AR 2018

COURSE STRUCTURE & SYLLABUS
FOR
UNDER GRADUATE PROGRAMME
IN
CIVIL ENGINEERING

COLLEGE OF ENGINEERING AND TECHNOLOGY

BHUBANESWAR

An Autonomous and Constituent College of

BIJU PATNAIK UNIVERSITY OF TECHNOLOGY, Rourkela, Odisha

COURSE: B. Tech. (Bachelor of Technology) **Duration: 4years**

Course Structure for UG – Civil Engineering

1st SEMESTER

Sl. No.	Subject Type	Subject Code	Subject Name	Teaching Hours/Week			Credit	Maximum Marks			
				L	T	P		IA	EA	PA	Total
1	Basic Science Course	UBSCH101	CHEMISTRY	3	1	0	4	30	70	0	100
2	Basic Science Course	UBSMH102	MATHEMATICS -I	3	1	0	4	30	70	0	100
3	Engineering Science Course	UESCS103	PROGRAMMING FOR PROBLEM SOLVING	3	1	0	4	30	70	0	100
4	Basic Science Course	ULCCH101	CHEMISTRY LAB	0	0	3	1.5	0	0	100	100
5	Engineering Science Course	ULCCS103	PROGRAMMING FOR PROBLEM SOLVING LAB	0	0	2	1	0	0	100	100
6	Engineering Science Course	ULCME104	ENGINEERING GRAPHICS AND DESIGN LAB	1	0	4	3	0	0	100	100
7	Mandatory Course	INDUCTION TRAINING(21 DAYS)					0				
			Total				**17.5**				**600**

2nd SEMESTER

Sl. No.	Subject Type	Subject Code	Subject Name	Teaching Hours/Week			Credit	Maximum Marks			
				L	T	P		IA	EA	PA	Total
1	Basic Science Course	UBSPH111	PHYSICS	3	1	0	4	30	70	0	100
2	Basic Science Course	UBSMH202	MATHEMATICS-II	3	1	0	4	30	70	0	100
3	Engineering Science Course	UESEE113	BASIC ELECTRICAL ENGG.	3	0	0	3	30	70	0	100
4	Humanities &Social Sciences	UHSMH205	ENGLISH	2	0	0	2	30	70	0	100
5	Basic Science Course	ULCPH111	PHYSICS LAB	0	0	3	1.5	0	0	100	100

6	Engineering Science Course	ULCEE113	BASIC ELECTRICAL ENGG. LAB	0	0	4	2	0	0	100	100
7	Engineering Science Course	ULCME114	WORK SHOP/BASIC MANUFACTURING PROCESS LAB	1	0	4	3	0	0	100	100
8	HS	ULCMH204	ENGLISH LAB	0	0	2	1	0	0	100	100
			Total				**20.5**				**800**
9	**Summer Internship programme (4 to 8 weeks) is mandatory as per AICTE rule**										

Semester – III

Sl. No.	**Subject Type**	**Subject Code**	**Subject Name**	**Teaching Hours/Week**			**Credit**	**Maximum Marks**			
				L	**T**	**P**		**IA**	**EA**	**PA**	**Total**
1	Core Course	UPCCE301	Environmental Engineering-I	3	0	0	3	30	70	0	100
2	Core Course	UPCCE302	Material Testing and Evaluation	3	0	0	3	30	70	0	100
3	Core Course	UPCCE303	Surveying and Geomatics	3	1	0	4	30	70	0	100
4	Engg. Science Course	UESCE304	Engineering Mechanics	3	0	0	3	30	70	0	100
5	Basic Science Course	UBSMH301	Mathematics-III	3	1	0	4	30	70	0	100
6	Humanities Science Course	UHSMH211	Engineering Economics	3	0	0	3	30	70	0	100
7	Lab Course	ULCCE301	Computer-aided Civil Engineering Drawing	0	0	3	1.5	0	0	100	100
8	Lab Course	ULCCE302	Environmental Engineering Lab.	0	0	3	1.5	0	0	100	100
			Total				23				800

Note: Each hour of practical/lab/sessional class = 0.5 credit

Environmental Engineering – I **(3-0-0)**

Course Objectives:

- To make the students conversant with sources and its demand of water
- To understand the basic characteristics of water and its determination
- To expose the students to understand the design of water supply lines
- To provide adequate knowledge about the water treatment processes and its design
- To have adequate knowledge on operation and maintenance of water supply design various units of a water treatment plant.
- Identify the parameters responsible for air pollution and their control strategies.
- Identify the parameters responsible for noise pollution and their preventive measures.

Course Content:

Module-I

Water Supply Engineering: General requirement for water supply. Estimation of water demand. Forecasting the population - variation in demand pattern. Types of demand and their contribution - rate of consumption.**Sources of water supply:**Types of Sources, Quantitative and qualitative studies, Intake structures and transportation of water. Pipe- Materials - laying- joining- testing - pipe appurtenances- Pumps and pumping stations . **Distribution systems -** . General description of water distribution system. Analysis of good distribution networks,Arrangement of Distribution Pipe and other Accessories. Layout of Distribution Network. Method of Distribution. Pressure in the Distribution system. System of Supply.

Module-II

Characteristics of water: Physical, chemical and biological characteristics of water and their significance, Water quality criteria, water analysis- IS and WHO standards Water borne diseases. **Engineered systems for water treatment:** Aeration, sedimentation, coagulation, filtration, softening, ion exchange, and disinfection. Advanced water treatment.

Note: Assignments include the drawings of various water treatment units.

Module-III

Air Pollution: Sources, classification, characteristics, effects, dispersion patterns and behaviour of air pollutants. Emission quantification, limiting concentrations and standards. Air pollution control systems: Classification and types, Source correction methods. Particulate emission control-Gravitational settling chamber, Cyclone separator, Fabric filter, Electrostatic precipitator, Wet scrubbers. Gaseous emission control-Absorption by liquids and solids. **Noise Pollution:** Structure and measurement of noise. Sources, effects and control of noise pollution, limiting concentrations and standards.

Text Book

1. “Environmental Engineering”, H.S. Peavy, D.R. Rowe, & G. Tchobanoglous, Seventh Edition, McGraw Hill, 1985.
2. Punmia B.C, Ashok Jain &Arun Jain, Water Supply Engineering, Laxmi Publications, Pvt. Ltd., New Delhi, 2004.
3. "Water Supply Engineering & Environmental Engineering (Vol. I)" by S.K. Garg., Twentieth Revised Edition, Khanna Publishers, 2013
4. “Environmental Engineering (Vol. II), Sewage Disposal and Air Pollution Engineering" by S.K. Garg., Twentieth Revised Edition, Khanna Publishers, 2013

References

1. “Introduction to Environmental Engineering”, M.L. Davis & D.A. Cornwell, Fourth Edition, Tata McGraw Hill, 2010.
2. “Unit Operations and Processes in Environmental Engineering”, T.D. Reynolds & P.A. Richards, Second Edition, PWS Publishing Company, CENGAGE Learning, 2009.
3. “Manual on water supply and Treatment”, CPHEEO, Ministry of Urban Development, GoI, New Delhi, 2009.

4. Manual on Water supply and Treatment - CPHEEO, 1999
5. Birdie, G.S. and Birdie, Water Supply and Sanitary Engineering, DhanpatRai& Sons, 1992.
6. Duggal, K.N. Elements of Environmental Engineering, S.Chand& Co, 2002.

Course Outcomes:

- Evaluate the quantity of drinking water
- Identify and Analyse Sources and Characteristics of water
- Could evaluate and Design Best Possible components of water supply systems
- Could Identify and Quantify the Sources of air Pollution and Noise Pollution

Environmental Engineering Lab **(0-0-3)**

A. Water Quality Analysis

1. Determination of pH (Electrometric and Colorimetric).
2. Determination of turbidity by using Nephelometer.
3. Determination of alkalinity and acidity.
4. Optimum dose of coagulants by jar test.
5. Total Hardness.
6. Total solids, Total suspended solids & Total Dissolve Solid, FS, VS
7. Residual chlorine and Combined Chlorine.
8. Chlorides.
9. Chemical Oxygen Demand.
10. Dissolved Oxygen &Biochemical Oxygen Demand.

B. Ambient Air Quality Analysis

11. Respirable Particulate Matter (PM10).
12. Total Suspended Particulate matter (TSP).
13. Determination of SO2 in ambient air.
14. Determination of NOx in ambient air.

C. Noise Pollution measurement

15. Indoor and ambient noise level analysis

D. Microbiological Analysis of Water

16. Microbiological culture analysis of bacterial samples
17. MPN Test

Material Testing and Evaluation **(2-0-0)**

Course Objectives:

1. Familiarize the students with different construction materials.
2. Recognizing the quality of materials required for construction works.
3. Exposure to a variety of established material testing procedures and techniques.

Course Content:

Module-I:

Introduction to Engineering Materials*:*Bricks: Brick as a construction material and its importance, materials suitable for manufacture of bricks, methods of brick manufacture, types of bricks, qualities of a good brick, testing of bricks, uses of bricks. Cements: chemical composition, Hydration, Setting of cement, Structure of hydrate cement, Test on physical properties, Different grades of cement. Aggregates: Classification of aggregate, Particle shape & texture, Bond, strength & othermechanical properties of

aggregate, Specific gravity, Bulk density, porosity, adsorption & moisture content of aggregate, Bulking of sand, Deleterious substance in aggregate, Soundness of aggregate, Alkali aggregate reaction, Thermal properties, Sieve analysis, Fineness modulus , Grading curves, Grading of fine & coarse Aggregates, Gap gradedaggregate, Maximum aggregate size.

Module-II:
Concrete:Plain, reinforced and steel fibre/ glass fibre-reinforced, light-weight concrete, HighPerformance Concrete, Polymer Concrete
Ceramics, and Refractories, Bitumen and asphalticmaterials, Timbers, Glass and Plastics,
Flooring material,Granite,Tiles,Wooden,ACP,Aluminium,Fittings, Types of pipping material(PVC,UPVC,CPVC,CMPDI,DIetc)Structural Steel and other Metals, Plastic deformation of metals; Tensile test – standards for different material(brittle, quasi-brittle, elastic and so on) True stress – strain interpretation of tensile test; hardness tests; Bending and torsion test;Paints andVarnishes, Acoustical material and geo-textiles, rubber and asbestos, laminates andadhesives, Graphene, Carbon composites and other engineering materials includingproperties and uses of these

Module-III:
Standard Testing & Evaluation Procedures covering,understanding i) Tests & testing of bricks, ii) Tests & testing of sand, iii) Tests & testing of concrete, iv) Tests & testing of soils, v) Tests & testing of bitumen & bituminous mixes, vi) Tests & testing of polymers and polymer based materials, vii) Tests & testing of metals & viii) Tests & testing of other special materials, composites and cementitious materials. Explanation of mechanical behaviour of these materials.

Text B**ooks/Reference Books**:
1.Material of Construction by D.N.Ghose, TMH Publishing Company Ltd.
2.Engineering Materialsby S. C. Rangwala et al., Charotar Publishing House
3. A text book of Building Construction by S K Sharma and B.K Kaul, S Chand & Company Limited.
4. Building Construction by Sushil Kumar, Standard Publishers Distributors, New Delhi.
5.Properties of concreteby A M Neville, Low Price Edition.
6.Building Construction by S P Arora.
7.Building Materialsby S.K.Duggal, TMH Publication.

Course Outcomes:

CO1: Select suitable materials for buildings.
CO2: Interpreting the laboratory data including conversion of the measurements into engineering values and derivation of material properties
CO3:Evaluate the mechanical and structural properties of materials.

Surveying and Geomatics (3-0-0)

Course Objective:
1. Able to understand the basic of survey engineering like chain surveying, Plane table surveying, levelling, countering etc.
2.To formulate and solve various problems in Theodolite surveying, Trigonometric levelingand curves used in surveying.
3.To know the basis of GPS, EDM, Distomat and modern surveying equipment used in Photogrammetry Surveying, Total Station Surveying etc.
Course Content:

Module-I

Principles, Linear, angular and graphical methods, Survey stations, Survey lines- ranging, Bearing of survey lines, Levelling: Plane table surveying, Principles of levelling- booking and reducing levels; differential, reciprocal leveling, profile levelling and cross sectioning. Digital and Auto Level, Errors in levelling; contouring: Characteristics, methods, uses.

Module-II

Theodolite survey: Instruments, Measurement of horizontal and vertical angle; Horizontal and vertical control - methods -triangulation - network- Signals. Baseline - choices - instruments and accessories - extension of base lines - corrections - Satellite station - reduction to centre - Intervisibility of height and distances - Trigonometric leveling - Axis single corrections.

Elements of simple and compound curves – Method of setting out– Elements of Reverse curve - transition curve – length of curve – Elements of transition curve - Vertical curves.

Module-III

Principle of Electronic Distance Measurement, Modulation, and Types of EDM instruments, Distomat, Total Station – Parts of a Total Station – Accessories –Advantages and Applications. Field Procedure for total station survey, Errors in Total Station Survey; Global Positioning Systems- Segments, GPS measurements, errors and biases.

Module-IV

Introduction to Photogrammetry Surveying, Basic concepts, perspective geometry of aerial photograph, relief and tilt displacements, terrestrial photogrammetry, flight planning; Stereoscopy, aerial triangulation, radial triangulation.

Text Books /Reference Books:

1 Madhu, N, Sathikumar, R and Satheesh Gobi, Advanced Surveying: Total Station, GIS and Remote Sensing, Pearson India, 2006.
2 Manoj, K. Arora and Badjatia, Geomatics Engineering, Nem Chand & Bros, 2011
3 Bhavikatti, S.S., Surveying and Levelling, Vol. I and II, I.K. International, 2010
4 Chandra, A.M., Higher Surveying, Third Edition, New Age International (P) Limited, 2002.
5 Anji Reddy, M., Remote sensing and Geographical information system, B.S. Publications, 2001.
6 Arora, K.R., Surveying, Vol-I, II and III, Standard Book House, 2015.

Course Outcomes:

CO1. Able to understand the basic of survey engineering like chain surveying, Plane table surveying, levelling, countering etc.

