SCHEME OF EXAMINATION FOR B.TECH. I – SEMESTER (CIVIL ENGG.) DEGREE COURSE

Course No.	**Subject**	**Teaching Schedule**				**Credit Points**
		L	T	P/D	Total	
HSIR11	Communication Skills in English	2	0	2	4	3
MAIR11	Differential Calculus & Differential Equations	3	1	0	4	4
PHIR11	Physics – I (Theory & Lab)	2	1	2	5	4
CHIR11	Environmental Studies	2	0	0	2	2
CSIR11	Basics of Programming (Theory & Lab)	2	0	2	4	3
CEIR11	Engineering Mechanics	3	0	0	3	3
CEIR12 / MEIR11	Engineering Graphics */ Engineering Practice *	1	0	3	4	2
SWIR11	NCC/Sports/Yoga	0	0	2	2	1
	Total	**15**	**2**	**11**	**28**	**22**

*** For half of the student strength**

SCHEME OF EXAMINATION FOR B.TECH. II – SEMESTER (CIVIL ENGG.) DEGREE COURSE

Course No.	**Subject**	**Teaching Schedule**				**Credit Points**
		L	T	P/D	Total	
HSIR12	Economics for Engineers	2	1	0	3	3
MAIR12	Integral Calculus & Difference Equations	3	1	0	4	4
PHIR12	Physics – II (Theory & Lab)	2	1	2	5	4
CHIR12	Chemistry (Theory & Lab)	2	1	2	5	4
CEPC12	Building Construction and Materials	3	0	0	3	3
CEPC14	Structural Analysis – I	3	0	0	3	3
CEPC16	Fluid Mechanics	3	1	0	4	4
CELR12	Material Testing (Practical)	0	0	2	2	1
CELR14	Fluid Mechanics (Practical)	0	0	2	2	1
CEIR12 / MEIR11	Engineering Graphics */ Engineering Practice *	1	0	3	4	2
	Total	**19**	**5**	**11**	**35**	**29**

*** For half of the student strength**

SCHEME OF EXAMINATION FOR B.TECH. III – SEMESTER (CIVIL) DEGREE COURSE

Course No.	**Subject**	**Teaching Schedule**				**Credit Points**
		L	T	P/D	Total	
MAIR13	Numerical & Statistical Methods	3	1	0	4	4
CEPC21	Structural Analysis – II	3	1	0	4	4
CEPC23	Surveying – I	3	1	0	4	4
CEPC25	Design of Steel Structures	3	0	2	5	4
CEPC27	Water Supply & Treatment	3	1	0	4	4
CEPC29	Irrigation Engineering	3	1	0	4	4
CELR21	Structural Analysis (Practical)	0	0	2	2	1
CELR23	Surveying – I (Practical)	0	0	3	3	1
CELR25	Environmental Engineering – I (Practical)	0	0	2	2	1
	Total	**18**	**5**	**9**	**32**	**27**

SCHEME OF EXAMINATION FOR B.TECH. IV – SEMESTER (CIVIL) DEGREE COURSE

Course No.	**Subject**	**Teaching Schedule**				**Credit Points**
		L	T	P/D	Total	
CEPC22	Design of Concrete Structures – I	3	0	2	5	4
CEPC24	Soil Mechanics	3	1	0	4	4
CEPC26	Transportation Engineering – I	3	1	0	4	4
CEPC28	Surveying – II	3	1	0	4	4
CELR22	Computational Hydraulics (Practical)	0	0	2	2	1
CELR24	Surveying – II (Practical)	0	0	3	3	1
CELR26	Soil Mechanics (Practical)	0	0	2	2	1
CELR28	Transportation Engineering – I (Practical)	0	0	2	2	1
	Total	**12**	**3**	**11**	**26**	**20**

Survey Camp during summer vacation after 4th semester

SCHEME OF EXAMINATION FOR B.TECH. V – SEMESTER (CIVIL) DEGREE COURSE

Course No.	**Subject**	**Teaching Schedule**				**Credit Points**
		L	T	P/D	Total	
CEPC31	Design of Concrete Structures – II	3	0	2	5	4
CEPC33	Geotechnology – I	3	1	0	4	4
CEPC35	Hydrology & Water Resources Engineering	3	1	0	4	4
CEPC37	Sewerage & Sewage Treatment	3	1	0	4	4
CEPC39	Transportation Engineering – II	3	1	0	4	4
CELR31	Geotechnology (Practical)	0	0	2	2	1
CELR33	Transportation Engineering – II (Practical)	0	0	2	2	1
CEPE39	Programme Elective – I (Computational Practical)	0	0	2	2	1
CELR35	Survey Camp	-	-	-	-	3
	Total	**15**	**4**	**8**	**27**	**26**

SCHEME OF EXAMINATION FOR B.TECH. VI – SEMESTER (CIVIL) DEGREE COURSE

Course No.	**Subject**	**Teaching Schedule**				**Credit Points**
		L	T	P/D	Total	
CEIR32	Industrial Training* / Project Work	0	0	20 (5)**	20 (5)**	10

*** To be monitored at the Institute Level**
**** Teaching Load**

SCHEME OF EXAMINATION FOR B.TECH. VII – SEMESTER (CIVIL) DEGREE COURSE

Course No.	**Subject**	**Teaching Schedule**				**Credit Points**
		L	T	P/D	Total	
CEPC41	Bridge Engineering	3	1	0	4	4
CEPC43	Railway & Airport Engineering	3	0	0	3	3
CEPC45	Geotechnology – II	3	1	0	4	4
CEPC47	Construction Management, Estimating and Costing	3	0	0	3	3
OE	Open Elective – I	3	1	0	4	4
CEPE	Programme Elective – II (Project)	0	0	6	6	3
CEPE	Programme Elective – III (Seminar)	0	1	0	1	1
HSIR14	Business Management	3	1	0	4	4
	Total	**18**	**5**	**6**	**30**	**26**

SCHEME OF EXAMINATION FOR B.TECH. VIII – SEMESTER (CIVIL) DEGREE COURSE

Course No.	**Subject**	**Teaching Schedule**				**Credit Points**
		L	T	P/D	Total	
CEPC42	Open Channel Hydraulics	3	0	0	3	3
CEPC44	Industrial Waste Water Treatment	3	0	0	3	3
CEPE	Programme Elective – IV (Theory)	3	0	0	3	3
OE	Open Elective – II	3	1	0	4	4
OE	Open Elective – III	3	1	0	4	4
CELR42	Environmental Engineering – II (Practical)	0	0	2	2	1
HSIR13	Professional Ethics and IPR	1	0	2	3	2
CEIR42	Comprehensive Viva Voce	0	0	0	0	3
	Total	**16**	**2**	**4**	**22**	**23**

CEIR11	ENGINEERING MECHANICS	EPR	3	0	0	3
Internal:50 Marks	End Term: 50 Marks	Total:100 Marks				

Pre-requisites: Knowledge of Applied Physics

Unit 1: Basic Concepts

Concept of Rigid body and deformable bodies, Free body diagram, Types of beams, simple and continuous beams, type of supports and reaction.

Fundamentals of Determinate and Indeterminate structures, Analysis of plane trusses by method of joint and method of section, Analysis of Plane frames.

Unit 2: Stresses and Strains.

Concept of stress and strain (linear, lateral, shear and volumetric), Hook's law, elastic constants and their relationship, stress-strain diagrams for brittle, elastic and plastic materials, generalized Hook's law.

Analysis of axially loaded members: Stresses, strains and deformations of the structures under concentrated loads, self-weight and temperature changes.

Unit 3: Shear Force and Bending Moment Diagram.

Concept of shear force diagram and bending moment diagram. Relation between shear force, bending moment and intensity of loading. Shear force and bending moment diagrams for cantilevers and simple beams due to concentrated, uniformly distributed, uniformly varying loads and couples in beams

Unit 4: Bending Stresses and Shear Stresses

Theory of simple bending, flexure formula, bending stress distribution, Shear stresses in beams, shear stress distribution

Reference Books

1. Merian, J.L, Kraige, L.G. Engineering Mechanics – Statics, 5th Edition, Wiley Publishers, New-Delhi, 2007.
2. Beer & Johnston, Mechanics for Engineers, 4th Edition, McGraw – Hill, New Delhi, 1987.
3. Timoshenko, S.P., Young, D.H., Rao, J.V. Engineering Machines,4th Edition, McGraw-Hill, Singapore,1956.
4. Singer, F.L. Strength of Materials, Third Edition, Harper and Row Publishers, New York, 1980.
5. Hearn, E.J., Mechanics of Materials, Pergaman Press, England, 1972.
6. Beer and Johnston E. R. Mechanics of Materials, 3rd Edition, Tata McGraw Hill, New Delhi, 2007.

Course Outcome

1. Determine the static indeterminacy and kinematic indeterminacy of trusses and to analyse the trusses by using methods of joints or method of sections.
2. To define and evaluate the different kinds of stresses and strains by analytical methods.
3. To define and reason about fundamental structural concepts such as shear force, bending moment relations, functions. To draw Shear force and Bending Moment Diagrams for determinate beams.
4. To evaluate bending and shear stresses for different loading of variuous types of beams.

CEIR12	ENGINEERING GRAPHICS	EPR	1	0	3	2

Internal:50 Marks	End Term: 50 Marks	Total:100 Marks

Pre-requisites: Knowledge of Applied Physics

Course Content

1. Orthographic Projections

Theory of orthographic projections, planes of projection, four quardrants, first angle projection, third angle projection, B.I.S. Code of practice, view analysis, orientation of the object, laying out three view drawings, hidden lines and curves surfaces, conventional lines, dimensioning and lettering, conversion of pictorial view into orthographic views, development of missing views.

2.Projections of Points, Straight Lines and Planes

Planes in different quadrants, projections of lines parallel to one or both the planes, contained by one or both the planes, perpendicular to plane, inclined to one plane and parallel to other, inclined to both the planes, contained by a plane perpendicular to both the planes, true length of a line and its inclinations with the reference plane, trances of line. Types of planes, perpendicular planes, oblique planes, traces of planes, projections of planes parallel to one plane, perpendicular to both the planes, perpendicular to one plane and inclined to other plane.

3. Projections of Solids

Types of solid-polyhedral, solids of revolution, projections of solids, axis perpendicular to one plane, axis parallel to both the planes, axis parallel to one plane and perpendicular to other plane, axis inclined to both the planes.

Section planes, sections, true shape of sections, sections of prisms, pyramids, cylinders, cone placed in simple position.

4. Graphical Statics

Graphical methods, Basic concept, Bow's notation, space diagram, force and polar diagram, funicular polygon, support and support reactions, analysis of trusses, compressive and tensile stresses, stresses in plane framed structures.

Reference Books

1. Engineering Drawing- P.S.Gill (S.K.Kataria & sons, Ludhiana)
2. Elementary Engineering Drawing- N.D.Bhatt (Charotar Publishing House)
3. Graphic Statics- P.S.Gill (S.K.Kataria & sons, Ludhiana)

Course Outcome: After the completion of the course, students are able

1. To understand the concepts like dimensioning, conventions and standard related to working drawings in order to become professionally efficient.
2. To understand the theory of projections.
3. To draw orthographic projections of lines, planes and solids.
4. To draw sections of solids including cylinders, cones, prisms and pyramids.
5. To analyses different force system (concurrent and non-concurrent) by using graphical method.

CEPC12	BUILDING CONSTRUCTION AND MATERIALS	EPR	3	0	0	3

Internal:50 Marks	End Term: 50 Marks	Total:100 Marks

Pre-requisites: None

Course Content

1. CONSTRUCTION

Masonry Construction

Introduction, various terms used, stone masonry-Dressing of stones, Classifications of stone masonry, safe permissible loads, Brick masonry-bonds in brick work, laying brick work, structural brick work-cavity and hollow walls, reinforced brick work, Defects in brick masonry, composite stone and brick masonry, glass block masonry.

Doors and Windows

Locations, sizes, types of doors and windows, fixures and fastners for doors and windows.

Acoustics, Sound Insulation and Fire Protection

Classification, measurement and transmission of sound, sound absorber, classification of absorbers, sound insulation of buildings, wall construction and accoustical design of auditorium, fire-resisting properties of materials, fire resistant construction and fire protection requirements for buildings.

2. MATERIALS

Stones

Classification, requirements of good structural stone, quarrying, blasting and sorting out of stones, dressing, sawing and polishing, prevention and seasoning of stone.

Brick and Tiles

Classification of bricks, constituents of good brick earth, harmful ingredients, manufacturing of bricks, testing of bricks. Tiles, Terra-cotta, manufacturing of tiles and terra-cotta, types of terra-cotta, uses of terra-cotta.

Cement and Mortars

Cements composition, types of cement, manufacturing of ordinary Portland cement, testing of cement, special types of cement, storage of cement.

Mortars

Definition, proportions of lime and cement mortars, mortars for masonry and plastering.

Timber

Classification of timber, structure of timber, seasoning of timber, defects in timber, fire proofing of timber, plywood, fiberboard, masonite and its manufacturing, important Indian timbers.

Concrete Constituents

Cement, tests on cement (physical tests), types of Portland cement, various types of cement-ordinary Portland cement, rapid hardening cement, low heat cement, sulphate resistant cement, portland-pozzolona cement, high strength Portland cement, high alumina cement, waterproof cement, white Portland cement, hydrophobic cement, coloured Portland cement. Aggregates, classification of aggregates based on petrographic, size, shape & texures,

deleterious substances in aggregates, bulking of fine aggregate, sieve analysis, grading of aggregates as per IS-383-1970. Fineness Modulus, Maximum size of aggregate. Quality of mixing water, curing water.

3. PROPERTIES Of CONCRETE:

Introduction, workability, factors influencing workability, measurement of workability, requirements of workability, properties of hardened concrete, stress and strain characteristics of concrete, Young's modulus of concrete, creep and shrinkage of concrete, permeability of concrete, durability of concrete sulphate attack, fire-resistance, thermal properties of concrete, construction joints, expansion and contraction joints.

4. SPECIAL CONCRETE

Light weight concrete, definition and its properties, applications, high strength concrete, definitions, its properties and applications, mass concrete, waste material based concrete, shortcrete, fiber reinforced concrete: Materials. Fibers-types and properties, ferrocement, polymer concrete composites, heavy-weight concrete for radiation shielding.

5. DRAWINGS

I. Typical drawings of
a) Cavity Wall
b) Bonds in brick work
c) Grillage foundation

II. Preparation of building drawing mentioning its salient features including the following details:
a) Ground floor plan
b) Two Sectional Elevations
c) Front and Side Elevations
d) Plan and Sectional Elevation of stair case, doors/ windows/ ventilators, floor and roof.

Reference Books

1. Building Construction, Sushil Kumar, Standard Pub., N. Delhi
2. Building Material, Rangawala
3. Construction Engineering, Y.S. Sane
4. Building Construction, Gurcharan Singh, Standard Pub., N. Delhi

Corse Outcome: On completion of the course, the students will be

1. Able to identify the various building materials with symbols.
2. Able to identify the properties of building materials.
3. Made acquainted with the manufacturing process of basic construction materials.
4. Made acquainted with the masonry construction and finishes
5. Aware of building services, acoustics, DPC, etc.

CEPC14	STRUCTURAL ANALYSIS-I	PC	3	0	0	3

Internal:50 Marks	End Term: 50 Marks	Total:100 Marks

Pre-requisites: Engineering Mechanics

Unit 1:

Principal stresses and strains: concept of principal planes and principal stresses, normal and shear stresses on an oblique plane, magnitude and orientation of principal stresses and maximum shear stress. Mohr's circle for plane stresses. Combined effect of axial stress, moment and shear.

Theories of failure: maximum normal stress, maximum shear stress and maximum strain theory.

Unit 2: Axially and Eccentrically Loaded Columns.

Slenderness ratio, end connections, short columns, Euler's critical buckling loads, eccentrically loaded short columns, cylinder columns subjected to axial and eccentric loading.

Unit 3: Deflections of beams:

Introduction, slope and deflections in beams by differential equations, moment area method and conjugate beam method, unit load method, principle of virtual work, Maxwell's Law of Reciprocal Deflections, Williot's Mohr diagram

Unit 4: Analysis of Statically Indeterminate Structures:

Introduction, Static and Kinematic Indeterminacies, Castigliano's theorems, Strain energy method, Analysis of frames with one or two redundant members using Castigliano's 2nd theorem.

Course Outcome

1. To evaluate the stresses due to combined loading analytically as well as graphically
2. To understand the behaviour of different kind of columns under axial as well as eccentric loading
3. To analyse the deflection of beams
4. To understand the concepts/ broad methods, sub-methods involved in the analysis of indeterminate structures.

References Books

1. Statically Indeterminate Structures, C.K. Wang, McGraw Hill Book Co., New York.
2. Advanced Structural Analysis, A.K. Jain, Nem Chand & Bros., Roorkee.
3. Indeterminate Structures, R.L. Jindal, S. Chand & Co., New Delhi.
4. Theory of Structures, Vol. I, S.P. Gupta & G.S.Pandit, Tata McGraw Hill, New Delhi.

CEPC16	FLUID MECHANICS	PC	3	1	0	4

Internal:50 Marks	End Term: 50 Marks	Total:100 Marks

Course Content

1. Introduction

Fluid properties, mass density, specific weight, specific volume and specific volume and specific gravity, surface tension, capillarity, pressure inside a droplet and bubble due to surface tension, compressibility viscosity, Newtonian and Non-newtonian fluids, real and ideal fluids.

2. Kinematics of Fluid Flow

Stready & unsteady, uniform and non-uniform, laminar & turbulent flows, one, two & three dimensional. flows, stream lines, streak lines and path lines, continuity equation in differential form, rotation and circulation, elementary explanation of stream function and velocity potential, rotational and irrotational flows, graphical and experimental methods of drawing flownets.

3. Fluid Statics:

Pressure-density-height relationship, gauge and absolute pressure, simple differential and sensitive manometers, two liquid manometers, pressure on plane and curved surfaces, center of pressure, Buoyancy, stability of immersed and floating bodies, determination of metacentric height, fluid masses subjected to uniform acceleration, free and forced vortex.

4. Dynamic of Fluid Flow

Euler's equation of motion along a streamline and its integration, limitation of Bernoulli’s equation, Pitot tubes, venturimeter, Orficemeter, flow through orifices & mouth pieces, sharp crested weirs and notches, aeration of nappe.

5. Laminar Flow:

Navier Stoke's equation, Laminar flow between parallel plates, Couette flow, laminar flow through pipes-Hagen Poiseuille law, laminar flow around a sphere-Stokes'law.

