B.Tech (Civil Engineering- II Year)

INSTITUTE OF ENGINEERING AND TECHNOLOGY

DR.R.M.L AVADH UNIVERSITY

AYODHYA

EVALUATION SCHEME &SYLLABUS

FOR

B.TECH (CIVILENGINEERING)

SECOND YEAR

ON

CHOICE BASED CREDIT SYSTEM

(CBCS)

[Effective from the Session: 2023-2024]

B.Tech (Civil Engineering- II Year)

Semester-III

S.No	Course Code	Course Title	Periods			Evaluation Scheme				End Semester	Total	Credit
			L	T	P	CT	TA	Total	PS	ESE		
1	ESE 305	Engineering Mechanics	3	1	0	30	20	50		100	150	4
2	HSMS 301	Effective Technical Communication	3	0	0	30	20	50		100	150	3
3	CEC 301	Building Materials & Constructions	3	0	0	30	20	50		100	150	3
4	CEC 302	Basic Surveying	3	1	0	30	20	50		100	150	4
5	CEC 303	Fluid Mechanics	3	1	0	30	20	50		100	150	4
6	CEC 3L1	Building Material Lab	0	0	2				25	25	50	1
7	CEC 3L2	Basic Surveying Lab	0	0	2				25	25	50	1
8	CEC 3L3	Fluid Mechanics lab	0	0	2				25	25	50	1
9	CEC 3L4	Quantity Surveying & Estimation Lab	0	0	2				25	25	50	1
10		Departmental Elective-I	2	0	2	15	10	25		25	NC*	0
		Total									950	22

B.Tech (Civil Engineering- II Year)

Semester-IV

Sl. No.	Subjects Code	Subjects	Periods			Evaluation Scheme				End Semester	Total	Credit
			L	T	P	CT	TA	Total	PS	ESE		
1	BSC401	Mathematics-IV	3	1	0	30	20	50		100	150	4
2	CEC401	Structure Analysis I	3	1	0	30	20	50		100	150	4
3	CEC402	Open channel Flow	3	1	0	30	20	50		100	150	4
4	CEC403	Concrete Technology	3	1	0	30	20	50		100	150	4
5	CEC 404	Environmental Engineering I	3	1	0	30	20	50		100	150	4
7	CEC4L4	Structure Analysis Lab	0	0	2				25	25	50	1
8	CEC4L5	Hydraulic Engineering and Machines Lab	0	0	2				25	25	50	1
9	CEC4L6	Concrete Technology Lab	0	0	2	-			25	25	50	1
10		Departmental Elective-I	2	0	0	15	10	25		25	NC*	
		Total									**900**	**23**

B.Tech (Civil Engineering- II Year)

ENGINEERING MECHANICS

Course Objective:

1. To understand the basic knowledge of structures.
2. Understand the two dimensional static force analyses.
3. To analyze the Pin jointed framed structure.
4. Understand the knowledge of Newton's law and basics of friction.

Course Outcomes:

1. Use scalar and vector analytical techniques for analyzing forces in statically determinate structures
2. Apply fundamental concepts of kinematics and kinetics of particles to the analysis of simple, practical problems.
3. Apply basic knowledge of mathematics and physics to solve real-world problems.
4. Understand basic dynamics concepts – force, momentum, work and energy;
5. Understand and be able to apply Newton's laws of motion;

Unit	Topics	No. of Lectures
I	**Two-Dimensional Static Force Analysis:** Two-dimensional force systems: Basic concepts, Laws of motion, Principle of transmissibility of forces, transfer of a force to parallel position, resultant of a force system, simplest resultant of two dimensional concurrent and non-concurrent force systems, distribution of force systems, free body diagrams, equilibrium and equations of equilibrium.	8
II	**Basics of Friction and Truss:** Friction: Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction – wedge friction. Belt-Rope-chain Friction. Trusses: Introduction, simple truss and solution of simple truss, methods of F-joint and methods of sections.	8
III	**Basic Analysis of Determinant Beams:** Beam: Introduction, shear force and bending moment, different equations of equilibrium, shear force and bending moment diagram for statically determined beams.	8
IV	**Analysis of Geometrical Shapes:** Centroid and moment of inertia: Centroid of plane, curve, area, volume and composite bodies. Moment of inertia of plane area, parallel axis theorem, perpendicular axis theorem, principle moment of inertia, mass moment of inertia of circular ring, disc, cylinder, sphere, and cone about their axis of symmetry.	8

V	**Introduction of Solid Mechanics:** Simple stress and strain: Introduction, normal and shear stresses, stress-strain diagrams for ductile and brittle material, elastic constants, one-dimensional loading of members of varying cross sections, strain energy. Pure bending of beams: Introduction, simple bending theory, stress in beams of different cross sections. Torsion: Introduction, torsion of shafts of circular cross sections, torque and twist, shear stress due to torque.	8

Books and References

1. Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall
2. F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, TMH
3. R. C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press.
4. Andy Ruina and Rudra Pratap (2011), Introduction to Statics and Dynamics, Oxford University Press
5. Shanes and Rao (2006), Engineering Mechanics, Pearson Education,
6. Hibler and Gupta (2010),Engineering Mechanics (Statics, Dynamics) by Pearson Education
7. Reddy Vijaykumar K. and K. Suresh Kumar(2010), Singer's Engineering Mechanics
8. Bansal R.K.(2010), A Text Book of Engineering Mechanics, Laxmi Publications
9. Khurmi R.S. (2010), Engineering Mechanics, S. Chand & Co.
10. Tayal A.K. (2010), Engineering Mechanics, Umesh Publications
11. Strength of Materials by Timoshenko and Youngs, East West Press.
12. Textbook of Applied Mechanics-Dynamics and Statics by Prasad I.B, Khanna Publications.

BUILDING MATERIAL & CONSTRUCTIONS

Course Objectives:

1. To understand the physical and mechanical properties of construction materials and their respective testing procedure.
2. To know the building materials available in market for construction purpose and Modern materials.
3. To learn the principles and methods to be followed in construction of various civil engineering structures.
4. To gain knowledge about doors, windows, plastering, painting, damp proofing, scaffolding, shoring, underpinning and to take suitable engineering measures.

Course Outcomes:

After completion of this course, the student will be able to:

1. Identify the relevant physical and mechanical properties of construction materials.
2. Choose the modern construction material appropriate to the climate and functional aspects of
3. the buildings.
4. Select the construction technique to be followed in brick, stone, masonry, concreting, flooring, roofing, plastering and painting etc.

Unit	Topics	No. of Lectures
I	**Study of common building Materials:** building materials and their performance, economics of the building materials. **Bricks**: Manufacturing process of clay bricks, classification of clay bricks. Properties of clay bricks, testing methods for clay bricks. Problems of efflorescence & lime bursting in bricks. **Cement**: Raw materials used, Process of Manufacturing, Chemical composition, compounds formed and their effect on strength, Types of cement, Uses of cement. **Aggregate**: Mineralogy, properties test and standard **Stones:** Requirement of good building stone, characteristics of building stone sand their testing. Common building stones. Methods of preservation of stones. **Masonry:** Stone & Brick Masonry.	8
II	**Supplementary Cementing Materials: Pozzolona**: Chemical composition and requirements for uses, Natural and Artificial fly ash, Surkhi, Metakaolin, Rice husk and ash Pozzolona, properties and specifications for use in construction. **Lime**: Manufacture of lime, classifications of limes, properties of lime. **Gypsum**: properties of gypsum plaster, building products made of gypsum and their uses. **Timber**: Classification and identification of timber, Fundamental Engineering Properties of timber, Defects in timber, Factor affecting strength of timber,	8

	Methods of seasoning and preservation of timber. Wood based products.	
III	**Modern Materials**: Glass, Tiles & Ceramics, Sealants for joints; Sheets for pitched roof coverings; Fiber glass reinforced plastic; Clay products – Refractories; Composite materials –Types, application of laminar composites. Fiber textiles- Mats and pads for earth reinforcement; Polymers and resins for building repair. Glass: Ingredients, properties types and use in construction. Insulating Materials: Thermal and sound insulating material, desirable properties and types.	8
IV	**Buildings:** Components of building, area considerations, Construction Principle and Methods for layout, damp proofing, antitermite treatment in buildings, Vertical circulation means: stair cases and their types, design and construction. Different types of floors, and flooring materials (Ground floor and upper floors). Bricks and stone masonry construction. **Doors and Windows:** Construction details, types of doors and windows and their relative advantages & disadvantages. Types of roof and roof treatments. Lintel sand Chhajja, Principles of building Planning	8
V	Natural Ventilation, Water Supply and Sanitary fittings (Plumbing), Electric Fittings. Heating Ventilation & Air conditioning (HVAC), Mechanical Lifts and Escalators, Fire Fighting and Fire Protection of Buildings. Acoustics. Plastering and its types, pointing, Distempering, Color washing, Painting etc. Principles & Methods of building maintenance.	8

Text and References Books:

1. Building Materials and construction – Arora &Bindra, Dhanpat Roy Publications.

2. B. C. Punmia, Ashok Kumar Jain, Arun Kumar Jain (2005), Building Construction, Laxmi Publications (P) ltd., New Delhi, India.

3. Building materials , construction and planning by S .MAHABOOB BASHA

4. Building materials by Duggal, New age Internations.

5. Building construction by PC verghese PHI.

6. Construction technology –vol -1 &2 by R. chuddy, Longman UK.

7. Basics of civil Engg by Subhash chander; Jain brothers.

NPTEL Lectures Links:

- https://nptel.ac.in/courses/105102088/
- http://www.nptelvidecs.in/2012/11/building-materials-and-construction.html

BASIC SURVEYING

Course Objectives-

1. To understand the basic principles of surveying and different methods of Surveying
2. To learn about Tacheometry, geodetic surveying and GPS surveying.
3. To know the types of errors encountered in different types of surveying .
4. Analyze the obtained spatial data to compute areas and volumes and draw contours to represent 3D data on plane figures

Course Outcome -After completion of this course, the student will be able to

1. Describe the function of surveying and work with survey instruments, take observations, and prepare plan, profile, and cross-section and perform calculations. Calculate, design and layout horizontal and vertical curves.
2. Operate a total station and GPS to measure distance, angles, and to calculate differences in elevation. Reduce data for application in a geographic information system.
3. Relate and apply principles of photogrammetry and GPS GIS for surveying

Unit	Topics	No. of Lectures
I	**Surveying:** definition, divisions, classification and principles of surveying. **Scales:** plain, vernier, diagonal, plan and map. Linear measurement: chain and tape surveying, types of chain and tape, ranging, obstacles and tape correction. **Accuracy and errors:** definitions, sources and kinds of errors, application of probability for computation of errors, laws of weights.	8
II	**Compass surveying**: Measurement of directions, Reference meridians, bearing and azimuths, local attraction. **Leveling:** Methods of determining elevations, Direct leveling- basic terms and definitions, principle, booking and reduction of field notes, curvature and refraction correction, use of Automatic level, Digital Level, Vertical Control. **Trigonometric leveling:** Accessible and inaccessible objects.	8
III	**Theodolite survey:** Vernier theodolite, Measurements of horizontal and vertical angles, Horizontal Control, working of Electronic Theodolites. **Traversing and triangulation:** Principles of traversing by compass and theodolite, computations of traverse coordinates, omitted measurements **Contouring:** Contours, contour interval, horizontal equivalent, characteristics, methods and interpolation, use to prepare profiles.	8
IV	Tachometry: Principles of stadia systems, subtense bar and tangential methods. Elements of simple circular curves, theory and methods of setting out simple circular curves, transition curves- types and their characteristics, ideal transition curve, equations of various transition curves, Introduction to vertical curves. Principles and classification of triangulation systems, strength of figures, satellite stations, and triangulation field work. Introduction to modern surveying Instruments /Techniques like total station	8

V	Photogrammetric Survey: basic principles, aerial camera, scale of a vertical photograph, relief displacement of a vertical photograph, height of object from relief displacement, flight planning for aerial photography, selection of altitude, interval between exposures, crab and drift, stereoscope and stereoscopic views, parallax equations.	8

References:

1. Schofield, "Engineering Surveying" 6/e, CRC Press Taylor & Francis Group.
2. BC Punamia et al: Surveying Vol. I, II, Laxmi Publication
3. Bannister, "Surveying" 7/e. Pearson Education, Noida.
4. AM Chandra: Plane Surveying, Higher Surveying, Narosa Pub.
5. AK Dey Plain Survey, S Chand
6. SK Duggal: Surveying Vol. I, II.
7. Chandra, A.M., Higher Surveying, Third Edition, New Age International (P) Limited,2002.

NPTEL Lecture Link:

- https://nptel.ac.in/courses/105107121/
- https://nptel.ac.in/courses/105107121/2
- https://nptel.ac.in/courses/105107157/

FLUID MECHANICS

Course Objective

1. To familiarize with the properties of fluids and the applications of fluid mechanics.
2. To formulate and analyze problems related to calculation of forces in fluid structure interaction.
3. To understand the concept of fluid measurement.
4. Types of flows and dimensional analysis.
5. To develop the idea what will happen when fluid and solid body interact with each other.

Course Outcomes:

At the end of this course the student will be able to-

1. Understand the broad principles of fluid statics, kinematics and dynamics
2. Understand definitions of the basic terms used in fluid mechanics
3. Understand classifications of fluid flow
4. Apply the continuity, momentum and energy principles
5. Apply dimensional analysis

Unit	Topics	No. of Lectures
I	Fluid and continuum, Physical properties of fluids, Rheology of fluids. Pressure-density height relationship, manometers, pressure on plane and curved surfaces, centre of pressure, buoyancy, stability of immersed and floating bodies, fluid masses subjected to linear acceleration and uniform rotation about an axis.	8
II	Types of fluid flows: Continuum & free molecular flows. Steady and unsteady, uniform and non-uniform, laminar and turbulent flows, rotational and irrotational flows, compressible and incompressible flows, subsonic, sonic and supersonic flows, sub- critical, critical and supercritical flows, one, two and three dimensional flows, streamlines, path lines, streak lines, stream tube, continuity equation for 1-D, 2-D and 3-D flows, circulation, stream function, velocity potential function, potential flow: source, sink, doublet and half-body.	8
III	Equation of motion along a streamline and its integration, Bernoulli's equation and its applications- Pitot tube, orifice meter, venturimeter and bend meter, notches and weirs, momentum equation and its application to pipe bends, resistance to flow, Minor losses in pipe in series and parallel, power transmission through a pipe, siphon, water hammer, three reservoir problems and pipe networks.	8
IV	Equation of motion for laminar flow through pipes, Stokes' law, mixing length concept and velocity distribution in turbulent flow over smooth and rough surfaces. Boundary layer thickness, boundary layer over a flat plate, displacement, momentum and energy thickness. Application of momentum equation. Laminar boundary layer, turbulent boundary layer, laminar sub-layer,	8

	separation and its control. Vortex Flow: Free & Forced.	
V	Drag and lift, drag on a sphere, aerofoil, Magnus effect, Similarity Laws; geometric, kinematics and dynamic similarity, undistorted and distorted model studies, Dimensional analysis, Buckingham's Pi theorem, important dimensionless numbers and their significance.	8

References:

Books and References

1. Hibbler, "Fluid Mechanics in SI Units" 1/e Pearson Education, Noida.
2. Fox & Donald, "Introduction to Fluid Mechanics" John Wiley &Sons Pvt Ltd,
3. Cengel&Cimbala, "Fluid Mechanics" TMH, New Delhi.
4. Katz, "Introductory Fluid Mechanics" Cambridge University Press
5. Pnueli&Gutfinger, "Fluid Mechanics" Cambridge University Press
6. Modi & Seth "Hydraulics & Fluid Mechanics" Standard Publications.
7. Gupta, "Fluid Mechanics & Hydraulic Machines" Pearson Education, Noida
8. Graebel, "Engineering Fluid Mechanics", CRC Press Taylor & Francis Group.
9. Janna, "Introduction to Fluid Mechanics" 4/e, CRC Press Taylor & Francis Group

BUILDING MATERIAL & CONSTRUCTION LAB

Experiments

1. Tension test on mild steel and HYSD bars
2. Compression test on mild steel, cast iron and wood.
3. Torsion test on mild steel circular sections.
4. Bending Test on Wood Under two point loading
5. Shear Test on Mild steel- single and double shear
6. Tests on Fine aggregates – Moisture content, Specific gravity, Bulk density, Sieve analysis and Bulking
7. Tests on Coarse aggregates – Absorption, Moisture content, specific gravity, Bulk density and Sieve analysis.
8. Hardness tests on ferrous and non-ferrous metals– Brinell's, Rockwell and Vicker's

B.Tech (Civil Engineering- II Year)

BASIC SURVEYING LAB

Experiments

1. To prepare conventional symbol chart based on the study of different types of topographical maps.
2. To measure bearings of a closed traverse by prismatic compass and to adjust the traverse by graphical method.
3. To find out reduced levels of given points using Auto/dumpy level.
4. To perform fly leveling with Auto/tilting level.
5. To study parts of a Vernier theodolite and measurement of horizontal and vertical angle.
6. To measure horizontal angle between two objects by repetition/reiteration method.
7. To determine the height of a vertical structure (e.g. chimney/ water tank etc.) using trigonometrical leveling by taking observations in single vertical plane.
8. To study various parts of Total Station and practice for measurement of distance, horizontal and vertical angles.
9. To set out a simple circular curve by Rankine's method.
10. To plot contour map of given area.