CO2. Ability to formulate and solve various problems in Theodolite surveying, Trigonometric leveling and appreciate the need for understanding various type of curves used in surveying.

CO3. Execute current skill and using modern surveying equipment to interpret data regarding Photogrammetry Surveying, counter map and Total Station Survey.

Engineering Mechanics **(3-0-0)**

Course Objectives:

1. To explain the importance of mechanics in the context of engineering and conservation equations.
2. To explain the significance of centroid, centre of gravity and moment of inertia.

3. To introduce the techniques for analyzing the forces in the bodies.
4. To apply the different principles to study the motion of a body, and concept of relative velocity and acceleration and describe the trajectory of a particle under projectile motion.

Course Content:

Module-I

Concurrent forces on a plane: Composition, resolution and equilibrium of concurrent coplanar forces, method of moment, friction.

Parallel forces on a plane: General case of parallel forces, center of parallel forces and centerof gravity, centroid of composite plane figure and curves. Vector analysis: Analysis of forces on rigid bodies through vector approach.

Module-II

General case of forces on a plane: Composition and equilibrium of forces in a plane, planetrusses, method of joints and method of sections, principle of virtual work, equilibrium of ideal systems.

Moments of inertia: Plane figure with respect to an axis in its plane and perpendicular tothe plane, parallel axis theorem, solid bodies.

Module-III

Rectilinear Translation: Kinematics, principle of dynamics, D Alembert's Principle,momentum and impulse, work and energy, impact

Module-IV

Curvilinear translation: Kinematics, equation of motion, projectile, D Alembert's principleof curvilinear motion. Kinetics of rotation of rigid body

Text Book/Reference Bokks:

1. Engineering mechanics: S Timoshenko & Young; 4th Edition (international edition) MC Graw Hill.
2. Vector Mechanics for Engineers : Beer & Johnston.
3. Fundamental of Engineering mechanics (2nd Edition): S Rajesekharan & G Shankara Subramanium; Vikas Pub. House Pvt ltd.
4. Engineering mechanics: K.L. Kumar; Tata MC Graw Hill.

Course outcomes:

CO1: Draw free body diagrams and determine the resultant of forces and moments.

CO2: Determine the centroid and second moment of area of sections.

CO3: Apply laws of mechanics to determine efficiency of simple machines with consideration of friction.

CO4: Analyse the motion and calculate trajectory characteristics.

CO5: Apply Newton's laws and conservation laws to elastic collisions and motion of rigid bodies.

Mathematics-III **(3-0-0)**

Module-I

Polynomials – Orthogonal Polynomials – Lagrange's, Chebysev Polynomials; Trigonometric Polynomials; Laplace Transform, Properties of Laplace Transform, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem. Evaluation of integrals by Laplace transform, solving ODEs and PDEs by Laplace Transform method.

Module-II
Fourier transforms, Z-transform and Wavelet transforms: properties, methods, inverses and their applications. Basic counting techniques – inclusion and exclusion, pigeon-hole principle, permutation, combination, summations. Graphs and their basic properties – degree, path, cycle, subgraph, isomorphism, Eulerian and Hamiltonian walk, trees.

Module-III
Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality.Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities.

Textbooks/References:
1. C. L. Liu, Elements of Discrete Mathematics, 2nd Ed., Tata McGraw-Hill, 2000.
2. R. C. Penner, Discrete Mathematics: Proof Techniques and Mathematical Structures, World Scientific, 1999.
3. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2006.
4. K. H. Rosen, Discrete Mathematics and its Applications, 6th Ed., Tata McGraw-Hill, 2007.
5. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003 (Reprint).
6. N. Deo, Graph Theory, Prentice Hall of India, 1974.
7. S. Lipschutz and M. L. Lipson, Schaum's Outline of Theory and Problems of Discrete Mathematics, 2nd Ed., Tata McGraw-Hill, 1999.
8. J. P. Tremblay and R. P. Manohar, Discrete Mathematics with Applications to Computer Science, Tata McGraw-Hill, 1997.

Engineering Economics (3-0-0)

Prerequisites:

1. Mathematics.
2. Basic Economics.

Module 1: (10 Hours)

Engineering Economics: Nature, Scope, Basic problems of an economy, Micro Economics and Macro Economics.

Demand: Meaning of demand, Demand function, Law of Demand and its exceptions, Determinants of demand, Demand Estimation and Forecasting, Elasticity of demand & its measurement (Simple numerical problems to be solved), Supply-Meaning of supply, Law of supply and its exception, Determinants of supply, Elasticity of supply, Determination of market equilibrium (Simple numerical problems to be solved).

Production: Production function, Laws of returns: Law of variable proportion, Law of returns to scale.

Module 2: (10 Hours)

Cost and revenue concepts, Basic understanding of different market structures, Determination of equilibrium price under perfect competition (Simple numerical problems to be solved), Break Even Analysis-linear approach (Simple numerical problems to be solved).

Banking: Commercial bank, Functions of commercial bank, Central bank, Functions of Central Bank.

Inflation: Meaning of inflation, types, causes, measures to control inflation.

National Income: Definition, Concepts of national income, Method of measuring national income.

Module 3: (10 Hours)

Time value of money: Interest - Simple and compound, nominal and effective rate of interest, Cash flow diagrams, Principles of economic equivalence.

Evaluation of engineering projects: Present worth method, Future worth method, Annual worth method, Internal rate of return method, Cost benefit analysis for public projects.

Depreciation: Depreciation of capital assert, causes of depreciation, Methods of calculating depreciation (Straight line method, Declining balance method), After tax comparison of project.

Text Books:

1. Riggs, Bedworth and Randhwa," Engineering Economics", McGraw Hill Education India.
2. Deviga Vengedasalam," Principles of Economics", Oxford University Press.
3. William G. Sullivan, Elin M. Wicks, C. Patric Koelling," Engineering Economy", Pearson.
4. R. Paneer Selvam," Engineering Economics", PHI.
5. S. P. Gupta," Macro Economics", TMH.
6. S. B. Gupta," Monetary Economics", Sultan Chand and Co.

Computer-aided Civil Engineering drawing (0-0-3)

Course Objectives:
1. Interpreting architectural civil engineering plans.
2. Ability to draw architectural and civil engineering plans by using AutoCAD.

Course Contents:
The drawing is to be drawn using AutoCAD.

1. Plan, elevation, side view of residential/office building
2. Drawing of 2 bed room/3 bed room houses (single and two storeyed), ground and first floorplans, elevation and section for load bearing and framed structures
3. Detailing of doors/windows
4.Drawing of several types of footing, bricks work, floor, staircases, masonry, arches and lintels
5.Types of steel roof trusses
6. Detailing of floor and wall joints
7. Project on establishments like Bank building/ Post office/ Hostel/ Library/ Hospital/Auditorium etc.

Text Books/Reference Books:
1. Civil Engineering Drawing and Design by D.N.Ghose CBS Publisher
2. Subhash C Sharma & Gurucharan Singh (2005), "Civil Engineering Drawing", Standard Publishers
3. Ajeet Singh (2002), "Working with AUTOCAD 2000 with updates on AUTOCAD 200I", Tata- Mc Graw-Hill Company Limited, New Delhi
4. Sham Tickoo Swapna D (2009), "AUTOCAD for Engineers and Designers", Pearson Education.
5. Venugopal (2007), "Engineering Drawing and Graphics + AUTOCAD", New Age International Pvt. Ltd.,
6. Balagopal and Prabhu (1987), "Building Drawing and Detailing", Spades publishing KDR building, Calicut,
7. Malik R.S., Meo, G.S. (2009) Civil Engineering Drawing, Computech Publication Ltd New Asian.
8. Sikka, V.B. (2013), A Course in Civil Engineering Drawing, S.K.Kataria& Sons.

Course outcomes:
CO1:Ability to use Auto-CAD for civil engineering plans and drawings.
CO2:Understanding of general Auto-CAD terminology, coordinate systems, inquiry commands, draw commands, edit commands, dimensioning, block commands, layers, display commands, utility commands, and setting prototype drawings.

Semester – IV

Sl. No.	Subject Type	Subject Code	Subject Name	Teaching Hours/Week			Credit	Maximum Marks			
				L	T	P		IA	EA	PA	Total
1	Core Course	UPCCE401	Geotechnical Engineering- I	3	0	0	3	30	70	0	100
2	Core Course	UPCCE402	Structural Analysis - I	3	1	0	4	30	70	0	100
3	Core Course	UPCCE403	Solid Mechanics	3	0	0	3	30	70	0	100
4	Engg. Science Course	UESCE404	Fluid Mechanics	3	0	0	3	30	70	0	100
5	Humanities Science Course	UHSMH212	Organizational Behavior	3	0	0	3	30	70	0	100
6	Lab Course	ULCCE401	Survey Lab	0	0	3	1.5	0	0	100	100
7	Lab Course	ULCCE402	Hydraulic Lab	0	0	3	1.5	0	0	100	100
8	Lab Course	ULCCE403	Material Testing Lab.	0	0	3	1.5	0	0	100	100
9	Mandatory Course	UMCCE401	Environmental Science	2	0	0	0	30	70	0	100
			Total				20.5				900
10	Summer Internship programme (4 to 8 weeks) is mandatory as per AICTE rule										

Note: Each hour of practical/lab/sessional class = 0.5 credit

Geotechnical Engineering- I **(3-1-0)**

Course objectives:

1. To explain what Geotechnical Engineering and how it is important to civil engineering. To explain clay mineralogy and shape and size of soil To explain how three phase system is used in soil and how are soil index properties estimated using three phase system.
2. To explain role of water in soil behavior and soil stresses, permeability and quantity of seepage including flow net are estimated
3. To determine shear parameters of soil and stress changes in soil due to foundation loads
4. To estimate the magnitude and time-rate of settlement due to consolidation
5. To explain the concept of slope stability analysis for various slope conditions including graphical methods

Course Content:

Module-I

Origin of Soil: Rock Cycle and the origin of soil, soil particle size, clay mineralogy, mechanical analysis of soil, grain size distribution curve, particle shape, weight volume relationships, specific gravity, unit weight, void ratio, moisture content, and relationships, relative density.

Consistency of soil: Atterberg limits - Liquidity index and consistency index, activity, soil structure. Engineering classification of soil: Types of Soil classification, IS, USCS, HRB and ASTM. Clay Minerals: Types of Clay Minerals

Module-II

Soil Hydraulics: Modes of occurrence of water in soil. Stress conditions in soil- total, effective and neutral stresses and relationships.

Permeability - Bernaulli's equation, Darcy's Law, hydraulic conductivity, laboratory determination of hydraulic conductivity, equivalent hydraulic conductivity in stratified soil.

Seepage- Laplace equation of continuity, flow nets, seepage calculation from a flow net, flow nets in anisotropic soils, seepage through earth dam, critical hydraulic gradient and quick sand condition.

Soil Compaction: mechanism and principles, SPT, factors affecting compaction, effect of compaction on soil properties, field compaction techniques.

Module-III

Consolidation of soils: Consolidation and compaction, primary and secondary consolidation, Terzhaghi's theory of one dimensional consolidation, consolidation test, coefficient of consolidation.

Stress Distribution: Normal and shear stresses on a plane, Boussinesq's solution for a point load, line load, strip load, uniformly loaded circular and rectangular areas, Isobar and pressure bulb concept, stress distribution on horizontal and vertical planes, Newmark's chart and its application, contact pressure.

Module-IV

Shear Strength: Mohr-Coulomb failure criterion, shear strength parameters and determination: direct and tri-axial shear test, unconfined compression test, vane shear test. Other methods of determining the un-drained shear strength of soil, sensitivity and thixotropy of clay.

Stability of Slopes: Terminology, stability of finite and infinite slopes, Swedish slip circle method and friction circle method of analysis of slopes, Taylor stability Number and stability curves, Bishops

Text Books/reference Books:

1. Principles of Geotechnical Engineering by Braja M. Das, Cengage Learning
2. Soil Mechanics and Foundation Engineering, by K.R. Arora, Stanard Publishers
3. Soil Mechanics and Foundation Engineering by B.N.D. NarasingaRao, Wiley India Pvt. Ltd.
4. Basic and applied soil mechanics, New Age International Publishers

5. Geotechnical Engineering by T.N. Ramamurthy & T.G. Sitharam,S. Chand & Co.
6. Geotechnical Engineering, S.K.Gulati and M. Datta, McGrow Hill

Course outcomes:

CO1: Define index properties and engineering properties of soil and identify the soil types and classify based on index properties.

CO2: Understand the stress conditions, seepage and permeability in soils and apply the concept of compaction and consolidation to evaluate the settlement of foundation.

CO3: Determine the vertical stress distribution on horizontal and vertical plane below the ground surface due to various types of loading..

CO4: Evaluate the shear strength parameters of soil and ability to understand the slope stability analysis.

Structural Analysis – I **(3-0-0)**

Course Objectives:

1. Apply knowledge of mathematics and engineering in calculating slope anddeflections
2. Identify, formulate and solve engineering problems
3. Analyze structural systems and interpret data.
4. Engage in lifelong learning with the advances in Structural Engineering.

Course Contents:
Module-I

Concept of determinate and indeterminate structures, determination of degree of static andkinematic indeterminacy in plane frame and continuous structures.

Methods of Analysis: Equilibrium equations, compatibility requirements, Introduction to forceand displacement methods.

Analysis of indeterminate structure by consistent deformation method, Analysis of fixed and

continuous beams by Moment-Area method, Conjugate beam method and theorem of three

moments.

Module-II

Energy theorems and its application, Strain energy method, Virtual work method, unit load

method, Betti's and Maxwell's laws, Castigliano's theorem, concept of minimum potential

energy.Analysis of redundant plane trusses.Deflection of pin jointed plane trusses. Analytical method and Williot –Mohr diagram.Introduction to space truss.

Module-III

Rolling loads and influence lines for determinate structures, simply supported beams, cantilever,ILD for reaction, shear force and bending moment at a section, ILD for wheel loads, point loads and UDL, maximum bending moment envelope.

Module-IV

Analysis of three hinged arches, Suspension cable with three hinged stiffening girders subjectedto dead and live loads, ILD for Bending Moment, Shear Force, normal thrust and radial shear forthree hinged arches.