6. Flow through pipes

Types of flows-Reynold's experiment, shear stress on turbulent flow, boundary layer in pipes-Establishment of flow, velocity distribution for turbulent flow in smooth and rough pipes, resistance to flow of fluid in smooth and rough pipes, Stanton and Moody's diagram. Darcy's weisbach equation, other energy losses in pipes, loss due to sudden expansion, hydraulic gradient and total energy lines, pipes in series and in parallel, equivalent pipe, branched pipe, pipe networks, Hardy Cross method, water hammer.

7. Drag and Lift

Types of drag, drag on a sphere, flat plate, cylinder and airfoil, development of lift on immersed bodies like circular cylinder and airfoil.

8. Dimensional Analysis and Hydraulic Similude

Dimensional analysis, Buckinghum theorem, important dimensionless numbers and their significance, geometric, kinematic and dynamic similarity, model studies, physical modeling, similar and distorted models.

Reference Books

1. Theory and application of fluid Mechanics including Hydraulic Mechanics by K Subramanya
2. Introduction to Fluid Mechanics by Robert N.Fox & Alan T.Macnold
3. Hydraulic and Fluid Mechanic by P.N.Modi & S.M.Seth
4. Introduction to Fluid Mechanics by Robert W.Fox & Alan T.McDonald
5. Fluid Mechanics Through Problems by R.J.Garde
6. Engineering Fluid Mechanics by R.J.Garde & A.G.Mirajgaoker

CELR12	MATERIAL TESTING (P)	ELR	0	0	2	1

Internal:60 Marks	End Term: 40 Marks	Total:100 Marks

Course Content

Tests on Cement

1. Standard consistency of cement using Vicat's apparatus.
2. Fineness of cement by Sieve analysis and Blaine's air permeability method.
3. Soundness of cement by Le-Chatelier's apparatus.
4. Setting time of cement, initial and final.
5. Compressive strength of cement.
6. Measurement of specific gravity of cement.
7. Measurement of Heat of Hydration of cement.

Tests on Aggregate

1. Moisture content and bulking of fine aggregate.
2. Fineness modulus of coarse and fine aggregates.

Tests on Concrete

1. Workability of cement concrete by (a) Slump test, (b) Compaction factor test, (c) Flow table test
2. Compressive strength of concrete by (a) Cube test, (b)Cylinder test
3. Indirect tensile strength of concrete-split cylinder test.
4. Modules of rupture of concrete by flexure test
5. Bond strength between steel bar and concrete by pull-out test
6. Non-destructive testing of concrete

Tests on other materials

1. Bending test on timber and plywood.
2. Compression test on timber.
3. Compressive strength, water absorption and efflorescence test on bricks.
4. Flexural strength of flooring and roofing tiles.
5. Abrasion test of flooring tiles: marble and mosaic tiles.
6. Tensile Strength, elongation, proof stress and ultimate strength of Steel Bars

CELR14	**FLUID MECHANICS (P)**	**ELR**	0	0	2	1

Course Content

Fluid Mechanics – Laboratory Experiments

1. To determine metacentric height of the ship model.
2. To verify the Bernoulli's theorem.
3. To determine coefficient of discharge for an Orificemeter/ venturimeter.
4. To determine coefficient of discharge for an Orifice under variable head.
5. To calibrate a given notch.
6. To study velocity distribution in a rectangular open channel.
7. To determine the coefficient of drag by Stoke's law for spherical bodies.
8. To study the phenomenon of cavitation in pipe flow.
9. To determine the critical Reynold's number for flow through commercial pipes.
10. To determine the coefficient of discharge for flow over a broad crested weir.
11. To study the characteristics of a hydraulic jump on a horizontal floor and sloping glacis including friction blocks.
12. To study the momentum characteristics of a given jet.
13. To determine head loss due to various pipe fittings.

CEPC21	STRUCTURAL ANALYSIS-II	PC	3	1	0	3

Internal:50 Marks	End Term: 50 Marks	Total:100 Marks

Pre-requisites: Structural Analysis – I

1 Analysis of continuous beam and frames

Slope deflection method, moment distribution method, Kani's method, Approximate analysis of frames for vertical and lateral loads

2. Unsymmetrical Bending

Introduction Centroidal principal axes of sections, Bending stresses in beam subjected to unsymmetrical bending, shear centre, shear centre for channel, Angles and Z sections.

3. Rolling Loads and Influence lines Diagrams

Introduction, Single concentrated load, uniformly distributed load longer than span, shorter than span , two point loads, several point loads, Max.B.M. and S.F.Absolute, Max.B.M.

Introduction, influence lines for three hinged and two hinged arches, load position for Max.S.F. and B.M. at a section in the span.

Muller-Breslau Principle, I.L. for B.M. & S.F. for continuous Beams.

4. Analysis of Arches:

Three Hinge Arches: Horizontal thrust, shear force and Bending Moment diagram
Two Hinge Arches: Parabolic and circular arches, Bending Moment Diagram for various loadings, temperature effets, web shortening, Axial thrust and Radial Shear force diagrams.
Fixed Arches: Expression for Horizontal thrust and Bending Moment at a section, elastic centre

Course Outcome

1. To analysis the structures using different displacement methods
2. To understand the behaviour of structure under unsymmetrical bending
3. To understand influence line diagram and be able to draw influence lines for various functions of determinate and indeterminate structures
4. To analyse the arches

References Books

1. Indeterminate structures, R.L.Jindal S.Chand & Co.,N.Delhi.Advanced Structural Analysis-A.K.Jain, NemChand & Bros.,Roorkee.
2. Structural Analysis-A Unified Approach, D.S.Prakash Rao,, University Press, Hyderabad.
3. Structural Analysis-A unified classical & Matrix Approach, A.Ghali & A.M.Neville,Chapman & Hall London.
4. Theory of Strucutres,- Vol. I&II,- S.P.Gupta & G.S.Pandit, Tata McGraw Hill, N.Delhi.

CEPC23	SURVEYING-I	PC	3	1	0	4

Internal:50 Marks	End Term: 50 Marks	Total:100 Marks

Course Objectives:

1. To understand the importance of surveying in Civil engineering
2. To study the basic of linear/angular/direction measurements using chain/tacheometer/compass and theodolite and their applications
3. To study the method of determination of height of points using various leveling method and Tacheometer
4. To study the significance of Plane Table surveying in preparation of map and setting of different types of curves
5. To study the determination of coordinates using satellite based method

Course Content

UNIT-I

1. Basics of Surveying: Definition, objects, classification, fundamental principles, methods of fixing stations, concept of Geoid and reference spheroids,
2. Linear measurement: Direct measurement, instruments for measuring distance, instruments for making stations, chaining of line, errors in chaining, tape corrections examples, Chain traversing
3. Direction Measurement: Bearings and angles; Compass surveying- magnetic bearings, prismatic and surveyors compass, declination, local attraction errors and adjustments; Methods of compass traversing, checks in traversing, adjustment of closed traverse,

UNIT-II

4. Angle Measurement: Theodolite: Theodolites, temporary adjustment of theodolite, measurement of horizontal and vertical angles, theodolite traverse.
5. Leveling: Definition of terms used in leveling, types of levels and staff, temporary adjustment of levels, principles of leveling, spirit and trigonometric levelling, reduction of levels, booking of staff readings, plane and geodetic trigonometric levelling, correction due to curvature and refraction, axis signal correction, Contouring, contour, characteristics of contours lines, locating contours, interpolation of contours, use of contours.

UNIT-III

6. Plane Table Surveying: Plane table accessories, various methods of plane table surveying, two point and three point problems, sources of error, advantages and disadvantages
7. Curves: Classification of curves, elements of simple circular curve, location of tangent points-chain and tape methods, instrumental methods, examples of simple curves Transition Curves-Length and types of transition curves, length of combined curve, examples. Vertical Curves: Necessity and types of vertical curves, setting out of a vertical curve by tangent correction, chord gradient and sight distance method.

UNIT-IV

8. Tacheometry: Principle of tacheometry, stadia and tangential method of tacheometry
9. GNNS: Global Navigation Satellite System (GNSS): basic concepts, History of GPS, GPS design objectives and details of segments: space, control and user. Brief of different GPS systems, including, NAVSTAR GPS, GLONASS, GALILEO,IRNSS, BeiDou etc, Advantages and limitations of GPS. GPS Signal structure: Carriers frequencies, GPS codes: C/A, P, navigational message, GPS receiver: Types. Principles of GPS position fixing, Pseudo ranging and carrier phase, GPS errors.

Reference Books

Surveying volume I and II: B C Punmia
Engineering Surveying (Sixth Edition): W. Schofield
Text Book of Surveying: C.Venkataramiah
Introduction to GPS: The Global Positioning System: Ahmed El-Rabbany
Various Online resources including NPTEL

Course outcomes: On completion of the course, the students would be able to: carry out surveying in the field for various civil engineering projects, prepare a contour map and plan of the area, taking accurate measurements with different surveying instruments, adjustment of traverse, understand the process of setting of different curves for road and railway designs

CEPC25	DESIGN OF STEEL STRUCTURES	PC	3	0	2	4

Internal:50 Marks	End Term: 50 Marks	Total:100 Marks

Pre-requisites: Knowledge of Structural Analysis-I

Course Content

1. **Elementary Limit Analysis and Design**

Introduction, Scope of plastic analysis, ultimate load carrying capacity of tension members and compression members, flexural members, shape factor, mechanisms, plastic collapse, analysis, plastic analysis applied to steel beams and simple portal frames and design.

Connections

Importance, various types of connections, simple and moment resistant, riveted, bolted and welded connections.

Design of Tension Members

Introduction, types of tension members, net sectional areas, design of tension members, lug angles and splices.

Design of Compression Members

Introduction, effective length and slenderness ratio, various types of sections used for columns, built up columns, necessity, design of built up columns, laced and battened columns including the design of lacing and battens, design of eccentrically loaded compression members.

2. **Design of Beams**

Introduction, types of sections, general design criteria for beams, design of laterally supported and unsupported beams, design of built up beams, web buckling, web crippling and diagonal buckling.

Plate Girder

Introduction, elements of plate girder, design steps of a plate girder, necessity of stiffeners in plate girder, various types of stiffeners, web and flange splices (brief introduction), Curtailment of flange plates, design beam to column connections: Introduction, design of framed and seat connection.

3. **Column Bases and Footings**

Introduction, types of column bases, design of slab base and gussested base, design of gussested base subjected to eccentrically loading, design of grillage foundations.

Beam Column

Introduction, bending about one axis, bending about both axes, boundary constraints, design considerations

4. **Roof Trusses**

Types and compoenents of roof truss, estimation of wind load, design of purlin with and without sag rod, lateral bracing and design of roof truss.

Cold Formed Sections

Introduction and brief description of various type of cold formed sections, local buckling, concepts of effective width and effective sections, elements with stiffeners, design of compression and bending elements.

Reference Books

1. Design of Steel Structures, A.S.Arya & J.L.Ajmani, Nem chand & Bros., Roorkee.
2. Design of Steel Structures, M.Raghupati, TMH Pub., New Delhi.
3. Design of Steel Structures, S.M.A.Kazmi & S.K.Jindal, Prentice Hall, New Delhi.
4. Design of Steel Structures, S.K.Duggal, TMH Pub., New Delhi.

Corse Outcome: On completion of the course, the students shall be able to:

1. Design Tension Members, Lug Angles and Splices.
2. Design Compression Members, Built-Up Compression Members.
3. Design a Welded and Riveted connection.
4. Design Plate Girders and Gantry Girders.
5. Design Roof trusses, Purlin, joints and end bearings of Steel Structures.

CEPC27	WATER SUPPLY AND TREATMENT	PC	3	1	0	4

Internal:50 Marks	End Term: 50 Marks	Total:100 Marks

Course Learning Objectives

1. To make the students conversant with sources of water and types of water demand
2. To understand the basic characteristics of water and its determination
3. To expose the students to understand components of water supply scheme
4. To provide adequate knowledge about the water treatment processes and its design
5. To have adequate knowledge on water conveyance and distribution network

Course Content

1 Water Quantity

Importance and necessity of water supply scheme. Components of water supply scheme, water demands and its variations. Population forecasting, estimation of total quantity of water requirement, quality and quantity of surface and ground water sources, selection of a source for water supply, types of intakes, pumps and pumping stations.

2 Water Quality

Sources of impurities, type of impurities in water and their sanitary significance, physical, chemical and bacteriological analysis of water, water quality standards.

3 Water Treatment

Objectives, treatment processes and their sequence in conventional water treatment plant, aeration, sedimentation – plain and aided with coagulation- types, features and design aspects, mixing basins and flocculation units. Filtration – mechanisms, types of filters - slow and rapid sand filtration units (features and design aspects), disinfection - theory, methods and practices, specific water treatment methods

4 Water Conveyance and Distribution

Hydraulic design of pressure pipe, pipe materials, types of distribution system – gravity system, pumping system, dual system, layout of distribution system – dead end system, grid iron system, ring system, radial system, their merits and demerits, distribution reservoir - functions and determination of storage capacity.

Reference Books

1. Water Supply and Sewerage: E.W. Steel.
2. Water Supply Engineering: S.R. Kshirsagar.
3. Water Supply Engineering: S.K. Garg.
4. Water Supply Engineering: B.C. Punmia.
5. Environmental Engineering: Peavy H. S., Rowe D. R. and Tchobanoglous G.
6. Introduction to Environmental Engineering: Davis M. L. and Cornwell D. A.
7. Water Supply and Sanitary Engineering: Birdie, G. S. and Birdie
8. Manual on Water Supply and Treatment: Ministry of Urban Dev., New Delhi.

Course outcomes

On completion of the course, the students will be able to

1. Forecast the population and estimate water demand
2. Analyze various water quality parameters
3. Differentiate various intake structures
4. Design various water treatment units and distribution network

CEPC29	IRRIGATION ENGINEERING	PC	3	1	0	4

Internal: 50 Marks	End Term: 50 Marks	Total: 100 Marks

Course Content

1. Introduction

Irrigation-necessity, impact of irrigation on human environment, need and historical development of irrigation in India, National water policy- Haryana Scenario, crops and crop seasons with crop water requirement.

2. Soil-water relationship and irrigation methods

Soil-water relationship, infiltration, basic terminology such as field capacity, wilting point, deltas, duty of water, flooding methods, border strip method, check basin and furrow method, assessment of irrigation water, sprinkler irrigation and its design, drip irrigation & its design.

3. Canal irrigation

Components of canal distribution system, alignment & losses of channels, Kennedy's and Lacey's theories and design procedure, Garrets and Lacey's diagrams.

4. Water logging and land reclamation

Water logging-effects, causes & preventive measures, lining of irrigation channels with types & design of lined channel, land drainage, open & closed drains design considerations, advantages of tile drains, discharge and spacing of closed drains, methods of land reclamation, quality of irrigation water.

5. River Training

River training and its objectives, classification of river training works, methods of river training, marginal embankments, guide banks, spurs, cutoffs, bank pitching and launching apron.

6. Canal outlets

Classification, requirements of a good outlet, design of pipe, APM and open flume outlet, flexibility proportionality, setting and sensitivity of outlet.

7. Diversion canal head works

Various components and their functions, layout plan, Bligh's creep theory, Khosla's method of independent variables, use of Khosla's curves, various corrections.

8. Regulation works

Canal falls-necessity and location, roughening devices, design of Sarda type fall. Off-take alignment, cross-regulator and distributory head regulators, devices to control silt entry into the off-taking channel and silt ejector, canal escapes.

Reference Books

1. Sharma, S.K., Principles and Practice of Irrigation Engg., S.Chand & Co, 1984.
2. Arora K R "Irrigation Water Power & Water Resources Engineering" Standard Publishers & Distributors, Delhi, 2002.
3. Garg S K "Irrigation Engineering & Hydraulic Structures" Khanna Publisherts, Delhi, 1995.

4. Varshney, Gupta & Gupta “Irrigation Engineering & Hydraulic Structure” Nem Chand & Bros., Roorkee, 1982.
5. Punmia, B.C., Irrigation and Water Power Engineering, Standard Publishers, 2001.
6. Modi P N “ Irrigation ,Water Resources and Water Power Engg” Standard Book House N Delhi 2000
7. A M Michael “Irrigation Theory and Practice” Vikas Publishing House Pvt Ltd N Delhi 2011

CELR21	STRUCTURAL ANALYSIS (P)	ELR	0	0	2	1
Internal:60 Marks	End Term: 40 Marks	Total:100 Marks				

Pre-requisites: Knowledge of Structural Analysis-I

Course Content

1. Verification of reciprocal theorem of deflection using a simply supported beam.
2. Verification of moment area theorem for slopes and deflections of the beam.
3. Deflections of a truss- horizontal deflections & vertical deflections of various joints of a pin- jointed truss.
4. Elastic displacements (vertical & horizontal) of curved members.
5. Experimental and analytical study of 3 hinged arch and influence line for horizontal thrust.
6. Experimental and analytical study of behaviour of struts with various end conditions.
7. To determine elastic properties of a beam.
8. Experiment on a two hinged arch for horizontal thrust & influence line for
9. Horizontal thrust
10. Experimental and analytical study of a 3 bar pin jointed Truss.
11. Experimental and analytical study of deflections for unsymmetrical bending of a Cantilever beam.
12. Experimental and analytical study of an elastically coupled beam.
13. Sway in portal frames - demonstration.
14. To study the cable geometry and statics for different loading conditions.

Corse Outcome: On completion of the course, the students shall be able to:

1. Verification of reciprocal theorem and moment area theorem
2. Analysis of truss and curved members
3. Analysis of three hinge arches
4. Determine elastic properties of beam and analysis of struts

CELR23	SURVEYING-I (P)	ELR	0	0	3	1

Internal:60 Marks	End Term: 40 Marks	Total:100 Marks

Course Content

1. Chain Traversing
2. Compass Traversing
3. Differential Leveling
4. Fly Levelling
5. Cross Sectioning
6. Profile leveling
7. Plane Table surveying: Radiation and Intersection
8. Resection- 2 and 3-point problem with plane Table
9. Working with digital level

Course outcomes:

- On completion of the course, the students will be able to:
- Use conventional surveying tools such as chain/tape, compass, plane table, levels in the field for various civil engineering applications.
- Enter observation in field book, adjusting and plotting a traverse
- Use plane table to prepare map of a small area.