FLUID MECHANICS LAB

Note: Ensure to conduct at least 10 experiments from the list:

Experiments

1. To verify the momentum equation using the experimental set-up on impact of jet.
2. To determine the coefficient of discharge of an orifice of a given shape. Also to determine the coefficient of velocity and the coefficient of contraction of the orifice mouth piece.
3. To calibrate an orifice meter and study the variation of the co-efficient of discharge with the Reynolds number.
4. To calibrate a Venturimeter and study the variation of the co-efficient of discharge with the Reynolds number.
5. To calibrate a bend meter and study the variatinn of the co-efficient of discharge with the Reynolds number.
6. To draw a flow-net using Electrical Analogy Method.
7. To study the transition from laminar to turbulent flow and to determine the lower critical Reynolds number.
8. To study the velocity distribution in a pipe and also to compute the discharge by integrating the velocity profile.
9. To study the variation of friction factor, 'f' for turbulent flow in commercial pipes.
10. To study the boundary layer velocity profile over a flat plate and to determine the boundary layer thickness.
11. To determine Meta-centric height of a given ship model.
12. To determine the head loss for a sudden enlargement

To determine the head loss for a sudden Contraction

B.Tech (Civil Engineering- II Year)

Quantity Surveying & Estimation Lab
Experiments
1. Estimation Of Building(Long Wall And Short Wall Method) 2. Estimation Of Building(Center Line Method) 3. Analysis Of Rate For Concret Work 4. Analysis Of Rate For Brick Work 5. Analysis Of Rate For Plaster Work 6. Estimate Quantity Of Reinforcement 7. Preparation For Approximate Estimate For Road Project 8. Estimating Cost Of Building On Plinth Area Method

MATHEMATICS IV

Unit	Topics	No. of Lectures
I	**Partial Differential Equations** Origin of Partial Differential Equations, Linear and Non Linear Partial Equations of first order, Lagrange's Equations, Charpit's method, Cauchy's method of Characteristics, Solution of Linear Partial Differential Equation of Higher order with constant coefficients, Equations reducible to linear partial differential equations with constant coefficients.	8
II	**Applications of Partial Differential Equations:** Classification of linear partial differential equation of second order, Method of separation of variables, Solution of wave and heat conduction equation up to two dimension, Laplace equation in two dimensions, Equations of Transmission lines.	8
III	**Statistical Techniques I:** Introduction: Measures of central tendency, Moments, Moment generating function (MGF) , Skewness, Kurtosis, Curve Fitting , Method of least squares, Fitting of straight lines, Fitting of second degree parabola, Exponential curves ,Correlation and Rank correlation, Regression Analysis: Regression lines of y on x and x on y, regression coefficients, properties of regressions coefficients and non linear regression.	8
IV	**Statistical Techniques II:** Durability of concrete: Permeability of concrete - Shrinkage-plastic shrinkage - drying shrinkage - Chemical attack - Sulphate attack of concrete structures - chloride attack, Alkali aggregate reaction., carbonation, freezing and thawing. Corrosion Curing and Methods of curing. Testing of hardened concrete, Creep– factors affecting creep.	8
V	**Statistical Techniques III:** Sampling, Testing of Hypothesis and Statistical Quality Control: Introduction , Sampling Theory (Small and Large) , Hypothesis, Null hypothesis, Alternative hypothesis, Testing a Hypothesis, Level of significance, Confidence limits, Test of significance of difference of means, T-test, F-test and Chi-square test, One way Analysis of Variance (ANOVA).Statistical Quality Control (SQC) , Control Charts , Control Charts for variables (X and R Charts), Control Charts for Variables (p, np and C charts).	8

Text Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 9thEdition, John Wiley & Sons, 2006.
2. P. G. Hoel, S. C. Port and C. J. Stone, Introduction to Probability Theory, Universal Book Stall, 2003(Reprint).
3. S. Ross: A First Course in Probability, 6th Ed., Pearson Education India, 2002.
4. W. Feller, An Introduction to Probability Theory and its Applications, Vol. 1, 3rd Ed., Wiley, 1968.

Reference Books

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 35th Edition, 2000.
2. T.Veerarajan : Engineering Mathematics (for semester III), Tata McGraw-Hill, New

Delhi.
2. R.K. Jain and S.R.K. Iyenger: Advance Engineering Mathematics; Narosa Publishing House, New Delhi.

STRUCTURE ANALYSIS I

Course Objective

1. To know the development of internal forces and resistance mechanism for one dimensional and two dimensional structural elements. To analyze and understand different internal forces and stresses induced due to representative loads on structural elements.
2. To analyze and understand principal stresses due to the combination of two dimensional stresses on an element and failure mechanisms in materials.
3. To evaluate the behavior of torsion members, columns and struts

Course Outcomes:

1. To evaluate the strength of various structural elements internal forces such as compression, tension, shear, bending and torsion.
2. To suggest suitable material from among the available in the field of construction and manufacturing.
3. To evaluate the behavior and strength of structural elements under the action of compound stresses and thus understand failure concepts.
4. To understand the basic concept of analysis and design of members subjected to torsion and bending, shear stress.

Unit	Topics	No. of Lectures
I	Introduction, Classification of Structures, Forms of structure, Loads & Forces Equation of static equilibrium, Internal Forces, Idealization of structure, Supports & connections, Free Body Diagram, Principle of superposition, Degree of static indeterminacy, Degree of Kinematic Indeterminacy, Stability, Settlement of supports.	8
II	**Displacements:** Slope and deflection of determinate beam by- Moment area method, Conjugate beam method, Slope and deflection of beams & frames by- strain Energy Method, Unit Load Method. Maxwell's reciprocal &Betti's theorem, Castigliano's theorems	8
III	**Arch Structure:** Analysis of three hinged parabolic and circular Arches. Three hinged parabolic arches with supports at the same and different levels. Determination of normal thrust, radial shear and bending moment. Linear arch, Eddy's theorem, spandrel braced arch, moving load & influence lines for three hinged parabolic.	8
IV	**Influence Line Diagrams:** Rolling loads and influence line diagrams for determinate beams, Absolute maximum bending moment and shear force. Muller-Breslau's principal & its applications for determinate structures.	8
V	**Analysis of cables:** Introduction, Analysis of cables Structures with concentrated and continuous loadings, Effect of Temperature upon length of cable. **Stiffening girders:** Analysis of three hinged stiffening girders.	8

Text & Reference Books :

1. Basic Structural Analysis by C.S Reddy, McGraw Hill Publication.
2. Indeterminate structural Analysis, C.K.Wang,McGraw Hill Publication.
3. Structural Analysis-I, S SBhavikatti, Vikas Publishing House Pvt Ltd.
4. Structural Analysis A Matrix Approach, McGraw Hill Publication

E Learning Link:

1. https://nptel.ac.in/courses/105/105/105105166/

Open Channel Flow

Course Objective

1. Apply their knowledge of fluid mechanics in addressing problems in open channels.
2. Solve problems in uniform, gradually and rapidly varied flows in steady state conditions.

Course Outcomes:

1. Students are able to differentiate between pipe flow & Open channel flow
2. Students are able to understand different types of flow in open stream.
3. Able to calculate discharge of open channel.
4. Able to analyze GVF & RVF profile.

Unit	Topics	No. of Lectures
I	Basic concepts of free surface flows, velocity and pressure distribution, Mass, energy and momentum principle for prismatic and non-prismatic channels critical, subcritical and super- critical type of flows.	8
II	Critical depth, concepts of specific energy and specific force Chezy's and Manning's equations for uniform flow in open channel. Velocity distribution, most efficient channel section, compound sections. Application of specific energy principle for interpretation of open channel phenomena, flow through vertical and horizontal contractions.	8
III	Equation of gradually varied flow and its limitations, flow classification and surface profiles, integration of varied flow equation by analytical, graphical and numerical methods.	8
IV	Measurments of discharge & velocity – Venturi flume, Standing wave flume, Parshall flume, Broad crested weir, Current meter and Floats.	8
V	Hydraulic jump: Evaluation of the jump elements in rectangular channels on horizontal and sloping beds, energy dissipater, open channel surge, celerity of the gravity wave, deep and shallow water waves.	8

Text & Reference Books :

1. Chow,V.T. "Open Channel hydraulics" McGraw Hill Publication
2. Subramanya, K., Flow through Open Channels, TMH, New Delhi
3. Ranga Raju, K.G., Flow through open channels, T.M.H. New Delhi
4. Rajesh Srivastava, Flow through Open Channels , Oxford University Press
5. Streeter, V.L & White E.B., "Fluid Mechanics" McGraw Hill Publication
6. Modi & Seth "Hydraulics & Fluid Mechanics" Standard Publications.
7. RK Bansal "Fluid Mechanics and Hydraulic Machines" Laxmi Publication
8. AK Jain "Fluid Mechanics" Khanna Publication.
9. Houghtalen, "Fundamentals of Hydraulics Engineering Systems" 4/e Pearson Education, Noida

NPTEL Lecture Link:

B.Tech (Civil Engineering- II Year)

- https://nptel.ac.in/courses/105101082/
- https://nptel.ac.in/courses/112105171/
- https://nptel.ac.in/courses/112103249/

B.Tech (Civil Engineering- II Year)

Concrete Technology

Course Objective

To get the knowledge on quality of concrete, Proportion ingredients of Concrete to arrive at most desirable mechanical properties of Concrete durability aspects, causes of deterioration, and repairing of concrete structures.

Course Outcomes:

1. Relate material characteristics and their influence on microstructure of concrete.
2. Distinguish concrete behaviour based on its fresh and hardened properties.
3. Illustrate proportioning of different types of concrete mixes for required fresh and hardened properties using professional codes

Unit	Topics	No. of Lectures
I	**Cement:** Manufacture, basic properties of cement compounds, types and cement chemistry ,Hydration of cement Aggregates: mineralogy, properties, test and standards. Workability :Factors affecting workability and its Measurement.	8
II	**Study of SCM's** : like fly ash, silica fume , ground granulated blast furnace slag, metakaoline and Pozzolana . Admixtures - process of various stages of concrete, study of accelerators, retarders, water reducers, air entrainers , water proofers, super plasticizers. Factors influencing strength, W/C ratio, gel/space ratio, Maturity concept.	8
III	**Mix design:** Principle of mix proportioning, properties related to mix design, Mix design method (IS method and ACI method). Mix design of concrete: packing density, Rheology, mix design examples.	8
IV	**Durability of concrete:** Permeability of concrete - Shrinkage-plastic shrinkage - drying shrinkage - Chemical attack - Sulphate attack of concrete structures - chloride attack, Alkali aggregate reaction., carbonation, freezing and thawing. Corrosion Curing and Methods of curing. Testing of hardened concrete, Creep– factors affecting creep	8
V	**Special concrete properties and their application :** Study and uses of high strength concrete, High performance concrete - high strength concrete, high density concrete - light weight concrete - Fibre reinforced concrete - self-compacting concrete - Polymer concrete	8

Text Books:

1. Neville A.M. "Properties of Concrete"-4th Ed., Long man.
2. M.S. Shetty, Concrete Technology - Theory and Practice Published by S. Chand and Company, New Delhi.
3. Kumar Mehta, P and Paulo J.M. Monteiro "Concrete-Microstructure, Property and

Materials", 4th Edition, McGraw Hill Education, 201 4
4. A.R. Santha Kumar, "Concrete Technology", Oxford University Press, New Delhi (New Edition)

Reference Books:

1. M L Gambir, "Concrete Technology", McGraw Hill Educ ation, 2014.
2. N. V. Nayak, A. K. Jain Handbook on Advanced Concrete Technology.
3. Job Thomas, "Concrete Technology", CENGAGE Learning , 2015
4. IS 4926 (2003): Code of Practice Ready-Mixed Concrete .
5. IS 10262 (2002) : code of Practice Concrete Mix Design.
6. Criteria for RMC Production Control, Basic Level Certification for Production Control of Ready Mixed Concrete-BMTPC
7. Specification and Guidelines for Self-Compacting Concrete, EFNARC, Association House

NPTEL Lecture Links :

- https://nptel.ac.in/courses/105102012/
- https://nptel.ac.in/courses/105106176/

B.Tech (Civil Engineering- II Year)

Environmental Engineering I

Course Objective

1. To understand the physical, chemical & biological properties of water
2. To understand the population forecasting techniques.
3. To understand the layout of treatment plant and methods involved to treat the raw water.
4. To understand the distribution system, pipe joints & valves,

Course Outcomes:

1. Students are able to identify the basic properties of raw water.
2. Students are able to treat raw water.
3. Students are able to design filteration tank.
4. Students are able to understand the layout of treatment plant & basic functioning of units.

Unit	Topics	No. of Lectures
I	Importance and necessity of water supply engineering, Sources of water, Suitability of water, Choice of source, Types of demand, Population forecast, Computation of quantity of water, Fluctuation in demand, Factors affecting demand, Impurities in water, Collection of water sample, Physical, Chemical and Biological Tests, Standards of quality of water	8
II	Objectives of water treatment, Location of water treatment plant, Layout of water treatment plant, Basic principles of working of treatment plant, Various stages of treatment of influent water; Functioning of Coagulation treatment plant, Sedimentation, Filtration, Disinfection	8
III	Types of pipes used for conveyance, Pipe joints, Laying of pipes, Distribution system, Types of valves, Types of meters, Pipe fittings and fixtures, Necessity, Methods to prevent leaks, Measures for conservation of water	8
IV	Characteristics of water: Physical, chemical and biological standards. Theory, Operation and design of aeration system, sedimentation, coagulation, and flocculation. Design of each units	8
V	Filtration: Slow and rapid gravity filter, multi-media filters and pressure filters. Design of slow sand filter and rapid sand filter. Disinfection: theory and application of chlorine. Miscellaneous methods of water treatment- removal of iron and manganese, hardness, fluorides, colour, taste and odour, dissolved metals and gases	8

Text & Reference Books:

1. Peavy, Howard S., Rowe, Donald R and Tchobanoglous, George, "Environmental Engineering" McGraw Hill Education (India) Pvt. Ltd., New Delhi.
2. Garg, SK: Water Supply Engineering (Environmental Engineering Vol. – I)
3. Nathanson, Schneider, "Basic Environmental Technology: Water Supply, Waste Management & Pollution Control" 6/e, Pearson Education.
4. Metcalf & Eddy, "Wastewater Engineering: Treatment & Reuse", Tata Mc-Graw Hill.

E Learning Links :

1. https://nptel.ac.in/courses/105/105/105105201/

B.Tech (Civil Engineering- II Year)

Structure Analysis Lab

Experiments

1. To determine Flexural Rigidity (EI) of a given beam
2. To verify Maxwell's Reciprocal theorem.
3. To find horizontal thrust in a three-hinged arch and to draw influence line diagrams for Horizontal Thrust end Bending moment.
4. To find horizontal thrust in a two hinged arch and to draw influence line diagrams for horizontal Thrust and bending moment.
5. To find deflection of curved members.
6. To find bar forces in a three members structural frames with pin jointed bar
7. To find Critical load in Struts with different end conditions.
8. To find deflections in Beam having unsymmetrical bending

B.Tech (Civil Engineering- II Year)

Hydraulic Engineering and Machines Lab

Experiments

1. To verify the momentum equation using the experimental set-up on impact of jet.
2. To determine the coefficient of discharge of an orifice of a given shape & also determine the coefficient of velocity and the coefficient of contraction of the orifice mouth piece.
3. To calibrate an orifice meter and study the variation of the co-efficient of discharge with the Reynolds number.
4. To calibrate a Venturimeter and study the variation of the co-efficient of discharge with the Reynolds number.
5. To calibrate a bend meter and study the variation of the co-efficient of discharge with the Reynolds number.
6. To draw a flow-net using Electrical Analogy Method.
7. To study the transition from laminar to turbulent flow and to determine the lower critical Reynolds number.
8. To study the velocity distribution in a pipe and also to compute the discharge by integrating the velocity profile.
9. To study the variation of friction factor, 'f' for turbulent flow in commercial pipes.
10. To study the boundary layer velocity profile over a flat plate and to determine the boundary layer thickness.
11. To determine Meta-centric height of a given ship model.
12. To determine the head loss for a sudden enlargement 13.To determine the head loss for a sudden Contraction

CONCRETE TECHNOLOGY LAB

Experiments

1. Testing of cement: Consistency, fineness, setting time, Specific Gravity, Soundness and strength.
2. Testing of fine aggregate: Specific Gravity, sieve analysis and zoning, bulking of fine aggregate, bulk density, silt content.
3. Testing of coarse aggregate: Specific Gravity, sieve analysis, bulk density, flakiness index, elongation index, water absorption & moisture content, soundness of aggregate.
4. Concrete Mix design by ACI 211.1-91 method, IS code method as per 10262- 2007 & 456-2000, DOE method
5. Tests on Concrete- Workability tests – Slump cone test, compaction factor test, Vee-bee consistometer test, flow table test, strength tests- compressive strength, flexural strength, split tensile strength.
6. Effects of Admixture - Accelerator, Retarder, Super Plasticizer.
7. Nondestructive Testing - Rebound Hammer test, Ultrasonic Pulse Velocity test.

INSTITUTE OF ENGINEERING AND TECHNOLOGY
Dr. R.M.L. AVADH UNIVERSITY
AYODHYA

EVALUATION SCHEME & SYLLABUS

FOR

B.TECH. (CIVIL ENGINEERING)

THIRD YEAR

ON

CHOICE BASED CREDIT SYSTEM
(CBCS)

[Effective from the Session: 2023-2024]

B Tech. (Civil Engineering)-III Year

Semester V

S.No	Course Code	Course Title	Periods			Evaluation Scheme				Subject Total	Credit
			L	T	P	Sessional Exam			ESE		
						CT	TA	Total			
1	HSMC501	Engineering Managerial Economics	3	0	0	30	20	50	100	150	3
2	CEC 501	Geotechnical Engineering	3	1	0	30	20	50	100	150	4
3	CEC 502	Design of Concrete Structures-I	3	1	0	30	20	50	100	150	4
4	CEC 503	Structural Analysis-II	3	1	0	30	20	50	100	150	4
5	CEC 504	Waste Water Engineering	3	1	0	30	20	50	100	150	4
Practical / Design / Drawing											
7	CEC 5L1	Geotechnical Engineering Lab	0	0	2			25	25	50	1
8	CEC 5L2	Environmental Engineering Lab	0	0	2			25	25	50	1
9	CEC 5L3	Computer Aided Design Lab	0	0	2			25	25	50	1
10	CEC 5L4	Cost Estimation Lab	0	0	2			25	25	50	1
		Total								950	23

B Tech. (Civil Engineering)-III Year

Semester VI

S No	Course Code	Course Title	Periods			Evaluation Scheme				Subject Total	Credit
			L	T	P	Sessional Exam			ESE		
						CT	TA	Total			
1	CEC 601	Design of Steel Structures	3	1	0	20	30	50	100	150	4
3	CEC 602	Design of Concrete Structures-II	3	1	0	20	30	50	100	150	4
4	CEC-603	Transportation Engineering	3	1	0	20	30	50	100	150	4
6	CEC -604	Integrated Solid Waste Management	3	1	0	20	30	50	100	150	4
7		Departmental Elective-III	3	1	0	20	30	50	100	150	4
Practical / Design / Drawing											
9	CEC 6L1	Transportation Engineering Lab	0	0	2			25	25	50	1
10	CEC 6L2	STAAD Lab	0	0	2			25	25	50	1
11	CEC 6L3	Seminar	0	0	2			50		50	1
		Total								900	23

GEOTECHNICAL ENGINEERING

Course Objectives:

The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course.

1. Analyze the soil for engineering parameters.
2. Calculate and analyze the stress on soil and be able to draw the stress path.
3. Analyze the effect of flow of fluids through soil.
4. Understand various bearing capacity determination techniques.

Course Outcomes:

1. To learn the basic engineering properties of soil.
2. To know the application of soil hydraulics.
3. To understand the stresses induced in soil.
4. To learn the effect of long term loading in soil.
5. Design the footing rest on soil medium.