Text Books/Reference Books:

1. Theory and Problems in Structural Analysis by L Negi, Mc Graw Hill

2.Structural Analysis by Norris and Wilber

3. Basic Structural Analysis by C S Reddy, McGraw Hill.

4.Elementary Structural Analysis by Norris and Wilber, McGraw Hill

5. Structural Analysis by Aslam Kassimali, Cengage Learing

6. Structural Analysis by R.C. Hibbeler, Pearson Education

7.Structural Analysis by T.S. Thandamoorthy, Oxford University Press.

Course Outcomes:

CO1: Understanding determinate and indeterminate structures, calculating the degree of indeterminacy and analysing fixed and continuous beam by Force methods.

CO2: Analysing beam, frame and trusses by energy methods.

CO3: Developing shear force and bending moment diagram of determinate structure by Influence Line Diagram.

CO4: Identifying types of arches and calculating its bending moment, shear force, radial shear, normal thrust for three hinged arches and also understand its ILD.

Solid Mechanics (3-1-0)
Course Objectives:

1. To develop the theoretical basis about the stress, strain and elastic modulus concepts in various components.
2. To understand the mechanical behavior of materials.
3. To familiarize about finding shear force, bending moment, deflection and slopes in various types of beams with different load conditions
4. To enable students to solve practical problems related to springs and shafts.
5. To study about strain energy, crippling load of columns for different boundary conditions.
6. To understand different theories of failure, stress in thin cylinder thick cylinder and spheres due to external and internal pressure.

Course Contents:

Module – I

Load, Stress,Principle of Superposition, Strain, Hooke's law, Modulus of Elasticity,Stress-Strain Diagrams, Working Stress, Factor of safety, Strain energy in tension and compression,Resilience, Impact loads,stresses due to freely falling weight.

Analysis of Axially Loaded Members : Composite bars in tension and compression - temperature stresses in composite rods, Shear stress, Complimentary shear stress, Shear strain, Modulus of rigidity, Poisson's ratio, Bulk Modulus,Relationship between elastic constants.

Analysis of Biaxial Stress. :Plane stress, Principal stress, Principal plane, Mohr's Circle for Biaxial Stress.

Strain Deformation:Two dimensional state of strain, Mohr's circle for strain, Principal strains and principal axes of strainmeasurements, Calculation of principal stresses from principal strains.

Module – II

Shear Force and Bending Moment for Simple Beams :Shear force and bending moment. Typesof load and Types of support. Support reactions, Relationship between bending moment and shear force, Point of inflection. Shear Force and Bending Moment diagrams.

Simple Bending of Beams:Theory of simple bending of initially straight beams, Bending stresses, Shear stresses in bending,Distribution of normal and shear stress, beams of two materials, Composite beams. Deflection of Beams:Differential equation of the elastic line, Slope and deflection of beams by double integration method and Moment –Areamethod.

Module – III

Stresses in thin cylinders, thin spherical shells under internal pressure -wire winding of thin cylinders. Introduction to thick cylinder. Torsion in solid and hollow circular shafts, Twisting moment, Strain energy in shear and torsion, strength of solid and hollow circular shafts. Stressesdue to combined bending and torsion, Strength of shafts in combined bending and twisting.

Module – IV

Theory of Columns:Eccentric loading of a short strut, Long columns, Euler's column formula, Lateral buckling, Critical Load,Slenderness ratio. Close - coiled helical springs.

Theories of failure: Maximum principal stress theory, maximum shear stress theory, maximum strain theory, total strain energy theory, maximum distortion theory, octahedral shear stress theory graphical representation and comparison of theories of failure.

Text Books/Reference Books:

1. Elements of Strength of Materials by S.P.Timoshenko and D.H.Young, Affiliated East-West Press
2. Strength of Materials by G. H. Ryder, Macmillan Press
3. Strength of Materials by James M. Gere and Barry J. Goodno, Cengage Learning
4. Mechanics of Materials by Beer and Johnston, Tata McGraw Hill
5. Mechanics of Materials by R.C.Hibbeler, Pearson Education
6. Mechanics of Materials by William F.Riley, Leroy D.Sturges and Don H.Morris, WileyStudent Edition
7. Mechanics of Materials by James M. Gere, Thomson Learning
5. Engineering Machanics of Solids by Egor P. Popov, Prentice Hall of India
6. Strength of Materials by S.S.Rattan, Tata Mc Graw Hill
7. Strength of Materials by R.Subramaniam, Oxford University Press

Course outcomes:

CO1: Understand the concepts of stress and strain and the stress-strain relationships for homogenous, isotropic materials.

CO2: Evalute the stresses and strains in axially-loaded members, circular torsion members, and members subject to flexural loadings.

CO3: Determine and illustrate principal stresses, maximum shearing stress, and the stresses acting on a structural member.

CO4: Understand the concept of bending moment and shear force and analyse different beams with different support and loading conditions.

CO5: Determine the deflections and slopes produced by the three fundamental types of loads: axial, torsional, and flexural.

Fluid Mechanics **(3-1-0)**

Course Objectives:

1. To give fundamental knowledge of fluid, its properties and behavior under various conditions of internal and external flows.
2. Apply conservation laws to derive governing equations of fluid flows.
3. To develop understanding about hydrostatic law, principle of buoyancy and stability of a floating body and application of mass, momentum and energy equation in fluid flow.
4. Apply principles of dimensional analysis to design experiments.

Module - I

Basic Concepts and Definitions:Distinction between a fluid, a gas and a solid.
Fluid properties: Density, Specific weight, Specific gravity, Kinematic and dynamic viscosity; variation of viscosity with temperature, Newton law of viscosity, vapour pressure, boiling point, cavitations, surface tension, capillarity, Bulk modulus of elasticity, compressibility.

Fluid Statics:Fluid Pressure: Pressure at a point, Pascals law, pressure variation with temperature, density and altitude. Manometer: classification, description and use. Hydrostatic pressure and force: horizontal, vertical and inclined surfaces.Buoyancy and stability of floating bodies.

Module - II

Fluid kinematics: Introduction, description of fluid flow, classification of fluidflow.Reynold's number, Acceleration of fluid particles, flow rate and continuity equation,differential equation of continuity,Mathematical definitions of irrotational and rotationalmotion. Circulation, potential function and stream function. Flow net

Module-III

Fluid Dynamics: Equations of motion - Euler's equation; Bernoulli's equation – derivation; Energy Principle; Practical applications of Bernoulli's equation: venturimeter, orifice meter and pitot tube; Momentum principle; Forces exerted by fluid flow on pipe bend; Vortex Flow – Free and Forced.
Flow through pipe:Loss due to friction, Minor energy losses in pipes HydraulicGradient Line(HGL), Total Energy Line (TEL), Power transmission in the fluid flow inpipes, fluid flow inpipes in series and parallel. Analysis of pipe networks: Hardy Cross method, water hammer in
pipes and control measures, branching of pipes, three reservoir problem.

Module-IV

Introduction to Open Channel Flow: Comparison between open channel flow and pipe flow, classification of open channel flow, Efficient Section Specific energy, Specific energy curve, critical flow, Specific force, Specific depth, and Critical depth, Gradually Varied Flow-Dynamic Equation of Gradually Varied Flow, Classification of surface profile, Characteristics of surface profile.

Text/Reference Books:

1. Fluid Mechanics and Machinery, C.S.P.Ojha, R. Berndtsson and P. N. Chadramouli, Oxford University Press, 2010
2. Hydraulics and Fluid Mechanics, P M Modi and S M Seth, Standard Book House
3. Theory and Applications of Fluid Mechanics, K. Subramanya, Tata McGraw Hill
4. Fluid Mechanics with Engineering Applications, R.L. Daugherty, J.B. Franzini and E.J. Finnemore, International Student Edition, Mc Graw Hill.

Course Outcomes:

1. Analyze the various properties of fluid.
2. Design experiments to evaluate the stability of floating and submerged body.
3. Investigate the problems related with the concept of fluid kinematics for the performance of civil engineering components.
4. Demonstrate the principles of equations of fluid dynamics for analyzing the problems related to water flow in a conduit.
5. Identify the properties of fluid in open channel flow and analyzing the effect of energy loss in hydraulic jump.

Organizational Behavior (2-0-0)

Module-I

The study of Organizational Behaviour : Definition and Meaning, Why Study OB? Learning –Nature of Learning, How Learning occurs, Learning and OB.Foundations of Individual Behaviour : Personality – Meaning and Definition, Determinants of Personality, Personality Traits, Personality and OB.
Perception – Meaning and Definition, Perceptual Process, Importance of Perception in OB. Motivation – Nature and Importance, Herzberg's Two Factor Theory, Maslow's Need Hierarchy Theory, Alderfer's ERG Theory, Evaluations.

Module-II

Organizational Behaviour Process : Communication – Importance, Types, Gateways and Barriers toCommunication, Communication as a tool for improving Interpersonal Effectiveness, Groups in Organizations – Nature, Types, Why do people join groups, Group Cohesiveness and Group Decision making
Managerial Implications, Effective Team Building. Leadership-Leadership & Management,Theories of Leadership-Trait theory, Leader Behaviour theory, Contingency Theory, Leadership and Follower ship, How to be an effective Leader, Conflict-Nature of Conflict and Conflict Resolution. An Introduction to Transactional Analysis (TA).

Module-III

Organization : Organizational Culture – Meaning and Definition, Culture and OrganizationalEffectiveness. Introduction to Human Resource Management-Selection, Orientation, Training and Development, Performance Appraisal, Incentives Organizational Change – Importance of Change, Planned Change and OB techniques. International Organisational Behaviour – Trends in International Business, Cultural Differences and Similarities, Individual and Interpersonal Behaviour in Global Perspective.

Text Books/Reference Books:

1. Keith Davis, Organisational Behaviour, McGraw-Hill.
2. K.Aswathappa, Organisational Behaviour, Himalaya Publishing House.**:**

3. Stephen P. Robbins, Organisational Behaviour, Prentice Hall of India
4. Pradip N. Khandelwal, Organizational Behaviour, McGraw-Hill, New Delhi.
5. Uma Sekaran, "Organizational Behaviour", TATA McGraw-Hill, New Delhi.
6.Steven L McShane, Mary Ann Von Glinow, Radha R Sharma" OrganizationalBehaviour" , TATA McGraw- Hill.

Survey Lab **(0-0-3)**

Course objective:

1. To test the plot a traverse by using Chain Surveying, Compass Surveying and Thedolite Surveying.
2. To study the function of Total Station and effectively note down the data for elevation and depression in Levelling and Contouring.

Course Content:

1. Study of Chain, Standardization of Chain & Measurement of a line
2. Compass traversing
3. Plane Table
4. Study of Dumpy level, its temporary adjustment, Differential Leveling and Fly leveling.
5. Contouring
6. Study of Theodolite, Temporary adjustment of Theodolite & measurement of horizontal and vertical angle.
7. Theodolite Traversing
8. Study on total station
9. Traversing by chain
10. Traversing by total station

Text Books/Reference Books:

1. Surveying & Field Work by Sir James Williamson,Constable, 1915.
2. A Text Book Of Surveying And Levelling by R. Agor, Khanna Publishers.

Course Outcomes:

CO1 Able to demonstrate their surveying knowledge to perform Chain surveying, Levelling Theodolite surveying and Compass Surveying in field
CO2 Development of engineering and managerial skill to execute team work in Field work of Surveying.

Hydraulics Lab(Practical) **(0-0-3)**

Course Objectives:

1. To measure the discharge coefficients in an open channel flow and pipe flow.
2. To understand the flow measurement in a pipe flow.
3. To measure the head loss in pipes.

Course Content:

1. Study of flow measuring equipment
2.Determination of Metacentric height of a pantoon
3.Verification of Bernoulli's equation
4.Flow classification using Raynolds Apparatus
5.Determination of head loss in pipes
6.Determination of Cc, Cv and Cd of an circular orifice

7.Determination of discharge coefficient (Cd) of Venturimeter
8.Determination of discharge coefficient (Cd) of orifice meters
9.Measurement of flow using V-notch and rectangular weir
10.Calibration of V-notch and Calibration of rectangular weir
11.Determination of Manning's and Chezy's coefficients of an open channel

Reference Books:

1. Laboratory Manual of Fluid Mechanics and Machines by V.P. Gupta, CBS Publisher

Course Outcomes:

1. Perform experiments for determination of fluid parameters such as discharge, velocity, etc.
2. Flexibility to execute as a team or individually to analyze the variation in different fluid properties.
3. Use the techniques of civil engineering for assessing different issues related to engineering practices.

Material Testing Lab .(Practical) (0-0-3)

Course Objectives:

1. Ability to apply knowledge of mathematics and engineering in calculatingthe mechanical properties of structural materials.
2. Ability to use the techniques, skills and modern engineering tools necessaryfor engineering.
3. Understanding of professional and ethical responsibility in the areas ofmaterial testing.
4. Ability to communicate effectively the mechanical properties of materials.

Course Contents:

***Brick*:** (a) Shape and size test for brick, (b) Water absorption test for brick, (c) Compressive strength of brick

***Cement*:** (a) Fineness of cement, (b) Soundness of cement by Lechattelier test, (c) Specific gravity of cement, (d) Fineness of cement by air permeability, (e) Standard consistency of a given sample by Vicat test, (f) Initial and final setting time of cement, (g) Fineness modulus of fine and coarse aggregate, (h) Aggregate crushing value of coarse aggregate, (i) Compressive strength of cement mortar, (j) Tensile strength of cement mortar

***Steel*:** (a) Compression test of cast iron, (b) Rigidity modulus of cast iron, (c) Fatigue test of steel (cyclic loading), (d) Tensile strength of steel

REFERENCE:

1. IS 1077 :1992
2. IS 12269:2013
3. IS 269
4. IS 1786:2008
5. IS 383:1970

Course Outcomes:

CO1: Planning an experimental program, selecting the test configuration, selecting the test specimens and collecting raw data.
CO2: Documenting the experimental program including the test procedures, collected data, method of interpretation and final results.
CO3:Operating the laboratory equipment including the electronic instrumentation, the test apparatus and the data collection system.
CO4: Measuring physical properties of common construction materials.