CELR25	ENVIRONMENTAL ENGINEERING –I (P)	ELR	0	0	2	1

Internal:60 Marks	End Term: 40 Marks	Total:100 Marks

Course Learning Objectives

1. To analyze the physical and chemical characteristics of water
2. To quantify chlorine requirement for disinfection
3. To quantify the chemical requirement for turbidity removal
4. To study bacterial contamination of water

Course Content

Physical, chemical and bacteriological characterization of water and chemical dose determination for water treatment by performing following laboratory experiments:

1. To determine the pH value of a given sample of water
2. To determine the turbidity of a given water sample
3. To determine free residual chlorine in a given sample of water
4. To determine the conductivity of a given water sample
5. To determine the chloride concentration in a given sample of water
6. To determine the optimum coagulant dose
7. To determine the temporary and permanent hardness in a given water sample.
8. To determine the chlorine dose required for a given water sample
9. To determine the dissolved oxygen (DO) in a given sample of water.
10. To determine the MPN coliform per 100 ml of a given sample of water
11. To determine the total plate count of a given water sample
12. Microscopic studies of water

Course Outcomes

On completion of the course, the students will be able to

1 Apply different analysis techniques for the measurement of physical and chemical parameters of wastewater
2 Quantify the pollutant concentration in water and wastewater
3 Recommend the degree of treatment required for the water
5. Assess the microbial contamination in water

CEPC22	DESIGN OF CONCRETE STRUCTURES-I	PC	3	0	2	4

Internal:50 Marks	End Term: 50 Marks	Total:100 Marks

Pre-requisites: Knowledge of Structural Analysis
Course Assessment: Continuous assessment (through assignments/Mid-semester Evaluation), End semester Examination.

Course Content

1. Design Philosophies in Reinforced Concrete
Working stress and limit state methods, Limit state v/s working stress method, Building code, Normal distribution curve, characteristic strength and characteristics loads, design values, Partial safety factors and factored loads, stress -strain relationship for concrete and steel.

2. **Design of flexural member : Limit State Method**
Basic assumptions, Analysis and design of singly, doubly reinforced rectangular sections & T beams and continuous beams.

3. Design of Slabs
One way and Two Ways Slabs
General considerations, Design of one way and two ways slabs for distributed and concentrated loads, Non-rectangular slabs, openings in slabs.

4. Columns and Footings
Effective length, Minimum eccentricity, short columns under axial compression, Uniaxial and biaxial bending, slender columns, Isolated and wall footings.

5. Foundations
Combined footings, raft foundation, design of pile cap and piles, under-reamed piles.

Reference Books

1. Design of Reinforced Concrete Structures,P.Dayaratnam,Oxford & IBH Pub.,N.Delhi.
2. Reinforced Concrete-Limit State Design, A.K.Jain, Nem Chand & Bros.,Roorkee.
3. Reinforced Concrete, I.C.Syal & A,K,Goel, A.H,Wheeler & Co.Delhi.
4. Reinforced Concrfete Design, S.N.Sinha, TMH Pub.,N.Delhi.
5. SP-16(S&T)-1980, 'Design Aids for Reinforced Concrete to IS:456, BIS, N.Delhi.
6. SP-34(S&T)-1987 'Handbook on Concrete Reinforcement and Detailing', BIS, N.Delhi.

Corse Outcome: On completion of the course, the students shall be able to:
1. Know various design philosophies for Structural Design
2. Design a Beam structure
3. Design one way and two way slabs
4. Know various design considerations for design of column and footing
5. Design the retaining wall

CEPC24	SOIL MECHANICS	PC	3	1	0	4

Internal:50 Marks	End Term: 50 Marks	Total:100 Marks

Course Learning Objectives:

1. To explain how three phase system is used in soil and how are soil properties estimated using three phase system
2. To explain the role of water in soil behaviour and how soil stresses, permeability and quantity of seepage including flow net are estimated
3. To emphasis the importance of soil stress distribution and stress influence due to varies loads.
4. To explain how soil shear parameters are affected by drainage conditions
5. To explain mechanism of compaction, factors affecting, and effects of compaction on soil properties
6. To estimate the magnitude and time-rate of settlement due to consolidation.

Course Content

1. Soil Formation and Composition

Introduction, soil and rock, Soil Mechanics and Foundation Engineering, origin of soils, weathering, soil formation, major soil deposits of India, particle size, particle shape, interparticle forces, soil structure, principal clay minerals.

2. Basic Soil Properties

Introduction, three phase system, weight-volume relationships, soil grain properties, soil aggregate properties, grain size analysis, sieve analysis, sedimentation analysis, grain size distribution curves, consistency of soils, consistency limits and their determination, activity of clays, relative density of sands.

3. Classification of soils

Purpose of classification, classification on the basis of grain size, classification on the basis of plasticity, plasticity chart, Indian Standard Classification System.

4. Permeability of Soils

Introduction, Darcy's law and its validity, discharge velocity and seepage velocity, factors affecting permeability, laboratory determination of coefficient of permeability, determination of field permeability, permeability of stratified deposits.

5. Effective Stress Concept

Principle of effective stress, effective stress under hydrostatic conditions, capillary rise in soils, effective stress in the zone of capillary rise, effective stress under steady state hydro-dynamic conditions, seepage force, quick condition, critical hydraulic gradient, two dimensional flow, Laplace's equation, properties and utilities of flownet, graphical method of construction of flownets, piping, protective filter.

6. Compaction

Introduction, role of moisture and compactive effect in compaction, laboratory determination of optimum moisture content, moisture density relationship, compaction in field, compaction of cohesionless soils, moderately cohesive soils and clays, field control of compaction.

7. Vertical Stress Below Applied Loads

Introduction, Boussinesq's equation, vertical stress distribution diagrams, vertical stress beneath loaded areas, Newmark's influence chart, approximate stress distribution methods for loaded areas, Westergaard's analysis, contact pressure.

8. Compressibility and Consolidation

Introduction, components of total settlement, consolidation process, one-dimensional consolidation test, typical void ratio-pressure relationships for sands and clays, normally consolidated and over consolidated clays, Casagrande's graphical method of estimating pre-consolidation pressure, Terzaghi's theory of one-dimensional primary consolidation, determination of coefficients of consolidation, consolidation settlement, Construction period settlement, secondary consolidation.

9. Shear Strength

Introduction, Mohr stress circle, Mohr-Coulomb failure-criterion, relationship between principal stresses at failure, shear tests, direct shear test, unconfined compression test, triaxial compression tests, drainage conditions and strength parameters, Vane shear test, shear strength characteristics of sands, normally consolidated clays, over-consolidated clays and partially saturated soils, sensitivity and thixotropy.

10. Earth Pressure

Introduction, earth pressure at rest, Rankine's active & passive states of plastic equilibrium, Rankine's earth pressure theory, Coulomb's earth pressure theory, Culmann's graphical construction, Rebhann's construction.

Reference Books

1. Gopal Ranjan, ASR Rao, Basic and Applied Soil Mechanics, New Age Intetrnational (P) Ltd. Publishers- N.Delhi, Edition No. - 3rd, 2016.
2. Alam Singh, Soil Engg. In Theory and Practice, Vol .I, Fundamentals and General Principles, CBS Pub.,N.Delhi.
3. S.K.Gulati, Engg.Properties of Soils, Tata-Mcgraw Hill, N.Delhi.
4. P.Purshotam Raj, Geotechnical Engg, Tata Mcgraw Hill, N.Delhi, Edition No.- I, 1995.
5. B.M.Das, Principles of Geotechnical Engineering, PWS KENT, Boston.

Course Outcome: On completion of this course, the student will be able to:

1. Understand the formation and structure of soils.
2. Understand the index properties of soil
3. Understand the permeability of soils and factors affecting permeability
4. Understand the concept of seepage
5. Understand Mechanism of compaction, factors affecting, and effects of compaction on soil properties
6. Understand the knowledge of consolidation of soils
7. Understand stress distribution in soils for point loads and areas of different shapes
8. Understand the shear strength of soils.

CEPC26	TRANSPORTATION ENGINEERING –I	PC	3	1	0	4

Internal:50 Marks	End Term: 50 Marks	Total:100 Marks

Pre-requisites: Geotechnical-I, Surveying-I
Course Learning Objectives:

1. To understand the importance of transportation, characteristics of road transport, highway planning, alignment and surveys
2. To know the geometric design of highways
3. To study the traffic characteristics, traffic control devices and principles of signal / intersection design
4. To learn the characteristics, properties and testing procedures of aggregate and bituminous materials
5. To know about granular and bituminous mixes and their designs

Course Content

UNIT-I

1. Introduction

Transportation and its importance. Different modes of transportation. Brief review of history of road development in India and abroad. Road patterns. PMGSY and other Highway projects

2. Highway Plans, Highway Alignment and Surveys

Road development plans in India. Classification of roads. Requirements of an ideal highway alignment. Factors affecting alignment. Engineering surveys for highway alignment.

Unit-II

3. Cross Section Elements and Sight Distance Considerations

Cross section elements, Camber, IRC recommended values. Sight distance: stopping sight distance, overtaking sight distance, overtaking zones, intermediate sight distance, sight distance at intersections, Critical locations for sight distance.

4. Design of Horizontal and Vertical Alignment

Design of superelevation. Providing superelevation in the field. Radius of circular curves. Extra-widening. Length of transition curves. Gradient, Summit and Valley curves, their design criteria. Introduction to software like MXROAD.

UNIT-III

5. Traffic Characteristics and Traffic Surveys

Traffic characteristics. Traffic volume, speed, O & D study, Parking and Accident studies. Fundamental diagram of traffic flow. Level of service. PCU. Capacity for non-urban roads. Road accidents. Introduction to Road Safety Audit

6. Traffic Control Devices

Traffic signs, signals, markings and islands. Design of an isolated fixed time signal by IRC method. Intersections at grade and grade separated intersections. Design of a rotary. Traffic pollution.

UNIT-IV

7. Highway Materials:Soil and Aggregate

Subgrade soil evaluation: CBR test, plate bearing test. Desirable properties of aggregates. Various tests for suitability of aggregates. Proportioning of aggregates for road construction by trial and error method.

8. Bituminous Materials and Bituminous Mixes

Types of bituminous materials: bitumen, tar, cutback and emulsions. Various tests for suitability of bitumen. Bituminous mix, desirable properties. Marshall' method of mix design. Basic concept of use of polymers and rubber modified bitumen in bituminous mixes, use of waste plastic in bituminous mixes.

Reference Books

1. Khanna, S.K. and Justo, C.E.G., Veeraragavan A., “Highway Engineering”, Nem Chand & Bros.
2. Khanna, S.K. and Justo, C.E.G., “Highway Material Testing Manual”, Nem Chand & Bros.
3. Kadiyali, L.R., “Traffic Engineering and Transportation Planning”, Khanna Publishers.
4. Jotin Khisty, C. and Kent Lall, B., “Transportation Engineering – An Introduction”, Prentice Hall.
5. G.V.Rao, Principles of Transportation and Highway Engg, Tata McGraw Hill Pub.
6. Principles of Transportation Engg, P. Chakroborty & Animesh Dass, Prentice Hall of India, 2003.

Course Outcomes:

At the end of the course, the students will be able to:

1. Gain Engineering knowledge of the subject and apply it for the solution of problems related to highway engineering.
2. Design geometrics, signals and intersections, make investigations, use modern tools and develop solutions to highway problems including safety of road users.
3. Understand the engineering solutions in societal and environmental context for sustainable development that takes care of pollution and environment.
4. Understand the norms of engineering practice and the need for life-long learning as per their exposure to relevant latest IS/IRC/MoRTH specifications.

CEPC28	SURVEYING-II	PC	3 1 0	4

Internal:50 Marks	End Term: 50 Marks	Total:100 Marks

Course objectives:

1. To understand the principle of surveying on very large scale by locating precise horizontal controls
2. To learn about surveying applications in setting out works
3. To learn about determining absolute positions of a point using celestial measurements
4. To learn about different types of errors in measurements and their adjustment
5. To introduce the basic concept of photogrammetry, Remote sensing, and GIS

Course Content

UNIT-I

1. Triangulation and Trilateration: Triangulation systems, classification, strength of figure, selection of triangulation stations, grade of triangulation, field work of triangulation, triangulation computations, Trilateration- Principle, Methods, advantages and disadvantages, introduction to total station
2. Survey layout/setting out: Introduction, controls for layout, examples of laying out

UNIT-II

3. Survey Adjustment and computations: Definitions, types of error, weight of an observation, law of weights, most probable values, principle of least squares, method of correlates, normal equation, adjustment of triangulation figures by method of least squares.

UNIT-III

4. Astronomy: Definitions of astronomical terms, celestial coordinate systems, Napier's rule of circular parts, star at elongation, star at prime vertical star at horizon, star at culmination, Astronomical triangle, Time: definitions of sidereal, apparent, solar and mean solar time, equation of time

5. Elements of Photogrammetry: Introduction, types of photographs, Terrestrial and aerial photographs, aerial , camera, scale and height displacements of vertical photographs, Stereoscopic vision and stereoscopes, height determination from parallax measurement, flight planning, principle of photo interpretation.

UNIT-IV

6. Introduction to remote sensing: Definition of Remote Sensing, types of remote sensing, remote sensing system and components. EMR source and characteristics, active and passive remote sensing, EMR propagation through medium, Role of atmosphere, Atmospheric windows, EMR interaction with objects, Spectral signature, EMR interaction with vegetation, soil and water. Satellite orbits and platforms: Geostationary and sun synchronous satellites, Resolution, Applications of remote sensing in civil engineering

7. Geographical Information System (GIS): Definition, and Objectives, Components of GIS, Spatial data models: Raster and Vector, Data inputting in GIS, Linkage between spatial and non spatial data, Spatial data analysis: Vector and raster based spatial data analysis, Integration of RS and GIS data, Digital Elevation Model, GIS Software Packages.

Reference Books

1. Chang.T.K. 2002: Geographic Information Systems, Tata McGrawHill
2. Punmia, B.C. 2005: Surveying I and II, Luxmi Publications
3. Charles D. Ghilani: Adjustment Computations: Spatial Data Analysis (Fifth Edition)
4. Paul R Wolf: Elements of Photogrammetry
5. G S Srivastava: An introduction to Geoinformatics
6. Basudeb Bhatta: Remote Sensing and GIS
7. G. L. Hosmer: Text-book on Practical Astronomy
8. Various Online resources including NPTEL

Course Outcome:

Students would be able to know about advanced methods of locating horizontal controls, set out various civil engineering structures, learn about different types of time and solution of astronomical triangle, apply corrections to the measurements for different errors, understand the difference between aerial photograph and satellite images and their use in map making.

CELR22	COMPUTATIONAL HYDRAULICS (P)	ELR	0	0	2	1

Internal:60 Marks	End Term: 40 Marks	Total:100 Marks

COMPUTATIONAL HYDRAULIC LABORATORY

Course objectives

To provide student skill in problem solving in water resources engineering

Course contents

1. Analysis and design packages in rainfall –runoff modeling
2. Analysis and design packages flood routing
3. Analysis and design packages in water balance model
4. Analysis and design packages in reservoir operation
5. Analysis and design packages for hydraulic structures
6. Design packages for pipe network analysis

Course outcomes

Students will be able to apply software skills in the field of water resources engineering

CELR24	SURVEYING-II (P)	ELR	0	0	3	1

Internal:60 Marks	End Term: 40 Marks	Total:100 Marks

Course Content

1. Study of theodolite
2. measurement of horizontal /Vertical angle with theodolite
3. Measurement of Tacheometric constants
4. Calculating horizontal distance and elevations using tacheometer.
5. Study of Total Station
6. Measurements of distance, elevation, coordinate with total station
7. Special problems with Total station
8. Plan and contour map with a total station and software (including AutoCAD)

Course outcomes:
On completion of the course, the students will be able to:

- Use the theodolite for measuring angles and using tacheometer to determine distance and elevation.
- Use a total station to measure distance, elevation and coordinates
- Use total station to plot a map of given area with softwares

CELR26	SOIL MECHANICS (P)	ELR	0	0	2	1

Internal:60 Marks	End Term: 40 Marks	Total:100 Marks

Course Learning Objectives:

1. To estimate index properties of soils.
2. To estimate consistency limits of fine grained soils.
3. To estimate shear strength of soil by direct shear test, triaxial shear test & unconfined compressive test.
4. To estimate the engineering properties of the soils by density tests & permeability test.

Course Content

1. Visual Soil Classification and water content determination.
2. Determination of specific gravity of soil solids.
3. Grain size analysis-sieve analysis.
4. Atterberg's Limits determination.
5. Field density by:
   a. Sand replacement method
   b. Core cutter method
6. Standard Proctor compaction test.
7. Coefficient of permeability of soils.
8. Unconfined compressive strength test.
9. Direct shear test on granular soil sample.
10. Unconsolidated undrained (UU) triaxial shear test of fine grained soil sample.

Reference Books

1. Gopal Ranjan, ASR Rao, Basic and Applied Soil Mechanics, New Age Intetrnational (P) Ltd. Publishers- N.Delhi, Edition No. - 3rd, 2016.
2. P.Purshotam Raj, Geotechnical Engg, Tata Mcgraw Hill, N.Delhi, Edition No. - I, 1995.

Course Outcome: On completion of this course, the student will be able to:

1. Properly classify soil and can comment on its suitability for construction
2. Estimate soil consistency and compaction characteristics
3. Estimate soil design parameter for shear strength estimation

CELR28	TRANSPORTATION ENGINEERING-I (P)	ELR	0	0	2	1

Internal:60 Marks	End Term: 40 Marks	Total:100 Marks

Pre-requisites: Transportation Engineering-I
Course Learning Objectives:

1. To understand the characterization of highway materials
2. To know the procedure for testing of aggregate and bituminous materials
3. To know the standard specifications of IS/IRC/MoRTH for judging suitability of these materials

Course Content:

1. Aggregate Impact Test
2. Los-Angeles Abrasion Test on Aggregate
3. Crushing Strength Test on Aggregate
4. Flakiness and Elongation Index of aggregates
5. Penetration Test on Bitumen
6. Ductility Test on Bitumen
7. Viscosity Test on Bituminous Material
8. Softening Point Test on Bitumen
9. Flash and Fire Point Test on Bitumen
10. CBR lab test on soil

Course Outcome: On completion of the course, the students shall be able to:

At the end of the course, the students will be able to:

1. Gain Engineering knowledge of the subject and apply it for judging the suitability of highway materials.
2. Make investigations, use modern test tools and develop solutions to use the highway materials for sustainable development that preserves the environment.
3. Understand the norms of engineering practice and the need for life-long learning as per their exposure to relevant IS/IRC specifications.

CEPC31	DESIGN OF CONCRETE STRUCTUTRES-II	PC	3	0	2	4

Internal: 50 Marks	End Term: 50 Marks	Total: 100 Marks

Pre-requisites: Knowledge of Structural Analysis and Concrete Structures-I

Syllabus:

1. Retaining Walls

Classification, Forces on retaining walls, design criteria, stability requirements, Proportioning of cantilever retaining walls, counterfort retaining walls, criteria for design of counteforts, design examples.

2. Design of beams curved in plan

Maximum moments and shear for beams curved in plan, analysis for torsion, torsional reinforcement, design examples.

3. Flat slabs

Advantages of flat slabs, general design considerations, approximate direct design method, design of flat slabs, openings in flat slab

4. Design of staircases

Design of various types of staircases, design examples.