Module	Topics	No. of Lectures
I	Origin and classification: Preview of Geotechnical field problems in Civil Engineering. Soil formation, transport and deposit. Soil composition, Basic definitions, Weight volume relationships, Clay minerals, Soil structure, Index properties, sensitivity and thixotropy, Particle size analysis, Unified and Indian standard soil classification system.	[8]
II	Soil Hydraulics: Stress conditions in soil- total, effective and neutral stresses and relationships. Permeability - Darcy's Law, hydraulic conductivity, equivalent hydraulic conductivity in stratified soil. Seepage, flow nets, seepage calculation from a flow net, flow nets in anisotropicsoils, seepage through earth dam, capillarity, critical hydraulic gradient and quick sand condition. uplift pressure, piping;	[6]
III	Soil compaction, water content-dry unit weight relationships. Factors controlling compaction. Field compaction equipment; field compaction control, Proctor needle method. Consolidation: Primary and secondary consolidation, Terzaghi's one dimensional theory of consolidation, Consolidation test, Normal and Over Consolidated soils, determination of coefficient of consolidation	[8]
IV	Shear Strength: Mohr-Coulomb failure criterion, shear strength parameters and determination; direct and tri-axial shear test; unconfined compression test; pore pressure, Skempton's pore pressure coefficients. Earth pressure: Classical theories, Coulomb and Rankine's approaches for frictional and c-o soils, inclined backfill, Graphical methods of earth pressure determination, Stability of slopes, Culman method & Method of slices, Stability number & chart.	[6]
V	Sub surface structure: Bearing capacity of shallow foundations, SPT, Plate load test; Effect of water table. Deep foundations: Types of piles, Static and dynamic formulae, Negative skin friction.	[5]

Suggested Readings:

Text & Reference Books:

1. V.N.S. Murthy – Soil Mechanics and Foundation Engineering (Fifth Edition)
2. K.R. Arora – Soil Mechanics and Foundation Engineering
3. Narasinga Rao, B.N.D, "Soil Mechanics & Foundation Engineering", John Wiley & Sons.
4. Alam Singh – Modern Geotechnical Engineering
5. B.C. Punmia –Soil Mechanics and Foundation ,Laxmi Publication

E Learning links :

1. E-Learning Link https://nptel.ac.in/courses/105/105/105105168/

DESIGN OF CONCRETE STRUCTURES –I

Course Objectives:

The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course.

1. Understand the stress Strain behaviour of concrete and reinforced concrete.
2. Design various structural members as per LSM theory
3. To understand flexural /shear behaviour of beam, column and slab
4. To analyze the behaviour of axial loaded structure.
5. To analyze the members for serviceability.

Course Outcomes:

1. To calculate the basic material properties.
2. To learn the theories of design philosophies
3. To know the beam and slab design.
4. To design the axially loaded members.
5. To apply the serviceability check in various structure.

Module	Topics	No. of Lectures
I	Introduction to various Design Philosophies and assumptions in Limit State Design, Partial Safety factors, Characteristic load and strength. Stress block parameters, concept of balanced section, under reinforced and over reinforced section. Method of Rectangular Singly and Doubly Reinforced Sections. Design of Rectangular Singly and Doubly Reinforced beams, T-beams, Lbeams by Limit State Design Method.	[8]
II	Behaviour of RC beam in Shear, Shear Strength of beams with and without shear reinforcement, minimum and maximum shear reinforcement, design of beam in shear. Introduction to development length Anchorage bond, flexural bond. Failure of beam under shear, Concept of Equivalent Shear and Moments.	[8]
III	Design of one way, One way continuous and cantilever solid slabs by Limit State Design Method, Design of RCC staircases. Design of two way slabs by limit state method, Serviceability Limit States. Control of deflection, cracking and vibrations.	[10]
IV	Design of Columns by Limit State Design Method- Effective height of columns, Assumptions, Minimum eccentricity, Short column under axial compression, requirements for reinforcement, Column with helical reinforcement, Short column under axial load and uni-axial bending. Design of columns under bi-axial loading by Design Charts.	[8]
V	Structural behaviour of footings, Design of isolated footings, combined rectangular and trapezoidal footings by Limit State Method, Design of strap footings.	[8]

Suggested Readings:

Text & Reference Books:

1. Reinforced Concrete Design by S. U. Pillai & D. Menon, T.M.H., Publication
2. Reinforced Concrete -Limit State Design by A. K. Jain, Nem Chand & Bros., Roorkee.
3. Reinforced Concrete Vol. - II by H.J. Shah, Charotar Publisher, Gujarat.
4. RCC Designs (Reinforced Concrete Structures) by B.C. Punmia, Ashoka Kumar Jain and Arun Kumar Jain, Laxmi Publishers, New Delhi.
5. Reinforced Concrete Structures by R. Park and Paulay
6. Bureau of Indian Standard IS 456-2000

E Learning links :

1. https://nptel.ac.in/courses/105/105/105105105/

STRUCTURAL ANALYSIS-II

Course Objectives:

The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course.

1. To understand the concept of static and kinematic indeterminacy
2. To learn various method of analyzing indeterminate structures
3. To draw influence lines for indeterminate structure
4. To understand the concept of Plastic Analysis
5. To apply the concept of FEM.

Course Outcomes:

1. To learn the degree of freedom in structures.
2. To know the analysis of indeterminate structure
3. To draw the ILD of various structure
4. To learn plastic hinge application
5. Analyze the structure using FEM techniques.

Module	Topics	No. of Lectures
I	Analysis of fixed beams, Continuous beams and simple frames with and without translation of joint, method of Consistent Deformation, Slope Deflection method, Moment Distribution method.	[8]
II	Muller-Breslau's Principle and its applications for drawing influence lines for indeterminate beams, Analysis of two hinged arches, Influence line diagrams for maximum bending moment, Shear force and thrust.	[8]
III	Suspension Bridges, Analysis of cables with concentrated and continuous loadings, Basics of two and three hinged stiffening girders, Influence line diagrams for maximum bending moment and shear force for stiffening girders.	[8]
IV	Basics of Force and Displacement Matrix methods for beams, and frames.	[6]
V	Basics of Plastic Analysis, Applications of Static and Kinematic theorem for Plastic Analysis of Beams and Frames.	[5]

Suggested Readings:

Text & Reference Books:

1. Jain, A. K., Advanced Structural Analysis, Nem Chand & Bros., Roorkee.
2. Hibbeler, R.C. Structural Analysis", Pearson Prentice Hall, Sector 62, Noida-201309
3. C. S. Reddy "Structural Analysis", Tata Mc Graw Hill Publishing Company Limited,
4. Wang, C. K. " Intermediate Structural Analysis", TMH Book Publishing Company
5. ThundavaMoorthy, T.S., "Structural Analysis" Oxford University Press, New Delhi

E Learning links :

1. https://nptel.ac.in/courses/105/105/105105109/
2. https://nptel.ac.in/courses/105/106/105106050/

WASTE WATER ENGINEERING

Course Objectives:

The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course.

1. Understand various type of waste water
2. Design of waste water treatment plants
3. Various technique of designing treatment plant
4. To learn the disinfection techniques.

Course Outcomes:

1. To learn the types and parameters of waste water.
2. To know the physiochemical properties of waste
3. To lean the treatment process of various units
4. To learn the secondary treatment process.

Module	Topics	No. of Lectures
I	Introduction: Wastewater flow and its characteristics, Wastewater collection systems. Estimation and variation of wastewater flows. Problems of industrial wastewaters, Sampling, Preliminary, primary, secondary and tertiary waste water treatment processes. Theory and design of screens, grit chambers, sedimentation, coagulation, flocculation.	[8]
II	Physico-chemical and biological treatment strategies and their evaluation, Theory of activated sludge process (ASP), extended aeration systems, trickling filters (TF), aerated lagoons, stabilization ponds, oxidation ditches, sequential batch reactor, rotating biological contactor, etc., Mass balancing in ASP and TF and their design.	[8]
III	Anaerobic treatment process, Effects of pH, temperature and other parameters on anaerobic treatment, Concept of anaerobic contact process, anaerobic filter, anaerobic fixed film reactor, fluidized bed and expanded bed reactors and upflow anaerobic sludge blanket (UASB) reactor.	[8]
IV	Indian standards for disposal of treated wastewaters on land and in natural streams, Agricultural irrigation, Ground water recharge, Treated wastewater reclamation and reuse, Introduction to duckweed pond, vermiculture and root zone technology for wastewater treatment, Special treatments, Recent technologies of treatment.	[6]
V	Study on wastewater generation points, wastewater characteristics, process flow sheets, treatment scheme for tannery, sugar, textile, steel, distillery, paper/ pulp and oil refinery industry wastewater.	[5]

Suggested Readings:

Text & Reference Books:

1. Peavy, Howard S., Rowe, Donald R, George, "Environmental Engineering" McGraw Hill Education.
2. Garg, SK. Water Supply Engineering (Environmental Engineering Vol. – I)
3. Nathanson, Schneider, "Basic Environmental Technology Pollution Pearson Education.
4. Metcalf & Eddy, "Wastewater Engineering: Treatment & Reuse", Tata Mc-Graw Hill
5. Garg, S.K. "Environmental Engineering Vol. II (Sewage Disposal and Air Pollution Engineering)"
6. Rao, M.N. & Dutta, A.K. "Wastewater Treatment", Oxford & IBH Publishing.

E Learning links :

1. https://nptel.ac.in/courses/105/105/105105178/
2. https://nptel.ac.in/courses/105/106/105106119/

GEOTECIINICAL ENGINEERING LAB

NOTE: Student will have to perform any 8 out of the listed experiments below:

List of Experiments

1. Determination of water content of a given moist soil sample by (i) oven drying method, (ii) pycnometer method.
2. Determination of specific gravity of a given soil sample by (i) density bottle, (ii) pycnometer method.
3. Determination of in situ dry density of soil mass by (i) core-cutter method, (ii) sand replacement method.
4. Determination of relative density of a given soil sample.
5. Determination of complete grain size distribution of a given soil sample by sieve analysis and sedimentation (hydrometer) analysis.
6. Determination of consistency limits (liquid, plastic and shrinkage limits) of the soil sample used in experiment no. 5 (grain-size analysis).
7. Determination of shear strength of soil by Direct shear test.
8. Determination of compaction characteristics (OMC & MDD) of a given soil sample.
9. Determination of permeability of a remoulded soil sample by constant head &/or falling head method.
10. Determination of consolidation characteristics of a remoulded soil sample by an odometer test.
11. Determination of shear strength characteristics of a given soil sample by U/U test from Tri-axial Compression Machine.
12. Retrieving soil samples and conducting SPT tests by advancing boreholes through hand-held auger.

ENVIRONMENTAL ENGINEERING LAB

NOTE: Student will have to perform any 8 out of the listed experiments below:

List of Experiments

1. Determination of turbidity and conductivity.
2. Determination of pH, alkalinity and acidity.
3. Determination of hardness and chlorides.
4. Determination of residual chlorine.
5. Determination of MPN (Most Probable Number) of coliforms.
6. Measurement of SPM and PM10 with high volume sampler.
7. Measurement of sound level with sound level meter.
8. Determination of total , suspended and dissolved solids.
9. Determination of BOD.
10. Determination of COD.
11. Determination of kjeldahl nitrogen.
12. Determination of fluoride.
13. Determination of optimum dose of coagulants by Jar Test Apparatus.
14. Field Visit of Water/ Sewage Treatment Plant of a nearby area.

COMPUTER ADDED DESIGN LAB
NOTE: Student will have to perform the listed experiments below:
List of Experiments
1. Working on Latest Version of ANALYSIS SOFTWARE LIKE ANSYS , ADINA , NISA, MATLAB/AUTO CAD-3D 2. Working on Latest Version of DESIGN SOFTWARE LIKE STAAD PRO / STRUDS / SAP / ETAB / STRAP 3. Working on Latest Version of GEOTECHNICAL SOFTWARES like GEO-5 / PLAXIS

STRUCTURE ANALYSIS LAB
NOTE: Student will have to perform any 8 out of the listed experiments below:
List of Experiments
1. To determine Flexural Rigidity (EI) of a given beam 2. To verify Maxwell's Reciprocal theorem. 3. To find horizontal thrust in a three-hinged arch and to draw influence line diagrams for Horizontal Thrust end Bending moment 4. To find horizontal thrust in a two hinged arch and to draw influence line diagrams for horizontal Thrust and bending moment. 5. To find deflection of curved members. 6. To find bar forces in a three members structural frames with pin jointed bar 7. To find Critical load in Struts with different end conditions. 8. To find deflections in Beam having unsymmetrical bending

QUANTITY ESTIMATION AND MANAGEMENT LAB
NOTE: Student will have to perform any 8 out of the listed experiments below:
List of Experiments
1. Study of DSR, CPWD specifications and NBC. 2. Estimation of quantities for any one of the following: Building/ Septic tank/Water supply 3. pipe line/road/bridge. 4. Preparation of Bill of Quantities (BOQ) for above project. 5. Practice on open source project management software / MS Project/Primavera software for 6. same problem. 7. Study of any full set of tender documents (Institute shall provide the set from ongoing/ completed tenders).

DESIGN OF STEEL STRUCTURES

Course Objectives:

The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course.

1. Analysis and design of steel structure.
2. Design of bolted and welded connections.
3. Analysis and design of axially loaded tension member, axially loaded column,
4. Design of lacing and batten system, design of slab base foundation.

Course Outcomes:

1. To know the basic properties of steel and to understand the behaviour
2. To know the different steel structure analysis and design.
3. To know the design and analysis of angle sections, bolted & welded connection.
4. To understand concepts of strength and stiffness considerations.
5. Analyze, and design the riveted and bolted connections.

Module	Topics	No. of Lectures
I	Introduction, Advantages of Steel as a Structural Material, Disadvantages of Steel as a Structural Material, Structural Steel,Stress-Strain Curve for Mild Steel, Rolled Steel Sections, , Local Buckling of Plate Elements. Introduction, Limit States for Steel Design, Limit States of Strength, Limit States of Serviceability.	[8]
II	Bolted Connections, Types of Bolts, Failure of Bolted Joints, Specification for Bolted Joints,Bearing-Type Connections, Prying Action, Tensile Strength of Plate, Efficiency of the Joint, Design of eccentric bolted connections. Simple Welded Connections: Introduction, Symbols, Welding Process, Weld Defects, Inspection of Welds, Assumptions in the Analysis of Welded Joints, Welds, Design of Fillet Welds, Design of eccentric welded connections.	[8]
III	Introduction, Types of Tension Members, Net Sectional Area, Effective Net Area, Types of Failure, Design Strength of Tension Members, Slenderness Ratio (λ), Displacement, Design of Tension Member, Lug Angles, Splices, Gusset Plate, Working Load Design.	[8]
IV	Introduction, Effective Length, Slenderness Ratio (λ), Types of Sections, Types of Buckling, Classification of Cross Sections, Column Formula, Design Strength, Design of Axially Loaded Compression Members, Built-Up Columns(Latticed Columns), Lacing, Batten, Compression Member Composed of Two Components Back-to-Back,Splices,Design of Column Bases.	[6]
V	Behaviour of Beam in Flexure, Section Classification, Lateral Stability of Beams, Lateral-Torsional Buckling, Bending Strength of Beams, Laterally Supported Beams, Laterally Unsupported Beams, Web Buckling, Bearing Strength, Web Crippling, Deflection, Design Procedure of Rolled Beams Bearing Plates, Effect of Holes in Beam, Introduction to Plate Girder, Introduction to Gantry Girder	[5]

Suggested Readings:

Text & Reference Books:

1. Design of Steel Structures by N.Subramanian, Oxford UniversityPress
2. Limit State Design Design of Steel Structures by KSSairam, Pearson Education
3. Design of Steel Structures by SRamamurtham, Dhanpat Rai PublishingCompany
4. Design of Steel Structures by S.K. Duggal,Tata MegrawHill.
5. Steel Structures by Robert Englekirk, HohnWiley & sonsinc.
7. Design of steel structures by WillamT Segui,CENGAGE Learning
8. Structural Steel Design By DMacLaughlin,CENGAGELearning

E Learning links :

1. https://nptel.ac.in/courses/105105162/

DESIGN OF CONCRETE STRUCTURES-II

Course Objectives:

The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course.

1. Understand and design Flat slab
2. Understand various components of retaining wall and design it
3. Learn the design of liquids retaining structure
4. Understand the concept of prestress

Course outcomes:

1. To learn the design of flat slab.
2. To know the forces acting on retaining wall .
3. To lean the design of various liquid retaining structure.
4. To learn the process off pre stressing.

Module	Topics	No. of Lectures
I	Flat slab: nature of stresses in flat slab with or without drop, coefficients for design of flat slab, Reinforcement in flat slab (IS Code Method).	[8]
II	Structural behaviour of retaining wall, stability of retaining wall against overturning and sliding, Design of cantilever retaining wall by Limit State Method, Concept of counterfort Retaining wall	[8]
III	Introduction, Design Philosophy, Type of Tanks, Components of Tank,Design & detailing of Underground Rectangular and Circular Water Tank	[8]
IV	Design & Detailing of Elevated circular & rectangular RC water tanks., Design & Detailing Intz Tank	[8]
V	Prestressing: Advantage of pre-stressing, Methods of pre-stressing, Losses in pre-stress, Analysis of simple prestressed rectangular section.	[8]

Suggested Readings:

Text & Reference Books:

1. Reinforced Concrete Design by S. U. Pillai & D. Menon, T.M.H., Publication
2. Reinforced Concrete -Limit State Design by A. K. Jain, Nem Chand & Bros., Roorkee.
3. Reinforced Concrete Vol. - II by H.J. Shah, Charotar Publisher, Gujarat.
4. RCC Designs (Reinforced Concrete Structures) by B.C. Punmia, Ashoka Kumar Jain and Arun Kumar Jain, Laxmi Publishers, New Delhi.
5. Reinforced Concrete Structures by R. Park and Pauley.
6. Bureau of Indian Standard IS 456-2000
7. Reinforced Concrete Structures by R. Park and Pauley.

E Learning links :

1. https://nptel.ac.in/courses/105/105/105105105/

INTEGRATED WASTE MANAGEMENT

Course Objectives:

The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course.

1. To understand the fundamental and municipal solid waste manage management systems
2. To apply various disposal methods of solid waste
3. Clear idea about management and disposal of demolition waste
4. Develop criteria to classify E waste

Course Outcomes:

1. To know about the classification of waste.
2. To know the disposal of various waste .
3. To learn the demolition waste and disposal.
4. To learn the E waste and their disposal.