Constitution of India **(2-0-0)**

Course Objectives:

1.To instill Moral and Social Values and Loyalty.
2. Create awareness among engineers about their social responsibilities
3. Appreciate the Ethical issues
4. To Know the Human rights and concept of women empowerment
5. To know features of our constitution.

Course Contents:

Module-I

History of Making of the Indian Constitution: History, Drafting, Committee. Philosophy of the Indian Constitution: Preamble, Salient Features.

Module-II

Fundamental Rights: Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies. Directive Principles of State Policy, Fundamental Duties.

Module-III

Parliament: Composition, Qualifications and Disqualifications, Powers and Functions.
Executive: President, Governor, Council of Ministers.
Judiciary: Appointment and Transfer of Judges, Qualifications, Powers and Functions.

References:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.
5. M.P. Jain, Outlines of Indian Legal and Constitutional History, Lexis Nexis, 2014.

Course Outcomes:

CO1: Discover of the set of justified moral principles of obligation, ideals that ought to be endorsed by the engineers and apply them to concrete situations

CO2: Justify the need for protection of human rights and to know about concept of women empowerment

CO3: Practice the moral values that ought to guide the Engineering profession.

Semester – V

Sl. No.	Subject Type	Subject Code	Subject Name	Teaching Hours/Week			Credit	Maximum Marks			
				L	T	P		IA	EA	PA	Total
1	Core Course	UPCCE501	Design of Concrete Structure	3	0	0	3	30	70	0	100
2	Core Course	UPCCE502	Transportation Engineering - I	3	0	0	3	30	70	0	100
3	Core Course	UPCCE503	Water Resources Engineering	3	0	0	3	30	70	0	100
4	Core Course	UPCCE504	Geotechnical Engineering-II	3	0	0	3	30	70	0	100
5	Professional Elective-I	UPECE501	Structural Analysis- II	3	0	0	3	30	70	0	100
		UPECE502	Design of Structural Systems	3	0	0	3	30	70	0	100
		UPECE503	Sustainable Construction Methods	3	0	0	3	30	70	0	100
6	Open Elective-I	Any one subject to be picked from the open elective courses offered by various departments		3	0	0	3	30	70	0	100
7	Lab Course	ULCCE501	Design of Concrete Structure	0	0	3	1.5	0	0	100	100
8	Lab Course	ULCCE502	Transportation Engineering Lab	0	0	3	1.5	0	0	100	100
9	Lab Course	ULCCE503	Geotechnical Engineering Lab.	0	0	3	1.5	0	0	100	100
			Total				22.5				900

Note: Each hour of practical/lab/ sessional class = 0.5 credit

Design of Concrete Structure **(3-0-0)**

Course Objective:

1. To introduce the students to the fundamentals of reinforced concrete design with emphasis on the design of rectangular and T beams, short and slender columns, slabs, and footings and foundations.
2. In addition, student will learn how to analyze and design reinforced concrete structural members under bending, shear, and/or axial loads according to the IS code requirements.

Course Contents:

Module-I

Properties of concrete and reinforcing steel, Philosophy, concept and methods of reinforced concrete design, Introduction to limit state method: Limit state of collapse and limit state of serviceability.Application of Limit state method to rectangular beams for flexure, shear, bond and torsion.

Module-II

Design of doubly reinforced beams. Design of T-and L-beams. Design of one way and two wayslabs, Design of staircases.

Module-III

Design of short and long columns with axial and eccentric loading, Design of isolated column footings.

Text Books/Reference Books:

1. Reinforced concrete: Limit state by A.K. Jain
2. Reinforced concrete vol. I [elementary reinforced concrete] by Dr. H.J. Shah
3. Limit state design of reinforced concrete by P.C. Verghese, PHI
4. IS456:2000, Code of practice for Plain and Reinforced Concrete, Bureau of Indian
5. Standards, New Delhi, 2000
6. SP16, IS456:1978 “Design Aids for Reinforced Concrete to Bureau of Indian Standards,New Delhi, 1999.
7. Reinforced concrete by B.C. Punmia, A.K. Jain and A.K. Jain
8. Gambhir.M.L., "Fundamentals of Reinforced Concrete Design", Prentice Hall of IndiaPrivate Limited, New Delhi, 2006.
9. Subramanian,N.,”Design of Reinforced Concrete Structures”,Oxford University Press, NewDelhi, 2013
10. Limit State Design of Reinforced Concrete -P.C Verghese
11. Design of Reinforced Concrete Structures: Pillai & Mennon, TMH Publications.

Course outcome:

CO1: Analyze the strength of reinforced concrete beams and slabs at various support conditions as per Limit state design

CO2: Design reinforced concrete beams, Columns and slabs at various support conditions for different loadings as per Limit state design

CO3: Understand various types of staircases and footings and can apply the knowledge in design as per Limit state.

Design of Concrete Structure – Lab **(0-0-3)**

Course Objective:

To enable students to design different components of such as beam, slab, column, footing etc.

Content:
Complete design of a simple load bearing residential building comprising of beams,slab, column, footing, staircases, etc.

Course Outcomes:
Design a simple load bearing residential building.

Transportation Engg – I **(3-0-0)**

Course Objectives:

1. To introduce the students with the principles and practice of transportation engineering which focuses on Traffic & Highway Engineering.
2. To enable the students to have a strong analytical and practical knowledge of Planning, designing and solving the transportation problems.
3. To introduce the recent advancements in the field of Sustainable Urban Development, Traffic Engineering, Systems Approach to Transport Planning, Highway Design, Construction and maintenance.
4. Participate and succeed in competitive examination like GATE, PSUs and IES etc

Course Contents:

Module-I

Modes of transportation, importance of highway transportation, history of road construction, Principle of highway planning, road development plans, highway alignments requirements,engineering surveys for highway location.

Geometric design- Design controls, highway cross section elements, cross slope or camber, roadwidth, road margins, typical cross sections of roads, design speed, sight distance, design ofhorizontal and vertical alignments, horizontal and vertical curves.

Module-II

Highway Materials: - Properties of subgrade, sub-base, base course and surface course materials, test on subgrade soil, aggregates and bituminous materials,Design of bituminous paving mixes.

Design of Pavements: Flexible pavements and their design using IRC:37-2012, equivalent single wheel load factor, rigid pavements, stress in rigid pavement, IRC design method (IRC:58-2015).

Module-III

Traffic Engineering: - definition, fundamentals of traffic flow, Traffic studies on flow, speed, travel time,Control devices, signal design by Webster's method; Types of intersections and channelization; Highway capacity and level of service of rural highways and urban roads, prevention of road accidents.

Module-IV

Highway Construction: Construction of various layers, earthwork, WBM, GSB, WMM, varioustypes of bituminous layers, joints in rigid pavements, Construction of RigidPavements, highway drainage.

Highway Maintenance: Various type of failures of flexible and rigid pavements.

Text Books:

1. Highway Engineering, by S.K.Khanna and CEG Justo, Nem Chand & Bros.
2. Transportation Engineering-Highway Engineering by C Venkatramaiah, UniversitiesPress.
3. A course in Highway Engineering by Dr. S.P. Bindra, Dhanpat Rai Publications.

Reference Books:

1. Principles of Highway Engineering and Traffic Analysis by Mannering Fred L.,Washburn Scottand Kilaresk Walter P., Wiley India Pvt. Ltd
2. Traffic Engineering and Transportation Planning by Kadiyali, L.R.,Khanna Publishers
3. Transportation Engineering and Planning by Papacostas, C.S. and Prevedouros,P.D.Prentice Hall.

Course Outcomes:

CO1: Understand historical development, planning of roads and apply knowledge of mathematics to design the geometrical elements of highway.

CO2: Identify the characteristics of pavement materials and basic fundamentals of traffic studies.

CO3: Analyse, design and construction of flexible and rigid pavements as per the relevant codes.

CO4: Understand basic requirements and mechanisms for highway maintenance and drainage.

Transportation Engineering Lab **(0-0-3)**

Course Objectives:

1. To test the different property of course aggregate
2. To test and access the grade of bitumen.
3. To test the structural and performance characteristics of Marshall mix design, GSB and WMM

Course Contents:

1. Determination of aggregate crushing value.
2. Determination of Los Angeles abrasion value of aggregates.
3. Determination of aggregate impact value.
4. Determination of penetration value of bitumen.
5. Determination of softening point value of bitumen.
6. Determination of ductility value of bitumen.
7. Determination of flash and fire point of bitumen.
8. Determination of specific gravity of bitumen.
9. Determination of stripping value of aggregate.
10. Determination of flakiness index and elongation index of coarse aggregate.
11. Determination of specific gravity and water absorption of coarse aggregate.
12. Determination of CBR of soil subgrade
13. Design of GSB and WMM
14. Marshall method of mix design
15. Demonstration of advanced equipments for characterization of pavement materials.

Reference:

1. Methods for Sampling and Testing of Mineral Aggregate. Sands and Fillers BS 812 (*British Standard Institute*)

Course Outcomes:

CO1: Able to demonstrate their Civil Engineering knowledge and skill in performing the different types of test in road materials

CO2: Developan engineering skill and flexibly to execute laboratory work to characterize theproperty of course/fine aggregate and bitumen.

CO3: Effectively use their civil engineering knowledge and current skill and tools to execute various pavement layer design and mix design.

Water Resources Engineering **(3-1-0)**

Course Objectives:

1. To study occurrence movement and distribution of water that is a prime resource for development of a civilization.
2. To know diverse methods of collecting the hydrological information, which is essential, to understand surface water hydrology.
3. To analyze hydrographs for its application in real world problems.

Course Content:

Module-I: Introduction - hydrologic cycle, water-budget equation, history of hydrology, world water balance, applications in engineering, sources of data.
Precipitation - forms of precipitation, characteristics of precipitation in India, measurement of precipitation, rain gauge network, mean precipitation over an area, depth-area-duration relationships, maximum intensity/depth-duration-frequency relationship, Probable Maximum Precipitation (PMP), rainfall data in India.

Module-II: Abstractions from precipitation - evaporation process, evaporimeters, analytical methods of evaporation estimation, reservoir evaporation and methods for its reduction, evapo-transpiration, measurement of evapo-transpiration, evapo-transpiration equations, potential evapo-transpiration over India, actual evapo-transpiration, interception, depression storage, infiltration, infiltration capacity, measurement of infiltration, modeling infiltration capacity, classification of infiltration capacities, infiltration indices.

Module-III: Stream flow measurement: Measurement of stage and velocity, Area-velocity method, Indirect methods: flow measuring structures, slope area method. Measurement of Velocity using current meter, Floats, Hot-wire anemometer.
Runoff: runoff volume, SCS-CN method of estimating runoff volume, flow duration curve, flow-mass curve,
Reservoir Planning:Classification, capacity of reservoirs, yield of reservoir, reservoir regulation, sedimentation, Inflow –Mass Curve, Sequent Peak Procedure, Area Elevation Curve.

Module-IV: Hydrograph: factors affecting runoff hydrograph, components of hydrograph, base flow separation, effective rainfall, unit hydrograph: derivation, limitations, different duration, Synthetic unit hydrograph, IUH. Flood: flood estimation, frequency analysis, Reservoir routing and Channel routing,

Text/Reference Books:
1. K Subramanya, Engineering Hydrology, Mc-Graw Hill.
2. K N Muthreja, Applied Hydrology, Tata Mc-Graw Hill.
3. K Subramanya, Water Resources Engineering through Objective Questions, Tata Mc- Graw Hill.
4. G L Asawa, Irrigation Engineering, Wiley Eastern
5. L W Mays, Water Resources Engineering, Wiley.
6. J D Zimmerman, Irrigation, John Wiley & Sons
7. C S P Ojha, R Berndtsson and P Bhunya, Engineering Hydrology, Oxford.

Course Outcomes:

CO1: Gain knowledge about hydrological parameters and its measurement procedures.

CO2: Identify the problems related to hydrological variables by using hydrological tools.

CO3: Develop rainfall-runoff models by using the concept of hydrograph and IUH in order to study the watershed management.

Geotechnical Engineering – II **(3-0-0)**

Pre-requisites: Geotechnical Engineering – I

Course objectives:

1. To explain how earth pressure theory is important in retaining structure design.
2. To explain the concept of bearing capacity and how to estimate the safe bearing capacity for various foundation system including settlement consideration
3. To explain in what circumstances pile is needed and how do analysis the pile and pile group under various soil conditions
4. To emphasize the importance of soil investigations and to explain brief knowledge on rock mechanics

Module-I

Earth Pressure and Retaining Walls:Effect of wall movement on earth pressure, Earth pressure at rest, Rankine's theory of earth pressure, Coulomb's theory of earth pressure, Coulomb's equation for c = 0 back fills, Cullman's graphical method, Passive earth Pressures-Friction circle method, Design considerations retaining walls.

Module-II

Bearing Capacity Of Shallow Foundations: Introduction, Basic definitions, Principal modes of soil failures, Terzaghi's bearing capacity theory/ equation and its modifications for square, rectangular and circular foundation, Skempton's bearing capacity analysis for clays, Meyerhof's analysis, Hansen's bearing capacity theory, Vesic's bearing capacity theory, IS code recommendations for bearing capacity, Bearing capacity of granular soils based on SPT value and Static cone resistance, Bearing capacity of footings on layered soils, Factors influencing bearing capacity, Allowable bearing pressure. General requirements of foundations, Factors affecting location and depth of foundation, Choice of type of foundations, Steps involved in the proportioning of footings. Spread footing, combined and strap footing, mat or raft footing, settlement of footings.

Module-III

Pile Foundations:Use of piles, Types of piles, Construction, Selection of pile type, Types of foundations to suit subsoil conditions, Pile load capacity, Static formulae, Dynamic formulae, Load tests, on piles, Group action of piles, Load carrying capacity of pile groups, Negative skin friction, Piles subjected to uplift loads, Settlement of pile group. Well Foundations: Types of wells and caissons, components of well foundation, shapes of wells, depth of a well foundation, forces acting on a well foundation, lateral stability of well foundation, construction and sinking of a well.

Module-IV

Subsoil Exploration:Necessity and planning for subsoil exploration, direct and indirect methods. Sampling procedures, disturbed and undisturbed samples, Standard penetration test, cone penetration test, Soil exploration report.
Rock Mechanics:Introduction, problems, defects in rock mass, joints, faults, Rock coring, RQD.