5. Water Tanks

Design requirements of water retaining structures, rectangular and cylindrical underground and overhead tanks, Intze tanks, design considerations, design examples.

6. Silos and Bunkers

Various theories, Bunkers with sloping bottoms and with high side walls, design examples.

7. Prestressed Concrete

Introduction, basic concepts of prestress concrete, various prestressing systems, losses in prestress, initial and final stress conditions, load balancing concept, analysis and design of sections for flexure and shear stresses

8. Yield Line Theory

Basic assumptions, Methods of analysis, yield line patterns and failure mechanisms, analysis of one way and two way rectangular and non-rectangular slabs, effect of top corner steel in square slabs, design examples.

References books

1. Plain and Reinforced Concrete, Vol.2, Jai Krishna & O.P.Jain, Nem Chand & Bros., Roorkee.
2. Pre-Stressed Concrete, N.Krishna Raju, TMH Pub.,N,.Delhi.
3. Design of Prestressed Concrete Structures, T.Y.Lin, John Wiley & Sons., N.Delhi.
4. Reinforced Concrete-Limit StaTge Design, A.K.Jain, Nem Chand & Bros.,Roorkee.
5. IS 1343-1980,IS Code of Practice for Prestressed Concrete.
6. IS 3370-1976(Part I to IV), Indian Standard Code of Practice for Liquid Retaining Structures.
7. IS 456-2000, Indian Standard of Practice for Plain and Reinforced Concrete.

IS 1893, 4326 & 13920 Indian Standard Code of Practice for Earthquake Resistant Design of Structures.

Corse Outcome: On completion of the course, the students shall be able to:

1. Continuous beams, beams curved in plan.
2. Flat slabs and staircase
3. Combined footing, raft foundation and pile foundation.
4. Water tank, silos and bunkers
5. Prestressed members
6. Slab using yield line method

CEPC33	GEOTECHNOLOGY-I	PC	3	1	0	4

Internal: 50 Marks	End Term: 50 Marks	Total: 100 Marks

Pre-requisites: Knowledge of Soil Mechanics

Course Content

1 Sub-Surface Exploration

Purpose, stages in soil exploration, depth and lateral extent of exploration, guidelines for various types of structures, ground water observations, excavation and boring methods, soil sampling and disturbance, major types of samplers, sounding methods-SCPT, DCPT, SPT and interpretation, geophysical methods, pressure-meter test, exploration logs.

2 Drainage & Dewatering

Introduction, ditches and sumps, well point systems, shallow well system, deep well drainage, vacuum method, Electro-osmosis, consolidation by sand piles.

3 Shallow Foundations-I

Design criteria for structural safety of foundation(i) location of footing,(ii) shear failure criterion, (iii) settlement criterion, ultimate bearing capacity, modes of shear failure, Rankine's analysis Tergazi's theory, Skempton's formula, effect of fluctuation of G.W.T. , effect of eccentricity on bearing capacity, inclined load, I.S Code recommendations, factors affecting bearing capacity, methods of improving bearing capacity.

4 Shallow Foundations-II

Various causes of settlement of foundation, allowable bearing pressure based on settlement, settlement calculation, elastic and consolidation settlement, allowable settlement according to I.S.Code. Plate load test and its interpretation, bearing capacity from penetration tests, design bearing capacity.

5 Shallow Foundations-III

Situation suitable for the shallow foundations, types of shallow foundations and their relative merits, depth of foundation, footing on slopes, uplift of footings, conventional procedure of proportioning of footings, combined footings, raft foundations, bearing capacity of raft in sands and clays, various methods of designing rafts, floating foundations.

6 Pile Foundations-I

Introduction, necessity of pile foundations, classification of piles, load capacity, static analysis, analysis of pile capacity in sands and clays, dynamic analysis, pile load tests, negative skin friction, batter piles, lateral load capacity, uplift capacity of single pile, under-reamed pile.

7 Pile Foundations-II

Group action in piles, pile spacing, pile group capacity, stress on lower strata, settlement analysis, design of pile caps, negative skin friction of pile group, uplift resistance of pile group, lateral resistance, batter pile group.

8 Drilled Piers and Caisson Foundations

Drilled piers-types, uses, bearing capacity, settlement, construction procedure. Caissons-Types, bearing capacity and settlement, construction procedure.

Well foundations-shapes, depth of well foundations, components, factors affecting well foundation design lateral stability, construction procedure, sinking of wells, rectification of tilts and shifts, recommended values of tilts & shifts as per I.S.3955.

Reference Books

1. Murthy, V.N.S, A text book of Soil Mechanics and Foundation Engineering, UBS Publishers & Distributors Pvt. Ltd., New Delhi 1999.
2. Punmia, B.C., Soil Mechanics and Foundation Engineering, Laxmi Publications Pvt. Ltd., New Delhi, 1995.
3. Gopal Ranjan, ASR Rao, Basic and Applied Soil Mechanics, New Age Intetrnational (P) Ltd. Publishers- N.Delhi, Edition No. - 3rd, 2016.
4. Nainan P Kurian, Design of foundation Systems Principles and Practices, Narosa, 2011
5. Braja M. Das, Principles of Foundation Engineering, Thomson Asia Pvt. Ltd., Singapore, 2005.
6. Donald P. Coduto, Man-Chu Ronald Yeung and William A. Kitch, Geotechnical Engineering, Principles and Practices, PHI Learning Private limited, 2011.
7. Joseph E. Bowles, Foundation Analysis and Design, McGRAW-Hill, 1998.
8. P.Purshotam Raj, Geotechnical Engg, Tata Mcgraw Hill, N.Delhi, Edition No. - I, 1995

Course Outcome: On completion of this course, the student will be able to:

1. Understand the importance of soil investigation for any civil engineering construction
2. Do proper bearing capacity estimation including IS code methods
3. Do proper foundation proportioning for any kind of shallow foundation system and also get exposed in foundation analysis
4. To estimate pile and pile group capacity for any kind of soils including group efficiency and negative friction
5. To emphasize the importance of soil investigations.
6. To explain the concept of bearing capacity and how to estimate the safe bearing capacity for various foundation system including settlement consideration
7. To explain how to select a suitable shallow foundation system for various site conditions and also analysis of different foundation system
8. To explain in what circumstances pile is needed and how to estimate pile and pile group capacity under various soil conditions

CEPC35	HYDROLOGY & WATER RESOURCES ENGINEERING	PC	3 1 0	4

Internal: 50 Marks	End Term: 50 Marks	Total: 100 Marks

Course objectives

To provide student knowledge in hydrology and hydraulics and understand concepts of water resources systems.

Course contents

1. **Introduction**
   Hydrologic cycle, scope and application of hydrology to engineering problems, drainage basins and its characteristics, stream geometry, hypsometric curves.
2. **Precipitation**
   Forms and types of precipitation, characteristics of precipitation in India, measurement of preciptation, recording and non recording raingages, raingage station, raingage network, estimation of missing data, presentation of rainfall data, mean precipitation, depth -area -duration relationship, frequency of point rainfall, intensity - duration- frequency curves, probable max. precipitation.
3. **Evaporation & Transpiration**
   Process, evaporimeters and empirical relationships, analytical method, reservoir evaporation and methods of its control, transpiration, evapotranspiration and its measurement, Penman's equation and potential evapotranspiration.
4. **Infiltration**
   Infiltration process, initial loss, infiltration capacity and measurement of infiltration, infiltration indices.
5. **Runoff**
   Factor affecting run-off, estimation of runoff, rainfall-run off relationships, measurement of stage-staff gauge, wire gauge, automatic stage recorder and stage hydrograph, measurement of velocity-current meters, floats, area velocity method, moving boat and slope area method, electromagnetic, ultra-sonic and dilution methods of stream flow measurement, stage discharge relationship.
6. **Hydrograph**
   Discharge hydrograph, components and factors affecting shape of hydrograph, effective rainfall, unit hydrograph and its derivation, unit hydrograph of different durations, use and limitations of UH, triangular UH, Snyder's synthetic UH, floods, rational methods, empirical formulae, UH method, flood frequency methods, Gumbel's method, graphical method, design flood.
7. **Ground Water**
   Occurrence, types of aquifers, compressibility of aquifers, water table and its effects on fluctuations , wells and springs, movement of ground water, Darcy's law, permeability and its determination, porosity, specific yield and specific retention, storage coefficient, transmissibility. Steady state flow to wells in unconfined and confined aquifers.
8. **Water Resources Planning**
   Role of water in national development, assessment of water resources, planning process, environmental consideration in planning, system analysis in water planning, some common problems in project planning, functional requirements in multipurpose projects, multipurpose planning, basinwise planning, long term planning.
   Reservoir planning-dependable yield, sedimentation in reservoir, reservoir capacity, empirical-area reduction method.

9. Water Resources Systems Engineering

Concept of system's engineering, optimal policy analysis, simulation and simulation modeling, nature of water resources system, analog simulation, limitations of simulation, objective function, production function, optimality condition, linear, non-linear and dynamic programming, applications to real time operations of existing system, hydrologic modeling and applications of basic concepts.

Reference Books

1 Engineering Hydrology by K.Subramanya.
2 Hydrology by H.M.Raghunath.
3 Hydrology for Engineers by Linsely, Kohler, Paulhus.
4 Water Resources Engineering by Linseley and Franzini
5 Economics of Water Resources Engineering by James and Lee.
6 Optimisation Theory and Applications by S.S.Roy
7 Water Resources Systems Planning & Economics by R.S.Varshney.
8 Operational Research-An Introduction by Hamdy A.Taha.

Course outcomes

Students will be able to understand and measure various hydrologic data required for water resources planning and design of hydraulic structures.

CEPC37	SEWERAGE AND SEWAGE TREATMENT	PC	3	1	0	4

Internal: 50 Marks	End Term: 50 Marks	Total: 100 Marks

Course Learning Objectives

1. To learn basics of sewage collection and design of sewers
2. To learn the basics of sewage composition and its characteristics
3. To have adequate knowledge about various sewage treatment processes and its design
4. To provide adequate information on various disposal standards for treated effluents

Course Content

1 Collection of Sewage

Importance of sanitation, types of sewerage systems – separate, combined and partially separate, quantity of sanitary sewage and variations, shapes of sewer - circular and egg shaped, design of sewers, self-cleansing velocity and slopes, construction and testing of sewer lines, sewer materials, joints and sewer appurtenances, building drainage and plumbing systems.

2 Sewage Characterisation

Quality parameters- BOD, COD, solids, oil and grease, Indian Standards for disposal of effluents into inland surface sources and on land, guidelines for reuse of treated wastewater.

3 Sewage Treatment

Objectives, sequence and efficiencies of conventional treatment units, preliminary treatment, screening and grit removal units, theory and design aspects of primary treatment, secondary treatment- activated sludge process & its modifications, tricking filter, UASB process, introduction to advance sewage treatment systems - sequencing batch reactor (SBR)-moving bed biofilm reactor (MBBR)-membrane bioreactor (MBR), Stabilization pond, aerated lagoon, septic tank, sludge disposal – thickening-digestion-dewatering, introduction of tertiary treatment

4 Disposal of Sewage

Recycling and reuse of treated wastewater, disposal of sewage by dilution - self-purification of streams - Streeter Phelps equation - oxygen sag curve, sewage disposal by irrigation (sewage treatment).

Reference Books

1 Environmental Engineering: Peavy H. S., Rowe D. R. and Tchobanoglous G.
2 Introduction to Environmental Engineering: Davis M. L. and Cornwell D. A.
3 Wastewater Engineering, Collection, Treatment and Disposal: Metcalf and Eddy
4 Water Supply and Sanitary Engineering: Birdie, G. S. and Birdie
5 Sewage and Sewage Treatment: S.K. Garg.
6 Sewage and Sewage Treatment: S.R. Krishansagar.
7 Waste Water Engineering: B.C. Punmia.
8 Manual on Sewerage and Sewage Treatment: Ministry of Urban Dev., New Delhi.

Course outcomes

On completion of the course, the students will be able to

1 Estimate quantity of sewage and design sewerage system
2 Determine the various characteristics of sewage
3 Design various sewage treatment units
4 Plan reuse of treated effluent and select appropriate disposal option

CEPC39	TRANSPORTATION ENGINEERING-II	PC	3	1	0	4

Internal: 50 Marks	End Term: 50 Marks	Total: 100 Marks

Pre-requisites: Transportation Engineering-I, SA-I

Course Learning Objectives:

1. To understand the design of flexible and rigid pavements.
2. To know the construction techniques of highways pavements.
3. To understand the pavement failures and maintenance of pavements including strengthening.
4. To learn economic evaluation of highway projects and sources of financing.
5. To know the basics of tunnel engineering.

Course Content:

UNIT-I

1. Design of Flexible Pavements

Types of pavements. Flexible and rigid pavements. Components of a pavement and their functions. Factors affecting design of pavements. Review of design by old methods, Design of a flexible pavement by CBR method (as per latest IRC guidelines).

2. Design of Rigid Pavements

Westergaard's theory, critical locations of loading, load and temperature stresses. Critical combination of stresses. IRC guidelines for determination of thickness of a rigid pavement. Joints: requirements, types, patterns. Spacing of expansion and contraction joints. Functions of dowel and tie bars.

UNIT-II

3. Highway Construction : Non-Bituminous Pavements

Subgrade and embankment construction, Construction of GSB, WBM, WMM. Construction of DLC & PQC. Fixed form and Slip-form paving techniques.

4. Construction of Bituminous Pavements

Various types of bituminous constructions. Prime coat, tack coat, seal coat and surface dressing. Construction of BUSG, Premix carpet, BM, DBM and BC. Mastic asphalt. Brief introduction to functions of Rollers, paver and hot mix plants. Introduction to various IRC and MoRTH specifications.

UNIT-III

5. Highway Maintenance

Failures and remedies of bituminous and cement concrete pavements. Pavement evaluation. Benkleman beam. Introduction to various types of overlays. Overlay design.

6. Highway Drainage and Hill Roads

Surface drainage: types, brief design. Types of sub-surface drainage. Special characteristics of hill roads: geometrics, hair pin bends.

UNIT-IV

7. Highway Economics and Finance

Need of economic evaluation. Highway user benefits and costs. Methods of economic evaluation, Highway finance. PPP Projects. Rate analysis of MoRTH standard data book & cost estimation.

8. Tunnels

Sections of tunnels, Shaft. Pilot tunnel. Driving tunnel in rocks. Driving tunnel in soft ground. Drainage and Ventilation of Tunnels.

Reference Books

1. Highway Engg by S.K.Khanna & C.E.G. Justo, Veeraragavan A., Nem Chand Bros., Roorkee, 2014.
2. Principles and Practice of Highway Engg. by L.R.Kadiyali, N.B. Lal, Khanna Publishers, Delhi, 2008.
3. Principles of Pavement Design by Yoder,E.J & Witczak,M.W., John Wiley and Sons, USA.
4. Tunnel Engineering by S.C.Saxena, Dhanpat Rai Publications, N.Delhi.
5. A text book of Tunnel, Bridges and Railway Engg. by S.P.Bindra, Dhanpat Rai Delhi.

Course Outcomes:

At the end of the course, the students will be able to:

1. Gain Engineering knowledge of the subject and apply it for the solution of problems related to pavement engineering.
2. Design flexible and rigid pavements, make investigations, use modern tools and develop solutions to problems related to highway pavements.
3. Understand the engineering solutions in societal context for sustainable development that takes care of environment and economical use of resources.
4. Understand the norms of engineering practice and the need for life-long learning as per their exposure to relevant latest IS/IRC/MoRTH specifications.

CELR31	GEOTECHNOLOGY (P)	ELR	0	0	2	1

Internal: 60 Marks	End Term: 40 Marks	Total: 100 Marks

Pre-requisites: Knowledge of Geotechnology

Course Learning Objectives:

1. To estimate index properties of soils
2. To estimate consolidation parameters of clayey soil.
3. To estimate shear strength parameters of soil by triaxial shear test.
4. To estimate the relative density and maximum dry density of soils.
5. To have a feel of plate load test.

Course Content:

1. Grain Size Analysis-Hydrometer method.
2. Modified Proctor compaction Test
3. Relative Density of Granular Soils.
4. Consolidated Drained (CD) Triaxial Test.
5. Consolidated Undrained (CU) Triaxial Test with Pore Water Pressure Measurement.
6. Consolidation Test.
7. Undisturbed Sampling.
8. Standard Penetration Test.
9. Dynamic Cone Penetration Test.
10. Model Plate Load Test.

Reference Books

1. Gopal Ranjan, ASR Rao, Basic and Applied Soil Mechanics, New Age International (P) Ltd. Publishers- N.Delhi, Edition No. - 3rd, 2016.
2. P. Purshotam Raj, Geotechnical Engg, Tata Mcgraw Hill, N.Delhi, Edition No.- I, 1995.

CELR33	TRANSPORTATION ENGINEERING – II (P)	ELR	0	0	2	1

Internal: 60 Marks	End Term: 40 Marks	Total: 100 Marks

Pre-requisites: Transportation Engineering-I & II

Course Learning Objectives:

1. To understand the characterization of highway materials
2. To learn the mix designs of granular, bituminous and CC mixes
3. To learn the use of modern equipment for traffic studies & pavement evaluation
4. To know the standard specifications of IS/IRC/MoRTH for judging suitability of these materials

Course Content:

1. Specific gravity and water absorption test on coarse aggregate
2. Specific gravity of bitumen
3. Stripping test on aggregates
4. Determination of bitumen content and gradation of bituminous mix
5. Granular Mix Design
6. Bituminous Mix Design by Marshall's method
7. Cement concrete mix design for pavements
8. Traffic volume and speed study using videography technique
9. Demonstration of Radar Gun & Automatic Counter Classifier
10. Demonstration of BBD & Bump Integrator

Corse Outcome: On completion of the course, the students shall be able to:

At the end of the course, the students will be able to:

1. Gain Engineering knowledge of the subject and apply it for judging the suitability of highway materials.
2. Make investigations, use modern test tools and develop solutions to use highway materials for sustainable development that preserves the environment.
3. Understand the norms of engineering practice and the need for life-long learning as per their exposure to relevant IS/IRC specifications.

CEPE39	COMPUTATIONAL PRACTICAL	PE	0	0	2	1

Internal: 60 Marks	End Term: 40 Marks	Total: 100 Marks

Pre-requisites: Knowledge of programming language, Structural analysis and drawing.

Solution of the following problems using MATLAB / C language / Excel

1. Design of the structural elements in concrete and steel.
2. Development of simple programs for solving Transportation Engineering problems: Highway geometrics, pavement design.
3. Development of simple programs for solving Geotechnical Engineering problems: Earth pressure, Foundation settlement and stress analysis, Consolidation.
4. Problems in Environmental and Water resources engineering: Treatment systems, Pipe networks analysis, Synthetic Unit hydrograph derivation, Flood routing, Water balance model.