Module	Topics	No. of Lectures
I	Introduction: Solid Waste Management- Definition, Concept of 4Rs (reduce, reuse, recycle and recover) of waste management, Elements and Issuesof a waste management system, Integrated Waste Management Hierarchy. Waste-to-Energy and Land filling. Review of waste management under Swachh Bharat Mission and Smart Cities Program.	[6]
II	Municipal Solid Waste: Waste Composition and Quantities, Collection Transportation, Segregation, and Processing.	[8]
III	Disposal of Municipal Solid Waste: Landfill, Biochemical Processes and Composting, Energy Recovery from Municipal Solid Waste. Municipal Solid Waste (MSW) Rules 2016	[6]
IV	Construction and Demolition (C&D) Waste Management: Overview, Components; C&D Waste Management Rules 2016, Beneficial Reuse of C & D Waste Materials	[6]
V	Electronic Waste (E-Waste) Management – Issues and Status in India and Globally, E-Waste Management Rules 2016 and Management Challenges.Hazardous Wastes: Definition, Classification, Risk assessment, Transportation of hazardous waste. Current Management Practices: Environmental audit, Containment, Remedial alternatives.	[6]

Suggested Readings:

Text & Reference Books:

1. George Tchobanoglous, Hilary Theisen and Samuel A Vigil, Integrated Solid Waste management, Tata McGraw Hill
2. Ramachandra T.V., Management of Municipal Solid Waste, 2009; by The Energy and Resource Institute, TERI
3. Sasikumar, K, Gopi Krishna, Sanoop, Solid Waste Management; 2009, PHI.
4. Manual on Solid Waste Management, prepared by The Central Public Health and Environmental Engineering Organization(CPHEEO), India
5. Construction and Demolition Waste Management Rules, 2016, MoEF&CC

E Learning links :

1. https://nptel.ac.in/courses/105/105/105105160/

TRANSPORTATION ENGINEERING

Course Objectives:

The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course.

1. Understand the principles and practices in transportation Engineering
2. To learn transportation planning and land use planning, economics, and master plan.
3. Identify and solve transportation problems.
4. To learn the design process of curves and signals
5. To learn the design of flexible and rigid pavements

Course Outcomes:

1. To learn types of roads.
2. To analyze the problems of SSD and OSD .
3. To learn the design of signals.
4. To learn the application of road design.

Module	Topics	No. of Lectures
I	Introduction: Role of Transportation, Modes of Transportation History of road development, Road types and pattern, Nagpur road plan, Bombay road plan & 3rd 20 Year Road Plan, Factors Controlling the alignment, Survey for route ocation.	[6]
II	Geometric Design (IRC:73-Latest revision): Cross sectional elements, camber, shoulder, sight distance, horizontal curves, super elevation, extra widening, transition curves and gradient, vertical curves, summit and valley curves.	[8]
III	Traffic Engineering. Traffic Characteristics, Traffic studies on flow, speed, travel time - delay and O-D study, PCU, peak hour factor, parking study, accident study and analysis, traffic capacity, density, traffic control devices: signs, Island, signal design by Webster's and IRC method . Intersection at grade and grade separated intersections.	[6]
IV	Highway Materials: Properties of Subgrade, Aggregates & Binding materials, Various tests and specifications, Design of Highway Pavement : Types of Pavements, Design factors, Design of bituminous paving mixes; Design of Flexible Pavement by CBR method (IRC : 37- Latest revision), Design of rigid pavement, Westergaard theory, load and temperature stresses, joints, IRC method of rigid pavement design (IRC:58-2015)	[6]
V	Highway Construction: Construction of Subgrade, Water Bound Macadam (WBM), Wet mix macadam (WMM), Granular Sub Base (GSB),Tack Coat, Prime Coat, Seal Coat, Surface Dressing, Bituminous Macadam (BM), Semi dense bituminous concrete (SDBC) and Bituminous concrete, Dry lean concrete (DLC), Cement Concrete (CC) road construction, Roller Compacted Concrete Roads	[6]

Suggested Readings:

Text & Reference Books:

1. Khanna S. K., Justo C.E.G, &Veeraragavan, A. "Highway Engineering", Nem Chand and Bros., Roorkee.
2. Khanna S. K., Justo C.E.G, &Veeraragavan A., "Highway Materials andPavement Testing", Nem Chand and Bros., Roorkee
3. I.R Kadiyali, Transportation Engineering, Khanna Publication

E Learning links :

1. https://nptel.ac.in/courses/105/101/105101087/
2. https://nptel.ac.in/courses/105/105/105105107/

TRANSPORTATION ENGINEERING LAB

NOTE: Student will have to perform any 8 out of the listed experiments below:

List of Experiments

1. To Determine the Crushing Value of Coarse Aggregates.
2. To Determine the Impact Value of Coarse Aggregates.
3. To determine the Flakiness Index and Elongation Index of Coarse Aggregates.
4. To determine the Los Angeles Abrasion Value of Coarse Aggregates.
5. To determine the Stripping Value of Coarse Aggregates.
6. To determine the penetration Value of Bitumen.
7. To determine the Softening Point of Bituminous material.
8. To determine the Ductility Value of Bituminous material.
9. To determine the Flash and Fire Point of Bituminous material

STAAD LAB
NOTE: Student will have tc perform the listed experiments below:
List of Experiments
1. Working on Latest Version of ANALYSIS SOFTWARE LIKE ANSYS , ADINA , NISA, MATLAB/AUTO CAD-3D 2. Working on Latest Version of DESIGN SOFTWARE LIKE STAAD PRO / STRUDS / SAP / ETAB / STRAP 3. Working on Latest Version of GEOTECHNICAL SOFTWARES like GEO-5 / PLAXIS

B.Tech (Civil Engineering- IV Year)

INSTITUTE OF ENGINEERING AND TECHNOLOGY

DR.R.M.L AVADH UNIVERSITY

AYODHYA

EVALUATION SCHEME & SYLLABUS

FOR

B.TECH (CIVILENGINEERING)

FOURTH YEAR

ON

CHOICE BASED CREDIT SYSTEM

(CBCS)

[Effective from the Session: 2023-2024]

B.Tech (Civil Engineering- IV Year)

Semester-VII

S No	Course Code	Course Title	PERIODS			Evaluation Scheme				Subject Total	Credit
			L	T	P	Sessional Exam			ESE		
						CT	TA	Total			
1	CEC-701	Design of Steel Structures	3	1	0	30	20	50	100	150	4
2	CEC-702	Water Resource Engineering	3	1	0	30	20	50	100	150	4
3		Department Elective-IV	3	1	0	30	20	50	100	150	4
4		Department Elective-V	3	1	0	30	20	50	100	150	4
PRACTICAL/DESIGN/DRAWING											
5	CLC-751	Nondestructive Testing Lab	0	0	2		-	25	25	100	1
6	CLC-752	Industrial Training**					-	50	-	50	1
7		Seminar	0	0	2		-	50	-	50	1
8	CLC-753	Mini Project#	0	0	6		-	200	-	200	4
		Total								950	22

** 4 weeks Industrial Training.

Project should be initiated in VII semester beginning and should be completed by the end of VIII semester.

B.Tech (Civil Engineering- IV Year)

Semester-VIII

S No	Course Code	Course Title	PERIODS			Evaluation Scheme				Subject Total	Credit
			L	T	P	Sessional Exam			ESE		
						CT	TA	Total			
1	CEC-801	Construction Technology and Management	3	1	0	30	20	50	100	150	4
2	CEC-802	Departmental Elective-VI	3	1	0	30	20	50	100	150	4
3	-	Department Elective-IV	3	1	0	30	20	50	100	150	4
PRACTICAL/DESIGN/DRAWING											
4	CLC-854	Project	0	0	12			150	300	450	12
		Total								950	24

B.Tech (Civil Engineering- IV Year)

WATER RESOURCE ENGINEERING

Course Objectives:

The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course

1. Understand the concept of hydrological cycle, mechanism of precipitation, evapotranspiration, and infiltration.
2. Measure and compute serial rainfall and intensity-duration curve. Estimate floods using rational, empirical unit hydrograph and flood frequency analysis.
3. Estimate water requirements of crops and storage capacity of reservoir.
4. Design of unlined channel of silt theories.
5. Different methods to determine suspended loads and bed load.
6. To know different River training methods.

Course Outcomes:

Understand the interaction among various processes in the hydrologic cycle.

1. Design of water management systems utilizing the basic principles of the hydrologic cycle.
2. Apply knowledge for efficient design methods for rapid conveyance of water with lesser loss in irrigation canals.
3. To demonstrate a knowledge of the multi-disciplinary nature of water resources engineering.
4. Realize the importance of optimal water use for growing the crops, and apply methods for saving land from water-logging.
5. To demonstrate technique involved in making design problems of canal and related structures to be safe and cost-effective.
6. Apply the knowledge in the design of hydraulic structures to be constructed for conveyance of irrigation water

Unit	Topics	No. of Lectures
I	Irrigation: Necessity and types, Advantages & disadvantages of irrigation; water resources of India, need of irrigation in India, development of irrigation in India, impact of irrigation on human environment, Methods of Irrigation, Hydrology: Hydrological Cycle and its components; Water Budget Equation, Precipitation: Types, measurements and analysis, Evaporation and consumptive use: estimation and measurement techniques	8
II	Water requirement of crops: Crops and crop seasons in India, cropping pattern; Quality of irrigation water: Soil-water relationships- soil characteristics significant from irrigation considerations, root-zone soil water, infiltration, consumptive use, irrigation requirement, frequency of irrigation; duty and delta. Methods of applying water to the fields: surface, sub-surface, sprinkler and drip irrigation types and its design and drawing.	8
III	Canals : Distribution systems for canal irrigation, canal capacity, canal	8

	losses, alignment of main and distributary canals, Design of canal by Kennedy's and Lacey's theory, Waterlogging and its prevention. Lining of Irrigation Canals: Advantages and types; factors for selection of a particular type, design of lined channels, cross-section of lined channels, Economics of canal lining.	
IV	Regulation Works: Falls, Classification; Introduction to design principle of falls, Design of Sarda type and straight glacis tall. Cross drainage works: Necessity and types; Aqueduct, Siphon Aqueduct, super passage, canal siphon, level crossing.	8
V	Types of dams, design principles of gravity and earth dams, stability analysis. Spillways: Spillway types energy dissipation. Principle and design of distributary head regulator and cross regulator, canal escape, Bed bars plants, important terms, types of turbines and their suitability; Power House layout and important structures of a powerhouse.	8

Suggested Readings:

Text Books:

1. Water Resources Engg. By Larry W Mays, John Wiley India
2. Water resources Engg. By Wurbs and James, John Wiley India
3. Water Resources Engg. By R. K. Linsley, Mc Graw Hill
4. Irrigation and Water Resources Engg. By G. L Asawa, New age International Publishers
5. Irrigation Engg. And Hydraulic Structures by S. K. Garg, Khanna Publishers.

References Books:

1. Fundamental of Hydraulic Engineering System by Houghalen, Pearson Publication.
2. Irrigation and water Power engineering by B. C. Punmia, Laxmi Publications.
3. Engineering Hydrology by K. Subramanya, TMH.
4. Irrigation Water Power and Water Resource Engg. By K. R. Arora.
5. Water resource engineering by Ralph A. Wurbs & Wesley P. James, Pearson Publication

E-Learning Link:

1. https://nptel.ac.in/courses/105105110/

B.Tech (Civil Engineering- IV Year)

DESIGN OF STEEL STRUCTURES

Course Objectives:

The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course

1. Analysis and design of steel structure.
2. Design of bolted and welded connections
3. Analysis and design of axially loaded tension member, axially loaded column, design of lacing and batten system, design of slab base foundation.

Course Outcomes:

1. To know the basic properties of steel and to understand the behaviour according to it.
2. To know the different steel structure analysis and design.
3. To know the design and analysis of angle sections, bolted & welded connection.
4. Design of steel structures according to IS-800-2007 by limit state method.
5. To understand concepts of strength and stiffness considerations.
6. Analyze, and design the riveted and bolted connections.

Unit	Topics	No. of Lectures
I	Introduction, Advantages of Steel as a Structural Material, Disadvantages of Steel as a Structural Material, Structural Steel, Stress-Strain Curve for Mild Steel, Rolled Steel Sections, Convention for Member Axes, Loads, Dead Load, Live Loads, Design Philosophies, Local Buckling of Plate Elements. Introduction to Limit State Design, Plastic analysis of structure. Introduction, Limit States for Steel Design, Limit States of Strength, Limit States of Serviceability, Actions (Loads), Probabilistic Basis for Design.	8
II	Introduction; Riveted Connections, Patterns of Riveted Joints, Bolted Connections, Types of Bolts, Types of Bolted Joints, Load Transfer Mechanism, Failure of Bolted Joints, Specification for Bolted Joints, Bearing-Type Connections, Prying Action, Tensile Strength of Plate, Efficiency of the Joint, Combined Shear and Tension Design of eccentric bolted connections. Simple Welded Connections Introduction, Types, Symbols, Welding Process, Weld Defects, Inspection of Welds, Assumptions in the Analysis of Welded Joints, Design of Groove Welds, Design of Fillet Welds, Fillet Weld Applied to the Edge of A Plate Or Section, Fillet Weld for Truss Members, Design of Intermittent Fillet Welds, Plug and Slot Welds, Design of eccentric welded connections.	8
III	Tension Members Introduction, Types of Tension Members, Net Sectional Area, Effective Net Area, Types of Failure, Design Strength of Tension Members, Slenderness Ratio (λ), Displacement, Design of Tension Member, Lug	8

	Angles, Splices, Gusset Plate, Working Load Design.	
IV	Compression Members Introduction, Effective Length, Slenderness Ratio (λ), Types of Sections, Types of Buckling, Classification of Cross Sections, Column Formula, Design Strength, Design of Axially Loaded Compression Members, Built-Up Columns (Latticed Columns), Lacing, Batten, Compression Member Composed of Two Components Back-to-Back, Splices, Design of Column Bases.	8
V	Beams Introduction, Types of Sections, Behaviour of Beam in Flexure, Section Classification, Lateral Stability of Beams, Lateral-Torsional Buckling, Bending Strength of Beams, Laterally Supported Beams, Laterally Unsupported Beams, Shear Strength of Beams, Web Buckling, Bearing Strength, Web Crippling, Deflection, Design Procedure of Rolled Beams, Built-Up Beams (Plated Beams), Purlins, Beam Bearing Plates, Effect of Holes in Beam, Introduction to Plate Girder, Introduction to Gantry Girder.	8

Suggested Readings:

Text Books:

1. Design of Steel Structures by N.Subramanian, Oxford University Press
2. Limit State Design Design of Steel Structures by KS Sairam, Pearson Education
3. Design of Steel Structures by S Ramamurtham, Dhanpat Rai Publishing Company
4. Design of Steel Structures by S. K. Duggal, Tata Mcgraw Hill.

Reference Books

1. Steel Structures by Robert Englekirk, Holm Wiley & sonsinc.
2. Structural Steel Design by Lambert tall (Ronald Press Comp. New york.
3. Design of steel structures by Willam T Segui, CENGAGE Learning
4. Structural Steel Design by D Mac Laughlin, CENGAGE Learning

E-Learning Link

1. https://nptel.ac.in/courses/105105162/

B.Tech (Civil Engineering- IV Year)

NON DESTRUCTIVE TESTING LABORATORY
NOTE: Student will have to perform minimum 3 test on concrete & two test on structural steel .
Experiments
1. Non Destructive testing of reinforced cement concrete (a) Strength assessment using rebound hammer (b) Quality assessment using ultrasonic pulse velocity test (c) Strength assessment using pullout method (d) Assessmentofcorrosionofreinforcingbarsusinghalfcellpotentiometer (e) To determine thickness of concrete cover, diameter & spacing of reinforcing bars using rebar scanner.
2. Testing of structural steel (a) Testing for corrosion of structural steel (b) Assessment of thickness of pipes/tubes/structural steel (c) Test for welding performance with Di-penetration test, ultrasonic test & magnetic particle test.

B.Tech (Civil Engineering- IV Year)

CONSTRUCTION TECHNOLOGY & MANAGEMENT

Course Objectives:

This course aims at the following educational objectives: To plan Bar Chart, CPM chart, PERT chart material requirement schedule, Manpower schedule, Machinery Schedule, Construction Management, to analyze, evaluate and design construction contract documents.

Course Outcomes:

The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand the use of advanced materials in construction projects
2. Plan and develop management solutions to construction projects.
3. Evaluate construction project economics, cost-benefit analysis and breakeven analysis.
4. Understand the principles of project management, resource management and inventory

Unit	Topics	No. of Lectures
I	Elements of Management: Project cycle, Organisation, planning, scheduling monitoring updating and management system in construction.	8
II	Network Techniques: Bar charts, milestone charts, work break down structure and preparation of networks. Application of network techniques like PERT, GERT, CPM AON and AOA in construction management. Project monitoring, cost planning, resource allocation through network techniques. Line of balance technique.	8
III	Engineering Economics: Time value of money, Present economy studies, Equivalence concept, financing of projects, economic comparison present worth method Equivalent annual cost method, discounted cash flow method, analytical criteria for postponing of investment retirement and replacement of asset. Depreciation and breakeven cost analysis.	8
IV	Contract Management: Legal aspects of contraction, laws related to contracts, land acquisition, labour safety and welfare, Different types of contracts, their relative advantages and disadvantages. Elements of tender preparation, process of tendering pre-qualification of contracts, Evaluation of tenders, contract negotiation and award of work, monitoring of contract extra items, settlements of disputes, arbitration and commissioning of project.	8
V	Equipment Management: Productivity, operational cost, owning and hiring cost and the work motion study. Simulation techniques for resource scheduling. Construction equipment for earth moving Hauling equipment, Hoisting equipment, Conveying equipment, Concrete Production equipment	8

Suggested Readings:

Text and Reference Books:

1. Construction Planning, Equipment and Methods: R. L. Peurify ,T.M.H., International Book Company.
2. PERT & CPM Principles and Applications L. S. Srinath, E.W.P. Ltd., New Delhi.
3. Network Analysis Techniques S. K. Bhatnagar, Willey Eastern Ltd.
4. Construction Technology by Sarkar, Oxford
5. Construction Project Management by K K Chitkara, McGraw Hill Publication.
6. Construction Management and Planning by Sengupta and Guha, McGraw Hill Publication

E Learning Link:

1. https://nptel.ac.in/courses/105103093/

DEPARTMENTAL ELECTIVES

S.NO	SUBJECT	SUBJECT CODE
1.	Ground Improvement Techniques	DCE 001
2.	Environmental Geotechnology	DCE 002
3.	AdvancedFoundationEngineering	DCE 003
4.	PrestressedConcrete	DCE 004
5.	Bridge Engineering	DCE 005
6.	Groundwater Hydrology	DCE 006
7.	Water Resources systems, Analysis, Planning & Management	DCE 007
8.	Remote Sensing and GIS	DCE 008
9.	Ecology & Environmental Impact Assessment	DCE 009
10.	Water Distribution and Wastewater Collection System Design	DCE 010
11.	Air and Water Quality Modelling	DCE 011
12.	Environmental Planning and Management	DCE 012
13.	Industrial Pollution Control	DCE 013
14.	Advanced Environmental Biotechnology	DCE 014
15.	Management of Water Resources	DCE 015
16.	Geo-environmental Engineering	DCE 016
17.	Engineering Behavior of Soil	DCE 017
18.	Analysis of Transportation System	DCE 018
19.	Transportation Environment Interaction	DCE 019
20.	Rehabilitation, Reconstruction and Recovery	DCE 020
21.	Disaster Resilient Structures and Retrofitting	DCE 021

Civil Engineering Departmental Elective

22.	Disaster Response and Preparedness	DCE 022
23.	Disasters and Special Structure	DCE 023
24.	Man-made and Biological Disasters-Detection and Mitigation	DCE 024
25.	Hydroinformatics	DCE 025
26	Zero Energy Buildings	DCE 026
27.	Carbon Audit and Management	DCE 027
28.	Energy Generation from Waste	DCE 028
29.	Ocean Renewable Energy	DCE 029
30.	Zero Emission Vehicles	DCE 030
31.	Safety in Engineering Industry	DCE 031
32.	TQM & TPM	DCE 032
33.	Global Disaster Scenario and Type of Natural Disaster	DCE 033
34.	Green Building & Energy Management	DCE 034
35.	Automation in Construction Industry	DCE 035
36.	Construction Techniques of Deep Foundations	DCE 036
37.	Construction Techniques of Steel and Concrete Composite Structures	DCE 037
38.	Estimating Tendering & Bidding	DCE 038
39.	Formwork for Concrete Structure	DCE 039
40.	Construction Economics	DCE 040
41.	Infrastructure Valuation	DCE 041
42.	Structural Masonary	DCE 042
43.	Engineering Geology	DCE 043
44.	Environmental Sciences	DCE 044
45.	Cyber Security	DCE 045

GROUND IMPROVEMENT TECHNIQUES

Course Contents:

Module 1: Introduction: Need of Ground Improvement: Different methods of Ground improvement, General Principal of Compaction: Mechanics, field procedure, quality control in field.

