introduction to relevant software packages.

Books Recommended

Lothers, J.E. Steel Structures, National Book Foundation

Gaylord, E.H. and C.N.Gaylord, Steel Structures, McGraw Hill

Spiegel & L. Burner. Steel Structures, McGraw Hill.

ENVIRONMENTAL ENGINEERING-I / ENVIRONMENTAL AND WATER SUPPLY ENGINEERING-I

Introduction to environmental engineering

Water Quantity

Population Forecast; Water uses & consumption; Types and variations in demand; Maximum demand & fire demand.

Rural Water Supply

Appropriate Technology.

Water Quality

Water impurities & their health significance; Water quality standards, (U.S. & WHO, etc); Water quality monitoring.

Water Distributions

Layout and design of water transmission works and distribution networks, service reservoirs, Fixtures and their installation ; Tapping of water mains.

Water Treatment

Treatment of surface & ground water, screening , sedimentation, coagulation, coagulants & dosages; Filtration, design aspects of slow sand and rapid sand filters; Filtration rates, operation head loss, backwash and filter efficiency; Pressure filters; Fluoridation, hardness removal; Iron & Manganese removal; Water softening methods; Water disinfection and chemicals; Use of chlorine, quantity, dosage & efficiency; Emergency treatment methods.

Water Sampling and Testing

Sampling techniques and examination of water (physical, chemical and microbiological parameters).

Diseases

Water borne, foodborne, milkborne and vectorborne diseases.

Pollutants

Effects and remediation of air, water, land, noise and radiation pollution;
Toxic/hazardous wastes.

Introduction to Relevant Software packages

Introduction to Environmental impact assessment

Methodology, baseline condition of soil, air, water; Impacts of flora, fauna and socio-economic conditions on human beings, mitigation of adverse impacts, environmental impact, etc.

Books Recommended

Peavy, H.S., Donald R.R. and George, T. Environmental Engineering, McGraw Hill.

FINAL YEAR

PLAIN AND REINFORCED CONCRETE-II

Advanced Concrete Technology

Modulus of elasticity of concrete; Tests for modulus of elasticity; Concrete water cement ratio and workability; Concrete mix design; Compaction, curing of concrete & their effects on strength; Additives & admixtures for concrete; Durability of concrete & factors affecting durability. Alkali-Silica reaction; Non-destructive testing of concrete structure; Quality control and inspection; Cracks in concrete; Repair of concrete

Concrete Member Design

Analysis and design of columns subjected to combined flexure and axial loading; Guidelines for design of shear walls; Analysis and design of isolated, combined and eccentric footings;

Introduction to Torsion in reinforced concrete members.

Analysis of sections in pure compression; Design of short columns under pure compression.

Pre-stressed Concrete

Principles of prestressing, properties of high strength materials used in prestressing; Importance of high strength concrete and steel used in prestressing; Behavioral aspects of prestressed beams and comparison with reinforced concrete beams, post tensioning and pre-tensioning techniques, comparison and hardware requirements; Prestress losses, immediate and time dependent losses, lump-sum and detailed estimation of prestress loss; Analysis and design of simply supported prestressed beams and girders..

Books Recommended

Nilson A.H., Design of Prestressed concrete, John Wiley and Sons.
Gregor, J.G.M. Reinforced Concrete Design, Prentice Hall

STRUCTURAL DESIGN AND DRAWING

Analysis and design of reinforced concrete and steel; Industrial and commercial type of buildings including effects of wind and earthquake; Analysis and design of underground, overhead tanks and reservoirs. Analysis and design of cantilever and counterfort retaining walls; Analysis and design of flat plate, flat slabs and waffle slabs for flexure and shear under gravity loading.

Introduction to design of strap, strip, mat footings and piles .

Introduction to analysis and design of non-planer roof, steel and RCC bridges.

Introduction to relevant software packages.

Books Recommended

Fintel, M. R.C.C.Handbook, CBS Delhi.

ENVIRONMENTAL ENGINEERING-II / ENVIRONMENTAL AND SANITARY ENGINEERING

Environmental legislation and regulation

Environmental Impact Assessment

Estimation of sewage quantities

Rain fall intensity formulas, hydrograph & dry weather flow, sewage quantities; Variations and rates of flows; Velocity gradient & limiting velocities.