Analysis, Design and detailing using software packages in Structural Engineering/Transportation Engineering/Environmental/Water Resources/Geotechnical Engineering/ GIS and Remote sensing applications

Reference Books

1. Rajasekaran S, Computational Structural Mechanics, Prentice Hall of India, New Delhi, 2001.
2. Manickaselvam V.K., Elements of Matrix and Stability Analysis of Structures, Khanna Publishers, New Delhi, 1998.
3. Software Manuals (STAAD Pro, SAP, ETABS etc.)

Course outcomes

On completion of the course, the students shall be able to:

1. Understand the need for software tools in analysis and design of Civil Engineering Systems
2. Identify the available open source software tools used for specific problems in Civil Engineering
3. Use the latest software tools for Modeling, Analysis and Design of Civil Engineering Systems
4. Apply the software skills in the transportation engineering, water resources and environmental engineering.
5. Apply computing skills to geotechnical engineering.

CEPC41	BRIDGE ENGINEERING	PC	3	1	0	4

Internal: 50 Marks	End Term: 50 Marks	Total: 100 Marks

Pre-requisites: Knowledge of Transportation Engineering and Concrete Structures
Syllabus:

1 Introduction
Definition, components of bridge, classification of bridges, selection of site , economical span and essential design data.

Standard Specifications For Roads And Railways Bridges
General, Indian Road Congress Bridge Code, width of carriage way, clearance, various loads to be considered for the design of roads and railway bridges, detailed explanation of IRC standard live loads.

2 Design Consideration for R. C. C. Bridges
Various types of R.C.C. bridges (brief description of each type) , design of R.C.C. culvert and T-beam bridges, PSC bridges

3 Design Consideration for Steel Bridges
Various types of steel bridges (brief description of each), design of truss and plate girder bridges, composite bridges

4 Hydraulic & Structural Design
Piers, abutments, wingwall and approaches.

Brief Description
Bearings, joints, articulation and other details.

Bridge Foundation
Various types, necessary investigations and design criteria of well foundation.

Reference Books

1. Essentials of Bridge Engineering, D.J.Victor, Oxford & IBH Pub.N.Delhi.
2. Design of Bridges, N.Krishna Raju, Oxford & IBH, N.Delhi.
3. Bridge Deck Analysis, R.P.Pama & A.R.Cusens, John Wiley & Sons.
4. Design of Bridge Structures, T.R.Jagadish & M.A.Jairam, Prentice Hall of India, N.Delhi.

Corse Outcome: On completion of the course, the students shall be able to:

1. Design the slab culvert, Box culvert
2. Design the T beam bridge and substructures
3. Design the Bridge bearings
4. Design the steel bridge for railways

CEPC43	RAILWAY AND AIRPORT ENGINEERING	PC	3	1	0	4

Internal: 50 Marks	End Term: 50 Marks	Total: 100 Marks

Pre-requisites: Transportation Engineering-I&II

Course Learning Objectives:

1. To understand the permanent way and its components
2. To know about points, crossings and train control systems
3. To understand the geometric design of track, about stations, yards and maintenance of tracks.
4. To learn airport layout planning and runway pavement design

Course Content:

UNIT-I
Introduction of Permanent Way
History and general features of Indian railways, Railway Track Gauge, Rails, Sleepers, Track fittings and fastenings, Creep of rails, Ballast, Subgrade and formation, Rail joints and welding of rails, modern welded railway track, Track and Track stresses.

UNIT-II
Stations and Yards, Points and Crossings, and Signalling
Stations and yards, Points and crossings, design of turnouts and crossings, Signalling and interlocking, Train Control systems, Track maintenance and drainage.

UNIT-III
Geometric Design of Track, High speed train systems
Geometric design of track, curves and super elevation, Train resistance and tractive power, Urban Railway system, High speed Tracks, high speed train system technologies, Introduction to RDSO/IS specifications.

UNIT-IV
Airport Planning, Runway Layout and Pavement Design
Airport planning, layout, geometric design, Airport pavements, introduction to runway pavement design software like FAARFIELD

Reference Books

1. Chandra, S. and Agarwal, M. M., "Railway Engineering", Oxford.
2. Arora, S. P. and Saxena, S. C., "A Text Book of Railway Engineering", Dhanpat Rai Publications.
3. Mundrey, J. S., "Railway Track Engineering", Tata Mcgraw Hill.
4. Khanna, S. K., Arora, M. G. and Jain, S. S., "Airport Planning & Design", Nem Chand and Bros.
5. Horonjeff, Robert and McKelvey, Francis X., "Planning & Design of airports', 4th Ed., McGraw Hill.
6. Saxena, S.C., "Airport Engineering – Planning and Design", CBS Publishers.
7. Transportation Engineering by C Venkatramaiah

Course Outcomes:

At the end of the course, the students will be able to:

1. Gain Engineering knowledge of the subject and apply it for the solution of problems related to railway and airport engineering.
2. Design points and crossings, design runway pavements, make investigations, use modern tools and develop solutions to problems related to railway / airport engg.
3. Understand the engineering solutions in societal context for sustainable development that takes care of environment and optimal use of resources.
4. Understand the norms of engineering practice and the need for life-long learning as per their exposure to relevant latest IS/RDSO/FAA/ICAO specifications.

CEPC45	GEOTECHNOLOGY-II	PC	3	1	0	4

Internal: 50 Marks	End Term: 50 Marks	Total: 100 Marks

Pre-requisites: Knowledge of Geotechnology-I

Course Learning Objectives:

1. To explain the concept of earth dam design including stability analysis under seepage.
2. To evaluate stability of slopes under different drainage conditions using different methods.
3. To explain design principles of retaining structures and coffer dams.
4. To explain the concept of soil stabilization.
5. To explain the significance of dynamic load in machine foundation analysis.
6. To explain theory of vibration for different field conditions.
7. To understand salient points of environmental engineering pertaining to Geotechnology

Course Content:

1 Earth Dams

Introduction, types of sections, earth dam foundations, causes of failure and criteria for safe design, control of seepage through the embankment, control of seepage through the foundation, drainage of foundations, criterion for filter design.

2 Stability of slopes

Causes of failure, factors of safety, stability analysis of slopes-total stress analysis, effective stress analysis, stability of infinite slopes types of failures of finite slopes, analysis of finite slopes-mass procedure, method of slices, effect of pore pressure, Fellinius method to locate center of most critical slip circle, friction circle method, Tayler's stability number.

3 Braced Cuts

Depth of unsupported vertical cut, sheeting and bracing for deep excavation, movements associated with sheeting and bracing, modes of failure of braced cuts, pressure distribution behind sheeting.

4 Cofferdams

Introduction, types of cofferdams, design and lateral stability of braced cofferdams, design data for Cellular cofferdams, stability analysis of cellular cofferdams on soil and rock, inter-locking stresses.

5 Cantilever Sheet Piles

Purpose of sheet piles, cantilever sheet piles, depth of embedment in granular soils-rigorous method, simplified procedure, cantilever sheet pile penetrating clay.

6 Anchored Bulkheads

Methods of design, free earth support method in cohesionless and cohesive soils, fixed earth support method in cohesionless soils.

7 Soil Stabilization

Soil improvement, mechanical treatment, use of admixtures, lime stabilization, cement stabilization, lime fly ash stabilization, Bituminous stabilization, chemical stabilization, stone column, grouting, methods of grouting.

8 Basics of Machine Foundations

Terminology, characteristics elements of vibratory systems, analysis of vibratory motions of single degree freedom system-undamped free vibrations, undamped forced vibrations, criteria for satisfactory action of a machine foundation, degrees of a freedom of a block foundation, Barken's soil spring constant, Barken's method of a determining natural frequency of a block foundation subjected to vertical oscillations.

9 Environmental Geotechnology

Introduction, Environmental cycles, natural cycles, development of environmental geotechnology, pollution process, contamination of sub-soil, contaminant transport, quantity of contaminants, contaminated site characterization, composition of solid wastes, waste containment.

Reference Books

1 S.Prakash, Gopal Ranjan & S.Saran, Analysis and Design of Foundation and Retaining Structures, Sarita Prakashan Meerut, 1977.
2 Swami Saran, Analysis and Design of Sub Structures, IBH Oxford
3 Gopal Ranjan, ASR Rao, Basic and Applied Soil Mechanics, New Age Intetrnational (P) Ltd. Publishers- N.Delhi, Edition No. - 3rd, 2016.
4 Shamsher Prakash, Soil Dynamic, McGraw Hill, 1981.
5 Teng, Foundation Design, Prentice Hall, Edition No. - 10th, 1984.
6 P.Purshotam Raj, Geotechnical Engg, Tata Mcgraw Hill, N.Delhi, Edition No.- I, 1995
7 Debashis Moitra, Geotechnical Engineering, Universities Press, Edition No. - I, 2016.

Course Outcome: On completion of this course, the students will be able to:

1. Do earth dam design and stability analysis for all kind of drainage conditions
2. Do stability analysis of any kind of slope and its protection
3. Understand the earth pressure theories and able to calculate lateral earth pressure for different conditions
4. Evaluate depth of embedment for cantilever as well as anchored sheet piles.
5. Learn the concept of soil stabilization and machine foundation
6. Understand salient points of environmental engineering pertaining to Geotechnology

CEPC47	CONSTRUCTION MANAGEMENT, ESTIMATING AND COSTING	PC	3	0	0	3

Internal:50 Marks	End Term: 50 Marks	Total:100 Marks

Pre-requisites: None

Course Content

1 Network Techniques in Construction Management-I:CPM

Introduction, network techniques, work break down, classification of activities, rules for developing networks, network development-logic of network, allocation of time to various activities, Fulkerson's rule for numbering events, network analysis , determination of project schedules, critical path, ladder construction, float in activities, shared float, updating, resources allocation, resources smoothing and resources leveling.

Network Techniques in Construction Management-II-PERT

Probability concept in network, optimistic time, pessimistic time, most likely time, lapsed time, deviation, variance, standard deviation, slack critical path, probability of achieving completion time, central limit theorem.

Cost-Time Analysis

Cost versus time, direct cost, indirect cost, total project cost and optimum duration, contracting the network for cost optimisation, steps in time cost optimisation, illustrative examples.

2 Construction Contracts & Specifications

Introduction, types of contracts, contract document, specifications, important conditions of contract, arbitration.

Necessity of specifications, types of specifications, general specifications, specification for bricks, cement, sand, water, lime, reinforcement; Detailed specifications for Earthwork, Cement, concrete, brick work, floorings, D.P.C., R.C.C., cement plastering, white and colour washing, distempering, painting.

3. Inspection & Quality Control

Introduction, principles of inspection, enforcement of specifications, stages in inspection and quality control, testing of structures, statistical analysis.

a. Estimate

Principles of estimation, units, items of work, different kinds of estimates, different methods of estimation, estimation of materials in single room building, two roomed building with different sections of walls, foundation, floors and roofs, R.B. and R.VC.C. works, Plastering, White-washing, Distempering and painting, doors and windows, lump sum items, Estimates of canals, roads etc.

b. Rate Analysis

Purpose, importance and requirements of rate analysis, units of measurement, preparation of rate analysis, procedure of rate analysis for items:- Earthwork, concrete works, R.C.C. works, reinforced brick work, plastering, painting, finishing(white-washing, distempering).

4. Public Works Account

Introduction, function of P.W. department, contract, guidelines, types of contracts, their advantages and disadvantages, Tender and acceptance of tender, Earnest money, security money, retention money, measurement book, cash book, preparation, examination and payment of bills, first and final bills, administrative sanction, technical sanction.

Reference Books

1. Construction Planning & Management by P.S.Gehlot & B.M.Dhir, Wiley Eastern Ltd.
2. PERT & CPM -Principles & Applications by L.S.Srinath. Affiliated East-west Press(P)Ltd.
3. Project Planning & Control with PERT & CPM by B.C.Punia & K.K.Khandelwal,Lakshmi Pub. Delhi
4. Construction Management & Planning by B.sengupta & H.Guha, Tata McGraw Hills.
5. Estimating and Costing for Building & Civil Engg.Works by P.L.Bhasin, S.Chand & Co., N.Delhi.
6. Estimating, Costing & Specification in Civil Engg. by M.Chakarborty, Calcutta.
7. Estimating & Costing in Civil Engg..: Theory & Practice by B.N.Dutta, S.Dutta & Co., Lucknow.
8. Building Construction Estimating by George H.Cooper, McGraw Hill Book Co., New York.

Corse Outcome: On completion of the course, the students shall be able to:

1. Understand the roles and responsibilities of a project manager
2. Prepare schedule of activities in a construction project
3. Prepare tender and contract document for a construction project
4. Understand safety practices in construction industry
5. Identify the equipment used in construction

CEPC42	OPEN CHANNEL HYDRAULICS	PC	3	1	0	4

Internal: 50 Marks	End Term: 50 Marks	Total: 100 Marks

Syllabus

1. **Basic fluid flow concepts**
   Definition, importance of study of open channel flow, Types of channels, Classification of Flows, Velocity distribution, One-Dimensional method of flow analysis, Pressure Distribution, Equation of Continuity, Energy Equation, Momentum equation.
2. **Energy-Depth Relationships**
   Specific Energy, specific fore, Critical Flow, critical depth, Calculation of Critical Depth for some shapes of channels.
3. **Uniform Flow in rigid boundary channels**
   Introduction, shear stress on boundary, shear stress in open channels, velocity distribution and effect of secondary circulation on velocity distribution, flow over roughness elements, Chezy Equation, Darcy-Weisbach Friction Factor, Manning's roughness Formula, Resistance Formulate for Practical Use, Normal Depth and it computation for some shapes of channels.
4. **Uniform Flow in mobile boundary channels**
   Incipient motion, Shield's diagram, regimes of flow, bed forms, sediment load and its measurement, regime channels, design of stable channels.
5. **Hydraulic Jump**
   Occurrence and importance, Momentum Equation for hydraulic Jump, computation of sequent depth, Classification of Jumps, Characteristics of Jump in a Rectangular Channel, location of jump, Hydraulic jump application, Use of the Jump as an Energy Dissipater.
6. **Rapidly-Varied Flow**
   Weirs, Sharp-crested Weir, Broad-crested Weir, submergence of weirs, Critical-Depth Flumes, Sluice-gate Flow, free and submerged flow and its analysis of sluice gate, free overfall.

Reference Books

1. Chow Ven Te, "Open Channel Hydraulics". McGaw Hill International Edition.
2. Ranga Raju, K.G. "Flow Through Open Channel". Tata McGraw-Hill
3. Choudhary, Hanif "Open Channel Hydraulics" Prentice Hall of India
4. Subramanya K. "Flow in Open Channels". Tata McGraw-Hill
5. Srivastava, R. "Flow Through Open Channels". Oxford University Press.

CEPC44	INDUSTRIAL WASTE WATER TREATMENT	PC	3	1	0	4

Internal: 50 Marks	End Term: 50 Marks	Total: 100 Marks

Course Learning Objectives

1 To study characteristics of industrial wastewater and its effects on water bodies
2 To know the quality of industrial effluents required before disposal on environment
3 To learn various physico-chemical and biological treatment techniques to treat industrial wastewater
4 To gain knowledge about the reuse of treated industrial effluents

Course Content

Prevention Vs control of industrial pollution, zero discharge concept, effects of industrial waste disposal on streams, sewerage systems and wastewater treatment plants, effluent standards for disposal into inland surface water sources and on land for irrigation, industry specific standards, quality requirements for reuse, various steps to minimize effects of industrial effluents on waste water treatment plants and receiving streams-conservation of water, process change, reuse of waste water, volume reduction, strength reduction, neutralization, equalization and proportioning, population equivalent, common effluent treatment plant (CETP), study of the following industries from waste generation, quality and its treatment including brief overview of manufacturing process: Textile, tannery, sugar mill, distillery, dairy, pulp & paper, metal plating, oil refinery, nitrogenous fertilizers, thermal power plants and radioactive wastes.

Reference Books

1 Industrial and Hazardous Waste Treatment: N. L. Nemerow and A. Dasgupta.
2 Industrial Effluents by N. Manivasakam
3 Waste Water Treatment: M. N. Rao and A. K. Dutta
4 Industrial Water Pollution Control: W. W. Eckenfelder
5 Handbook of Industrial Pollution and Control, Volume I & II: S. C. Bhatia
6 Pollution Control in Process Industries: S. P. Mahajan

Course outcomes

On completion of the course, the students will be able to

1 Recognize various environmental problems due to improper management of industrial wastewater
2 Determine appropriate technologies for treatment and management of industrial wastewater
3 Recommend different techniques for the safe disposal of industrial effluents
4 Analyse the quality requirements for reuse of industrial effluents

CELR42	ENVIRONMENTAL ENGINEERING – II (P)	ELR	0	0	2	1

Internal: 50 Marks	End Term: 50 Marks	Total: 100 Marks

Course Learning Objectives

1. To analyze the physical and chemical characteristics of wastewater
2. To familiarize the methods to estimate the organic strength of wastewater
3. To study the growth of microorganisms and its quantification

Course Content

Physical, chemical and bacteriological characterization of wastewater and strength assessment of wastewater by performing following laboratory experiments:

1. To determine the acidity of a wastewater sample
2. To determine the alkalinity of a wastewater sample
3. To determine total, suspended, dissolved and settable solids in a wastewater sample
4. To determine volatile and fixed solids in a wastewater sample
5. To determine oil and grease in a wastewater sample
6. To determine the chloride concentration in a wastewater sample.
7. To determine the sulphate concentration in a wastewater sample.
8. To determine the B.O.D. of a given wastewater sample.
9. To determine the C.O.D. of a given wastewater sample.
10. To determine the T.O.C. of a given wastewater sample.
11. To determine the fecal count of a given wastewater sample.
13. Microscopic studies of a wastewater

Course Outcomes

On completion of the course, the students will be able to

1 Apply different analysis techniques for the measurement of physical and chemical parameters of wastewater
2 Quantify the pollutant concentration in wastewater
3 Recommend the degree of treatment required for the wastewater
4 Assess the microbial population in wastewater

CEPE11	ADVANCED DESIGN OF STEEL STRUCTURES	PE	3	0	0	3

Internal:50 Marks	End Term: 50 Marks	Total:100 Marks

Pre-requisites: Knowledge of Structural analysis, Steel structures

Contents

1. Introduction to plastic analysis and design, plastic bending of beams, stages of bending, shape factor, plastic hinge, load factor, failure mechanism - Theorems of plastic analysis, collapse load for beams and frames, design of continuous beams.
2. Design of round tubular structures - Introduction, sectional properties, permissible stresses, grades of steel tubes, tubular tension members, tubular compression members, tubular flexural members, combined bending and axial stresses.
3. Analysis and design of steel stacks - Wind load estimation as per IS875 part 3, functional and structural requirements, self supporting and guyed stacks, base plate and anchor bolts, stability considerations.
4. Wind load - Introduction to wind load, analysis and design of structural elements.
5. Connections - Welded and bolted connections for un-stiffened and stiffened connections, moment resistant beam end connections.
6. Composite construction - Introduction, composite beams, method of construction, limit state of collapse, limit state of serviceability, design examples.
7. Design of steel tanks - Design loads, permissible stresses, design of cylindrical tanks with suspended bottom, supporting ring beam, staging for tanks, rectangular pressed steel tanks.