Module 2: Ground Improvement in Granular Soil: In place densification by (i) Vibrofloaration (ii) Compaction pile (iii) Vibro Compaction Piles (iv) Dynamic Compaction (v) Blasting

Module 3: Ground Improvement in Cohesive Soil: Compressibility, vertical and radial consolidation, preloading methods. Types of Drains, Design of vertical Drains, construction techniques. Stone Column: Function Design principles, load carrying capacity, construction techniques, settlement of stone column foundation.

Module 4: Ground Improvement by Grouting and Soil Reinforcement: Grouting in soil, types of grout,desirable characteristics, grouting pressure, grouting methods. Soil Reinforcement: Mechanism, Types of reinforcing elements, reinforcement-soil interaction, Reinforcement of soil beneath the roads, foundation. Geosynthetics and their application.

Module 5: Soil Stabilization: Lime stabilization-Base exchange mechanism, Pozzolanic reaction, lime-soil interaction, line columns, Design of Foundation on lime columns. Cement stabilization: Mechanism, amount, age and curing. Fly-ash - Lime Stabilization, Soil Bitumen Stabilization.

Text Books:

1. R. M. Korner, *Design with Geosynthetics*, Prentice Hall, New Jersy, 3rd Edn. 2002
2. P. Purushothama Raj, *Ground Improvement Techniques*, Tata McGrawHill, New Delhi, 1995.
3. Dr. B.C.Chattopadhyay and J.Maity, *Ground Control and Improvement Techniques*, PEEDOT, Howrah, 2011.
4. G. V. Rao and G. V. S. Rao, *Text Book On Engineering with Geotextiles*, Tata McGraw Hill
5. T. S. Ingold and K. S. Miller, *Geotextile Hand Book*, Thomas Telfrod, London
6. N. V. Nayak, *Foundation Design Manual*, Dhanpat Rai and Sons, Delhi.
7. M.P.Moasley, *Ground Improvement Techniques*

ENVIRONMENTAL GEOTECHNOLOGY

Course Contents:

Module 1: Soil and ground water pollutants - their sources, nature, composition and polluting effects. The physico-chemical aspects of soils contaminated by various pollutants. Effects of environment and wastes on the properties of soils.

Module 2: Solid and liquid wastes disposal method and management. land treatment systems.

Module 3: Man made changes in geotechnical environment - mining, embankments, pumping, reservoir, land fills and reclamation effects and control.

Module 4: Control of contamination with use of clay barriers, geosynthetics, cut-off walls, leachate collection systems.

Module 5: Stabilization - different materials and techniques in control of ground pollution and treatment.

References:

1. Lakshmi N. Reddy, Hilary. I. Inyang – *Geo-Environmental Engineering – Principles and Applications* – Makcel Dekker
Ink, 2000
2. D.E.Daniel, *Geotechnical Practice for Waste Disposal*, Chaman & Hall, London.

ADVANCEDFOUNDATIONENGINEERING

A. DETAILEDSYLLABUS

- Planningofsubsoilexplorationofmajorcivilengineeringprojects,derivingcharacteristicstrengthdeformationparametersfromsoilexplorationreport,
- Calculationofsafebearingcapacityforvari-ous soil types from shear as well as settlement criteria, pull out resistance of foundations, extrap-olationofplateloadtestandpileloadtests.
- Proportioningofisolatedfootings,combinedfootings,raft,floatingfoundationsfordifferentload combinations,
- Design of pile foundation for axial load – compression and pull out, lateral loads, negative skinfriction,groupactioninpiles,designofpilecap
- Foundationsforwatertanks, chimney, and transmissionlinetowers,antennaetc
- Freeand fixedcantilevered sheet pilewalls,anchoredbulkheads

PREREQUISITES/SELF-STUDY:

- Methodsofdrilling/boringand sampling.
- FieldTestProceduresasperISCode:SPT, SCPT,PlateLoadTest, PileLoadTest
- LaboratoryTestProceduresasperISCode:ClassificationTests,ShearTests,ConsolidationTest, SwellTests,
- BearingCapacityasperIS6403forShallowFoundations,SettlementCalculationsforSandandClaysoils as perIS8009.

B. RECOMMENDEDTEXT/REFERENCEBOOKS

1. Analysisand designoffoundation -J.E.Bowles
2. Soilmechanics& foundationengg.vol-II -V.N.S.Murthy
3. PrinciplesoffoundationEngg. -BrajM.Das
4. FoundationEngineering - M.J.Tomlinson
5. AnalysisandDesignofSubstructures -SwamiSaran
6. FoundationDesign–Coduto
7. Design Aids in Soil Mecahnics and Foundation Engg. - Kaniraj8. SP36,pt1and2,IS6403,IS8009pt.1,IS2911(all),

Civil Engineering Departmental Elective

THEORYOFTHINPLATESANDSHELLS

A. DETAILEDSYLLABUS

Thin plate: small deflection theory, plate equation. Applications of Navier's solution, Levy's solution,tables & charts for solution of rectangular and circular plates, use for rectangular water tanks withdifferentboundaryconditions.

Shell behaviour, shell surfaces and characteristics, classification of shells equilibrium equations incurvilinear co-ordinates. Stress-strain & force displacement relations. Membrane analysis of shells ofrevolutionandcylindricalshells underdifferentloads.
Applications of membrane solution of elliptic paraboloids and hyperboloids. Solution of some typicalproblems.

B. RECOMMENDEDTEXT/REFERENCEBOOKS

1. TheoryofPlatesandshells -S.P.TimoshenkoandWoinowsky-Krieger
2. Designofcylindricalshellroofs - W.T.Marshall
3. Design&constructionofconcreteshellroofs - Ramaswamy, G. S.4

ATextBookofPlateAnalysis -BairagiN.K.

5. ShellAnalysis -BairagiN.K.
6. TheoryandAnalysisofPlates:Classicaland NumericalMethods-SzilardR.

Civil Engineering Departmental Elective

THEORYOFSTRUCTURALSTABILITY

A. DETAILED SYLLABUS

- Criteria for Design of Structures: Stability, Strength, and Stiffness, Classical Concept of Stability of Discrete and Continuous Systems, Linear and nonlinear behaviour.
- Stability of Columns: Axial and Flexural Buckling, Lateral Bracing of Columns, Combined Axial, Flexural and Torsion Buckling.
- Stability of Frames: Member Buckling versus Global Buckling, Slenderness Ratio of frame members.
- Stability of Beams: Lateral torsional buckling.
- Stability of Plates: Axial flexural buckling, Shear flexural buckling, buckling under combined loads.
- Introduction to Inelastic Buckling and Dynamic Stability.

B. RECOMMENDED TEXT / REFERENCE BOOKS

1. Theory of elastic stability - Timoshenko and Gere,
2. Principles of Structural Stability Theory - Alexander Chajes
3. Structural Stability of columns and plates - Iyengar, N. G. R. 4 Strength of Metal Structures - Bleich F. Bucking

PRESTRESSEDCONCRETE

A. DETAILEDSYLLABUS

Prestressing concepts, materials, systems of prestressing and losses. Introduction to working stressmethod, limit state analysis and design of members for bending. Shear torsion and forces. End blockdesign. Deflections,useofrelevantcodesofpractice.

B. RECOMMENDEDTEXT/REFERENCEBOOKS

1. DesignofPrestressedConcreteStructures–KrishnaRaju
LimitStateDesignofPrestressedConcreteStructures–Mallick &Gupta

B.Tech Civil Engineering Departmental Elective

BRIDGEENGINEERING

A. DETAILEDSYLLABUS

- LoadingStandards.
- DesignofBalancedCantilever Bridge.
- DesignofBowStringGirderBridge.
- Design of prestressed concrete girder and box girder bridges considering only primary tor-sion.Designofendblock.
- BridgeBearing:TypesofBearings, Elastomericbearing.
- Piers,Abutments,Wingwallsfactorseffectingandstability.Wellfoundations.Designofwell, Construction, opensinkingofwalls, Plugging,sandfillingandcastingofwellcap.

B. RECOMMENDEDTEXT/REFERENCEBOOKS

1. ConcreteBridgespractice Analysis.Design&Economics-V.K.Raina
2. DesignofConcrete Bridges-Vazirani, RatwaniandAswani

B.Tech Civil Engineering Departmental Elective

GROUNDWATER HYDROLOGY

Course Objectives:

1. To introduce the basic theory and computational techniques for modeling multiphase flow in subsurface porous media

2. To describe and investigate porous media, together with relevant single and multi-phase transport phenomena.

3. To focused on the achievement of a clear and rigorous understanding of the fundamental properties,

4. Concepts and theories which are of importance in treating storage and multiphase fluid flow in sub-surface porous media.

Course Content:

Unit-1

Occurrence and movement of ground water, Surface and subsurface investigation of ground water, Flow through saturated porous medium.

Unit-2

Mechanics of well flow, Aquifer parameters, Pumping tests, Design of water wells, Monitoring well design and construction, Well development, Well maintenance and rehabilitation, Natural and artificial recharge of ground water,

Unit-3

Salt water intrusion, Ghyben-Herzberg interface, shape of the fresh-salt water interface, upconing of saline water, control of saline water intrusion, recognition of seawater in ground water.

Unit-4 Ground water pollution in relation to water use, attenuation of pollution, distribution of pollution underground, evaluation of pollution potential, monitoring groundwater quality.

Unit-5 Management of ground water, technical procedures of basin managements, planning ground water investigations, water budget of ground water basins, Analytical methods; Introduction to analog and numerical models to solve ground water problems, Application of finite difference method in ground water.

References:

1. Bear, J., Dynamics of Fluids in porous Media, Dover Publications, 1972.

2. Fetter, C.W., Contaminant Hydrogeology, Prentice Hall, 1999.

3. Bear, J. and Verruijt. A., Modeling Groundwater Flow and Pollution, Reidel Publishing Company, 1990

4. Fetter, C.W., Applied Geohydrology, Prentice Hall, 2001.

Course Outcomes (Cos):

1. The students will be able to understand the occurrence and movement of ground water.

2. The students will be able to understand the surface and subsurface investigation of ground water, Flow through saturated porous medium

3. The students will be able to understand the mechanics of well flow, Aquifer parameters. Pumping tests.

4. The students will be able to understand the design of water wells, monitoring well design and construction, well development, well maintenance and rehabilitation

5. The students will be able to understand the natural and artificial recharge of ground water, Salt water intrusion

6. The students will be able to understand the introduction to analog and numerical models to solve ground water problems, Application of finite difference method in ground water.

B.Tech Civil Engineering Departmental Elective

WATER RESOURCES SYSTEM ANALYSIS, PLANNING & MANAGEMENT

Course Objectives:

1. To impart knowledge about the planning and management of water resources.

2. To introduce the concepts of watershed management, integrated water resources management, environmental interaction of water resources and policies/framework related to water resources.

3. To enable the students to understand the different components of water resources and their management.

Course Content:

Unit-1

Basic concepts of systems need for systems approach in water resources, system design techniques, problem formulation, modeling of water resource system

Unit-2

Optimization techniques, LP, NLP, dynamic programming, multi-objective optimization, stochastic optintization.

Unit-3

Simulation, reservoir operation problems, case studies; planning, role of a planner, sensitivity analysis, performance measures

Unit-4

National water policies, public involvement, social impact, economic analysis.

Unit-5

Water resources system modelling, river basin planning and management, water distribution system, ground water system, water quality modelling, floodplain management, urban storm water management; Fuzzy optimization, genetic algorithm, multi criteria decision making, decision support system, expert systems.

References:

1. Loucks, D.P., Stedinger, P.J.R., Haith, D.A., "Water Resources Systems Planning and Management", Prentice Hall, New Jersy, 1987.

2. Hall, K., A and Draoup, J.A., Water Resources Systems Engineering, Tata McGraw Hill, 1970.

3. Neil, G.S., Water Resources Planning, McGraw Hill, 1985.

4. National Water Policy, Ministry of Water Resources, Government of India, 1987.

Course Outcomes (Cos):

1. The students will be able to understand the basic concepts of systems, need for systems approach in water resources, system design techniques, problem formulation.

2. The students will be able to understand the optimization techniques, LP, NLP, dynamic programming, genetic algorithm, and sensitivity analysis.

3. The students will be able to understand the capacity expansion: reservoir operation problems, simulation, case studies.

4. The students will be able to understand the planning, role of a planner, National water policies, public involvement, social impact, economic analysis.

Remote Sensing and G.I.S.

Course Objectives:

The objective of this course is to understand the fundamentals of remote sensing and G.I.S.

Course Outcomes:

After completing the course, student will:

Learn the state of art technology, being effectively used to monitor and assess the earth's resources

Able to develop skills of interpretation of the visual and digital satellite data

Understand the interaction of humans with the geological environment.

Unit	Topics	No. of Lectures
I	Remote Sensing: Electromagnetic Radiation – Characteristics and Remote Sensing Regions and bands, Scattering, Reflection, Atmospheric Window; Spectra of common natural objects – soil, rock, water and vegetation; Toposheet, Aerial photos– types, scale, resolution; properties of aerial photos.	12
II	Stereoscopy, Parallax, Relief displacement, Elements of photo and imagery pattern and interpretation, General Orbital characteristics of remote sensing satellites, G P S	12
III	Data Processing and Interpretation (Digital Image Processing – D.I.P.), Characteristics of remote sensing data, Pixel, Digital number; Preprocessing; Enhancements, Classification	12
IV	Types of Indian and Foreign Remote Sensing Satellites, Application in Geology: Remote sensing applications in Structure, Mineral Exploration, Groundwater potentials, Environmental monitoring.	12
V	Introduction to Geographic Information System (G.I.S.), components of G.I.S.; product generation in G.I.S.; tools for map analysis; integration of G.I.S. with remote sensing. Applications of G.I.S. in Landslides, Route location and pipeline alignments; Neo tectonism, seismic hazard and damage assessment.	12

Suggested Readings:

1. Drury, S.A. (1987): Image Interpretation in Geology. Allen and Unwin.
2. Gupta, R.P. (1991): Remote Sensing Geology. Springer, Berlin.
3. Halls, J.R. (1983): Applied Geomorphology
4. Holmes, A. (1992): Holmes Principles of Physical Geology. Edited by P. McL. D. Duff. Chapman and Hall, London
5. Lillesand, T.M. and Kiefer, R.W. (1987): Remote Sensing and Image Interpretation. John Wiley, New York.

6. Sabins, F.F. (2007): Remote Sensing: Principles and Interpretation. Waveland Pr. Inc., New York.
7. Sharma, H.S. (1990): Indian Geomorphology. Concept Publishing Co. New Delhi.
8. Siegal, B.S. and Gillespie, A.R. (1980): Remote Sensing in Geology. John Wiley
9. Thornbury, W.D. (1980): Principles of Geomorphology. Jhon Wiley and Sons, I.N.C. London.

B.Tech Civil Engineering Departmental Elective

ECOLOGY & ENVIRONMENTAL IMPACT ASSESSMENT

Course objectives:

1. To make the students able to understand structure and function of ecosystem in conservation of different kind of Environmental system.

2. To have adequate knowledge on principles, modeling and application of ecological engineering.

3. To have adequate knowledge on scope and contents, methodologies and techniques of Environmental Impact Assessment.

4. To have understanding of prediction and assessment of impacts on the surface water environment.

5. To have understanding of prediction and assessment of impacts on the air environment.

6. To have understanding of prediction and assessment of impacts on the land environment.

7. To understand the basics of risk characterisation and risk reduction.

8. To have sufficient knowledge of case studies related to Environmental Impact Assessment.

Course content:

Unit 1

Ecology – Classification of Ecosystems, Structure and Function of Ecosystems, Energy Flow in Ecosystems, Ecological Niche and succession, Bio-geo-chemical cycles, Ecological Pyramids. Ecosystems – Biotic and abiotic components, production and consumption, trophic levels, productivity and energy flow, food webs, cycling of elements. Changes in ecosystems – Succession, long range changes, long range stability, the organization and dynamics of ecological communities, description and study of typical natural and artificial ecosystems

Unit 2

Principles of ecological engineering – Principles, components and characteristics of Systems - Classification of systems - Structural and functional interactions of environmental systems - Environmental systems as energy systems - Mechanisms of steady-state maintenance in open and closed systems - Modelling and ecotechnology - Elements of modelling - Modelling procedure - Classification of ecological models - Applications of models in ecotechnology - Ecological economics. Aquatic and Terrestrial Ecosystems – Diversity and dominance Indices, Ecosystem Models. Climate change and biodiversity, Application of ecological engineering – Ecosanitation - Principles and operation of soil infiltration systems - Wetlands and ponds - Source separation systems - Aquacultural systems - Detritus based treatment for solid wastes - Applications of ecological engineering for marine systems. Lake Ecosystem – trophic levels, nutrient loading, nutrient enrichment, Leibig's Law, control of eutrophication.

Unit 3

Environmental Impact Assessment – Definition, Objectives, Types – Rapid and Comprehensive EIA, EIS, FONSI, Step-by-step procedure for conducting EIA and Limitations of EIA,

Prevention of Significant Deter.oration (PSD) Programme. Frame work of Impact Assessment – scope and contents of EIA, methodologies and techniques of EIA.