Characteristics of Sewage

Sampling and Testing Techniques

Sampling techniques and examination of waste water (Physical, chemical and microbiological parameters).

Design, construction and maintenance of sewage system
Separate & combined systems; Types, shapes, sizes and materials of sewers; Sewer appurtenances, pipe strengths and tests.

Construction & maintenance of sewer system and analysis; Diameter and gradient, sewer joints, grading, laying, jointing and testing of sewers.

Municipal and industrial wastes; Water pollution, causes and control parameters; Effluent disposal guideline and standards; Pakistan National Environmental Quality Standards (NEQS).

Sewage Treatment and Disposal

Primary, secondary & tertiary treatment; Screening grit chamber, skimming tanks & sedimentation tanks; Activated sludge treatment, trickling filters, oxidation ponds, etc.

Receiving body, assimilation capacity; Stream pollution and self recovery, sludge handling & disposal; Effluent re-use, Control and management of industrial waste waters.

Requirements and arrangement of building drainage

Soil pipes, antisiphon pipes and waste water pipes; Sanitary fixtures and traps; House connection and testing of house drainage; Cross connection and back syphonage control.

Solid waste management

Types, characteristics, sources and quantities of solid wastes; Collection disposal and recycling.

Introduction to relevant software package

Books Recommended

Metcalf and Eddy, Waste Water Engineering, McGraw Hill
Steel, E.W. Water Supply and Sewerage, McGraw Hill

TRANSPORTATION ENGINEERING-II

Introduction to Road Systems

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

Highway Engineering

Highway Components, Location, Survey & Types; Elements of a typical cross-section of road.
Types of cross-section; Highway location; Classification of Highways; Highway Materials, Types & Characteristics, Specifications & tests.

Pavement Design

Types of pavements. Wheel loads. Equivalent single wheel load. Repetition and impact factors. Load distribution characteristics; Pavement evaluation and rehabilitation; Design of flexible and rigid pavements

Geometric Design

Driver Characteristics; Horizontal curves; Vertical curves; Grade line; Super Elevation; Transition curve; Curve Widening; Sight Distance requirements.

Traffic Engineering.

Operating and Design speeds; Traffic estimates; Traffic Lane Capacity; Traffic Survey; Traffic Safety; At-grade and grade-separated intersections; Traffic Control Devices; Traffic Management.

Introduction to relevant software packages

Books Recommended

Vazirani, Transportation Engineering, Khana Publication
Horonjeff, R. Planning and Design of Airports, McGraw Hill.

CONSTRUCTION PLANNING, PROJECT MANAGEMENT AND ENGINEERING ECONOMICS.

Introduction

The construction industry, construction economy and the engineer and the contractor, value engineering, making a value engineering study, objections to value engineering studies, the time value of money.

Project Planning, Scheduling and Controlling by Deterministic Models.

Construction activities; Rectangular bar chart; CPM; Developing a critical path schedule; Determining the minimum total cost of a project; Manual versus computer analysis of critical path methods, preparing a construction schedule, Scheduling resources, Delivering Materials, Scheduling manpower; Financing the project, Job layout, Project control during construction, keeping equipment records, Project supervision. Construction Cost Control, Cost Control records.

Project Planning, Scheduling and Controlling by Probabilistic Models.

PERT project Evaluation & Review Technique, Statistical tools including mean, variance and standard Deviation, Probability distribution, Beta curves and centre limit.

Use of computer software in project management and planning.

Claims and Arbitration

Claims, escalation, indexation, arbitration and litigation.

Factors affecting the Selection of Construction Equipment

Standard types of equipment, special equipment, the cost of owning and operating equipment, Depreciation cost, Straight Line depreciation, Decline balance method, sum of the year, digit method, Investment costs, operating costs, Economical life of construction equipment, cost of depreciation and replacement, Maintenance and repair costs, Down time costs, Economical cost of equipment, sources of Construction equipment.