Text Books/Reference Books:

1.Basic and Applied Soil Mechanics by GopalRanjan and ASR Rao, New Age International Publishers, Second Edition, 2007.

2.Soil Mechanics and Foundation Engineering by V. N. S. Murthy, CBS Publishers & Distributors, New Delhi.
3.Foundation Analysis and Design by J.E. Bowles, MacGraw Hill, 1996.
4.Geotechnical Engineering Principles and Practices by Donald P. Coduto, Man-Chu Ronald Yeung and William A.Kitch, PHI Learning Pvt. Ltd., Second Edition.
5.Foundation Design by W. C. Teng, Prentice hall.

Course Outcomes:

CO1: To understand and analyze the earth pressure theories behind the retaining structures
CO2: To evaluate the bearing capacity and settlement of shallow foundations and design (soil)
CO3: To analyze and design behavior of different types of deep foundation
CO4: To understand the different subsoil exploration methods in geotechnical engineering (in-situ test.

Elective-I: Structural Analysis- II **(3-0-0)**

Course Objectives:
1. To understand the structural behavior before and after application of loads.
2. To be able to analyze various structure.
3. To be aware of various methods of analysis of structure.

Course Contents:

Module -I

Analysis of continuous beams and plane frames by slope deflection method and moment distribution method.

Module –II

Analysis of two hinged and fixed arches for dead and live loads, Suspension cables with two hinged stiffening girders

Module –III

Plastic Analysis: Plastic modulus, shear factor, plastic moment of resistance, Load factor, Plastic analysis of continuous beam and simple rectangular portals, Application of upper bound and lower bound theorems

Module –IV

Matrix methods of analysis: flexibility and stiffness methods; Application to simple trusses and beams.

Text Books/reference Books:
1.Structural analysis by C.S. Reddy Mc Graw Hill
2.Structural Analysis by T.S. Thandamoorthy, Oxford University Press
3.Structural analysis a matrix approach by Pandit & Gupta, Mc Graw Hill.
4.Limit Analysis of Structures: Monikaselvam, Dhanpat Ray Publication
5.Indeterminate Structures: J.S.Kinney.
6.Indeterminate Structural Analysis: C.K.Wang ,Mc Graw Hill
7.Structural Analysis by D.S.Prakash Rao, Universities Press
8.Matrix Analysis of Structures by P.K.Singh, Cengage Learing

Course Outcomes:

CO1: Understand the various displacement methods of analysis and apply it to continuous beams and plane frames.
CO2: Analysis of two hinged, fixed arches and Suspension cables with two hinged stiffening girders.
CO3: Understand Plastic analysis and its application to continuous beam and simple rectangular portals
CO4:Application of Matrix methods to simple trusses and beams.

Elective-I: Design of Structural Systems (3-0-0)

Course Objectives

1. To have the detailed study about the various components and functions of a building, bridge, dam, roads, railways, airports, factories, power plants and transmission units.
2. To study about the detailed analysis and design of various wooden and masonry components in a system.
3. To study the estimation of various static and dynamic loads acting in a structure using the various IS Codes.

Course Contents:

Module-I

Introduction to Structural Systems: Bridges, buildings, dams, transportation facilities, liquid or gas storage facilities, industrial factories and plants, power generation and transmission units.

Module-II

Structural Analysis and Strength of Materials Review, Design of various loads, Design of various wood components in a system, Design of various masonry components in a system.

Design Process, Review of Steel and Reinforced Concrete Design, Review of design codes and LRFD design.

Module-III

Estimation of building Loads, Gravity loads, Wind loads, Seismic Loads. Lateral Systems, Bracing, Shear Walls, and Moment resisting frames.

Text Books /Reference Books:

1. Masonry Structural Design, R. E. Klingner
2. Reinforced concrete: Limit state by A.K. Jain
3. Reinforced concrete vol. I [elementary reinforced concrete] by Dr. H.J. Shah
4. Limit state design of reinforced concrete by P.C. Verghese, PHI
5. IS456:2000, Code of practice for Plain and Reinforced Concrete, Bureau of Indian Standards, New Delhi.
6. Limit State Design of Steel structures by S.K. Duggal, TMH Publication
7. Design of Steel Structures by L.S. Negi, Tata McGraw Hill Book Co.
8. Design of Wood Structures-ASD/LRFD,Donald Breyer.

Course Outcomes:

CO1:Detailed idea about the various structural system

CO2. Design of various wood components in a system.
CO3. Design of various masonry components in a system.
CO4. Estimation of static and dynamic load components acting in a building system.

Elective-I: Sustainable Construction Method (3-0-0)

Course Objectives:

1. To define key terms of sustainability
2. To identify and apply green building assessment tools to evaluate the sustainability of a building
3. To interpret green building requirements related to the site, water, air quality, energy consumption and materials and resources.
4. To evaluate first cost versus life cycle cost for sustainable construction materials and methods

Course Contents:

Module-I

Introduction: Life Cycle impacts of materials and products – sustainable design concepts – strategies of Design for the Environment -The sun-earth relationship and the energy balance on the earth's surface, climate, wind – Solar radiation and solar temperature – Sun shading and solar radiation on surfaces – Energy impact on the shape and orientation of buildings – Thermal properties of building materials.

Module-II

Energy efficient buildings: Passive cooling and day lighting – Active solar and photovoltaic- Building energy analysis methods- Building energy simulation- Building energy efficiency standards- Lighting system design- Lighting economics and aesthetics- Impacts of lighting efficiency – Energy audit and energy targeting- Technological options for energy management.

Module-III:

Indoor Environmental Quality management: Psychrometry- Comfort conditions- Thermal comfort-Ventilation and air quality-Air conditioning requirement- Visual perception- Illumination requirement-Auditory requirement- Energy management options- -Air conditioning systems- Energy conservation in pumps- Fans and blowers- Refrigerating machines- Heatrejection equipment- Energy efficient motors-Insulation.

Module-IV:

Green building concept: Green building rating tools- Leeds and IGBC codes. – Material selection, Embodied energy- Operating energy- Façade systems- Ventilation systems- Transportation-Water treatment systems- Water efficiency- Building economics.Green building design case study.

Text Books/References:

1. Kibert, C. "Sustainable Construction: Green Building Design and Delivery", John Wiley & Sons, 2005
2. Edward G Pita, "An Energy Approach- Air-conditioning Principles and Systems", Pearson Education, 2003.
3. Colin Porteous, "The New Eco-Architecture", Spon Press, 2002.
4. Energy Conservation Building Codes: www.bee-india.nic.in

Course Outcomes:

CO1: Understand the core building science fundamentals (to include but not limited to: thermodynamics as related to wind, air, moisture, pressure, and heat).
CO2: Understand and perform some building sustainability concepts (to include, but not limited to, site layout, building design, advanced framing, and insulation)
CO3: Evaluate energy efficiency in relation to cost performance, ROI, etc.

CO4: Understand and analyze some building performance testing (ex. energy audit, HERS Rating) and be exposed to different agencies (ex. BPI, RESNET) involved in the testing.
C05: Understand and analyze the weatherization fundamentals.

Geotechnical Engineering Lab **(0-0-3)**

Course objectives:

1. To estimate index properties of soils (coarse and fine)
2. To estimate consistency limit of fine grained soils
3. To estimate shear strength of soils by direct shear test, triaxial shear test, vane shear test & unconfined compressive test
4. To estimate the engineering properties of the soils by density test, CBR test permeability test and consolidation test

Course Content:

1. Determination of specific gravity of soil grains
2. Determination of grain size distribution of soil (a)Sieve test (b) Hydrometer
3. Determination of Atterberg limits of soil Liquid limit (b) plastic limit (c) shrinkage limit
4. Measurement of soil compaction in the field using (a) Core cutter method (b) Sand replacement method
5. Determination of OMC-MDD of soil (i)Proctor compaction test (ii) Modified Proctor compaction test (iii)) Use of Proctor penetration needle
6. Determination of relative density of granular soil
7. Determination of shear strength parameters of soil (a)Shear Box test (b) Tri-axial compression test (c) Unconfined compression test (d) Vane shear test
8. Determination of consolidation characteristics of soil using fixed ring Oedometer
9. Determination of California Bearing Ratio (CBR) of soaked and un-soaked soil specimens
10. Determination of coefficient of permeability of soil (a)Constant head permeameter (b) Falling head permeameter

Course Outcomes

CO1: Evaluate index properties and engineering properties of soil.
CO2: Identify the soils as per IS classification System

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Semester – VI

Sl. No.	Subject Type	Subject Code	Subject Name	Teaching Hours/Week			Credit	Maximum Marks			
				L	T	P		IA	EA	PA	Total
1	Core Course	UPCCE601	Estimation and Construction Management	3	0	0	3	30	70	0	100
2	Core Course	UPCCE602	Irrigation Engineering	3	0	0	3	30	70	0	100
3	Professional Elective-II	UPECE601	Design of Steel Structures	3	0	0	3	30	70	0	100
		UPECE602	Industrial Structure	3	0	0	3	30	70	0	100
		UPECE603	Masonry Structures	3	0	0	3	30	70	0	100
4	Professional Elective-III	UPECE604	Environmental Engineering - II	3	0	0	3	30	70	0	100
		UPECE605	Air Pollution and Control	3	0	0	3	30	70	0	100
		UPECE606	Solid Waste and Hazardous waste management	3	0	0	3	30	70	0	100
5	Open Elective-II	Any one subject to be picked from the open elective courses offered by various departments		3	0	0	3	30	70	0	100
6	Lab Course	ULCCE601	Design of Irrigation Structures	0	0	3	1.5	0	0	100	100
7	Lab Course	ULCCE602	Design of Steel Structures	0	0	3	1.5	0	0	100	100
8	Lab Course	ULCCE603	Concrete Lab	0	0	4	2	0	0	100	100

			Total				**20**				**800**
9	**Summer Internship programme (4 to 8 weeks) is mandatory as per AICTE rule**										

Estimation and Construction Management (3-0-0)

Objective:
To provide the student with the ability to estimate the quantities of item of works involved in buildings and road works ; to equip the student with the ability to do rate analysis, valuation of properties and preparation of reports for estimation of various items; ability to apply theoretical and practical aspects of project management techniques to achieve project goals.

Course Contents:
Module-I:
Estimation: Principles of estimation, methods and units, Estimation of materials in buildings, Principles of general and detailed specification for various types building works.
Estimation of Road , culverts and bridges.

Module-II:
Specifications-Types, requirements and importance, detailed specifications for buildings, roads, minor bridges and industrial structures.
Rate analysis-Purpose, importance and necessity, factors affecting Analysis of rates, Prime cost, Schedule rates, Analysis of rates for various types of works.
Tender- Types of Tender, Preparation of tender documents, inviting tenders,general and special conditions, contract types. termination of contracts, penalty and liquidated charges, Settlement of disputes, Arbitration, R.A. Bill & Final Bill, Payment of advance, insurance, claims, price variation, Introduction to e-tendering.
Module-III:
Objective and functions of management in construction.
Project Management: Project Planning, Scheduling and Controlling, Bar charts: Development of Bar charts and its shortcomings. Network techniques: Event, activity, Dummy activity. Network rules, Numbering of events, Critical Path Method, Critical activities, Slack, Project Evaluation and Review Techniques (PERT): Time estimates, Different types of Float of activity, Probability of meeting schedule date for the project.
Cost Model: Project cost, indirect and direct cost, slope of direct cost curve, optimum project duration, contracting the network for cost optimization. Introduction to updating, resources smoothing and resources leveling
Quality Control: Quality Control by Statistical Methods, Sampling Plan, Control Charts, X Chart, R Chart, C chart and P Chart. Introduction to construction safety.

Text/Reference Books:

1. Dutta, B.N., Estimating and Costing in Civil Engineering (Theory & Practice), UBSPublishers, 2016
2. Peurifoy, Construction Planning, Equipment and Methods, McGraw Hill
3. Construction Management and Planning, B Sengupta & H Guha, Tata McGraw Hill
4. PERT & CPM, L. S. Sreenath. East - West Press.
5. Relevant IS Code: National Building Code-2016

6. Schedule of Rates & Analysis of Rates
7. OPWD Code

Course Outcomes:
CO1: Able to do detailed estimate of minor structures.
CO2: Able to understand the technical specifications for various works to be performed for a project and how they impact the cost of a structure.
CO3: Able to understand how competitive bidding works and how to submit a competitive bid proposal.
CO4: A basic ability to plan, control and monitor construction projects with respect to time and cost and how to optimize construction projects based on costs.
CO5: Know how to apply different methods to quality control.

Estimation and Construction Management (Sessional/Practical) (0-0-3)

Objectives: To provide the student with the ability to estimate the quantities of item of works involved in buildings, road works and culverts; to prepare bid documents for a tender; do rate analysis and apply software to calculate quantities of item of a building.
Course Contents:

1. Detailed estimate for a singly storeyed building
2. Detailed estimate for a Culvert
3. Detailed estimate for Bituminous road.
4. Estimation of Road – earthwork fully in banking, cutting,partly cutting & partly filling
5. Estimation of R.C.C. works and structures
6. Detailed estimate of a building using computer software.
7. Preparation of a bid document for a tender
8. Analysis of rates for various types of works
9. Introduction to project planning software

Text/Reference Books:
1. Dutta, B.N., Estimating and Costing in Civil Engineering (Theory & Practice), UBS Publishers, 2016
2. Relevant IS Code: National Building Code-2016
3. Schedule of Rates & Analysis of Rates
4. OPWD Code

Course Outcomes:
CO1: Able to do detailed estimate of minor structures by application of softwares.
CO2: Able to prepare bid documents for a tender.
CO3: Able to calculate rates for various types of works.

Irrigation Engineering (3-1-0)

Course Objectives:
1. To understand the basic concepts of irrigation and construction of various hydraulic structures.
2. To impart the knowledge of various irrigation techniques and water requirements of the crops.
3. To learn about distribution systems for canal irrigation, design of unlined and lined irrigation canals design sediment problems associated with canal

4. The structures involving the elementary hydraulic design of different structures and the concepts of river training works is also imparted.