Unit 4

Prediction and Assessment of Impacts on the Surface Water Environment – Quality Impacts, Quantity Impacts, Water Quality Index, Mass Balances, Quantitative Modeling, Water Conservation - Case Study. Prediction and Assessment of Impacts on the Groundwater Environment: Hydrogeological Information, Vulnerability Mapping, Subsurface Transport and Fate.

Unit 5

Prediction and Assessment of Impacts on the Air Environment – Air Pollutants Emission, Ambient Air Quality and Standards, Emission Inventories, Meteorological Data, Mass Balances, Dispersion Models, Pollutant Emissions Minimization - Case Study. Prediction and Assessment of Impacts on the Land Environment – Soil & Geological properties. Universal Soil Loss equation, mitigation measures. Risk Assessment – Hazard Identification, Effect Assessment, Risk characterization, Risk Reduction. Attributes, Standards and Value functions, public participation in EIA. Environmental Management Plan (EMP) and Disaster Management Plan (DMP). EIA Case Studies – Thermal Power Plant, Mining, Fertilizer, Construction Projects, Airport, Water and Wastewater Treatment Plants.

References

1. Kormandy, (1996), "Concepts of Ecology", 4th Edition, Prentice Hall publication, New Jersey.

2. Odum, (1974), "Fundamentals of Ecology", 3rd Edition, W.B. Saunders & CO, NBF.

3. Krebs J., (2008), "Ecology – The Experimental Analysis of Distribution and Abundance", 6th Edition, Perason International.

4. Hall C.A.S., and Day J.W. (1977), "Ecosystem Modeling in Theory and Practice: An introduction with Case Histories", John Willey.

5. Canter L., (1995), "Environmental Impact Assessment", 2nd Edition, McGraw Hill Higher Education.

6. Weathern, P., (1982), "Environmental Impact Assessment – Theory and Practice", Unwin Hyman, London.

7. Jain R.K., Urban L.V., Stacey G.S., (1981), "Environmental Impact Analysis – A New Dimension in Decision Making", 2nd Edition, Van Nostrand Reinhold Co.

8. Clark B.C., Bisett and Tomilson P, (1985), "Perspective on Environmental Impact Assessment", Allied Publishers.

9. Charles, H., (2011), "Environmental Impact Assessment", 1st Edition, CRC Press.

10. Rau and Wooten, (1981) "Environmental Impact Assessment Handbook", McGraw Hill.

Course outcomes (CO):

B.Tech Civil Engineering Departmental Elective

1. Students will be able to understand structure and function of ecosystem in conservation of different kind of Environmental system.

2. Students will be able to understand principles, modeling and application of ecological engineering.

3. Students will have adequate knowledge of scope and contents, methodologies and techniques of Environmental Impact Assessment.

4. Students will have understanding of prediction and assessment of impacts on the surface water environment, air environment and land environment.

5. Students will have understanding of basics of risk characterisation and risk reduction.

6. Students will have sufficient knowledge of case studies related to Environmental Impact Assessment.

B.Tech Civil Engineering Departmental Elective

WATER DISTRIBUTION AND WASTEWATER COLLECTION SYSTEM DESIGN

Courses objective:

1. To understand the water supply system and its components.
2. To grasp the significance of Design period, Factors affecting water consumption and variation in demand.
3. To understand the design of water distribution network.
4. To understand the design parameters and methods of service reservoirs.
5. To understand the design principles of wastewater collection systems.
6. To understand maintenance of water supply and wastewater systems.

Course content:

Unit 1

Components of water supply systems: Water use and demand estimation, Design period, population data and flow rates for water supply systems.

Unit 2

Factors affecting water consumption and variation in demand.

Unit 3

Design of water distribution systems, methods of analysis for optimal distribution network design. Types of reservoirs and design parameters and methods: Design of water pumping stations.

Unit 4

Design principles of wastewater collection systems: separate, combined and semi- combined sewers; Estimation of dry weather flows; Sewer pipe hydraulics: sizing of pipes and design; Manhole chambers and storm water overflows.

Unit 5

Pumping stations, screens and inverted screens, Maintenance of water supply and wastewater systems.

References

1. Peavey, H.S., Rowe and Tchobonoglous,G., (2017), "Environmental Engineering", 1st Edition, McGraw Hill.
2. McGhee, T. J., (1991). "Water Supply and Sewerage, 6th Edition, McGraw Hill International
3. Garg, S. K., (2001), "Water Supply Engineering", Khanna Publication.
4. Garg, S. K., (2005), "Sewage Disposal and Air Pollution Engineering", Khanna Publication.

Course outcome:

1. Students will be able to learn about the water supply system and its components.
2. Students will be able to about Design period, Factors affecting water consumption and variation in demand.
3. Students will be able to design water distribution network.
4. Students will be able to design service reservoirs.
5. Students will be able to learn the design principles of wastewater collection systems.
6. Students will be able to understand about maintenance of water supply and wastewater systems.

AIR AND WATER QUALITY MODELING

Courses objective:

1. To understand the importance of mathematical models for water and air quality management.
2. To understand the cause and effect of surface water quality
3. To assess required level of controls in surface water quality modeling
4. To develop a clear conceptual model to predict ground water contaminants
5. To study about computer-based modeling for surface and ground water quality
6. To understand the ambient air quality standards.

Course content:

Unit 1

Systems Approach: Water and air quality management - Role of mathematical models, systems approach - systems and models - kinds of mathematical models - model development and validation effluent and stream standards, ambient air quality standards.

Unit 2

Surface Water Quality Modeling: Water quality description, various characteristics of water, water quality criteria and standards. Elements of reaction kinetics, spatial and temporal aspects of contaminant transport, transport mechanism-advection, diffusion, dispersion. Historical development of water quality models: rivers and streams water quality modeling river hydrology and flow - low flow analysis - dispersion and mixing - flow, depth, and velocity estuaries - estuarine transport, net estuarian flow, estuary dispersion coefficient; Lakes and impoundments - water quality response to inputs, water quality modeling process- model sensitivity - assessing model performance; Models for dissolved oxygen, pathogens: Streeter - Phelps models.

Unit 3

Air Quality Modeling: Transport and dispersion of air pollutants - Kinetics of air pollutants: Atmospheric advection-diffusion of pollutants; Fick's law of diffusion, wind velocity, wind speed and turbulence: estimating concentrations from point sources, area sources and line sources of pollution; - the Gaussian Equation - determination of dispersion parameters, atmospheric stability, Pasquill-Gifford stability classes; Inversions; Potential temperature gradient, dispersion instrumentation - Atmospheric traces: concentration variation with averaging time: Air pollution modeling and prediction - Plume behavior; Mixing heights, Plume rise, modeling techniques, modeling for nonreactive pollutants, single source - short term impact: multiple sources and area sources, model performance, accuracy and utilization: computer models. Advanced techniques in air quality modeling: Artificial Neural Networks (ANN),

Hybrid modeling approach, Fuzzy logic theory (FLT), and Environmental wind tunnel (physical) models.

Unit 4

Groundwater Quality Modeling: Mass transport of solutes, degradation of organic compounds, application of concepts to predict groundwater contaminant movement. Ground water remediation.

Unit 5

Computer Models: Exposure to computer models for surface water quality, groundwater quality and air quality.

References:

1. Steven C. Chapra, (2008), "Surface Water quality modeling", The McGraw-Hill Companies, Inc., New York.

2. R.W. Boubel, D.L. Fox, D.B. Turner & A.C. Stern, (2008), "Fundamentals of Air pollution", 4th Edition, Academic Press, New York.

3. Ralph A. Wurbs, (1995), "Water Management Models - A Guide to Software", Prentice Hall PTR, Facsimile edition, New Jersey.

4. Thomann, R.V. and Mueller, J.A., (1997), First Edition, Principles of surface water quality modeling and control, Pearson Education India

5. Barratt, R., Atmospheric Dispersion Modeling, Earthscan Publication Ltd, 2003

Course outcome:

1. Students will be able to understand importance of mathematical models for water and air quality management.

2. Students will be given a broad idea to understand the cause and effect of surface water quality

3. Students will be able to assess required level of controls in surface water quality modeling.

4. Students will be able to develop a clear conceptual model to predict ground water contaminants.

5. Students will be able to understand the ambient air quality standards.

6. Students will be able to aware of various computer-based modeling for surface and ground water quality.

ENVIRONMENTAL PLANNING AND MANAGEMENT

Courses objective:

1. To understand the basic theory of environment and sustainable development.
2. To study the engineering methodology in planning and its limitations.
3. To study the environmental protection.
4. To have adequate knowledge on environmental impact assessment.
5. To have adequate knowledge on engineering and environmental economics.
6. To have adequate knowledge on total quality management in environmental management and protection.

Course content:

Unit 1

Environment and Sustainable Development - carrying capacity, relationship with quality of life. carrying, indicators of sustainability, sustainability strategies, barriers to sustainability, resource utilization, resource degradation, industrial ecology, socio economic policies for sustainable development and clean development mechanism.

Unit 2

Engineering Methodology in Planning and Its Limitations - carrying capacity based short- and long-term regional planning. Environmental impact assessment (EIA) - definitions and concepts, rationale and historical development of EIA, sustainable development, initial environmental examination, environmental impact statement, environmental appraisal, environmental impact factors and areas of consideration, measurement of environmental impact, organization, scope and methodologies of EIA, status of EIA in India.

Unit 3

Environmental Protection - Economic development and social welfare consideration in socio economic developmental policies and planning. Total cost of development and environmental protection cost. Case studies on Regional carrying capacity.

Unit 4

Engineering Economics - Value Engineering, Time Value of Money, Cash Flows, Budgeting and Accounting, Environmental Economics: Introduction, economic tools for evaluation, Green GDP, Cleaner development mechanisms and their applications.

Unit 5

Environmental Audit - methods, procedure, environmental audit versus accounts audit, compliance audit, methodologies and regulations reporting and case studies, Life cycle assessment; Triple bottom line approach, Total Quality Management in Environmental Management and Protection - ISO 9000, 14000 and 18000 series of standards.

References:

1. Lohani B.N and North A.M., (1984)., "Environmental Quality Management", South Asian Publishers, New Delhi.

2. Chanlett E.T., (1979), "Environmental Protection", McGraw Hill Publication, New York.

3. Danoy G.E., and Warner R.F., (1989), "Planning and Design of Engineering Systems", First Edition, CRC press, Unwin Hyman Publications.

4. MOEF, Government of India, "Carrying Capacity Based Developmental Planning Studies for the National Capital Region", 1995-96.

5. NEERI, Nagpur, Annual Reports 1995 & 1996.

6. UNEP/UNDP (2012) "Environmental Sustainable Development".

Course outcome:

1. Students will be able to understand the theory of environment and sustainable development.

2. Students will be able to understand the engineering methodology in planning and its limitations.

3. Students will be able to get adequate knowledge on environmental protection.

4. Students will be able to assess the environmental impact.

5. Students will be able to get adequate knowledge on engineering and environmental economics.

6. Students will be able to understand total quality management in environmental management and protection.

INDUSTRIAL POLLUTION CONTROL

Course objectives:

1. To have sufficient knowledge on Engineering ethics, environment and Ecological.
2. To have sufficient knowledge on fundamentals of EIA and ESA.
3. To have better understanding of Industrial Air pollution management.
4. To have adequate knowledge on Wastewater treatment processes.
5. To have understanding of advanced wastewater treatment processes.
6. To have sufficient knowledge on Hazardous Waste Management.

Course content:

Unit 1

Engineering ethics and environment. Ecological systems and pollution. Fundamental definitions of pollution parameters, Standards and legislation, EIA and ESA.

Unit 2

Air and water pollution management through waste minimization.

Unit 3

Industrial Air pollution management - air pollution meteorology (Generation, transportation and dispersion of air pollutants). Outlines of industrial air pollution control. Selection, design and performance analysis of air pollution control equipment.

Unit 4

Industrial Water pollution management - Wastewater treatment processes and advanced wastewater treatment processes.

Unit 5

Hazardous Waste Management - Sources, Classification, Regulations for Hazardous Waste Management, Waste Minimization and Resource Recovery – Approaches, Development of a Waste Tracking, Treatment of hazardous waste, Thermal treatment, Soil contamination and site remediation, monitoring of disposal sites.

References:

1. Jr. W. Eckenfelder (2007), "Industrial Waste Water Pollution Control", McGrawHill Exclusive (CBS).

2. Pichtel J., (2014), "Waste Management Practices: Municipal, Hazardous and Industrial", 2nd Edition, CRC Press.

3. Bhatia, S. C., (2007), "Solid and Hazardous Waste Management", 1st Edition, Atlantic Publishers & Distributors.

4. Rao, C.S., (2018), "Environmental Pollution Control Engineering", 3rd Edition, New Age International Publishers.

5. De Nevers, N., (2000), "Air Pollution Control Engineering", 2nd Edition, McGraw-Hill Education.

6. Nemerow, N. L., (1978), "Industrial water pollution: Origin, characteristics and treatment", Addison-Wesley Educational Publishers Inc.

Course outcomes (CO):

1. Students will be able to understand fundamentals of Engineering ethics, environment and Ecological.

2. Students will have knowledge on EIA and ESA.

3. Students will have adequate knowledge Industrial Air pollution management.

4. Students will have understanding of designing Wastewater treatment processes.

5. Students will have understanding of designing of advance Wastewater treatment processes.

6. Students will have sufficient knowledge on Hazardous Waste Management.

ADVANCED ENVIRONMENTAL BIOTECHNOLOGY

Course objectives:

1. To have sufficient knowledge on fundamentals of Environment and Microbiology.

2. To have adequate knowledge on Microbial Genetics, metabolism, Health and hygiene, interactions and Toxicology.

3. To have better understanding on microbiology of Suspended Growth Process.

4. To have better understanding on microbiology of Attached Growth Process.

5. To have understanding of Bioremediation of Hazardous contaminants and emerging contaminants, Environmental sustainability.

6. To have sufficient knowledge on Environmental sustainability, Bio-fertilizers and Biopesticide.

Course content:

Unit 1

Review of concepts of Environment and Microbiology, Microbial Ecology, Microbial energetics, Microbial kinetics.

Unit 2

Concept of Microbial Genetics, Microbial metabolism, Microbiology of Health and hygiene, Microbial interactions, Microbial Toxicology, Degradation of Xenobiotics.

Unit 3

Microbiology of wastewater: Suspended Growth Process- Aerobic and Anaerobic, Biofilm kinetics.

Unit 4

Attached Growth Process- Aerobic and Anaerobic, Biological nutrient removal, Facultative Processes.

Unit 5

Biodegradability, Bioremediation: Engineering strategies for bioremediation, Microbial Remediation of Solid-wastes, Bioremediation of Hazardous contaminants and emerging contaminants, Environmental sustainability, Bio-fertilizers and Biopesticide.

References:

1. Metcalf and Eddy Inc., (2012), "Wastewater Engineering – Treatment and Reuse", 4th Edition, Tata McGraw Hill Publishing Co. Ltd., New Delhi.

2. Odum, (1974), "Fundamentals of Ecology", 3rd Edition, W.B. Saunders & CO, NBF.

3. R.L. Smith, (2000), "Ecology and field biology", 6th Edition, Benjamin Cummings.

4. Manahan S.E., (2009), "Principals of Environmental chemistry", 9th Edition, CRC press.

5. R.B. Philip, (1995), "Environmental hazards & human health", Lewis Publisher, Boca Raton, FL.

6. Uppadahay A., Uppadahay K., and Nath N. "Principles of Biophysical chemistry", 7th Edition, Principles and Techniques of Biochemistry and Molecular Biology.

7. Pelczar M.J, Chan ECS, Krieg, NR(2004) "Textbook of Microbiology" 5th edition Tata McGraw Hill Publishing Co. Ltd., New Delhi.

Course outcomes (CO):

1. Students will be able to understand fundamentals of Environment and Microbiology.

2. Students will have knowledge on Microbial Genetics, metabolism, Health and hygiene, interactions and Toxicology.

3. Students will have adequate knowledge on microbiology of Suspended Growth Process.

4. Students will have adequate knowledge on microbiology of Attached Growth Process.

5. Students will have understanding of Bioremediation of Hazardous contaminants and emerging contaminants, Environmental sustainability.

6. Students will have sufficient knowledge on Environmental sustainability, Bio- fertilizers and Biopesticide.

MANAGEMENT OF WATER RESOURCES

Courses Objective:

1. To impart knowledge about the planning and management of water resources.

2. To introduce the concepts of watershed management, integrated water resources management, environmental interaction of water resources and policies/framework related to water resources.

3. To enable student to understand the different components of water resources and their management

Course content:

Unit- 1

Management of hydrological data, Linear Programming and its application in water resources development, Inventory control.

Unit -2

Analysis of risk and uncertainties, Dynamics programming Statistical decision model, Water policies and institutional aspects of management of water resources.

Unit -3

Hierarchical modeling of water resources development, Management of watersheds and water quality.

Unit -4

Reservoir & stream flow routing, probability, risk and uncertainty analysis.

Unit – 5

Urban water supply planning/management, cost-benefit analysis in water resources planning, planning of watersheds, Watershed behaviour and conservation practices, trans-boundary water resources, National water policy, water withdrawals & uses, trans-boundary water resources.

References:

1. Water Management, Warren Viessman Jr. and Claire Welty, New York : Harper & Row, 1985. 1st Edition.

2. Water Resources Engineering, Larry W. Mays, Wiley Global Education US, 2019, 3rd Edition.

3. Water Resources Engineering, Ralph A. Wurbs and Wesley P. James, Pearson, 2001, 1st Edition.

4. Water Resources Systems, Planning & Management, S. K. Jain & V. P. Singh, Elsevier Science, 2003, 1st Edition.

5. Modeling Water qualities and Management, Asit K. Biswas, McGraw-Hill Professional, 1997, 1st Edition.

6. Hierarchical Analysis of Water Resources System, Y.Y. Haimes, McGraw Hill Higher Education, 1977, 1st Edition.

7. Waste Water Engineering Treatment and Reuse, Matfalf / Eddy, McGraw-Hill Education (India) Pvt Limited, 2002, 4th Edition.

8. Sustainable water Management Solutions for Large Cities, Dragar A, Savic, Mignel A, International Association of Hydrological Science, 2005, 1st Edition.

Course outcome:

1. Students will be able to identify different problems related to water resources planning, management and development.

2. Students will be able to describe various concept and problems of water related issues.

3. Students will be able to identify the risk and uncertainties of water related issues

4. Students will be able to do the cost-benefit analysis in water resources planning

5. Students will be able to do the urban water supply planning/management, cost-benefit analysis in water resources planning, planning of watersheds.

6. Students will be able to gain knowledge about the national water policy.

GEOENVIRONMENTAL ENGINEERING

Course objectives:

1. To have sufficient knowledge on fundamentals of Geoenvironmental Engineering.
2. To have adequate knowledge on planning and design of MSW and Hazardous waste Landfills.
3. To have better understanding on planning and design of slurry ponds - ash ponds and tailing ponds.
4. To have better understanding on subsurface contamination.
5. To have understanding of geotechnical reuse of waste.