Fundamentals of Engineering Economics

Basic concepts, Engineering economics definition, measures of financial effectiveness, Non-monetary values, Demand and supply analysis, Theory of pricing, Theory of production and laws of return. Funding, funding agencies and planning commission; Types of ownership, types of stocks, partnership and joint companies, Banking and Specialized credit institution; Labour problems, labour organization, prevention and settlement of disputes.

Techniques of report writing

Introduction to ISO-9000 with respect to construction planning and management

Books Recommended

Blank, L.T. & Anthony J. Tarquin, Engineering Economics, McGraw Hill Book Co.

Barrie and Paulson, Professional Construction Management, McGraw Hill.

MODERN METHODS OF STRUCTURAL ANALYSIS

Introduction to matrix methods

Flexibility Methods

Formation of element flexibility matrix for flexural member; Force transformation matrix; Structure flexibility matrix. Partitioning of load vector, deformation vector and flexibility matrix; Analysis of statically indeterminate structures using flexibility methods.

Stiffness Methods

Formation of element stiffness matrix for truss, beam and frame element; Deformation transformation matrix; Structures stiffness matrix for truss, beam & frame elements; Analysis of Indeterminate structure using stiffness method.

Introduction to Finite Element Method

Basic concepts of structural dynamics

Types of time varying loads, Equations of motion, free vibration and forced vibration, single degree & multi degree freedom of structures, generalized mass approach. Earthquake Forces on Structures.

Computer Applications.

Books Recommended

Hibbler, R.C. Structural Analysis, Prentice Hall.

FOUNDATION ENGINEERING

Vertical Stresses in Soils

Definition, Stresses caused by self weight of soil, Geostatic stresses, Stresses caused by point loads and uniformly distributed loads: Boussinesq and Westergaard theories, Pressure bulb, stress distribution diagram on horizontal and vertical planes; Stress at a point outside loaded area, Newmark's charts and 2:1 Method.

Foundations

Definition, purpose and types, General requirements of foundations, Depth of footings, Selection of foundation type, Dewatering of foundations for construction.

Bearing Capacity

Definition, Sources of obtaining bearing capacity, Presumptive values, Plate load test and standard penetration test, Terzaghi's and Meyerhof's theories of bearing capacity, effect of load eccentricity on bearing capacity, Effect of Water table on bearing capacity, Factors effecting bearing capacity,

Foundation Settlement

Definition, types, components, causes and remedial measures; Immediate/elastic settlement (approximate method only); Consolidation Settlement: Mechanics of consolidation by spring analogy, Terzaghi's one dimensional consolidation Theory, Assumptions and validity, Oedometer test and graphical representation of data, Compression index, Coefficient of compressibility and

Coefficient of volume change, Normally and over consolidated clays, Determination of Pre-consolidated Pressure, Degree of consolidation, Time rate of consolidation settlement, Determination of coefficient of consolidation, Primary and secondary consolidation, Estimation of Consolidation settlement for footings.

Design of footings

Geotechnical aspects of isolated, combined and strip footing design. Geotechnical aspects of raft foundation design, Differential settlements and cracks. Proportioning of footings for a given settlement or equal settlements.

Introduction to deep foundations

Types of pile foundations, Methods of constructing pile foundations, Load carrying capacity of piles, Group action, Negative skin friction, Pile load tests.

IRRIGATION ENGINEERING

Introduction

Definition, Necessity of Irrigation, Planning of irrigation projects, Scope of Irrigation Engineering, Benefits and ill effects of Irrigation. Water resources and irrigation system of Pakistan. Indus basin treating, water budget of Pakistan.

Methods of Irrigation

Classification of irrigation methods, Factors affecting the choice of irrigation method, Surface methods, Sprinkler irrigation methods, Sub-surface irrigation methods.

Soil-water Crop Relationship

Soils and their physical and chemical properties, Root zone soil water, Crops of Pakistan, Crop rotation.

Water requirement of crops

Functions of irrigation water, Preparation of land for Irrigation, Crop/Base period, Duty and Delta of crop, Relationship between duty and delta, Factors on which duty depends, Depth and frequencies of irrigation, Kharif-

Rabi ratio, Optimization of irrigation water, Irrigation efficiencies, Uniformity co-efficient, Consumptive use of Water, Effective rain fall, Net irrigation requirements. Field irrigation requirement, Gross Irrigation Requirement. Estimation of consumption use, Blaney criddle/Hargreaves methods, Assessment of irrigation water charges.