Course Content:

MODULE-I

Introduction: Necessity of Irrigation in India, Advantages and disadvantages of Irrigation, Techniques of water distribution in firms, Quality of irrigation water.

Water requirements of Crops: Crops and crop season, Duty and Delta, Consumptive use, Irrigation requirements, Estimation of consumptive use of water by climatic approaches, Irrigation efficiencies, Soil moisture-irrigation relationship.

MODULE-II

Canal Irrigation: Classification of canals, Canal losses, Alignment of canals, Design of stable channels using Kennedy's and Lacey's theory, Garret's diagram, Cross section of irrigation canals.

Lining of Irrigation Canals: Advantages and economics of lining, Various types of lining, Design of lined canals.

Reclamation of Water Logged and Saline Soils: Causes and control of water logging. Reclamation of saline and alkaline land, Surface and Sub-surface drainage.

MODULE-III

Types of Cross-Drainage Works: Types of CD works, Selection of a suitable type to suite a particular condition, Design consideration for CD works.

Diversion Head works: Weirs and Barrages, Types of weirs and barrages, Layout of a diversion head works, Introduction to different components of a diversion head works.

Design of weirs and barrages: Bligh's creep theory, Design of weir using Bligh's theory, Lane's weighted creep theory, Khosla's theory, Khosla's method of independent variables, Exit gradient.

Canal Falls: Necessity, Proper location, Types.

MODULE-IV

Gravity Dams: Typical cross section, Various forces acting on gravity dam, Combination of forces for design, Modes of failure and criteria for structural stability, High and low gravity dam, Design of high dam, Typical section of low gravity dam.

Earth Dams: Types, Causes of failure, Preliminary section of an earth dam, Seepage control in earth dams

Spillways: Descriptive study of various types of spillways.

Rivers training: controlling River, types and characteristics of river, river training.

Text Books/Reference Books:

1. Irrigation Engineering and Hydraulic Structures by S. K. Garg, Khanna Publication, New Delhi
2. Irrigation Engg. By B.C. Punmia and Pande, Laxmi Publication, New Delhi
3. Irrigation Engg. By Birdie and Das, Dhanpat Rai, New Delhi
4. Irrigation Engg. By Sharma and Sharma, S. Chanda and Company, New Delhi

Course Outcomes:

1. Understand the core area of irrigation for its application in irrigation field.
2. Plan and design canal projects.
3. Analyze various head-works and irrigation structure on erodible and non-erodible soil by using different theories.
4. Understand the characteristics of different irrigation structures by calculating the stability criteria.

Design of Irrigation Structure (Sessional/Practical) (0-0-3)

Course Objectives:
Gaining knowledge regarding design of various hydraulic structures and Irrigation systems.
Course Content:

1. Canal design:
   a.Canal Dimension study
   b.Canal Fall: Design of any one fall.
2. Land drainage: Depth and spacing of Tile drains.
3. Design of Cross Drainage Works
4. Gravity Dam Design
   a.Profile of the dam, Forces on Dam, Safety of Dam
   b.Shear stress, Principal Stress on Dam
5. Earthen Dam:
   a.Seepage line determination
   b.Slope stability design
6. Design and detailing of any one type of fall.
7. Spillway: design of any one type of spillway

Text/Reference Books:

1. S.K. Garg, Irrigation Engineering and Hydraulic Structure , Khanna publisher.
2. J.K.Sharma and Laxmi Narain, Analysis and Design of Hydraulic Structures, Krishna Prakashan Media.
3. Dr. V.C. Agarwal, Irrigation Engineering And Hydraulic Structures, S.K. Kataria & Sons

Course Outcomes:

1. Design different irrigation structures.
2. Apply civil engineering tools for evaluating the performance of dams, spillways, canals, etc.

Elective- II: Design of Steel Structures (3-0-0)

(Based on limit state method as per IS:800-2007)

Course Objectives:

1. To learn the behavior and design of structural steel components (members and connections)
2. To gain an educational and comprehensive experience in the design of simple steel structures.

Course Contents:

Module-I

Introduction, advantages/disadvantages of steel, structural steel, rolled steel section, various types of loads, design philosophy.
Limit state design method, limit states of strength and serviceability, probabilistic basis for design Riveted, bolted and pinned connections,
Welded connections-assumptions, types, design of fillet welds, intermittent fillet weld, plug and slot weld, failure of welded joints, welded joints vs bolted and riveted joints

Module-II

Tension members, types, net cross-sectional area, types of failure, slenderness ratio, design of tension members, gusset plate.

Compression members, effective length, slenderness ratio, types of cross-section, classification of cross-section, design of axially loaded compression members, lacing, battening, design of column bases, and foundation bolts.

Module-III

Design of beams, types of c/s, lateral stability of beams, lateral torsional buckling, bending and shear strength, web buckling and web crippling, deflection, design procedure.

Plate girders- various elements and design of components. Eccentric and moment connections, roof trusses

Text Book/ Reference Books:

1. Limit State Design of Steel structures by S.K. Duggal, TMH Publication
2. Design of Steel Structures by L.S. Negi, Tata McGraw Hill Book Co.
3. Design of steel structures by S.S.Bhavikatti, I.K. International Publishing house.
4. Design of Steel Structures by K. S. Sairam, Pearson
5. Fundamentals of Structural Steel Design by M.L.Gambhir, Mc Graw Hill
6. Steel Structures-Design and Practice by N. Subramanian, Oxford University Press

CODE:IS:800-2007

Course outcomes:

CO1: Understand the properties of steel & design the different types of connections as per Limit state method.

CO2: Design and analyse the tension & compression members.

CO3: Understand the design procedure of beams and analyse the failure criteria.

CO4: Design of plate girders and steel roof trusses as per Limit State design.

Design of Steel Structures (Practical) (0-0-3)

Course Objectives:

1. To design basic elements of steel structure like tension members, compression members, beams etc.

Content Contents:

1. Design and detailing of steel roof trusses/ industrial buildings
2. Design of columns(with lacing and battening) and column bases
3. Design of plate girders
4. Detailing of structural steel connections, seated and framed connections

Course outcomes:

CO1: Detailing of structural steel connections.

CO2: Design of columns (with lacing and battening) and column bases.

CO3: Design & detailing of steel roof trusses.

Elective- II: Industrial Structure (3-0-0)

Course Objectives:

1. To identify various requirements of industrial buildings- planning & layout of its components.
2. To understand various functional requirements of industrial buildings.
3. To design steel roof for industrial building, bunkers, silos & chimney.
4. To design different RC structural elements for industrial buildings.

Course Contents:

Module-I

Planning: Classification of industries and industrial structuresGeneral requirements of various industries,Planning and layout of buildings and components.

Module-II

Functional Requirements: lighting,ventilation,acoustics,fire safety, guidelines from factories act.

Module-III

Design Of Steel Structures:Industrial roofs, Crane girders, Mills buildings, Bunkers and Silos,Chimney.

Module-IV

Design Of R.C. Structures: Corbels, Brackets and Nibs, Silos and bunkers, Chimney, Principles of folded plates and shell roofs

Prefabrication: Principles of prefabrication,Prestressed precast roof trusses, Construction of roof and floor slabs, Wall panels.

TextBooks/References Books:

1. Ramamrutham.S.,"Design of Reinforced Concrete Structures", Dhanpat Rai Publishing Company, 2007.
2. Varghese.P.C. "Limit State Design of Reinforced Concrete", Prentice Hall of India Eastern Economy Editions, 2nd Edition, 2003.
3. Bhavikatti.S.S.,"Design of Steel Structures", J.K. International Publishing House Pvt.Ltd., 2009.
4. SP32-1986, Handbook on Functional Requirements of Industrial buildings, Bureau of Indian Standards, 1990
5. Structural Engineering Research Centre,Course Notes on Modern Developments in the Design and Construction of Industrial Structures, Madras, 1982
6. Koncz.J., "Manual of Precast Construction", Vol.I and II, Bauverlay GMBH, 1971

Course Contents:

CO1: Identify various requirements of industrial buildings- planning & layout of it's components.
CO2: Understand various functional requirements of industrial buildings.
CO3: Design steel roof for industrial building, bunkers, silos & chimney.
CO4: Design different RC structural elements for industrial buildings.

Elective- II: Masonry Structures **(3-0-0)**

Course Objectives:

1. To understand different masonry units & its properties.
2. To understand different tests to determine its various strength.
3. To design load bearing masonry for buildings using BIS codal provisions.
4. To understand the behaviour of masonry buildings during earthquakes, design procedure for earthquake resistant masonry.

Course Contents:

Module-I

Introduction, Masonry units, materials and types: History of masonry, Characterics of Brick, stone, clay block, concrete block, stabilized mud block masonry units-Strength, modulus of elasticity and water absorption.
Strength of Masonry in Compression:Behaviour of Masonry under compression, strength and elastic properties, influence of masonry unit and mortar characteristics, effect of masonry unit height on compressive strength, influence of masonry bonding patterns on strength, prediction of strength of masonry in Indian context, failure theories of masonry under compression.

Module-II

Flexural and shear bond, flexural strength and shear strength:Bond between masonry unit and mortar, tests for determining flexural and shear bond strengths, factors affecting bond strength, effect of bond strength on compressive strength,

Module-III

Design of load bearing masonry buildings:Permissible compressive stress, stress reduction and shape reduction factors, increase in permissible stresses for eccentric vertical and lateral loads, permissible tensile and shear stresses, Effective height of walls and columns, opening in walls, effective length, effective thickness, slenderness ratio, eccentricity, load dispersion, arching action, lintels; Wall carrying axial load, eccentric load with different eccentricity ratios, wall with openings, freestanding wall; Design of load bearing masonry for buildings up to 3 to 8 storeys using BIS codal provisions.

Module-IV

Earthquake resistant masonry buildings: Behaviour of masonry during earthquakes, concepts and design procedure for earthquake resistant masonry, BIS codal provisions
Masonry arches, domes and vaults:Components and classification of masonry arches, domes and vaults, historical buildings, construction procedure.

Text Books/Reference Books:

1. Dayaratnam P, "Brick and Reinforced Brick Structures"- Oxford & IBH
2. Sinha B.P & Davis S.R., "Design of Masonry structures"- E & FN Spon
3. Hendry A.W.,"Structural masonry"- Macmillan Educaon Ltd., 2nd edion.
4. Curtin, "Design of Reinforced and Prestressed Masonry"- Thomas Telford.
5. Sven Sahlin, "Structural Masonry"-Prence Hall.

Course Outcomes:

CO1: Understand different masonry units & its properties.
CO2: Understand various strength of masonry and related tests.
CO3: Design load bearing masonry for buildings using BIS codal provisions.
CO4: Understand the concept of earthquake resistant masonry buildings & design procedure.

Elective-III: Environmental Engineering – II (3-0-0)

Course objectives:

- To learn the basics of sewage composition and its characteristics
- Estimate sewage and storm water discharge and thereby design sewer pipeline and storm water drain.
- To depict the information about various sewage treatment processes
- Design modern and low cost wastewater treatment plants.
- Assess the impact of sewage discharge on land and water bodies.
- To provide the adequate information on list the various appurtenances used in sewerage system.
- Characterize solid wastes and methods of their collection and transportation.
- To understand the knowledge about management solid wastes using different techniques

- To be conversant with various Environmental Acts.in India

Course Contents:

Module I: Wastewater Engineering: Generation and collection of wastewater, sanitary, storm and combined sewerage systems, Quantities of sanitary wastes and storm water. Hydraulic design of sewerage system,Sewage Pumping.**Sewer Appurtenances:** Manholes, Drop manholes, Lampholes, street inlets, catch basins, flushing tanks, storm water regulators, grease and oil-traps, inverted siphons.- drainage in buildings-plumbing systems for drainage

Characteristics of Waste water: Physical, chemical and biological characteristics of ewagetheir significance. Relative Stability, Population Equivalent. **Disposal standards**-Self-purification of rivers-Streeter Phelps equation - oxygen sag curve Natural Method of Waste disposal,Wastewater disposal standards.**Disposal of effluent and sludge** in land and waterbodies.

Module II: Treatment of sewage: Preliminary Treatment, Aeration,screening, grit,chamber, skimming tanks Primary- sedimentation, Secondary- Basics of microbiology,classification of secondary treatments, activated sludge process, trickling filter, , Tertiary Treatment - oxidation ponds, aerated lagoons, Septic tank, Imhofftank,etc.Advanced Treatment - Removal of nitrogen and phosphorus Sludge digestion and handling.

Note: Assignments include the designs and drawings of various wastewater treatment units.

Module III: Solid Waste Management: Municipal Solid Waste Management: Characteristics, classification, generation, collection and transportation of solid wastes, engineered systems for solid waste management (reuse, recycle, energy recovery, treatment and disposal E-waste management and recycle

Environmental Legislation: Regulatory authorities and important Environmental Acts in India. Introduction to EIA.

Text Book

1. "Environmental Engineering (Vol. II), Sewage Disposal and Air Pollution Engineering" by S.K. Garg., Twentieth Revised Edition, Khanna Publishers, 2013
2. "Environmental Engineering", Peavy H.S., Rowe, D.R. and Tchobanoglous, G.. Seventh Edition, Tata McGraw Hill, 1985
3. *Duggal, K.N., Elements of Environmental Engineering, S.Chand and Co., New Delhi, 2002.*

References

1. *Birdie, G.S. and Birdie, J.S., Water Supply and Sanitary Engineering, DhanpatRai and Sons, New Delhi, 1992.*
2. *Metcalf and Eddy, Waste Water Engineering, Collection, Treatment and Disposal, Tata McGraw Hill, Inc., New York, 2005.*
3. *Manual of Sewage and Sewage Treatment - CPHEEO, 1999.*
4. "Water Supply and Sewerage", Terence J. McGhee. Sixth Edition, Tata McGraw Hill, 2014.
5. "Water and Wastewater Technology", M.J. Hammer. Seventh Edition, Prentice Hall, 2011.
6. "Handbook of Solid Waste Management", Tchobanoglous G. and Kreith, F., Second Edition; McGraw Hill, 2002.
7. "Water and Wastewater Engineering", Davis, Mackenzie. First Edition, McGraw Hill, 2010.