Reference Books:

1. Subramanian N, Design of Steel Structures, Oxford University Press, New Delhi 2008.
2. Bhavikatti, S.S., Design of Steel Structures, I.K. International Publishing House Pvt. Ltd., New Delhi, 2010.
3. Krishnaraju, N. Structural Design and Drawing, Universities Press, 2009
4. IS 800 - 2007, Code of practice for general construction in steel, Bureau of Indian Standards, New Delhi.
5. SP6 (1)-1964, IS hand book for structural Engineers. Bureau of Indian Standards, New Delhi.
6. IS 875 Part (3)-1987, Code of Practice or Design Loads (other than earthquake) for buildings and structures: wind loads, Bureau of Indian Standards, New Delhi.

CEPE12	DYNAMICS OF STRUCTURES	PE	3	0	0	3

Internal: 50 Marks	End Term: 50 Marks	Total: 100 Marks

Contents

1. Seismology:
Introduction, plate tectonics, earthquake distribution and mechanism, seismicity, seismic waves, earthquake magnitude and intensity, seismic zoning and seismometry.

2. Single Degree of Freedom Systems:
Various types of dynamic loads, vibration of single degree of freedom system, Free and forced vibrations, types of damping, critical damping. Transmissibility, vibration measuring instruments, response spectrum.

3. Multi-degrees of Freedom(MDOF)Systems:
Equation of Motion, normal modes and natural frequencies, semi-definite systems, dynamic vibration absorbers, vibration dampers, principle of orthogonally, Stodolas method, Holzer's method, matrix method, modal analysis and its limitations. Mode super position method.

4. Seismic Analysis and Design:
General principles, assumptions, seismic coefficient method, response spectrum method, strength and deflection, design criterion for structures, significance of ductility, design and detailing for ductility, codal provisions, design examples.

5. Seismic Performance, Repair and Strengthening:
Methods for assessing seismic performance, influence of design ductility and masonry infills, criterion for repair and strengthening, repair and strengthening techniques and their applications, additions of new structural elements.

6. Vibrational Control:
General features of structural control, base isolation, active and passive control system. Earthquake resistance design as per I.S.:1893, I.S.4326 and I.S.13920.

Reference Books

1 Elements of Earthquake Engineering, Jai Krishna, A. R. Chandershekaran & Brajesh Chandra , South Asian Pub New Delhi.
2 Dynamics of Structures, Clough & Penzion, McGraw Hill
3 Earthquake Engineering, Y-X Hu,S-C.Liu and W.Dong, E and FN Sons., Madras.
4 Earthquake Resistant Concrete Structures, George G. Penelis and J. Kapoors, E & FN Sons, Madras.
5 Structural Dynamics, Mario Paz, CBB Pub. N. Delhi.

CEPE13	INTRODUCTION TO FINITE ELEMENT METHOD	PE	3	0	0	3

Internal: 50 Marks	End Term: 50 Marks	Total: 100 Marks

Pre-requisites: Knowledge of Mathematical Methods, Structural Analysis

1. **Introduction:**
   Field conditions, boundary conditions, functional approximation, finite differences method, development of finite element method.
2. **Element Properties:**
   Displacement models, relation between the nodal degrees of freedom and generalized coordinates, convergence requirements, natural co-ordinate systems, shape functions, element strains and stresses, development of element stiffness, matrix and equivalent nodal loads, static condensation.
3. **Isoparametric Elements:**
   Isoparametric, super-parametric and sub-paramatric elements, computation of stiffness matrix of isoparametric elements, convergence criteria for isoparametric elements, numerical integration technique using Gauss Quadrature.
4. **One Dimensional Element:**
   Truss element, analysis of plane truss problem, Hermitian beam element, beam on elastic foundation, solution of beam problem.
5. **Plane Stress and Plane Strain Analysis:**
   Triangular elements, rectangular elements, isoparametric elements, patch test, axisymmetric solid element.
6. **Plane Bending Analysis:**
   Displacement functions, plate bending elements, reduced integration, stress smoothing technique.
7. **Conduction Heat Transfer:**
   Formulation of finite element method for heat conduction, various weighted residual techniques, one dimensional heat conduction, two dimensional conduction heat transfer.
8. **Direct Stiffness Method of Analysis and Solution Technique:**
   Assemblage of elements, direct stiffness method, boundary conditions and reactions, Gauss elimination and matrix decompsition.
9. **Finite Element Analysis Software:**
   Pre-and Post-processors finite element analysis software, error estimates and adaptive meshing.

Reference Books

1. Krishnamurthy, C.S.,'Finite Element Analysis-Theory and Programming', TMH Pub.N.Delhi.
2. Cook, R.D.,Malkus,D.S. and Plesha,M.E.,'Concept and Applications of Finite Element Analysis', John Wiley & Sons, New York.
3. Desai, C.S. and Abel,J.F.,'Introduction to the Finite Element Method', Affiliated East-West Press Pvt.Ltd.N.Delhi.
4. Manicka Selvam,V.K.,'Finite Element Primer', Dhan

Corse Outcome: On completion of the course, the students shall be able to:

1. Develop shape functions and stiffness matrices for spring and bar elements
2. Develop global stiffness matrices and global load vectors
3. Apply natural and arial coordinate systems to constant strain triangle and linear strain triangle elements
4. Analyze planar structural systems using finite element modelling

CEPE14	ROCK MECHANICS	PE	3	0	0	3

Internal: 50 Marks	End Term: 50 Marks	Total: 100 Marks

Pre-requisites : Knowledge of Engineering Geology and Geotechnical Engineering.

Course Learning Objectives:

1 To understand the problems associated with underground excavations
2 To understand the rock mass classification
3 To understand the failure criteria of rock
4 To understand about in-situ stresses from field test data

Contents

1 Introduction

Importance of rock mechanics, composition of rocks, geological and lithological classification of rocks, classification of rocks for engineering purposes, R.Q.D. method of classification of rocks. Theories of Brittle failure.

2 Laboratory Testing of Rocks

Various methods of obtaining rock cores, methods of sample preparation, methods of removing end friction of the rock samples. Compression testing machine, uniaxial compression strength of rock samples, methods of finding tensile strength-direct and indirect methods, Brazilian test, shear box test, triaxial shear test, punch shear test.

3 In-situ Testing of Rocks

Field direct shear test on rock blocks, field triaxial strength, use of flat jacks, chamber test, plate load test, cable jacking test.

4 Stress Evaluation in Field

Stress-relief technique(over coring), use of strain gauges, bore hole, deformation cell, photo-elastic stress meter, stress measurement with flat jack. Hydraulics Fracturing Techniques.

5 Stabilization of Rocks

Rock bolting, principle of rock bolting, various types of rock bolts, application of rock bolting. Field testing of rock bolts and cable anchors.

6 Elastic and Dynamic Properties of Rocks

Stress-strain behaviour dynamic properties, resonance method and ultra-sonic pulse method.

7 Pressure on Roof of Tunnels

Trap door experiment, Terzaghi's theory, Bieraumer, kommerel, Protodyakanov theory.

8 Stress Around the Tunnels

Basic design and Principles of tunnels in rocks, design of pressure tunnels in rocks.

Reference Books

1 Lama,et.al Rock Mechanics, Vol.I,II,III,IV
2 Jaeger and Cook, Fundamentals of Rock Mechanics
3 Stagg & Zienkiewiez, Rock Mechanics

4 Obert & Duvell, Rock Mechanics & Design of Structures in Rocks
5 Jaeger, Rock Mechanics & Engineering
6 Schzy, Art of Tunneling

Course Outcome: On completion of this course, the students will be able to:

1 Identify the problems associated with underground excavations
2 Classify the rock mass using the reference data
3 Understand the failure criteria of rock
4 Determine in-situ stresses from field test data

CEPE15	GEOSYNTHETICS ENGINEERING	PE	3	0	0	3

Internal: 50 Marks	End Term: 50 Marks	Total: 100 Marks

Course Learning Objectives:

1. To explain the basic mechanisms of soil reinforcement and design principles in reinforced earth wall
2. To understand the applications of Geosynthetics in geotechnical problems and its design principles
3. To explain the usage of Geosynthetics in geoenvironmental and pavement engineering with design
4. To explain the present status of development in geo-synthetics and filed instrumentation and control

Contents

1. Basic Description of Geosynthetics

Historical Development, the Nomenclature, Function, Use Around the World, Applications, Development in India.

2. Raw Materials – Their Durability and Ageing

Raw Materials, Durability, Degrading Agencies, Polymers, Biological Resistance, Chemical Resistance, Weathering Resistance.

3. Manufacturing Methods

Fibers, Yarn, Nonwoven Geotextiles, Woven geotextiles, D.S.F. Fabrics.

4. Geogrids – Testing And Evaluation

Factors Influencing Testing, Sampling, Physical Properties, Mechanical Properties under Uniaxial loading, Creep Testing.

5. Erosion Control With Geogrids

Wind Erosion, Rain Water Erosion, Erosion Control Measures, Placement of Geogrid.

6. Bearing Capacity Improvement with Geogrids

Advantages, Mechanism. Modes of Failure, Friction Coefficient, Experimental Studies.

7. Application of Geosynthetics in Water Resources Projects

Case Studies: Dharoidam, Hiran II Dam, Meda Creek Irrigation Scheme, Lining of Kakarapar Canal.

Reference Books

1. Robert M. Koerner, Designing with Geosynthetics, Prentice-Hall
2. G.V. Rao & G.V.S. Raju, Engineering with Geosynthetics, Tata McGraw-Hill
3. Debashis Moitra, Geotechnical Engineering, Universities Press, Edition No. - I, 2016.

Course Outcome: On completion of this course, the students will be able to:

1 Identify the functions of geosynthetics
2 Select the geosynthetic products
3 Identify the testing methods for geosynthetics
4 Design geosynthetic products

CEOE16	TRAFFIC ENGINEERING AND ROAD SAFETY	/OE	3	1	0	4

Internal: 50 Marks	End Term: 50 Marks	Total: 100 Marks

Course Learning Objectives:

1. To understand the importance of traffic engineering, characteristics of traffic and Causes of road accidents
2. To know the relationship between contributing factors and road accidents
3. To study the traffic control devices and principles of signal / intersection design to address the problem of road accidents
4. To learn the environmental issues related to road traffic

Course Content:

UNIT-I

Organisational set up of traffic engg department in India. Traffic characteristics. Max dimensions and weights of vehicles. Traffic growth. Traffic studies. Accident statistics, Accident study. Parking Issues. Road alignments and road geometrics affecting road safety. Land use planning and road safety.

UNIT-II

Space and time headway. Fundamental diagram of traffic flow. Relationship between speed, volume and density. Level of service. PCU. Design service volume. Capacity of non-urban & urban roads. Road congestion and road safety. IRC recommendations. Traffic control devices. Signal & Intersection Designs. Road markings, Traffic control aids and street furniture. Traffic control devices and road safety.

UNIT-III

Traffic regulations. Regulation of speed, vehicles and drivers. General traffic regulations. Motor vehicle act. Scope of traffic management. Traffic management measures: restrictions on turning movements, one way streets, tidal flow operations, exclusive bus lanes, traffic restraint, road pricing. Enforcement and education measures for road safety.

UNIT-IV

Road safety audit, RSA team, RSA Report, Elements of RSA, Detrimental effects of traffic. Vehicular air pollution. Situation in India. Vehicular emission norms in India and abroad. Alternate fuels. Factors affecting fuel consumption. Arboriculture.

Reference Books

1. Traffic Engg. and Transportation Planning by L.R.Kadiyali, Khanna Publishers, Delhi, 2002.
2. Highway Engg by S.K.Khanna & C.E.G. Justo, Veeraragavan A., Nem Chand Bros., Roorkee, 2014
3. Traffic Engg. by Matson, T.M., Smith, W.S. and Hurd, F.W., McGraw- Hill Book Co., New York.
4. Traffic Flow Theory by Drew, D.R., McGraw- Hill Book Co., New York.
5. Trainers Road Safety Manual, NHA and Ministry of Shipping, Road Transport and Highways, Govt of India.

Course Outcomes:

At the end of the course, the students will be able to:

1. Gain Engineering knowledge of the subject and apply it for the solution of problems related to road safety.
2. Design geometrics, signals and intersections, make investigations, use modern tools and develop solutions to traffic problems including safety of road users.
3. Understand the engineering solutions in societal and environmental context for sustainable development that takes care of pollution and environment.
4. Understand the norms of engineering practice and the need for life-long learning as per their exposure to relevant latest IS/IRC/MoRTH specifications.

CEPE17	TRANSPORTATION PLANNING	PE	3	0	0	3

Internal: 50 Marks	End Term: 50 Marks	Total: 100 Marks

Pre-requisites: Transportation Engineering-I

1. To understand the importance of transportation planning
2. To know the planning process
3. To study the forecasting of travel demand
4. To learn the evaluation of transportation plans
5. To learn the problems of urbanisation

Contents

Unit-I

1. **TRANSPORT PLANNING PROCESS**

Status of transportation in India. Objectives and scope of transport planning. Urban, regional and national transport planning. Transport planning process, various stages. Land use and traffic.

2. TRANSPORTATION SURVEY

Definition of study area. Zoning. Types of surveys. O-D surveys. Inventories of existing transport facilities, land use and economic activities.

Unit-II

3 . TRIP GENERATION

Trip purpose. Factors affecting trip generation. Trip generation estimation by multiple linear regression analysis, brief review of category analysis, advantages and limitations of these methods.

4. TRIP DISTRIBUTION

Methods of trip distribution. Basic concepts of uniform factor method, average factor method and opportunity model. Trip distribution by gravity model.

Unit-III

5. TRAFFIC ASSIGNMENT

Principles of assignment. Assignment techniques. All or nothing assignment. Brief review of multipath assignment, capacity restraint assignment and diversion curves.

6. MODAL SPLIT

General considerations for modal split. Factors affecting modal split. Brief introduction to various methods of modal split.

Unit-IV

7. EVALUATION

Need for evaluation. Several plans to be formulated. Testing. Considerations in evaluation. Economic evaluation, basic principles, brief introduction to various methods of economic evaluation, comparison.

8. MASS RAPID TRANSIT SYSTEMS

Problems of Urban Transport. Introduction to MRTS. Requirements of MRTS. Types of MRTS. MRTS in India. MRTS Corridor selection

References Books

(i) Traffic Engg. and Transport Planning by L.R.Kadiyali, Khanna Publishers, Delhi.
(ii) Highway Engg by S.K.Khanna & C.E.G. Justo, Nem Chand Bros., Roorkee.

(iii) Introduction to Transport Planning by Bruton, M.J., Hutchinson Technical Education, London.
(iv) Principles of Transportation Engg, P. Chakroborty & Animesh Dass, Prentice Hall of India, 2003.

Course Outcomes:

At the end of the course, the students will be able to:

1. Gain Engineering knowledge of the subject and apply it for the solution of problems related to urbanisation
2. Make investigations, use modern tools, forecast travel demand and develop solutions to cater to increased future traffic.
3. Understand the engineering solutions in societal and environmental context for sustainable development that takes care of optimal use of resources.
4. Understand the norms of engineering practice and the need for life-long learning as per their exposure to relevant latest know-how in the field of planning.

CEPE18	POLLUTION CONTROL AND WASTE MANAGEMENT	PE	3	0	0	3

Internal: 50 Marks	End Term: 50 Marks	Total: 100 Marks

Course Learning Objectives

1 To understanding environment, impact of various activities on environment, sustainable development, ecology and biodiversity conservation
2 To understand air pollution, its effects and control methods
3 To understand noise pollution, its effects and control measures
4 To understand the sources, types and composition of municipal solid waste and the methods of solid waste disposal

Content

1. **Environment, Ecology and Biodiversity**
   Global environment, impact of humans upon environment, impact of environment upon humans, population explosion and its effects on environment, need of sustainable development, conventional sources of energy and their impact on environment. Ecology: Ecosystem and its types, energy flow in ecosystems, food chains, trophic levels, food web, ecological pyramids, biogeochemical cycles - nitrogen, sulphur and phosphorus cycles, biodiversity and its importance, measures of biodiversity conservation
2. **Air Pollution**
   Composition and structure of atmosphere, classification and sources of air pollutants, effects of air pollution on plants, animals, human health, economic effects of air pollution, greenhouse effect and global warming, ozone layer depletion and acid rains. Meteorological parameters influencing air pollution, plume behaviour. Air quality standards, air quality index, automobile pollution - effects and control measures. Atmospheric self – cleansing processes, approaches and techniques of air pollution control. Air pollution control devices: Gravitational settling chamber, cyclones, wet scrubbers, fabric filters, ESP and catalytic converters.
3. **Noise Pollution**
   General introduction to noise pollution, human acoustics, unit of measurement, loudness, measurements of noise and weighting networks, sources and effects of noise pollution, noise abatement/control, noise standards.
4. **Solid Waste Management**
   Definition, types, composition and sources of solid wastes, Solid Waste Management Rules (2016), storage and collection of municipal solid waste, methods of solid waste disposal – composting, incineration, pyrolysis and sanitary land filling, recovery of materials and energy from solid waste.

Reference Books

1 Environmental Engineering by H. S. Peavy, D. R. Rowe and G. Tchobanoglous
2 Ecology by E. P. Odum
3 Air Pollution by M. N. Rao
4 Environmental Noise Pollution by P. F. Cuniff
5 Solid Waste Management Collection, Processing and Disposal by A. D. Bhide and B. B. Sundaresan

Course outcomes

On completion of the course, the students will be able to

1 Understand importance of sustainable development, biodiversity conservation and environmental protection
2 identify the types and sources of air pollutants
3 predict the effects of air pollutants on human health and the environment
4 choose appropriate technologies for control of air pollutants
5 understand and select appropriate measures for noise pollution control
6 explain the various functional elements involved in solid waste management system
7 select suitable solid waste processing technologies and disposal methods

CEPE19	ENVIRONMENTAL IMPACT ASSESSMENT	PE	3	0	0	3

Internal: 50 Marks	End Term: 50 Marks	Total: 100 Marks

Course Learning Objectives

1 To learn the importance of environmental impact assessment in various development projects
2 To understand the legal provisions on EIA and EIA notifications
3 To brief the various methodologies involved in environmental impact assessment
4 To identify the prediction tools for the assessment of different environmental impacts
5 To describe the concepts of environmental management system.