Canal Irrigation System

Alluvial and Non alluvial canals; Alignment of canal; Distribution system for canal irrigation, Basic definitions, Determination of required canal capacity, Canal losses, Evaporation, Seepage, Empirical formula for channel losses, Channel section for minimum seepage loss. Cross drainage works.

Design of Irrigation Channel

Design of stable channel, Regime Channels, Kennedy's theory, critical velocity ratio, Kutter's formula, Manning's formula, Lacey's theory, Design procedure for Lacey's theory, Estimation of transported sediment, bed load equations, Meyer-peter's and Einstein's formula, Muneer and Qureshi formula, Design procedure for lined/non-erodable irrigation channel, Maintenance of irrigation channels.

Diversion Head Works

Difference between weir, barrage and headworks; Layout of diversion head works. The diversion weir, Types and components of diversion weir, The canal head regulator, canal regulation and silt control at the head works.

Theories of Seepage and Design of Weir & Barrage

Causes of failure by piping and direct uplift, Safety against piping and uplift, Bligh's Theory, Lane's theory, Khosla's theory and concept of flow nets, Stream lines and equipotential lines, Critical gradient, Khosla's method of independent variables for determination of pressure and exit gradient below a weir or barrage, Khosla's simple standard profiles, Design examples of barrage, head regulator, etc. Cross regulator and its design, Canal outlets or Modules, Types of modules.

Reservoir Planning and Dams in General

Types of reservoirs, Flood control reservoir Multi purpose reservoir; Capacity of reservoirs, Storage zones of reservoirs, Reservoir yield,

Estimation of demands and optimal reservoir operation, Flooding routing or flood absorption, Reservoir sedimentation, Silt control in reservoir, selection of suitable site for reservoir; Economics of combined project, Cost-benefit consideration and general principle of optimizing capital budget.

Books Recommended

Sharma, R.K. and T.R.Sharma, Irrigation and Drainage, Vol-I to V. Oxford and IBH Pub. Co.

Linslay, R.K. and Joseph, B.F. Water Resources Engineering, McGraw Hill.

GEOTECHNICAL ENGINEERING

Soil Exploration. Importance of soil exploration , Soil exploration methods; probing, test trenches and pits, auger boring, wash boring, rotary drilling, Percussion drilling and geophysical methods, Soil samplers, Disturbed and undisturbed samples , In-situ tests (SPT, CPT, & PLT). The soil report.

Seepage

Definition and scope, derivation of Laplace equation for two dimensional flow, flow nets, methods of construction of flow nets, Seepage Analysis, Design of filters, piping , Quick sand condition, Sand boiling , liquefaction.

Earth Pressures

Active and passive earth pressures, pressure at rest. Strains associated with active and passive earth pressures, Coulomb's and Rankine's theories. Lateral earth pressure due to surcharge load , effect of water table on earth pressures , Bell's equation for cohesive soils , Culmann's method.

Stability of Slopes

Type of slopes , Factors affecting stability, Methods of stability analysis: planar rupture surfaces , circular slip surface; Taylor's method , Swedish circle method, Types of failures and remedial measures.

Soil Improvement

Basic principles and objectives. Various methods of soil improvement.

Earthen Dams

Types of earthen dams. Components and their functions. General Design considerations and typical cross-section. Methods of seepage control.

Introduction to Soil Dynamics.

Introduction to Geotechnical Computer Software packages

HYDRAULIC ENGINEERING

Pipe Networks

Branching pipes connecting reservoirs.

Steady Flow in Open Channels

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

Unsteady Flow

Flow through pipes, orifices and over-weirs, under varying heads. Water hammer and its elementary analysis; Surges in open channel.