Course Outcomes:

- Evaluate the quantity of Waste water Generated
- Identify and Analyse Sources and Characteristics of waste water
- Could evaluate and Design Best Possible components of waste water treatment systems
- Characterize solid wastes and methods of their collection and transportation.

- Ale to manage solid wastes disposal using different techniques
- To be conversant with various Environmental Acts.in India

Elective-III: Air Pollution and Control (3-0-0)
Course Objectives:

- Develop an understanding of the classification, sources and effects of pollutants
- Describe general air pollution problems, air transport equations
- To understand the fundamentals of meteorology
- Study the principles and equipment description of control technologies
- Introduction of major problems in indoor air pollution and control, regulations

Course Contents:

Module I:

Introduction: sources, effects on – ecosystems, classification of atmospheric pollutants, air pollution episodes of environmental importanceMeteorology - composition and structure of the atmosphere, wind circulation, solar radiation, lapse rates, atmospheric stability conditions, wind velocity profile, Maximum Mixing Depth (MMD), Temperature Inversions, Windrose diagram. General characteristics of stack emissions, plume behaviour, heat island effect.

Module II :

Air Quality models - Gaussian convection-diffusion model for point, line and areal sources. Air Pollution Control of particulate matter & gaseous pollutants from point & non-point sources – gravity settling chambers, centrifugal collectors, wet collectors, fabric filters, electrostatic precipitator (ESP). – adsorption, absorption, scrubbers, condensation and combustion. Dust suppression measures.

Module III :

Indoor Air Pollution – sources, effects and control. Noise - sources, measurements, effects and occupational hazards. Standards, Noise mapping, Noise attenuation equations and methods, prediction equations, control measures, Legal aspects of noise.

Monitoring of particulate matter and gaseous pollutants – respirable, non-respirable and nano - particulate matter.CO, CO2, Hydrocarbons (HC), SOX and NOX, photochemical oxidants.

Text Books/References books:

1. Nevers N.D.(2000), Air Pollution Control Engg, McGraw Hill.
2. Peavy, H.S., Rowe and Tchobonoglous,G., (1985), "Environmental Engineering", McGraw Hill
3. Seinfeld N.J., (1975), "Air Pollution", McGraw Hill.
4. WarkK ., Warner C.F., and Davis W.T., (1998), "Air Pollution - Its Origin and Control", Harper & Row Publishers, New York.
5. Lee C.C., and Lin S.D., (1999), "Handbook of Environmental Engineering Calculations", McGraw Hill, New York.
6. Perkins H.C.(1974), "Air Pollution", McGraw Hill.
7. Stern A.C., "Air Pollution", Vol I, II, III.
8. Stern A.C.(1968), (ed) Vol. V, "Air Quality Management".

Course Outcomes:

- Identify anthropogenic sources and atmospheric effects to pollutions
- Understand Regional, global pollution transport mechanisms
- Appreciate development of transport equations and applications, stack Learn theory and development of pollution control devices: Cyclone, electrostatic particle precipitator, packed towers, gravitational espirator,bag house.

Elective-III: Solid and Hazardous Waste Management (3-0-0)

Course Objective:

- To provide comprehensive overview of solid, biomedical and hazardous waste management.
- To provide knowledge on solid waste management design aspects.
- To learn about the different methods of solid waste management.

Course Contents:

Module I:

Solid waste – sources and engineering, classification, characterization, generation and quantification. Transport - collection systems, collection equipment, transfer stations, collection route optimization

Module II :

Treatment methods - various methods of refuse processing, recovery, recycle and reuse, composting – aerobic and anaerobic, incineration, pyrolysis and energy recovery, Disposal methods – Impacts of open dumping, site selection, sanitary land filling – design criteria and design examples, leachate and gas collection systems, leachate treatment.

Module III :

Biomedical Waste management – sources, treatment and disposal Hazardous Waste Management-Introduction, Sources, Classification, Physio-chemical, Chemical and Biological Treatment of hazardous waste, regulations.

Thermal treatment –Incineration and pyrolysis. Soil contamination and site remediation – bioremediation processes, monitoring of disposal sites.

Text Books/References books:

1. Tchobanoglous G., Theissen H., and EIiassen R.(1991), "Solid Waste Engineering - Principles and Management Issues", McGraw Hill, New York.
2. PavoniJ.L(1973)., "Handbook of Solid Waste Disposal".
3. Peavy, Rowe and Tchobanoglous (1985), "Environmental Engineering", McGraw Hill Co. 4th Edition
4. Mantell C.L., (1975), "Solid Waste Management", John Wiley.
5. CPHEEO, Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organisation, Government of India, New Delhi, 2000.
6. WHO Manual on Solid Waste Management.
7. Vesiland A.(2002), "Solid Waste Engineering", Thompson Books.
8. Hazardous waste (management and handling) rules, 2001
9. Biomedical (Handling and Management) Rules 2008

Course outcomes:

- Know solid waste remedial measures and their importance.
- Undertake projects related to solid waste management.

Concrete Lab (Practical) **(0-0-3)**

Course Objectives:

1. Explain the properties of Constituent material of concrete.
2. Carry out concrete mix design.
3. Carry out test procedures for major laboratory properties of fresh and hardened concrete.

Course Contents:

1. Workability test of concrete:Slump test, compaction factor test and flow table test
2. Cube Test of Concrete(Nominal Mix)
3. Cylinder Test for Concrete(Nominal Mix): Determination of axial stress,longitudinal strain, lateral strain and Poision's ratio. Plotting of stress-strain curveand determination of modulus of elasticity.
4. Split Tensile Strength Test of Concrete
5. Prism test for determining modulus of rupture of concrete
6. Design of Concrete Mix (As per Indian Standard Method)
7. Failure of RC beam in bending and shear (two point and one point loading)

CODE:

1.IS 516
2.IS 4031
3.IS 10262(2009)

Course Outcomes:

CO 1 Outline the importance of testing of cement and its properties
CO 2 Assess the different properties of aggregate
CO 3 Summarise the concept of workability and testing of concrete
CO 4 Describe the preparation of green concrete
CO 5 Describe the properties of hardened concrete

Semester – VII

Sl. No.	Subject Type	Subject Code	Subject Name	Teaching Hours/Week			Credit	Maximum Marks			
				L	T	P		IA	EA	PA	Total
1	Professional Elective-IV	UPECE701	Ground Improvement Engineering	3	0	0	3	30	70	0	100
		UPECE702	Rock Mechanics	3	0	0	3	30	70	0	100
		UPECE703	Environmental Geo-Technology	3	0	0	3	30	70	0	100
2	Professional Elective-V	UPECE704	Transportation Engineering- II	3	0	0	3	30	70	0	100
		UPECE705	Structural Analysis by Matrix Method	3	0	0	3	30	70	0	100
		UPECE706	Urban Hydrology and Hydraulics	3	0	0	3	30	70	0	100
3	Open Elective-III	Any one subject to be picked from the open elective courses offered by various departments		3	0	0	3	30	70	0	100
4	Open Elective-IV	Any one subject to be picked from the open elective courses offered by various departments		3	0	0	3	30	70	0	100
5	Humanities Science Course	UHSMH701	Entrepreneurship Development	3	0	0	3	30	70	0	100
6	Project Course	UPRCE701	Project Stage-1	0	0	6	3	0	0	100	100
7	Seminar	USECE701	Internship Seminar	0	0	2	1	0	0	100	100
			Total				**19**				**700**

Elective IV: Ground Improvement Engineering (3-0-0)

Pre-requisites: Geotechnical Engineering - I and Geotechnical Engineering - II
Course objectives:

1. To explain the necessity of ground improvement.
2. To explain the concept of dewatering and grouting methods.
3. To explain the method of compaction and soil stabilization using chemical.
4. To explain the importance of reinforcement techniques in different geotechnical structures.

Course Contents:
Module – I
Introduction, Necessity of ground improvement, Dewatering, methods, Analysis and design of dewatering systems.
Grouting types, Properties, Method of grouting, Ground selection and control.

Module – II
Compaction, Methods of compaction, Engineering properties of compacted soil, Field compaction and its control.

Module – III
Soil stabilization, Use of chemical additives, Stone columns, Principle, design and method of installation. Reinforced earth, Concept, Materials, Application and design, Use of geo-synthetics and geo-cells in construction work.

Module-IV
Reinforcement techniques, bearing capacity improvement, slope stability, retaining walls and pavements.

Text Books/Reference Books:
1.Grond improvement techniques by P.P.Raj, Laxmi Publications.
2.Foundation Design and Construction, M.J. Tomlinson
2. Foundation Engineering, G.A. Leonard, Tata McGraw Hill
3. Modern Geotechnical Engineering, Alam Singh, IBT Publishers
Course Outcomes:

Course Outcomes:
CO1: To understand necessity and selection of ground improvement technique.
CO2: Ability to understand mechanism behind dewatering techniques and principles of grouting.
CO3: Ability to apply suitable techniques for compaction of different soil and consolidation techniques.

Elective IV: Rock Mechanics (3-0-0)

Pre-requisites: Geotechnical Engineering - I and Geotechnical Engineering - II

Course objectives:

1. To explain how rock form, physical properties of rock and classify the rock.
2. To explain the laboratory and field test of rock

3. To explain strength behavior of rock.
4. To explain how it is important to civil engineering.

Course Contents:

Model-I

Rock: Formation of rocks, Physical properties, Classification of rocks and rock masses, Static Elastic constants of rock.

Model-II

Rock Testing: Laboratory and Field tests; Discontinuities in Rock Masses: Discontinuity orientation, Effect of discontinuities on strength of rock.

Model-III

Strength Behaviour: Compression, Tension and Shear, Stress-Strain relationships, Rheological behavior; Strength/ Failure.

Model-IV

Criterion: Coulomb, Mohr, Griffith theory of brittle strength and other strength criteria. Stresses in rock near underground openings; Application of rock mechanics in Civil Engineering: Rock tunneling, Rock slope stability, bolting, blasting, grouting and rock foundation design.

Text Books/Reference Books

1. W. Farmer, Engineering Behavior of Rocks, Chapman and Hall Ltd.
2. R. E. Goodman, Introduction to Rock Mechanics
3. P.R. Sheorey, Empirical Rock Failure Criteria, Balkema, Rotterdam, 1997
4. V.S. Vutukuri and R D Lama, Hand Book on Mechanical Properties

Course Contents:

CO1: Understand the importance and application of rock mechanics to engineering problems
CO2: Able to find out the engineering properties of rock by laboratory and field method.
CO3:Provide brief explanation onrock tunneling, Rock slope stability, bolting, blasting, grouting and rock foundation

Elective IV: Environmental Geo-Technology (3-0-0)

Pre-requisites: Geotechnical Engineering - I and Environmental Engineering

Course objectives:

1. To explain about waste generation and its impact on enviroment.
2. To explain the engineering properties of various waste.
3. To explain various concept of waste remedial techniques.
4. To explain the selection and design of landfill.

Course Contents:

Module-I

Scope of geoenvironmental engineering -: Multiphase behavior of soil, role of soil in geo-environmental applications, importance of soil physics, soil chemistry, hydrogeology, biological process

:sources and type of ground contamination, impact of ground contamination on geo-environment, Soil mineralogy characterization and its significance in determining soil behavior.

Module-II

Soil-water interaction and concepts of double layer – forces of interaction between soil particles. Concepts of unsaturated soil – importance of unsaturated soil in geo-environmental problems, measurement of soil suction, water retention curves.

Soil-water-contaminant interactions and its implications – Factors effecting retention and transport of contaminants.

Module-III

Evolution of waste containment facilities and disposal practices – Site selection based on environmental impact assessment,different role of soil in waste containment – different components of waste containment system and its stability issues. Site characterization, risk assessment of contaminated site,

Remediation methods: objectives of site remediation, selection and planning of remediation methods, some examples of in-situ remediation.

Module-IV

Landfills: Types of landfill, site selection, waste containment liners, leachate collection system, cover system, gas collection system.

Text Books/Reference Books:

1. Rowe R.K.,"Geotechnical and Geoenvironmental Engineering Handbook" Kluwer Academic Publications, London, 2000.
2. Reddi L.N. and Inyang, H. I.,"GeoenvironmentalEngineering,Principles and Applications" Marcel Dekker Inc. New York, 2000.
3. Sharma H.D. and Reddy K.R.,"GeoenvironmentalEngineering:Site Remediation, Waste Containment, and Emerging Waste Management Technologies" John Wiley & Sons, Inc., USA, 2004.
4. Mitchell, J.K.,"Fundamentals of Soil Behavior" Wiley, 2005.
5. Hillel D.,"Introduction to Soil Physics" Academic Press, New York, 1982.
6. Sparks, D.L.,"Environmental Soil Chemistry" Academic Press, New York, 2002.

Course Outcomes:

CO1: Analyze and able to find various engineering properties of wastes
CO2: Analyze and design of geosynthetic for waste contaminant
CO3: Anlyze and design of engineering landfill

Elective- V: Transportation Engineering- II (3-0-0)

Course Objectives:

1. To know the history of Indian railway and acquire the knowledge about various railway components.
2. Able to design the railway geometrical elements, railway turnout and signal for different conditions.
3. Able to design geometric elements of runway and taxiway and to know the basic of Airport components.
4. To understand the basic concepts and components of the harbours and ports.

Course Content:

Module-I

History of Indian railways, component parts of railway track, problems of multi gauge system,coning of wheels, alignments and survey, permanent way track components , Type of rail sections,creep of rails, wear and failure in rails , Ballast requirements, sleeper requirements, types ofsleepers, various train resistances

Module-II

Geometric design: Gradients and grade compensation, various speeds on a railway track, superelevation,horizontal and vertical curves, Points and crossings, Design of simple turn-out, Signalling and interlocking.

Module-III

Airport site selection, Air craft characteristics, various surface of an airport, Wind rose diagram,Geometric elements of run way and taxiway , holding apron, parking configuration , terminalbuilding , visual aids, air traffic control, airport marking and lighting.

Module-IV

Harbour Engineering: Classification of Harbour basin, general layout of harbours, Docks, Differentcomponents of docks. Inland waterways, Inland water transportation in India, classification of waterways, economics of inland waterways transportation, national waterways.