Course content:

Unit 1

Concepts and principles of Geoenvironmental Engineering.

Unit 2

Geotechnical aspects of planning and design of MSW and Hazardous waste Landfills

Unit 3

Geotechnical aspects of planning and design of slurry ponds - ash ponds and tailing ponds.

Unit 4

Geotechnical aspects of detection & monitoring of subsurface contamination and control & remediation of contaminated sites.

Unit 5

Rehabilitation of waste dumps and geotechnical re-use of waste.

References:

1. Rowe R.K.,"Geotechnical and Geoenvironmental Engineering Handbook" Kluwer Academic Publications, London, 2000.

2. Reddi L.N. and Inyang, H. I.,"Geoenvironmental Engineering,Principles and Applications" Marcel Dekker Inc. New York, 2000.

3. Yong, R. N.,"Geoenvironmental Engineering, Contaminated Soils,Pollutant Fate, and Mitigation" CRC Press, New York, 2001.

4. Sharma H.D. and Reddy K.R.,"Geoenvironmental Engineering: Site Remediation, Waste Containment, and Emerging Waste Management Technologies" John Wiley & Sons, Inc., USA, 2004.

5. Fredlund D.G. and Rahardjo, H.,"Soil Mechanics for Unsaturated Soils" Wiley- Interscience, USA, 1993.

6. Mitchell, J.K.,"Fundamentals of Soil Behavior" Wiley, 2005.

7. Hillel D.,"Introduction to Environmental Soil Physics" Academic Press, New York, 2003.

Course outcomes (CO):

1. Students will be able to understandfundamentals of Geoenvironmental Engineering.

2. Students will have knowledge on planning and design of MSW and Hazardous waste Landfills.

3. Students will have adequate knowledge on planning and design of slurry ponds - ash ponds and tailing ponds.

4. Students will have adequate knowledge on subsurface contamination.

5. Students will have understanding on reuse of geotechnical waste.

ENGINEERING BEHAVIOR OF SOIL

Module 1: Introduction – formation of soils – different soil deposits and their engineering properties – Genesis of clay minerals –identification and classification – Anion and cation exchange capacity of clays – specific surface area – bonding in clays.

Module 2: Physical and physio-chemical behavior of soils – diffused double layer theory – computation of double layer distance – effect of ion concentration, ionic valency, pH, dielectric constant, temperature on double layer – stern layer – attractive and repulsive forces in clays – types of soil water – mechanism of soil – water interactions – soil structure.

Module 3: Problems associated with swelling and shrinkage behavior of soils –Causes, consequences and mechanisms – factors influencing swell – shrink characteristics – swell potential – osmotic swell pressure – soil fabric and measurement – sensitivity, thixotrophy of soils – soil suction – soil compaction – factors affecting soil compaction.

Module 4: Compressibility, shear strength and permeability behavior of fine and coarse grained soils – mechanisms and factors influencing engineering properties – liquefaction potential – causes and consequences.

Module 5: Conduction in soils – hydraulic, electrical, chemical and thermal flows in soils – applications – coupled flows – Electro-kinetic process – thermo osmosis – electro osmosis – prediction of engineering behavior of soils using index properties – empirical equations and their applicability.

References

1. Mitchell. J.K., Fundamentals of Soil Behaviour, John Wiley, New York, 1993.
2. Yong, R.N. and Warkentin, B.P., Introduction to Soil Behaviour, Macmillan, Limited, London, 1979.

3. Coduto, D.P., Geotechnical Engineering – Principles and practices, Prentice Hall of India Pvt. Ltd., New Delhi, 2002.
4. Das, B.M.,Principles of Geotechnical Engg, PWS Publishing Comp, Boston, 1998
5. McCarthy D.F., Essentials of Soil Mechanics & Foundations, Prentice-Hall, 2002.

ANALYSIS OF TRANSPORT SYSTEM

Module 1

Introduction: Evaluation issues, Evaluation process, values, goals, objectives, criteria and standards frame work – Estimation of cost, impacts and performance levels – evaluation of alternatives, economic environmental and safety evaluations; multi criteria evaluation methods, techniques – scoring techniques – group consensuous.

Module – 2

Economic Evaluation: Review of Engineering Economics-Welfare Theories and Equilibrium-Theoretical Basis-Discounted Cash Flow Methods-Cost, Benefit Cost Effectiveness and Shadow Pricing Techniques- Criteria for Pricing Services-Average Cost Vs Marginal Cost - Allocation of Resources within Transportation Section-Financing of Transport Sections in India

Module – 3

Environmental Evaluation: Introduction, air pollutants, pollutant effects, air quality standards, factors influencing air pollution, air pollution dispersion & pollution models, air pollution reduction measures - Noise pollution: noise measurement, noise propagation, noise modeling, noise control and abatement techniques, Energy related issues, energy consumption of different modes, energy related transportation actions

Module – 4

Safety Evaluation: Highway safety problem, accident categories, highway safety improvement program – planning, implementation & evaluation stages, steps in HSIP, counter measures for accidents and probable causes, road safety audit.

References

1) Hutchinson B.G., Principle of Transportation Systems Planning, McGraw-Hill.
2) Dickey J.W., et. al., Metropolitan Transportation Planning, Tata McGraw-Hill.
3) ITE (1982), Transportation and Traffic Engineering Hand Book, Chapters 21 and 22', Prentice-Hall, New Jersy.
4) Heggei, I.G., Transportation Engineering Economics, Mc-Graw Hill Book Company, New York.
5) CANTER, L.W., Environmental impact assessment, McGraw-Hill, 1997
6) CRRI, Road user Cost Study in India, Central Road Research Institute, New Delhi, 1982
7) Robley Winfrey, Economic analysis for highways, International Textbook Co.
8) M. Wohl, B.J. Martin, Traffic System Analysis for Engineers and Planners, McGraw Hill Text,1967.
9) Babkov, V.F., Road Conditions and Traffic Safety, MIR Publishers, Moscow

TRANSPORTATION ENVIRONMENT INTERACTION

Course Objectives

- To impart the knowledge of how transportation facilities affecting the environment
- To make the students understand the noise sources and its mitigation for urban and non-urban transportation
- To make the students understand different vehicle emission parameters, pollution standards and its mitigation strategies

Transportation Safety: Pre-crash, Crash and Post-crash models; Roles of vehicle, roadway, traffic, driver and environment; Crash and injury causations Modes of Transportation, Mixed Traffic Flow, Transport Related Pollution, Technology Vision-2020, Urban and Non-urban Traffic Noise, Noise Sources, Noise Level Factors, Effects of Traffic Noise, Noise Standards. Measurement and Prediction, Control Measures, Noise Studies, Road Transport related air pollution, Sources of air pollution, effects of weather conditions, Vehicular emission parameters, Pollution standards, measurement and analysis of vehicular emission, Mitigative measures, EIA requirements of Highway Projects, procedures, Ministry of Environment and Forests (MOEF)/World Bank/IRC/UK Guidelines, EIA Practices in India.

Course Outcomes

Upon successful completion of the course, the students will be able to
1: Map traffic noises
2: Model vehicle emission for given conditions
3: Design transportation facility ensuring less environmental impact as per standard guidelines

REHABILITATION, RECONSTRUCTION AND RECOVERY

Unit-1:

Recovery and reconstruction: Introduction, Medium and long term recovery aspects, Community participation in defining objectives and their priorities, Disaster risk communication.

Unit-2:

Rehabilitation: Physical and social infrastructure, Relocation and reconstruction of housing, public buildings, bridges, dams, archives and monuments, services such as water supply, electricity, waste management, communication, capacity building for self-help construction.

Unit-3:

Numerical condition surveys for foundation, Structural and functional deterioration, Design criteria, Materials and techniques.

Unit-4:

Predictive performance models. Repair and retrofitting: Earthquake damages of buildings, their retrofitting and restoration.

Unit-5:

Superficial repair, Structural repair, Structural strengthening of habitable spaces, public buildings, roads, bridges, dams, culverts etc.

Books:

1. Sharma, Vinod K., "Disaster Management", NCDM, IIPA, New Delhi, 1994

2. Mathur, G. C., "Housing in Disaster Prone Areas", National Building Organization and U.N. Regional Centre. ESCAP, New Delhi, 1986.

3. Mishra, P. K., "Transforming Adversity into Opportunity: Experiences from Gujarat Earthquake Reconstruction Program", World congress on Natural disaster mitigation proceedings, February 2004.

4. Twigg, John, "Disaster Risk Reduction", London: Overseas Development Institute, Humanitarian Policy Group, 2015.

DISASTER RESILIENT STRUCTURES AND RETROFITTING

Unit-1:

Earthquake effects on the structures, Classification of loads, Seismic methods of analysis, Seismic design methods, Seismic damages during past earthquakes and effect of irregularities and building architecture on the performance of structures.

Unit-2:

Basic design considerations for multistoried RC and steel structure with foundation as per latest IS:1893, Capacity based design of building, Types of ductility, Factors affecting ductility, Ductile detailing as per latest IS:13920, Seismic design considerations for masonry buildings.

Unit-3:

Fire safety of buildings, Effect of high temperatures on different types of steel and concrete structural members, Fire resistance by structural detailing.

Unit-4:

Analytical determination of the ultimate bending moment, Design of RC members for fire resistance, Introduction of IS:1642. General characteristics of blast and effects on structures, Blast load on above and below ground structures, Response of structural elements to blast force, Dynamic strength of materials and design stresses, Load combinations for design, Introduction of IS:4991. Sources of weakness in RC and Steel framed buildings.

Unit-5:

Classification of retrofitting techniques, Conventional and non-conventional methods, IS code provisions for retrofitting of masonry structures.

Books:

1. Thomas Paulay and Priestley M. J. N., "Seismic Design of Reinforced Concrete and Masonry Buildings", Wiley India Pvt Ltd.

2. Agarwal Pankaj and Shrikhande Manish, "Earthquake Resistant Design of Structures", PHI. 3. Datta T. K., "Seismic Analysis of Structures" Wiley.

4. Duggal Shashikant K., "Earthquake Resistant Design of Structures", 2nd Edition, Oxford. 5. Priestley M. J. N., Calvi G. M. and Kowalsky M. J., "Displacement-Based Seismic Design of Structures", 2nd Edition, EUCENTRE.

6. Varghese P. C., "Advanced Reinforced Concrete Design", 2nd Edition, PHI Learning Pvt. Ltd.

7. Cormie David, Mays Geoff and Smith Peter, "Blast Effects on Buildings", 3rd Edition, Thomas Telford Publishing.

DISASTER RESPONSE AND PREPAREDNESS

Unit-1:

Global Disaster: Global and Indian scenario, Science and policy, Institutional framework for disaster preparedness and mitigation, Managing natural and anthropogenic disasters.

Unit-2:

Principles and practice of disaster response operations and management, Disaster Planning, Public Administration/Policy and Emergency management, Incident command center, Training need analysis and human resource development plan, Corporate/public agency coordination, Human element in preparedness planning, Current trends in disaster preparedness.

Unit-3:

Hazard monitoring, tracking and modelling, Early warning systems, Warning protocols, Indian disaster resource network, Public health aspects of disaster management and emergency services systems, Urban hazards and disaster planning, Fire services preparedness, Emergency sanitation, Shelter environments.

Unit-4:

Conceptual and Applied Issues in Emergency Management: Operational decision making, Introduction to emergency management and planning, Organization and structure of emergency management, Emergency management research methods and analysis, Public information for emergency management, Principles and practice of disaster relief and recovery, Logistic support system, Computer applications in emergency management.

Unit-5:

Principles of natural hazard reduction, Toxicology and biohazards in emergency management, Terrorism Preparedness: Critical infrastructure and emergency management, Emergency preparedness, response, and planning for hazardous materials, Terrorism, WMD and other contemporary issues, Incident management systems and emergency operations center, Contingency planning, Community emergency response team, Community relations for environmental and emergency managers, Contingency planning for business and industry, International disasters.

Books:

1. Collins Larry R. and Schneid Thomas D., "Disaster Management and Preparedness", Taylor and Francis 2000.

2. Goel S.L. and Kumar Ram, "Disaster Management", Deep and Deep Publications, 2001.

3. Arora R. and Arora P., "Disaster Management: Medical Preparedness, Response and Homeland Security", Eds, 2013, CAB International.

4. Maiden R. P., Paul R., Thompson C., "Workplace Disaster Preparedness, Response, and Management", Routledge, 2007.

5. Beach, M., "Disaster Preparedness and Management", F A Davis Company, 2010.

DISASTERS AND SPECIAL STRUCTURES

Unit-1:

Introduction to Special Structures and Their Uses: Bridges, Dams, Nuclear power plants, Thermal power plants.

Unit-2:

Underground Structures: Tunnels, Subways and Storage Tanks, Pipelines, Railways, Roads, Retaining structures, Liquid storage tanks, Waterways, Reservoirs, Wastewater infrastructure and Offshore structures.

Unit-3:

Performance of special structures during past disaster, Vulnerability of special structures, Health monitoring, Operations and maintenance, Potential threats and risk assessments.

Unit-4:

National and international policies, Environmental impact due to damage of special structures.

Unit-5:

Case study, Emergency plan and risk reduction, Post-Disaster recovery and reconstruction.

Books:

1. Pitilakis, K., Crowley, H. and Kaynia, A. M., "SYNER-G: Typology Definition and Fragility Functions for Physical Elements at Seismic Risk - Buildings, Lifelines, Transportation Networks and Critical Facilities", Springer.

2. Pitilakis, K., Franchin, P., Khazai, B. and Wenzel, H., "SYNER-G: Systemic Seismic Vulnerability and Risk Assessment of Complex Urban, Utility, Lifeline Systems and Critical Facilities - Methodology and Applications", Springer.

3. Chopra, A. K., "Earthquake Engineering for Concrete Dams: Analysis, Design, and Evaluation", Wiley-Blackwell.

4. Wang, J. N., "Seismic Design of Tunnels", Parsons Brinckerhoff Quade & Douglas, Inc.

5. Lew, H. S., "Wind and Seismic Effects", National Bureau of Standards, SP-477.

6. Andrews, A. and Folger, P., "Nuclear Power Plant Design and Seismic Safety Considerations", Congressional Research Service.

7. Sibal, R. S., "Are You Prepared for a Disaster? Mitigation and Management of Disasters", Bloomsbury.

MAN-MADE AND BIOLOGICAL DISASTERS-DETECTION AND MITIGATION

Unit-1:

Bioterrorism Bioterror agents: Bacterial and viral; Agribioterrorism- introduction of plant and animal diseases

Unit-2:

Infectious diseases Infectious agents, mortality due to major bacterial outbreaks, spread of bacterial infections and the never ending fight, pathogens and multiple drug resistance, means of detecting and mitigating bacterial pathogens, Viral diseases - Outbreaks and incidences; Viral outbreaks - SARS, Bird flu, Swine flu and HIV, detection and mitigation of viral agents.

Unit-3:

Chemical Emergencies: Pesticides, industrial pollutants, heavy metal contamination.

Unit-4:

Radiation emergencies: Nuclear radiation leakage, Chernobyl disaster and implications on biological systems, effect on genetic material; Mutations-chromosomal

Unit-5:

Biotechnology and Biodiversity Issues of Biodiversity, value of biodiversity; Emergence of Biotechnology: Biotechnology and promises to society; Biotechnology Techniques; Managing the Hazards of Genetic Engineering, regulations and control of biotechnology: Biosafety

Suggested Books:

1. Grey M. and Spaeth K., The Bioterrorism Sourcebook, McGraw Hill, 2006.

2. Yousef A. K., et al., Biology, Pathogenicity, Epidemiology, and Biodefense, Wiley-Blackwell, 2007

3. Luther E. L., George Korch, Biological Weapons Defense: Infectious Diseases and Counter bioterrorism, Humana Press, 2004.

4. Hawksworth D.L., Methods and Practice in Biodiversity Conservation, Springer, 2009.

5. Fong I W. and Alibek K., Bioterrorism and Infectious Agents: A New Dilemma for the 21st Century, Springer, 2009.

HYDROINFORMATICS

Course Content

Unit-1: Introduction: Introduction to data-driven modeling for water systems; Model classification; Introduction to Matlab and R Programming.

Unit-2: Supervised Learning for classification/regression: Linear Models and Generalized Linear Models (GLM) including Logistic and Poisson Regression; k-Nearest Neighbor (k-NN) method; Polynomial Regression and Generalized Additive Models, Kernel-based Methods; Decision trees – Classification and Regression Trees (CART) – Bagging, Boosting and Random Forests; Support Vector Machines (SVM); Artificial Neural Networks (ANN); Resampling Methods - Bootstrap; Regularization and Machine Learning System Design.

Unit-3: Unsupervised Learning: Clustering: i) hard (k-means) clustering and ii) fuzzy clustering (fuzzy c-means) with introduction to fuzzy logic; Multivariate analysis – dimension reduction, Singular Value Decomposition (SVD), Principal Component Analysis (PCA), Canonical Correlation Analysis (CCA).

Unit-4: Applications: Hydroinformatics for Climate Change Impact Assessment and Regional Flood Frequency Analysis.

Unit-5: Example of a Hydrologic Information System.

References:

1. James, G., Witten, D., Hastie, T., & Tibshirani, R. (2013). An introduction to statistical learning (Vol. 112). New York: Springer. (Or Hastie et al. for advanced)

2. von Storch and Zwiers, 1999, Statistical Analysis in Climate Research, Cambridge Univ. Press, U.K.

3. Myers, R. H., Montgomery, D. C., Vining, G. G., & Robinson, T. J. (2012). Generalized linear models: with applications in engineering and the sciences (Vol. 791). John Wiley & Sons.

4. Abbott, 1991, Hydroinformatics- Information Technology and the Aquatic Environment, Avebury Technical, Aldershot, U.K.

5. Nielsen, 2016, Neural Networks and Deep Learning, Web-book. http://neuralnetworksanddeeplearning.com/index.html

6. Other relevant research articles.

ZERO ENERGY BUILDINGS

Course Content

Unit 1:

Introduction: Zero Energy Buildings (ZEBs) and its Concepts; Different definitions of ZEBs; Relevance of such systems; Steps to Achieve ZEBs; Challenges Involved in the Design of Such Systems; Sources of Renewable Power for ZEBs.

Unit 2:

Design Concepts of ZEBs: Thermal loads and energy use in buildings; Design considerations in ZEBs; Building fabric/ envelope; HVAC and Lighting Systems; Integration with Solar/ Renewable Energy Systems.

Unit 3:

Building Energy & Operation Management: Building Management Systems; Optimal resource dispatch (thermal and electrical), demand side management with ZEB operation including HVAC, lighting control; Operation of building micro-grids in grid connected/islanded modes; provision of ancillary services sharing among the various buildings.