Hydraulic Similitude

Forces involved in hydraulic similitude; Dimensionless numbers and their significance; Geometric, kinematic and dynamic similarities; Model analysis based on Reynolds and Froudes numbers; Buckingham's Pi-Theorem and its application

Sediment Transport in Open Channels

Properties of individual particles. Fall velocity; Movement of bed and suspended load; Collection and analysis of field data;

Dams

Types of storage dams. Forces on dams; Design of gravity dams. Economic height of dam; Problems in dam construction, Factors governing the

selection of particular type of dam, Selection of dam site, Environmental impacts of dams; Reservoir Engineering. Regulation of storage reservoirs.

Water Power Engineering

Selection of Water power sites, components & layout of water power schemes.

CIVIL ENGINEERING PROJECT

Civil Engineering Project must be critical study or research oriented. Number of students per group must not be more than four. Number of groups per teacher should not exceed three.

Project monitoring and assessment / evaluation details in recommendations of the committee.

**RECOMMENDED COURSES
FOR M.SC. IN CIVIL ENGINEERING UNDER DIFFERENT DISCIPLINE**

TRANSPORTATION ENGINEERING

1. Urban Transportation Planning
2. Geometric Design of High Ways.
3. Traffic Engineering and Management
4. Pavement analysis and design
5. Highway materials and construction
6. Probability and Statistics

STRUCTURAL ENGINEERING

1. Advanced Structural Analysis
2. Advanced Reinforced Concrete Structures
3. Concrete Materials and Properties
4. Prestressed Concrete Design
5. Theory of Plates and Shells.
6. Seismic design of structures.
7. Steel Structures
8. Bridge Engineering

GEOTECHNICAL ENGINEERING

1. Advanced Soil Mechanics
2. Foundation Engineering
3. Embankment Dam Engineering
4. Soil Stabilization
5. Soil Investigation
6. Rock Mechanics.
7. Soil Dynamics
8. Geotechnical Instrumentation
9. Probability and Statistics.

WATER RESOURCES AND HYDRAULIC ENGINEERING

1. Fluid Mechanics
2. Surface and groundwater Hydrology
3. Water resources Engineering and planning
4. Irrigation and Hydraulic Structures
5. Open Channel flow
6. Sediment Transport
7. River Mechanics
8. Probability and Statistics.

RECOMMENDATIONS

1. Higher Education Commission may organize a workshop bringing together senior officials from Government Departments such as WAPDA, Irrigation, NHA and Leading consultants such as NESPAK, ACE as well as the faculty of various universities. A mechanism for close interaction between the industry and the universities shall be devised through this workshop. The workshop shall develop a firm methodology for the industry to provide internship to all fresh graduates. The workshop shall also focus on interaction between the industry and universities regarding research. WAPDA, NHA and the consultants are involved in major civil engineering projects. The field engineers come across many research oriented problems. The industry shall share these problems with the universities so that research work may be initiated. All the projects exceeding Rs.100 million may have some percentage earmarked for research work.. The workshop shall devise a mechanism so that valuable data gathered during the execution of projects is readily available to the faculty for undertaking research.
2. Higher Education Commission may develop a central library of engineering literature and shall have the latest computerized library facilities to facilitate research work at the various universities.
3. Higher Education Commission may provide fast internet facilities to all the universities to facilitate research work.
4. During the meeting, it was felt that HEC may also guide the universities to adopt a uniform procedure for the final year project.
5. HEC may invite some more specialists for future curriculum revision meetings from the industries through which there will be greater interaction of the universities and industries.

6. Similar to the undergraduate courses formulation, HEC, should arrange a meeting for M.Sc. curricula finalization.
7. HEC may pressurize/enforce the industries through Government to entertain a large number of students for training and internship. HEC may pursue the Government for an act of parliament to achieve this goal.
8. HEC may constitute a committee for comparison of the universities and the respective disciplines. This way top 3 or 5 universities can be rated. This will make a healthy competition amongst the universities and the various disciplines. This will help the students and their parents to select a university and the relevant discipline. It will also help the industries to consult the relevant university for the solution of their problems.
9. HEC may lay down the mandatory professional training requirements for graduate engineers before the award of B.Sc. Civil Engineering degree. These should include a list of engineering organizations/companies eligible for imparting professional training together with the minimum period specified for the training say 3 or 6 months.

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(Dr. Jahangir Durrani)

Convener

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(Dr. Mir Shabbar Ali)

Secretary