National environmental policy, impacts of development projects on environment, Environmental Impact Assessment (EIA) and Environmental Impact Statement (EIS) - Objectives - EIA Types, EIA in project cycle - Capacity and limitations, Legal provisions on EIA, Environmental Impact Assessment notification, Methods of categorization of industries for EIA, Elements of EIA - Process screening, baseline studies, mitigation, Methods of EIA - matrices, checklist - strength, weakness and applicability, Prediction and assessment of impact on land, water, air, noise and energy, flora and fauna, Socio economic impact, Mathematical models for impact prediction, rapid EIA, public participation, Post environmental audit. Plan for mitigation of adverse impact on environment – Options for mitigation of impact on water, air and land, energy, flora and fauna; addressing the issues related to the project affected people, Environment Management Plan – ISO 14000. EIA case studies for new and expansion projects: township projects, river valley projects, thermal power plants and industrial plants.

References Books

1 Environmental Impact Assessment by Canter, R. L.
2 Environmental Impact Assessment Methodologies, Anjaneyulu, Y
3 Concepts in Environmental Impact Analysis by Shukla S. K. and P. R. Srivastava
4 Environmental Impact Analysis by John G. Rao and David C. Hooten (Ed.).

Course Outcomes

At the end of the course, the students will be able to

1 Analyse the environmental impacts of proposed projects
2 Categorize the type of EIA required for proposed projects
3. Predict and assess the impact of proposed projects on the environment
4. Use mathematical tools to predict the environmental impacts
5. Propose proper mitigation measures to avoid environmental impacts
6. Summaries the EIA report with suitable environmental management plan

CEPE20	GROUND WATER ENGINEERING	PE	3	0	0	3

Internal: 50 Marks	End Term: 50 Marks	Total: 100 Marks

Properties of Aquifers, Formation constants, compressibility of aquifers, Equation of motion for steady and unsteady ground water flow in isotropic homogeneous aquifers, Dupit's assumptions. Unconfined flow with a recharge, tiled train problem. Ground water exploration and methods of investigations.

Effect of boundaries, interference of water, leaky aquifers, Thiem's equilibrium formula for unconfined and confined aquifers and determination of hydraulic properties of aquifers. Partial penetration of an aquifer by a well, spherical flow in a well. Non equilibrium formula for aquifer (unsteady radial flows).

Tube wells, optimum capacity, silting of tube well, design of tube wells in different aquifers, tube well types, parts, bore hole, strains, its types, well pipe, casing pipe, blind pipe. Construction and working of tube wells, site selection, drilling operation, cable tool method, hydraulic method, rivers Rotary Method and drilling fluids, well screen assembly installation, verticality and alignment of tube wells, gravel packing, development of tube wells, sickness, corrosion and failure of tube wells, Pumping equipment and hydraulic testing of pumps.

Artificial recharge of ground water, considerations and methods, recharge techniques induced infiltration, water spreading, flooding, basins, ditching, modification of natural channels, irrigation, recharge pits, shafts and recharge wells.

Occurrence of saline water intrusion, Ghyben-Herzberg Relation between fresh and saline water shape and structure of fresh water and salt water interface, upcoming saline water, fresh water and salt water relations on oceanic islands, Control of salt water intrusion, Recognition of sea water in the ground water.

Reference Books

1. Ground water Hydrology, D.K.Todd, John Wiley & Sons Inc.Newyork.
2. Groundwater, H.M.Raghunath, Wiley Eastern Ltd., N.Delhi
3. Karamouz, M, Ahmadi, A, and Akhbari, M, Groundwater Hydrology: Engineering, Planning and Management, CRC Press
4. Davis, S.N., and De Weist, R.J.M., Hydrogeology, John Wiley & Sons, New York
5. Domenico, Concepts and Models in Groundwater Hydrology, McGraw Hill Inc. New York.

CEPE21	FLOOD CONTROL & DRAINAGE ENGG.	PE	3	0	0	3
	Internal: 50 Marks	End Term: 50 Marks	Total: 100 Marks			

FLOOD PROBLEMS

Introduction, Indian rivers and flood, Causes of flooding and economic losses, Flood management measures, Flood control strategies, Alleviation of flooding

ESTIMATION OF DESIGN FLOOD

Methods of design flood computations, Observation of highest flood, Empirical flood formulae, Flood frequency study, Derivation from storm studies and application of unit hydrograph principal, Rainfall analysis Infiltration approach, By runoff percentage, Soil Conservation service-US curve number method , Rational method, Derivation of regional flood formula, Hydrograph and derivation of unit hydrograph, Derivation of unit hydrograph, Duration of unit storm period, Limitations of the unit hydrograph theory, Concentration of runoff near peak, Synthetic unit hydrograph , Changing the duration of a unit hydrograph, Estimation of design storm and the design flood therefrom, Estimation of design flood

FLOOD ROUTING THROUGH RESERVOIRS AND CHANNELS

Flood routing through reservoirs: General, Basic Principle of routing, Pul's method or inflow- storage discharge method, Electronic analogue, Mechanical flood router, Routing through river channels, Muskingum method

FLOOD MITIGATION THROGH PLANNING OF RESERVOIR CAPACITIES AND OPERATION OF RESERVOIRS

Introduction, General design factors, Storage capacity determination, Live storage capacity, Mass curve, Flood storage, Dead storage, Reservoir silting , Sediment outflow, Trap efficiency, Computation of unit weight, Measurement of sediments yields, Reservoir sedimentation surveys, Sediment load measurements, Distribution of Sediment in a reservoir, Moody's method to find new zero elevation, Useful life of reservoirs, Ideal reservoir operation for flood control , Operation procedure of multipurpose reservoir , Reservoir operation from practical considerations, Based on annual storage capacity to the annual runoff , Based on regulation of reservoirs, Single-purpose reservoirs for flood control, Conservation reservoir, Multipurpose reservoir, System of reservoirs, Spillway gate operation schedule , Operation to

ensure maximum and minimum flow, Single-purpose reservoir, Operation of multipurpose reservoir

FLOOD MITIGATION THROUGH RIVER PROTECTION AND IMPROVEMENT WORKS

Introduction, Types of river, Theoretical background in river engineering, types of flow, Resistance laws, Energy slope, Gradually varied flow, River improvement works , River and hydrographic surveying, Embankment, Discharge capacity, Design of river dyke or embankment, Computation of wave heights, Design of dyke section, Stability analysis of the dyke, Bank protection, Causes of bank recession , Classification of bank protection works, Direct protection, Indirect protection, Channel improvement, Cutoffs, Diversion, Flood relief or by-pass channel, Floods ways , Flood-plain zoning or redevelopment ,Spreading grounds ,Soil conservation methods

FLOOD FORECASTING, WARNING AND ECONOMICS OF FLOOD CONTROL

General, Basic data, Communication network, Forecasting techniques and procedures , Forecasting rainfall, Determination of runoff from rainfall data, Methods of forecasting stages, The Relationship for the peak travel time , Example on forecasts reporting, Flood warning, Engineering measures for flood fighting, Estimating flood damages, Estimates of benefit analysis for a flood control project, Flood control planning through remote sensing, General Remote sensing technique

Reference Books:

1. Flood Control and Drainage Engg. By S.N.Ghosh OXFORD & IBH Publishing Co. Pvt. Ltd. New Delhi
2. Fundamentals of Irrigation Engg. by Bharat Singh, Nem Chand & Bros. Roorkee UP
3. Handbook of Applied Hydraulics, edited by C.V. Davis & T.E. Sorensen, Mc Graw Hill, Company

CEPE22	HEALTH MONITORING OF STRUCTURES	PE	3	0	0	3

Internal: 50 Marks	End Term: 50 Marks	Total: 100 Marks

Course Learning Objectives

To investigate the materials, products, structures or components that fall or do not operate or function as intended causing personal injury or damage the property.

Course content

Introduction- Qualitative and non-continuous methods of evaluation of structures- SHM definition- Detecting the existence of the damage on the structure- Locating the damage- Identifying the types of damage- Quantifying the severity of the damage-Sensors- Feature extraction through signal processing and statistical classification-Structure- Data acquisition systems-Data transfer and storage mechanism-Data management- Data interpretation and diagnosis : System Identification-Structural model update-Structural condition assessment-Prediction of remaining service life Different sensors - accelerometers, strain gauges, displacement transducers, level sensing stations, anemometers, temperature sensors and dynamic weight-in-motion sensors- Case studies- SHM for bridges

Reference Books

1. Raghavan, A. and Cesnik, C. E., Review of guided-wave structural health monitoring," Shock and Vibration Digest, vol. 39, no. 2, pp. 91-114, 2007.
2. Shen-En Chen, R. Janardhanam, C. Natarajan, Ryan Schmidt, Ino-U.S. Forensic Practices - Investigation Techniques and Technology, ASCE, U.S.A., 2010.
3. Natarajan C., R. Janardhanam, Shen-En Chen, Ryan Schmidt, Ino-U.S. Forensic Practices - Investigation Techniques and Technology, NIT, Tiruchirappalli, 2010.
4. Gary L. Lewis, Guidelines for Forensic Engineering Practice, ASCE, U.S.A., 2003.
5. Joshua B.Kardon, Guidelines for Forensic Engineering Practice, ASCE, U.S.A., 2012.

Course Outcomes

On completion of the course, the students will be able to:

1. Perform Structural health monitoring
2. Handle emerging technologies using sensors
3. Perform notable applications of structural health monitoring in Civil applications

CEPE23	EXPERIMENTAL STRESS ANALYSIS	PE	3	0	0	3

Internal: 50 Marks	End Term: 50 Marks	Total: 100 Marks

Course Learning Objectives

1. To study the working principles of different types of strain gauges
2. To understand the model analysis
3. To know the fundamentals of photo elastic coatings
4. To study the effects of 2-D photo elasticity
5. To study the working principle of load, pressure and displacement transducers

Course Content

Strain gauges – Mechanical, optical, acoustic, electrical inductance and capacitance pneumatic types – description and working principles Electrical resistance strain gauges, gauge characteristics and types – Equipment for recording static strain – reduction of strain gauge data. Load, pressure and displacement transducers. Model analysis – direct and indirect models – law of structural similitude – choice of scales – Model materials – limitations of model studies –Buckingham PI theorem – design of direct and indirect models – Beggs deformeter and its applications. Two dimensional photo – elasticity – optical principles stress optic law – Methods of producing isoclines and isochromatics using polariscopes – Methods of measuring fractional fringe orders – model materials – separation techniques Fundamental of Photo elastic coatings, Moire fringe and brittle coating techniques – Introduction to stress freezing techniques – Introduction to non-destructive testings.

Reference Books

1. Daley and Riley, Experimental Stress Analysis, McGraw Hill Book Company, 1987
2. Srinath, L.S. et al., Experimental Stress Analysis, Tata McGraw Hill 1984.
3. Hetenyi, M., Hand Book of Experimental Stress Analysis, John Wiley & Sons. Inc New York. 1980.

Course outcomes

On completion of the course, the students will be able to:

1. Identify the different types of strain gauges
2. carry out model analysis
3. apply the concepts of photo elastic coatings
4. analyze the behavior of 2-D photo elasticity
5. apply the working principles of transducers

CEPE24	CONSTRUCTION TECHNIQUES AND EQUIPMENTS	PE	3	0	0	3

Internal: 50 Marks	End Term: 50 Marks	Total: 100 Marks

Course Learning Objectives

1. To learn the principles of construction of building components
2. To know about prefabricated construction and building services
3. To study the different repair and rehabilitation technique
4. To understand the planning and operation of various construction equipment

Course Content

Principles of construction: Bonding , Reinforced brick work , Stone masonry, Hollow block masonry Composite masonry, Cavity walls, Flooring, Formwork, Centering and Shuttering sheet piles, Slip and moving forms, Roofs and roof covering, Joints in Concrete, Plastering and Pointing, Shoring and Scaffolding, Under pinning, Submerge Structures. Prefabricated structures and building services: Prefabricated panels & structures, Production, Transportation and Erection of structures, Sound insulations, Ventilations, Fire resisting construction, Damp proofing, Termite proofing. Construction damages & repair techniques: Causes of damage and deterioration in masonry and concrete structures, Symptoms & Diagnosis, Types of repair and rehabilitation techniques. Basics of construction equipment: Factors affecting the selection of equipment, economic life of equipment, cost of equipment, maintenance of equipment. Construction equipment and machinery: Earthwork equipment, Hoisting and lifting equipment, Material handling equipment, Concrete equipment, dewatering equipment.

Reference Books

1. Arora, S.P. and Bindra, S.P. A Text Book of Building Construction, Dhanpat Rai Publications, New Delhi, 2005.
2. Varghese, P.C., Building Constructions, Prentice Hall, 2007.
3. Sharma & Kaul, Building Construction, S.Chand & Company Pvt, New Delhi, 1998
4. Peurifoy, R.L., Schexnayder, J.C., and Shapira, A, Construction Planning, Equipment and Methods, Tata McGraw Hill, New Delhi, 2010.
5. Sharma S.C. Construction Equipment and Management, Khanna Publishers, New Delhi, 2013.

Course outcomes

On completion of the course, the students will be able to:

1. Supervise and execute all the construction jobs with the knowledge of the different construction techniques
2. Identify the building defects and apply suitable repair techniques to rectify them
3. Evaluate the costs of equipment and make proper selection of the suitable construction equipment
4. Ensure the proper completion of a construction task using particular construction equipment

CEPE25	STEEL CONCRETE COMPOSITE STRUCTURES	PE	3	0	0	3

Internal: 50 Marks	End Term: 50 Marks	Total: 100 Marks

Course Learning Objectives

1. To introduce the concept of composite construction and their applications in engineering
2. To discuss shear connector types, degree of shear connector, interaction and their strength
3. To introduce design of composite beams under propped and un-propped condition
4. To introduce design of different types of composite deck slabs
5. To discuss effects of temperature, shrinkage and creep and cyclic loading on composite sections

Course content

Introduction – types – advantages – comparison – applications - limit states of composite sections – introduction to plastic analysis – mechanism of composite members. Shear connectors – types of shear connectors – degree of shear connection – partial and complete shear connections – strength of shear connectors – experimental evaluation of shear connectors. Analysis and design of composite beams without profile sheet - propped condition – un-propped condition – deflection - design of partial shear connection. Design of composite beam with profile sheet – propped and un-propped condition – deflection of composite beams –design of partial shear connection. Introduction – Composite slabs – profiled sheeting – sheeting parallel to span – sheeting perpendicular to span – analysis and design of composite floor system.

Reference Books

1. Johnson R.P., "Composite Structures of Steel and Concrete"' Volume-I, Black Well Scientific Publication, U.K., 1994
2. Teaching Resources for "Structural Steel Design". Vol.2 of 3, Institute of Steel Development and Growth (INSDAG), 2000
3. Narayanan R., "Composite Steel Structures – Advances, Design and construction, Elsevier, Applied Science, U.K., 1987
4. Owens, G.W & Knowles, P., Steel Designers Manual," (fifth edition), Steel Concrete Institute (U.K), Oxford Blackwell Scientific Publication, 1992.
5. IS 11384 – 1985 Indian Standard Code of Practice for Composite Construction in Structural Steel and Concrete, Bureau of Indian Standards, New Delhi

Course outcomes

On completion of the course, the students will be able to:

1. Apply the concepts of composite construction in engineering.
2. Analyse the behavior of shear connectors, degree of shear connection and their interaction.
3. Design composite beams under propped and un-propped condition.
4. Design different types of composite deck slabs.
5. Analyse the effects of temperature, shrinkage and creep and cyclic loading on composite sections.

CEPE26	EARTHQUAKE RESISTANT STRUCTURES	PE	3	0	0	3

Internal: 50 Marks	End Term: 50 Marks	Total: 100 Marks

Course Learning Objectives

1. To introduce the basics of Earthquake Engineering
2. To introduce the engineering seismology, building geometrics & characteristics, structural irregularities,
3. To introduce tips on earthquake engineering - do's and don'ts
4. To introduce cyclic loading behaviour of RC, steel and pre-stressed concrete elements
5. To discuss code provisions and their application on different types of structures

Course Content

Elements of Engineering Seismology - Theory of Vibrations -Indian Seismicity -Earthquake History - Behavior of structures in the past Earthquakes. Seismic Design Concepts - Cyclic loading behavior of RC, Steel and Prestressed Concrete elements - Response Spectrum-Design spectrum - capacity based design. Provision of Seismic Code frames, shear walls, Braced frames, Combinations - Torsion. Performance of Regular Buildings 3D Computer Analysis of Building Systems (Theory only) - Design and Detailing of frames - Shear walls and Frame walls. Seismic performance - Irregular Buildings -Soil performance, Modern Concepts - Base Isolation - Adoptive systems - Case studies.

Reference Books

1. Pankaj Agarwal and Manish ShriKhande, Earthquake Resistant Design of Structures, Prentice- Hall of India, New Delhi, 2003.
2. Bullen K.E., Introduction to the Theory of Seismology, Great Britain at the University Printing houses, Cambridge University Press 1996.

Course outcomes

On completion of the course, the students will be able to:

1. apply the basics of Earthquake Engineering
2. demonstrate the dynamics of structural system under earthquake load
3. analyze the influence of the structural / geometrical design in building characteristics
4. demonstrate the cyclic loading behaviour of RC steel and pre-stressed concrete elements
5. Apply Codal provisions on different types of structures.

CEPE40	APPLICATION OF ARTIFICIAL INTELLIGENCE TO CIVIL ENGINEERING	PE	3 0 0	3

Internal: 50 Marks	End Term: 50 Marks	Total: 100 Marks

Pre-requisites: Knowledge of basic civil engineering

Introduction to Artificial Neural Network: Feed-forward and Feed-Backward -work. Neural network learning rules. Linear separability of training patterns, Perceptron learning Algorithms. Multilayer Networks: Exact and approximate representation using feed forward net-works, Fixed Multilayer feed forward Network Training by Back propagation.

Recurrent Network: Symmetric networks and Associative Memory, Bi-directional Associative Memory. Analog Hopfield networks, simulated Annealing in optimization. Case studies for modeling using ANN and Fuzzy.

Introduction to Fuzzy logic: Statistics and random Processes, Uncertainty in information. Classical Sets and Fuzzy Sets: Classical sets, operations on classical sets, properties of classical sets. Mapping of classical sets to functions, Fuzzy sets, fuzzy set operations, properties of Fuzzy sets

Classical Relations and Fuzzy Relations: Cartesian product, crisp, relations, cardinality of crisp relations, operations on crisp relation, properties of crisp relations. Composition, fuzzy relations. Cardinality of Fuzzy relations, operations on Fuzzy relations. Properties of Fuzzy relations. Membership Functions: Fuzzification, Membership value assignment. Fuzzy-to-crisp Conversions: Defuzzification Methods.