Text Books/Reference Books:

1. A text book of railway engineering , By S.C.Saxena and M.G.Arora
2. Railway Engineering by Satish Chandra & MM Agrawal, Oxford University Press.
3. Transportation Engineering, Volume-II- Railways, Airports, Docks and Harbours, Bridgesand Tunnels by C. venkatramaih, Universities Press
4. Air-port Engineering by S.K.Khanna and M.G.Arora

Course Outcome:

CO1: Understand the concepts of permanent way section of Indian Railway

CO2: Ability to design the railway geometrical elements, railway turnoutand signal for different conditions.

CO3: Ability to select feasible airport site, decide runway orientation, design geometric elements of runway and taxiway

CO4: Understand the concepts of the harbours and ability to select feasible site for port operation.

Elective- V: Structural Analysis by Matrix Method (3-0-0)

Course Objectives :

1. Review of the fundamental concepts of structural analysis using matrix notation.
2. Detailed study of the force and displacement methods of analysis as applied toStatically loaded beams and framed structures using matrix.

Course Contents:

Module-I

Introduction to Flexibility Matrices and Stiffness Matrices, Static and kinematic indeterminacy - properties of stiffness and flexibility matrices, concept of co-ordinates, solution of simple problems.

Module-II

Analysis of Beams: Flexibility and stiffness matrices for beams, solution of problems, bending moment diagram
Analysis of Plane Truss: Flexibility and stiffness matrices for plane truss, solution of problems, internal forces due to thermal expansion, lack of fit.

Module-III
Analysis of Plane Frame: Flexibility and stiffness matrices for plane frame, solution of problems, bending moment diagram.

Module-IV
Use of Software Packages. Analysis of beam, plane truss & plane frame by STAAD-PRO.

Text Books/Reference Books:

1. Mukhopadhyay M and Sheikh A.H (2004) Matrix and Finite element analyses of structures, First edition, Ane Books Pvt. Ltd.

2. Pandit G.S., & Gupta S.P. (1998), Structural Analysis (A matrix approach), Tata McGraw Hill Publishing Ltd.

Course Outcomes:
CO1: Understand the basics of matrix methods of analysis, generate flexibility matrix & stiffness matrix.
CO2: Analysis of beams by flexibility matrix & stiffness matrix method.
CO3:Analysis of plane truss & plane frames by flexibility matrix & stiffness matrix method.
CO4: Analysis of beam, plane truss & plane frame by STAAD-PRO.

Elective- V: Urban Hydrology and Hydraulics (3-0-0)

Course Objectives:
1. Able to perform storm water management in urban areas.
2. Learn the techniques for peak flow estimation for storm water drainage system design.
3. Understand the importance of short duration rainfall runoff data for urban hydrology studies.
4. Understand the concepts of preparation master urban drainage system.

Course Content:
Module-I
Water in the urban eco-system – Urban Water Resources – Major problems – Urban hydrological cycle – Storm water management objectives and limitations – Storm water policies – Feasibility consideration.
Storm water management practices (Structural and Non-structural Management measures) – Detention and retention concepts , Modelling concept , Types of storage, Magnitude of storage, Hydraulic analysis and design guidelines, Flow and storage capacity of urban components, Temple tanks.

Module-II
Planning and organizational aspects: Potential costs and benefit measures, Measures of urban drainage and flood control benefits, Effective urban water user organizations.
General approaches to operations and maintenance: Complexity of operations and need for diagnostic analysis, Operation and maintenance in urban water system, Maintenance Management System, Social awareness and involvement.

Module-III

Types of water supply systems: piping system, distribution network, labeling, network components, Network models, design, and optimization in practice. Energy and hydraulic gradient lines, head loss in links, equivalent pipes, path head loss and loop head loss, analysis of water distribution network, static node, dynamic node, network performance, flow analysis, Layout , in situ lining, pipes material, appurtenances, minimization of water losses, leak detection.

Module-IV

Planning , runoff estimation, rainfall data analysis, storm water drain design Introduction to Buried pipes, external loads, gravity flow design, pressurized flow- rigid and flexible pipes, installation, trenchless technology. Uncertainty and reliability, affecting events, assessment, reliability parameters, configurations. Design methodology and strengthening and expansion.

Text Books/Reference Books:

1.Geiger, W.F., Marsalek, F., and Zuidena, F.C., (Ed), manual ondrainage in urbanized areas – Vol.1 and Vol.II, UNESCO, 1987.
2. Hengeveld, H. and C. De Voch.t (Ed)., Role of Water in Urban Ecology, 1982.
3. Martin, P. Wanelista and Yousef, A. Yousef., Storm Water Management, John Wiley and sons, 1993.
4. Neil S. Grigg., Urban Water Infrastructure Planning, Management and Operations, John Wiley and Sons, 1986.
5. Bhave P. R, Optimal design of water distribution networks, Narosa publishing House, New Delhi, 2003
7. Manual on water supply and treatment, CPHEEO, Ministry of Urban Development, GOI, New Delhi, 1999
8. B.A. Hauser, practical hydraulics Hand Book, Lewis Publishers, New York, 1991
9. Moser A. P, Buried pipe Design, 3rd Edition, American Water Works Association.
10.Bajwa. G. S, Practical handbook on Public Health Engineering, Deep publishers, Shimla 2003.

Course Outcomes:

1. Analyze urban storm water systems, urban precipitation and storm water runoff.
2. Learn quantification of impacts of climate change on short duration high intensity rainfall in urban areas.
3. Apply best management practices to manage urban flooding.
4. Prepare master drainage plan for an urbanized area.

Entrepreneurship Development (3-0-0)

Prerequisites:

1. Organizational Behaviour.

2. English.

Module 1: (06 Hours)

Entrepreneurship: Concept of Entrepreneurship and Intrapreneurship, Types of Entrepreneur, Nature and Importance, Entrepreneurial Motivation and Achievement, Entrepreneurial Personality & Traits and Entrepreneurial Skills.

Module 2: (08 Hours)

Entrepreneurial Environment, Identification of Opportunities, Converting Business, Opportunities into reality. Start-ups and business incubation, Skill Development. Setting up a Small Enterprise. Issues relating to location, Environmental Problems and Industrial Policies and Regulations.

Module 3: (08 Hours)

Basics of Accounting, Terms: Assets, Liabilities, Equity, Revenue, Expense, Working capital, Marketing Mix and STP.

HRM: Concepts and Function, Labour Laws- Factories Act, Organizational sup- port services - Central and State Government, Incentives and Subsidies.

Module 4: (08 Hours)

Sickness of Small-Scale Industries, Causes and symptoms of sickness, cures of sickness, Role of Banks and Government in reviving sick industries.

Text Books:

1. Entrepreneurship Development and Management, Vasant Desai, HPH.
2. Entrepreneurship Management, Bholanath Dutta, Excel Books.
3. Entrepreneurial Development, Sangeeta Sharma, PHI.
4. Entrepreneurship, Rajeev Roy, Oxford University Press.

Semester – VIII

Sl. No.	Subject Type	Subject Code	Subject Name	Teaching Hours/Week			Credit	Maximum Marks			
				L	T	P		IA	EA	PA	Total
1	Professional Elective-VI	UPECE801	Advanced Concrete Design	3	0	0	3	30	70	0	100
		UPECE802	Reliability Analysis	3	0	0	3	30	70	0	100
		UPECE803	Pre-stressed Concrete	3	0	0	3	30	70	0	100
2	Open Elective-V	Any one subject to be picked from the open elective courses offered by various departments		3	0	0	3	30	70	0	100
3	Open Elective-VI	Any one subject to be picked from the open elective courses offered by various departments		3	0	0	3	30	70	0	100
4	Project Course	UPRCE801	Project Stage-2	0	0	14	7	0	0	100	100
5	Core Course	UPCCE801	Comprehensive Viva-Voce	0	0	2	1	0	0	100	100
			Total				**17**				**500**

Elective – VI: Advanced Concrete Design (3-0-0)

Course objectives:

1. To review the fundamentals of earthquake design as per IS code.
2. To make the students to understand the Analysis and Design of various types of retaining walls and combined footings.
3. To enable the students understand, analysis and design different types of water tanks.
4. Introduce the basic principles about structural behaviour of pre stressed concrete structures with reference to IS 1343 code .

Course Contents:

Module-I

Design of Foundations: Combined Footing: Rectangular,Trapezoidal,raft,strap,pile foundation:single/group

Retaining walls: Forces acting on retaining wall, Stability requirement, Design of Cantilever and Counter fort Retaining walls/Reinforced earth retaining wall.

Module-II

Design of Water tanks: Design requirements, Design of tanks on ground, underground, elevated and Intze type. Design of portal frames and domes by LSM and using latest IS codes.

Module-III

Introduction to EQ Engineering: Cyclic behaviour of concrete and reinforcement, significance of ductility, ductility of beam, design and detailing for ductility, simple problems based on above concept, Computation of earthquake forces on building frame using Seismic Coefficient Method as per IS 1893-2016.

Module-IV

Prestressing systems,materials,basic concepts and design of prestressing, losses of prestress, analysis of prestressed beams and slab (pretension and post tension), advantages and application.

Text Books/Reference Books:

1. Advanced Concrete Structure Design by P. C. Verghese, Prentice Hall of India
2. Limit state design- A K Jain, Nem Chand and Brothers
3. Reinforced Concrete Vol. II [Advanced reinforced concrete] By Dr. H. J. Shah Edition
4. P. Dayaratham, Design of Reinforced Concrete Structures, New Delhi, Oxford and IBH Publishing Co
5. Relevant IS codes.
6. Limit state design of reinforced concrete by B.C. Punmia, AK Jain and A.K. Jain, Laxmi Publishers New Delhi 2007
7. J. Krishna and O. P. Jain, Plain and Reinforced Concrete Vol-I & II, Nem Chand and Bros., Roorkee.

Course Outcomes:

CO1: Understand the significance of ductility as per IS code and the earthquake design and detailing codal provisions as per IS 1893-2002
CO2: Analyze forces acting on retaining walls and design cantilever and counterfort retaining walls.
CO3: Understand the design concept of different types of combined footings.
CO4: Able to design various types of water tanks as per Limit state design.
CO5: Understand the terminology, concept and principles related to Pre-stressing systems and post tensioning systems.

Elective – VI: Reliability Analysis (3-0-0)

Course Objectives :

1. To understand the role of structural reliability in civil engineering design.
2. Tounderstand the fundamentals of structural reliability analysis and different levels of reliability &their sequential developments.
3. To introduce different simulation techniques like Monte-Carlo simulation, Latin Hypercube Simulations and the advance techniques like variance reduction and subset simulation
4. To understand the applications of these methods for code calibrations and reliability analysis under multiple failure modes.

Course Contents:

Module-I

Introduction, Basic Statistics, Theory of Probability, Probability Distributions (Continuous & Discrete), Random Variables.

Module – II

Reliability Methods, Failure Surface & Definition of Reliability in Std. Normal Space (Cornell'sReliability Index), First Order Reliability Method (FORM), Hasofer-Lind's Definition of Reliability, Rackwitz-Fiessler Algorithm, Asymptotic Integral, Second Order Reliability Method(SORM).

Module –III

Monte-Carlo Methods, Latin Hypercube Sampling, Variance ReductionTechnique, Importance Sampling and AdaptiveSampling,Subset Simulation

Module –IV

Stochastic Models of Loads, Code Calibration, Partial Safety Factors, LRFD Format,System Reliability, Time Varying Reliability Analysis, Reliability Based Optimization, Introduction to Stochastic FEM, Case Studies Using MATLAB & ANSYS in Batch Mode.

Text Books/Reference Books:

1. Papoulis A. Probability, Random Variables and Stochastic Processes, McGraw-Hill, New York, USA, 1991.
2. Ranganathan R. Structural Reliability Analysis & Design. Jaico Publishing House, Mumbai, India, 1999.
3.Probability, reliability, and statistical methods in engineering design, Achintya Haldar, Sankaran Mahadevan

Course Outcomes:

CO1: Understand the importance of structural reliability in civil engineering design.
CO2: Understand the fundamentals of structural reliability analysis and different levels of reliability &their sequential developments.
CO3: Introduce different simulation techniques like Monte-Carlo simulation, Latin Hypercube Simulations and the advance techniques like variance reduction and subset simulation
CO4: Understand the applications of these methods for code calibrations and reliability analysis under multiple failure modes.
CO5: Apply the reliability methods for structural design optimization

Elective – VI: Prestressed Concrete (3-0-0)

Course Objectives:

1.The aim of this course is to introduce the basic principles about structural behavior of pre-stressed concrete structures with reference to IS 1343 code

2. The objective is to equip the students with a thorough understanding of the behavior and analysis ,design of prestressed concrete beam

3. Various time dependent factors, such as cracking, creep and shrinkage of concrete, and prestress losses, are discussed thoroughly.

4. To provide students with an opportunity to enhance their skills in pre stressed concrete design and applications.

Course Contents:

Module-I

Prestressing system, materials and codes: Basic concept, Losses of prestress, analysis of prestress and bending stresses. Need for high strength steel and concrete. Advantages and applications. Pre-tensioning and post tensioning systems.

Module – II

Design of beams : Analysis and design of section for bending and shear, pressure line, concept of load balancing, cracking moment, bending of cables, limit state analysis and design, anchorage zone stresses, design of end block, Application to bridges.

Module –III

Selection of prestress concrete members, short term and long term deflections of uncracked members.

Module –IV

Flexural strength of prestresed concrete sections,Continuous beams, Design concept concordancy of cables, Secondary design consideration. Design pre-tensioned and post tensioned beam.

Text Books/Reference Books:

1. Prestressed Concrete, Raju,N.K., Tata McGraw Hill
2. Prestressed Concrete, T. Y. Lin

Course outcomes:

CO1: Understand the terminology, concept and principles related toPre-stressing systems and post tensioning systems.

CO2: Evaluate different losses in the prestress and analyse the sections for resultant stresses.

CO3: Analyse and design of pre-tensioned as well as post-tensioned concrete beams using limit state method for bending and shear.

CO4: Understand the design concept concordancy of cables andtransmission of prestress in pre-tensioned & post-tensioned members.