Reference Books

1. Zurada, J.M. Introduction to artificial neural Network System. Jaico Publicating House.
2. Haykin, S.ANN a comprehensive Foundation. Macmillan College Publising Company, New York.
3. Bose, N.K. and Liang, P. Neural network Fundamentals with Graphs Algorithms, and Applications. Tata Mc'Graw Hill. ~
4. Ross, J. Timothy. " Fuzzy logic with Engineering Applications". Mc Graw Hill.
5. Asai, K. Fuzzy systems for information processing". IOS press.

Course Outcome: On completion of the course, the students shall be able to:

1. Incorporate skills in developing models for various systems
2. Develop neural network and fuzzy logic model.
3. Provides basic knowledge on fuzzy system and optimization tools
4. Apply modeling tools to civil engineering problems

CEOE11	MACHINE FOUNDATIONS	OE	3	1	0	4

Internal: 50 Marks	End Term: 50 Marks	Total: 100 Marks

Pre-requisites: Knowledge of Geotechnical Engineering.

Course Learning Objective:

1. To explain the principles of machine foundation design for reciprocating and impact machines
2. To explain the concept and method of foundation isolation

Course Content:

1. Theory of Vibrations

Definitions, harmonic motion, vibrations of a single degree freedom system, transmissibility, theory of vibration measuring instruments.

2. General Principles of Machine Foundation Design

Types of machines and machine foundations, criteria for satisfactory action of a machine foundation, permissible amplitude, allowable soil pressure, permissible stresses in concrete and steel, permissible stresses in timber.

3. Evaluation of Parameters

Modes of vibration of a rigid block foundation, Barken's soil spring constants, determination of coefficients of elastic uniform compression and Elastic uniform shear.

4. Foundations for Reciprocating Machines

Analysis of block foundation by Barken's theory of linear elastic weightless spring analogy, Indian Standard for design and construction of foundation for reciprocating machine, design procedure, design examples.

5. Foundation for Impact Machines

Dynamic analysis, Barken's recommendations for weight and base contact area, IS Code practice for design and construction of foundations for impact machines, design procedure, design examples.

6. Foundations for Rotary Machines

Special considerations, design criteria, methods of analysis and design.

7. Vibration Isolation and Screening:

Active isolation, passive isolation, methods of isolation, wave screening, vibration absorbing materials, planning for vibration isolation.

Reference Books

1. D.D.Barken, Dynamics of Bases and Foundations
2. Shamsher Prakash, Soil Dynamic, McGraw Hill, 1981.
3. Swami Saran, Soil Dynamics and Machine Foundations
4. B.M.Das, Principles of Soil Dynamics
5. Crede, Vibration and Shock Isolation

Course Outcome: On completion of this course, the students will be able to:

1 Understand the dynamic behaviour of foundations.
2 Select foundations for dynamic loading
3 Design machine foundations
4 Identify vibration isolation techniques

CEOE12	GEOTECHNICAL EARTHQUAKE ENGINEERING	OE	3	1	0	4

Internal: 50 Marks	End Term: 50 Marks	Total: 100 Marks

Pre-requisites : Knowledge of Engineering Geology and Geotechnical Engineering.

Course Learning Objectives

1. To explain the mechanism of earthquake and its related causes to build structures and in-situ soils
2. To explain how ground motion is recorded and how do quantify the earthquake intensity and frequency related parameters
3. To explain how seismic site investigation will be done and seismic soil design parameters are estimated
4. To explain how seismic resistant design of foundation will be done and also explain the concept of liquefaction and related causes including codal recommendations
5. To explain how to do hazard assessment and mitigation and explain how do prepare a risk and microzonation mapping

Course Content

1. Mechanism of Earthquakes - Causes of earthquake - Earthquake Fault sources – Elastic Rebound theory - Seismic wave in Earthquake shaking - terminology - Locating an earthquake - Quantification of earthquakes. Strong Motion Records - characteristics of ground motion - Factors influencing Ground motion - Estimation of frequency content parameters
2. Seismic site investigations – Selected Case Studies - Evaluation of Dynamic soil properties – Codal Provisions Design Ground Motion - Developing
3. Design Ground Motion-Codal recommendations.
4. Earthquake Resistant Design of foundation of buildings - Design considerations -. Earthquake Response of slopes - Evaluation of slope stability – Liquefaction Susceptibility - Liquefaction Resistance-Codal recommendations.
5. Risk mapping - Hazard assessment – Mitigation measures - Seismic microzonation and its importance

Reference Books

1. Kameswara Rao, N.S.V., Dynamics soil tests and applications, Wheeler Publishing - New Delhi, 2000.
2. Krammer S.L., Geotechnical Earthquake Engineering, Prentice Hall, International Series, Pearson Education (Singapore) Pvt. Ltd., 2004.
3. Kameswara Rao, Vibration Analysis and Foundation Dynamics, Wheeler
4. Robert W. Day, Geotechnical Earthquake Engineering Hand book, McGraw Hill, 2002
5. Debashis Moitra, Geotechnical Engineering, Universities Press, Edition No. - I, 2016.

Course Outcomes: On completion of the course, the students will be able to:

1. Demonstrate the principles of earthquake loading
2. Quantify earthquake intensity and ground motion
3. estimate seismic soil design parameters
4. analyze and design seismic resistant foundation for buildings
5. prepare soil risk and microzonation maps

CEOE13	TRAFFIC ENGINEERING AND ROAD SAFETY	OE	3	1	0	4

Internal: 50 Marks	End Term: 50 Marks	Total: 100 Marks

Course Learning Objectives:

1. To understand the importance of traffic engineering, characteristics of traffic and Causes of road accidents
2. To know the relationship between contributing factors and road accidents
3. To study the traffic control devices and principles of signal / intersection design to address the problem of road accidents
4. To learn the environmental issues related to road traffic

Course Content:

UNIT-I

Organisational set up of traffic engg department in India. Traffic characteristics. Max dimensions and weights of vehicles. Traffic growth. Traffic studies. Accident statistics, Accident study. Parking Issues. Road alignments and road geometrics affecting road safety. Land use planning and road safety.

UNIT-II

Space and time headway. Fundamental diagram of traffic flow. Relationship between speed, volume and density. Level of service. PCU. Design service volume. Capacity of non-urban & urban roads. Road congestion and road safety. IRC recommendations. Traffic control devices. Signal & Intersection Designs. Road markings, Traffic control aids and street furniture. Traffic control devices and road safety.

UNIT-III

Traffic regulations. Regulation of speed, vehicles and drivers. General traffic regulations. Motor vehicle act. Scope of traffic management. Traffic management measures: restrictions on turning movements, one way streets, tidal flow operations, exclusive bus lanes, traffic restraint, road pricing. Enforcement and education measures for road safety.

UNIT-IV

Road safety audit, RSA team, RSA Report, Elements of RSA, Detrimental effects of traffic. Vehicular air pollution. Situation in India. Vehicular emission norms in India and abroad. Alternate fuels. Factors affecting fuel consumption. Arboriculture.

Reference Books

6. Traffic Engg. and Transportation Planning by L.R.Kadiyali, Khanna Publishers, Delhi, 2002.
7. Highway Engg by S.K.Khanna & C.E.G. Justo, Veeraragavan A., Nem Chand Bros., Roorkee, 2014
8. Traffic Engg. by Matson, T.M., Smith, W.S. and Hurd, F.W., McGraw- Hill Book Co., New York.
9. Traffic Flow Theory by Drew, D.R., McGraw- Hill Book Co., New York.
10. Trainers Road Safety Manual, NHA and Ministry of Shipping, Road Transport and Highways, Govt of India.

Course Outcomes:

At the end of the course, the students will be able to:

1. Gain Engineering knowledge of the subject and apply it for the solution of problems related to road safety.
2. Design geometrics, signals and intersections, make investigations, use modern tools and develop solutions to traffic problems including safety of road users.
3. Understand the engineering solutions in societal and environmental context for sustainable development that takes care of pollution and environment.
4. Understand the norms of engineering practice and the need for life-long learning as per their exposure to relevant latest IS/IRC/MoRTH specifications.

CEOE14	ENVIRONMENTAL STUDIES	OE	3	1	0	4

Internal: 50 Marks	End Term: 50 Marks	Total: 100 Marks

Course Learning Objectives

1. To become aware of various issues related to environment degradation, poverty, development and social welfare and their interlinking.
2. To understand various environmental problems arising due to human activities and the reasons of those problems.
3. To understand importance of natural resources, ecosystem preservation, biodiversity conservation and pollution control.

Course Content

Unit 1: Multidisciplinary nature of environmental studies

Definition, scope and importance, need for public awareness.

Unit 2: Natural Resources: Renewable and non-renewable resources

Natural resources and associated problems

a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.

b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

e) Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources, case studies.

f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

Role of an individual in conservation of natural resources, Equitable use of resources for sustainable lifestyles.

Unit 3: Ecosystems

Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids, Introduction, types, characteristic features, structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries

Unit 4: Biodiversity and its conservation

Introduction – Definition : genetic, species and ecosystem diversity, Biogeographical classification of India, Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, National and local levels, India as a mega-diversity nation, Hot-sports of biodiversity, Threats to biodiversity : habitat loss, poaching of wildlife, man-wildlife conflicts, Endangered and endemic species of India, Conservation of biodiversity : In-situ and Ex-situ conservation of biodiversity.

Unit 5: Environmental Pollution

Definition, Cause, effects and control measures of - Air pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution, Nuclear hazards

Solid waste Management: Causes, effects and control measures of urban and industrial wastes, Role of an individual in prevention of pollution, Pollution case studies.

Disaster management: floods, earthquake, cyclone and landslides.

Unit 6: Social Issues and the Environment

From Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation of people; its problems and concerns, Case Studies, Environmental ethics: Issues and possible solutions. Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, Case Studies, Wasteland reclamation, Consumerism and waste products, Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act, Wildlife Protection Act, Forest Conservation Act, Issues involved in enforcement of environmental legislation, Public awareness.

Unit 7: Human Population and the Environment

Population growth, variation among nations, Population explosion – Family Welfare Programme, Environment and human health, Human Rights, Value Education, HIV/AIDS, Women and Child Welfare, Role of Information Technology in Environment and human health, Case Studies.

Reference Books

1 Text Book for Environmental Studies by Erach Bharucha

Course outcomes

On completion of the course, the students will be able to

1 Understand various problems related to environmental degradation and suggest appropriate measures for environmental protection.
2 Take appropriate measures for ecosystem and biodiversity conservation to maintaining ecological balance.
3 Device appropriate strategies for control effects of pollution.
4 Involve all stakeholders for sustainable development of society.

CEOE15	GEOINFORMATICS	OE	3	1	0	4

Internal: 50 Marks	End Term: 50 Marks	Total: 100 Marks

Course objectives

(1) To develop understanding about Photogrammetry, remote sensing system, Global Navigation Satellite System (GNSS) and GIS.

(2) To enable students to understand the process of acquiring remotely sensed data and extract information from them.

UNIT-I

AERIAL PHHOTOGRAMMETRY:

History and classification of Photogrammetry, Aerial Photogrammetric processes: acquisition of data, classification of photographs, photographic scale, relief displacement, flight planning, stereo Photogrammetry: parallax, stereoscopic view, streoscope and parallax bar.

UNIT-II

REMOTE SENSING

Introduction to Electromagnetic Spectrum (EMR), interaction of EMR with atmosphere and target, Resolutions: Spatial, temporal, spectral and radiometric, sensor characteristics, satellite data products, digital imaging, digital image processing, visual image interpretation, digital image interpretation. microwave remote sensing.

UNIT-III

GNSS

Global Navigation Satellite System (GNSS) basic concepts, GPS (NAVSTAR), Galileo, GLONASS and Indian Regional Navigation Satellite System (IRNSS). Functional segments of GPS and components. Working principle, factors affecting, GPS setup and accessories, satellites & receivers, Differential GPS (DGPS), Applications of GNSS.

UNIT-IV

GIS

Structure of GIS: Cartography, Geographic mapping process, GIS data models, database management systems, Raster data representation, Vector data representation, transformations, map projections, Geographic Data Representation, Storage, Quality and Standards, Assessment of data quality, Managing data errors, Geographic data standards.

Raster and vector based GIS data processing – Queries, Spatial analysis, Descriptive statistics, Spatial autocorrelation, Network analysis, Surface modeling.

Reference Books

1. B. Bhatta, Remote Sensing and GIS, 2nd Edition, Oxford University Press, New Delhi
2. G S Srivastava: An introduction to Geoinformatics
3. P.A. Burrough and R.A. McDonnell, Principles of Geographical Information Systems, 2nd ed.Oxford, England, Oxford University Press.
4. T.M. Lillesand, R.W. Kiefer and J.W. Chipman, Remote Sensing and Image Interpretation, (5th edition), John Wiley and Sons, India
5. George Joseph, Fundamentals of Remote Sensing, Universities Press, India, 2005

Course Outcome:

After learning the course the students should be able to understand the basics of Geoinformatics and their applications in various engineering disciplines.

CEOE16	HYDRO POWER ENGINEERING	OE	3 1 0	4
Internal: 50 Marks	End Term: 50 Marks	Total: 100 Marks		

1. Introduction

Sources of power, estimation of water power, necessity and importance of harnessing small hydro power, flow duration and power duration curves, load curve, load factors, capacity factors, utilization factors, firm and secondary power.

2. Types of Hydro Power Plants

Elements of Hydro power, classification of hydro-power plants, run-of-river plants, storage plants diversion canal development, pumped storage plants, tidal power plants, base load and peak load plants in a power grid.

3. Intakes

Intake structures, functions and their types, components of intakes-forebay, trash racks, gates and valves, force required to operate gates.

4. Conveyance System

Penstocks, design criterion, economical diameter anchor blocks, cradles and footings, water hammer, instantaneous closure of power canal, surge tank, surges in canals.

5. Turbines

Types of turbines, specific speed and classification of turbines, synchronous speed, scroll casing, flumes and draft tubes, dimensions of scroll casing and draft tubes, setting of turbines

6. Power House

General layout and arrangements of hydro-power units, number and size of units, sub-structure, spacing of units, super-structure, underground power stations, tidal power.

Reference Books

1 Water Power Engineering, Dandekar, M.M., Sharma,K.N.
2 Hydro-Electric Engineering Practice Vol.I ,II & III Brown J.G.
3 Water Power Engineering, Borrows, H.K.
4 Water Power Development, Vol.I & II, Mosonyi,E.
5 Water Power Engineering, M.M.Deshmukh.

CEOE17	DRAUGHT AND FLOOD	OE	3 1 0	4
Internal: 50 Marks	End Term: 50 Marks	Total: 100 Marks		

Course objectives

To provide student knowledge of shortage and excess of precipitation and its impact on human life.

Course contents

1. **Drought**
   Definition, causes, types, indices, management, water harvesting
2. **Flood Problems**
   Causes, alleviation
3. **Estimation of design floods**
   Methods of computations
4. **Flood routing through reservoirs and channels**
   Puls method, Muskingum method
5. **Spillway designs**
   Functions, types
6. Flood mitigation
   Various types of storages, Reservoir operation, river improvement works
7. **Flood forecasting, warning and fighting**
   Forecasting techneques, engineering measures for flood fighting
8. **Design of subsurface drainage systems**
   Necessity, design of underdrains
9. **Design of surface drainage systems**
   Necessity, design of underdrains

Reference Books

1 Engineering Hydrology by K.Subramanya.
2 Hydrology for Engineers by Linsely, Kohler, Paulhus.
3 Flood Control and Drainage Engineering by S.N. Ghosh
4 Water Resources Engineering by Larry W. Mays
5 Land drainage Principles, methods and applications by A K Bhattacharya and AM Micael

Course outcomes

Students will be able to understand methods of design structures required to drought and flood.

CCEOE18	ADVANCED CONCRETE TECHNOLOGY	OPEN ELECTIVE	3	0	0	3

Internal: 50 Marks	End Term: 50 Marks	Total: 100 Marks

Pre-requisites: Knowledge of Concrete and its ingredients.

Introduction - Concrete materials - Cement: Physical tests on cement - Concrete materials - Tests on aggregates - Quality of Water for mixing and curing - use of sea water for mixing concrete. Rheology of concrete- Introduction, Rheological behaviour, Factors affecting rheological properties, mixture adjustments.

Mix Design - factors influencing mix proportion - Mix design by ACI method and I.S. code method - Design of normal concrete, high strength concrete and self compacting concrete. Admixtures - accelerating admixtures - Retarding admixtures - water reducing admixtures - Air entraining admixtures - coloring agent - Plasticizers. Batching - Mixing -Transportation - Placing of concrete - curing of Concrete.

Strength of Concrete - Shrinkage and temperature effects - creep of concrete - permeability of concrete - durability of concrete - Corrosion - Causes and effects - remedial measures- Thermal properties of concrete - Micro cracking of concrete, microstructure of concrete. Classification of causes of concrete deterioration – Permeability of concrete – Chloride penetration – Acid attack - Sulfate attack – Alkali-aggregate reaction – Concrete in sea water – AC impedance test - Corrosion of embedded steel in concrete – Case histories..

Special Concrete - High Performance Concrete (HPC) Introduction – Principles of HPC – Ingredients used for HPC – Production of HPC – Curing of HPC – Mechanism of HPC – Properties of HPC during the fresh and hardened state. Durability of HPC - Acid Attack – Permeability – Scaling resistance – Chloride penetration – Resistance to sea water – sulfate attack – Alkali-aggregate reaction – Fire resistance – Mix design methods of HPC. Special High Performance Concrete-Air-entrained HPC Reactive powder Concrete-Bio concrete-Geo polymer, Fiber reinforced concrete Quality control - Sampling and testing-Acceptance criteria.

Reference Books

1. Shetty, M.S., Concrete Technology, Theory & Practice, S.Chand and Co, 2004.
2. Gambhir, M.L., Concrete Technology, Tata McGraw Hill, 2004.
3. Nevile, Properties of Concrete, Longman Publishers, 2004.
4. Santakumar A.R., Concrete Technology, Oxford University Press, New Delhi, 2007.
5. P.-C.Aïtcin, High Performance Concrete, E &FN SPON, 1998
6. E.G.Nawy, Fundamentals of High Performance Concrete, John Wiley & Sons., 2nd edition, 2000
7. High Performance Concrete Structural Designers Guide published by FHWA, USA, 2005.
8. Geert De Schutter, Peter J.M. Bartos, Peter Domone, John Gibbs, Self Compacting Concrete, Whittles Publishing, 2008.

Course Outcome: On completion of the course, the students shall be able to:

1. Test all the concrete materials as per IS code.
2. Design the concrete mix using ACI and IS code methods.
3. Determine the properties of fresh and hardened of concrete.
4. Design special concretes and their specific applications.
5. Ensure quality control while testing/ sampling and acceptance criteria.