Unit 4:

Comfort considerations in ZEBs: Thermal Comfort, Visual Comfort, Acoustic Comfort, Indoor Air Quality.

Unit 5:

Economics of ZEBs: Carbon Footprint Mitigation; Economic assessment of ZEBs; ZEB Case Studies; Future prospects & direction.

Text & Reference Books:

1. Arora, C. P., Refrigeration and Air Conditioning, McGraw Hill Education (2017).

2. Athienitis A. and O'Brien W., Modeling, Design, and Optimization of Net-Zero Energy Buildings, Ernst &Solin, (2015).

3. Goswami, D. Y., Principles of Solar Engineering, CRC Press Taylor & Francis Group (2015).

4. Chwieduk, D., Solar Energy in Buildings, Elsevier (2014).

5. Holman, J. P., Heat Transfer, McGraw Hill Education (2010).

6. Duffie, J. A , Beckman, W. A., Solar Engineering of Thermal Processes, John Wiley & Sons (2006).

Course Outcomes:

To provide the students with

1. Thorough understanding of Zero Energy Building definitions.

2. Understanding solar energy utilization in buildings.

3. Understanding of other Renewable sources of power generation for buildings.

4. Understanding of energy conservation studies in building perspective

5. Understanding of contemporary HVAC equipment and possible integration of renewable energy

6. Understanding of introduction to novel materials and designs for ZEB construction

7. Understanding of tangible strategies for reducing energy demands in different climatic zones

CARBON AUDIT AND MANAGEMENT

Course Content

Unit 1:

Introduction: Energy and society; Greenhouse gas emissions from the energy sector and their time trend; Relative contribution of various sectors to global greenhouse gas emissions.

Unit 2:

Sources and estimation of carbon emissions: Climate change and other potential impacts of enhanced greenhouse effect caused by emissions from different sectors, storage and utilization of energy carriers; Measurement and estimation of carbon emissions from different sectors and utilization of various energy carriers.

Unit 3:

Carbon auditing: Carbon footprints; Carbon audit; Estimation of direct and supply chain carbon footprints; Need for reducing carbon footprints; Identification of niche areas for carbon management.

Unit 4:

Carbon Management: Tools and accounting techniques for carbon audit and management; Sustainability accounting; Life cycle assessment approach; Integrated supply chain analysis with respect to carbon; Standards; Carbon management policies; Carbon management regulations and protocols. Carbon Management Applications: Carbon management in energy generation, transport, water and wastewater, manufacturing, information and communication technology

etc.; Carbon management in new buildings and cities; Carbon implications of waste reduction and recycling; Strategies for carbon storage in soil and in oceans.

Unit 5:

Carbon Credits and Carbon Economics: Carbon credits; Trading schemes; Carbon economics; Low carbon investments; Carbon labeling challenges and opportunities in carbon management in energy sector and energy intensive industries and applications; Energy generation for a low carbon society for sustainable development.

Text & Reference Books:

1. Subramanian S. M., The Carbon Footprint Handbook, CRC Press (2015).

2. UNDP, Carbon Handbook, United Nations Development Programme (2014).

3. Emmanuel R., Keith B., Carbon Management in the Built Environment, Routledge (2012).

Course Outcomes:

To provide the students with

1. Identify the effects of carbon emissions on the environment and consequent challenges.

2. Acquire necessary knowledge and skills to conduct carbon audits and life cycle analysis to identify carbon management opportunities.

3. Implement efficient and effective carbon management strategies in the energy sector and energy intensive industries and document the same.

ENERGY GENERATION FROM WASTE

Course Content

Unit 1:

Introduction: The Principles of Waste Management and Waste Utilization. Waste Management Hierarchy and 3R Principle of Reduce, Reuse and Recycle. Waste as a Resource and Alternate Energy source.

Unit 2:

Waste Sources & Characterization; Waste production in different sectors such as domestic, industrial, agriculture, postconsumer, waste etc. Classification of waste – agro based, forest residues, domestic waste, industrial waste (hazardous and non-hazardous). Characterization of waste for energy utilization. Waste Selection criteria.

Unit 3:

Technologies for Waste to Energy; Biochemical Conversion – Energy production from organic waste through anaerobic digestion and fermentation. Thermo-chemical Conversion – Combustion, Incineration and heat recovery, Pyrolysis, Gasification; Plasma Arc Technology and other newer technologies.

Unit 4:

Waste to Energy Options; Landfill gas, collection and recovery. Refuse Derived Fuel (RDF) – fluff, briquettes, pellets. Alternate Fuel Resource (AFR) – production and use in Cement plants, Thermal power plants and Industrial boilers. Conversion of wastes to fuel resources for other useful energy applications. Energy from Plastic Wastes – Non-recyclable plastic wastes for

energy recovery. Energy Recovery from wastes and optimization of its use, benchmarking and standardization. Energy Analysis.

Unit 5:

Waste To Energy & Environmental Implications; Environmental standards for Waste to Energy Plant operations and gas clean-up. Savings on non-renewable fuel resources. Carbon Credits: Carbon foot calculations and carbon credits transfer mechanisms.

Text and Reference books:

1. John Pichtel, Waste Management Practices: Municipal, Hazardous, and Industrial, Second Edition, CRC Press.

2. Banwari Lal and Patwardhan, Wealth from Waste: Trends and Technologies by, TERI Press.
3. S.N Mukhopadhyay, Fundamentals of waste and Environmental Engineering, TERIPress.

4. George Tchobanoglous,Frank Kreith, Handbook of Solid Waste Management, Second Edition,The McGraw-Hill.

Course Outcomes:

To provide the students

1. The knowledge about the operations of Waste to Energy Plants.
2. The various aspects of Waste to Energy Management Systems.
3. with knowledge to carry out Techno-economic feasibility for Waste to Energy Plants.
4. with the knowledge in planning and operations of Waste to Energy plants

OCEAN RENEWABLE ENERGY

Course Content:

Unit 1:

Introduction to wave mechanics; Basic equation; Conservation of mass, momentum and energy in fluid mechanics; Surface stress on a particle; Hydrostatics; Translational equation of motion, Review of vector analysis; Line integrals, Velocity potential, Cylindrical coordinates; Bernoulli equation.

Unit 2:

Small amplitude water wave theory formulation and solution; Governing equation, assumptions and boundary conditions; Solution of linearized water wave boundary value problem for a horizontal bottom.

Unit 3:

Wave properties; Water particle kinematics for progressive waves; Wave classification by relative depth; Particle velocity; Acceleration and orbit geometry; Pressure field; Wave energy; Energy flux and group celerity; Momentum flux; Radiation stress; Wave refraction; Wave diffraction; Combined refraction and diffraction; Nonlinear properties derivable from small amplitude waves. Nonlinear wave equation; Validation of stokes expansion; Solitary wave; Cnoidal wave; Validity of nonlinear wave theories.

Unit 4:

Wave body interaction; Potential flow approach; Force due to real fluid; Morison equation; Total force calculation; Methodology for determining drag and inertia coefficients; Wave force on pipelines resting on the sea floor; Numerical methods for wave loading on arbitrary shapes objects.

Unit 5:

Wave maker theory; Simplified theory for plane wave makers in shallow water; Complete wave maker theory for plane waves produced by a paddle; Planar wave energy absorbers; Cylindrical wave makers; Plunger wave makers.

Text and Reference books:

1. Robert G Dean & Robert A. Dalrymple "Water wave mechanics for engineers and scientists" World scientific publishers.

2. Robert M. Sorensen "Basic wave mechanics: for costal and ocean engineering" John Wiley& sons, Inc.

3. Robert L. Wiegel "Oceanographical Engineering". Prentice-Hall India

4. Maarten W. Dingemans "Water wave propagation over uneven bottom Part 1 - Linear wave propagation".

Course Outcomes:

To provide the students with

1. Good understanding of the fundamentals of tidal turbines and wave energy converter performances

2. The knowledge of how to assess the performances of these technologies.

ZERO EMISSION VEHICLES

Course Content

Unit 1:

Introduction: Introduction to zero emission vehicles, different types of power train / vehicles

Unit 2:

Fundamentals of Internal combustion (IC) engines: Spark ignition and Compression ignition engines; Emissions formation mechanisms in internal combustion engines (UHC, CO, NOx, N2O, PM, etc.), Overview of technologies for achieving zero emission: Lean burn combustion (PCCI and HCCI); Controlled auto ignition; Homogeneous charge preparation strategies.

Unit 3:

Hydrogen fuelled IC engines: Back firing; Power drop; Fuel induction techniques; Technologies for improvement of power and thermal efficiency; NOx emission reduction technologies and strategies: exhaust gas recirculation, water injection, after treatment devices (selective catalyst reduction, Lean NOx Trap, particulate trap, oxidation catalyst, etc.).

Unit 4:

Hybrid vehicles: Introduction, Classification; Advantages and disadvantages; IC engines with electrical motor system; Regeneration of energy through breaking: Power-torque characteristics;

Fuel economy improvement for urban driving cycle. Battery operated vehicles: Type of battery for vehicle applications; Accessories of battery operated vehicles; Battery recharging systems; Variable frequency drive. Fuel cell vehicles: Introduction; Fuel cell system; Classification; Speed-Torque and Speedpower characteristics; Operational issues; Overall efficiency; Power output; Comparison of fuel cell and IC engines at same conditions for their efficiency and transient performance.

Unit 5:

Environment impact (assessment of CO2 emission) of zero emission vehicles.

Text & Reference Books:

1. Babu M. K. G., Subramanian K. A., Alternative Transportation Fuels: Utilization in Combustion Engines, CRC Press(2013).

2. Willard W. P., Engineering Fundamentals of the Internal Combustion Engine, Pearson Prentice Hall(2008).

3. Addy M. W., Khair M. K., Diesel Emissions and Their Control, SAE International (2006). 4. Ferguson C. R., Allan T. K., Internal Combustion Engines Applied Thermosciences, John Wiley & Sons, Inc. (2001).

5. Turns S. R., An Introduction to Combustion, McGraw-Hill Companies(2000).

6. Heywood J. B., Internal Combustion Engine Fundamentals, McGraw-Hill, Inc. (1988).

Course Outcomes:

To provide the students with

1. Knowledge of various transportation vehicles with zero/near-zero emissions in details.
2. Knowledge-base for development of sustainable transportation vehicle.

SAFETY IN ENGINEERING INDUSTRY

Course Content

Unit 1:

Introduction - definitions - classification of engineering industry - different process in engineering industry.

Unit 2:

Foundry operations - furnace - health hazard - safe methods of operation. Forging operations - heat radiation - maintenance of machines - final checking of tools, guards, lubrication, shop equipment and hand tools - safe work practice. Operations in hot and cold rolling mills.

Unit 3:

Safety in the use of power presses - shearing -bending - rolling - drawing - turning - boring - milling - planning - grinding. Selection and care of tools - health hazards and prevention.

Unit 4:

Safety in welding, cutting, finishing, cleaning, polishing, buffing. Safety in heat treatments - safety in handling and storage, disposal of effluents - health precautions, elimination and prevention of long time exposure to the hazardous fumes, source of fumes, ventilation and fume protection.

Unit 5:

Care and maintenance of common elements used in material handling Equipment like rope chains slings, hooks, clamps, general safety consideration in material handling - manual and mechanical handling. Handling assessments - handling techniques – lifting, carrying, pulling, pushing, palletizing and stocking. Occupational diseases due to physical and chemical agents.

Text Books and Reference Books

1. Som, S C and Biswas, G. "Introduction to fluid mechanics and Fluid Machines" McGraw Hill Publishing Company, New Delhi

2. Young, D. F., Munson, B. R., Okiishi, T. H., & Huebsch, W. W. (2010). A brief introduction to fluid mechanics. John Wiley & Sons.

3. Kumar, D. S. (2015). Fluid Mechanics and Fluid Power Engineering. Katson Books

4. Accident Prevention Manual, 13th Edition, Engineering and Technology- NSC Chicago

5. ILO Encyclopedia of Occupational Health and Safety - Part XIII, Manufacturing Industries

TQM & TPM

Course Content

Unit 1:

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - - Barriers to TQM - Quality statements - Customer focus - Customer orientation, Customer satisfaction, Customer complaints, and Customer retention - Costs of quality.

Unit 2:

Juran Approach to Quality: Juran,Trilogy, Contributions of Deming, Juran and Crosby Shigeo Shingo, Ishikawa, Meaning Kaizen –Innovation, Kaizen Management Practices, TQC. The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types. Control Charts - Process Capability - Quality Function Development (QFD) - Taguchi quality loss function

Unit 3:

Need for ISO 9000 - ISO 9001-2015 Quality System - Elements, Documentation, Quality Auditing - QS 9000 - ISO 14000 - Concepts, Requirements and Benefits - TQM Implementation in manufacturing and service sectors. Introduction of TPM, Eight Pillars of TPM, Six big losses,

Traditional model of TPM, Overall equipment efficiency (OEE) and its calculation. Changing Company Culture; Xerox Corporation – Using TQM as a Competitive Strategy; Motorola's Secret to TQC; Motorola's Quest for Quality.

Text Books and Reference Books

1. Evans, J. R., Dean J. W. Total quality management, organization and strategy. Thomson, 2003.

2. Kanji G. K., Asher M. 100 Methods for Total Quality Management. London: SAGE Publications, 1996.

3. Oakland G. F. Total Quality Management, Oxford, 1995.

4. Goetsch D. L., Davis S. B. Quality management. Introduction to TQM for production, processing and services. New Jersey: Prentice Hall, 2003. Longman Publishers. ISBN: 9780582285972.

5. Besterfield, DH, et.al. 2003, Total Quality Management, 3rd edn, Prentice Hall

6. Goetsch, DL & Davis, B 2006, Quality Management: Introduction to Total Quality Management for Production, Processing and Services, 5th edn, Pearson

7. Gryna FM 2001, Quality Planning & Analysis, 4th edn, Jr., McGraw-Hill

GLOBAL DISASTER SCENARIO AND TYPE OF NATURAL DISASTER

Course Content

Unit 1:

Introduction - Disaster Management Cycle, Public administration/policy and emergency management – incident command center – training need analysis and human resource development plan – corporate/public agency coordination and the human element in preparedness planning. Institutional framework in India for disaster preparedness and mitigation

Unit 2:

Earthquake: Introduction – general characteristics – mechanism – causes and effects – prediction - seismic zones and waves – vulnerability – damage potential – magnitude and intensity – geological and geographical analysis – epicenter – characteristics of general motion and attenuation. Landslide and land degradation: Causes – tectonic conditions – erosion – avalanches – rock fall – damage assessment.

Unit 3:

Floods: General characteristics – causes – geomorphology and floods – flood forecasting – river and coastal flood – flash flood – lake outburst – risks, environmental planning – flood control

and management. Cyclone and Tsunami: Structure and nature of cyclones and Tsunamis – characteristics hazard donation – factors-hazard potential – impact assessment.

Unit 4:

Manmade hazards: Toxic chemicals – noise pollution – environment ground water pollution and management – solid waste management. Terrorist disaster/War: Hazardous wastes – reactivity – toxicity – nuclear war – biological weapons – armed conflicts – land mines etc.

Unit 5:

National & World Wide Scenario: History of disasters - various disasters in various countries - Disasters in India Relief and rehabilitation in disasters at local, national and global levels, Gaps in disaster management identified on analysis, Worldwide Aid and Agencies, Study of different case studies on natural disaster & man-made disaster.

Text Books and Reference Books

1. Donald Hyndman, David Hyndman "Natural Hazards and Disasters" Third Edition

2. Coppola P Damon, 2007. Introduction to International Disaster Management, Carter, Nick 1991.

3. Disaster Management: A Disaster Manager's Handbook. Asian Development Bank, Manila

4. Government of India, Ministry of Home Affairs, National Disaster Management Division, 2004, Disaster Management in India – A Status Report

5. National Policy on Disaster Management 2009, NDMA, Government of India.

GREEN BUILDING & ENERGY MANAGEMENT

Course Objective:

1. To study about the concepts of green building and low energy approaches.

2. To get a thorough knowledge about Green building systems, auditing and energy management.

3.Recognize and demonstrate methods for green project management, certification registration and documentation and green rating system compliance.

Course Contents:

Module 1: Green Composites for buildings - Concepts of Green Composites - Water Utilisation in Buildings, Low Energy Approaches to Water Management - Management of Solid Wastes , Sullage Water and Sewage - Urban Environment and Green Buildings - Green Cover and Built

Environment. Comfort in Building, Thermal Comfort in Buildings- Issues, Heat Transfer Characteristic of Building Materials and construction techniques, and Incidence of Solar Heat on Buildings-Implications of Geographical Location- Green management in India - relevance in twenty first century.

Module 2: Environmental reporting and ISO 14001,Climate change business and ISO 14064 , Energy and resource conservation-Principles, Design of green buildings-rating systems-LEED Standards – Indian green building council rating system for various types of projects

Module 3: Fundamentals of Energy - Energy production systems - Heating, Ventilating and Air conditioning - Solar Energy - Energy Economic Analysis - Energy Conservation and Audits - Domestic Energy Consumption - Savings - Primary Energy use in Buildings – Residential - Commercial - Institutional and Public Buildings.

Module 4: Energy in Building Design-Energy Efficient and Environmental Friendly Building-Climate, Sun and solar radiation-Psychometrics-Passive Heating and Cooling Systems- Energy Audit-Types - analysis of results-Energy flow diagram-Energy consumption/Unit production-Identification of wastage-Priority of conservative measures-Maintenance of Energy Management Programme

Module 5: Energy Management of Electrical Equipment-Improvement of Power Factor-Management of Maximum Demand- Energy Savings in Pumps – Fans – Compressed Air Systems-Lighting Systems-Air Conditioning Systems –Operation and Maintenance-Modifications- Energy Recovery Dehumidifier- Water Heat Recovery-Steam Plants.

References:

1. Osman Attmann, (2010), "Green Architecture Advanced Technologies and Materials". McGraw Hill.

2. Md. Zakiur Rahman, Most. Sharmin Islam, Md. Shahedur Rashid, (2012) "Practice of Green Building Technologies and Water Conservation Process" LAP Lambert Academic Publishing.

3. Sam Kubba, (2012). "Handbook of Green Building Design and Construction: LEED, BREEAM, and Green Globes" Elsevier Science.

AUTOMATION IN CONSTRUCTION INDUSTRY

Course Objective:

1. To get knowledge about application of automation and use of robots in construction.
2. To learn the basic concept of Sensors and inspection
3. To study the existing and prototype equipment for construction.
4. To study on Data networking, robotic technologies for prefabrication elements.

Module 1: Concept and application of Building Management System (BMS) and Automation. requirements and design considerations and its effect on functional efficiency of building automation system, architecture and components of BMS- Review and analysis of state- of –art in construction automation .Field sensors actuators, controllers, non-destructive evaluation, data acquisition , examples of sensors in existing automated equipment

Module 2: Off- site automation in construction Information processing (computer applications), materials processing, case study (concrete batch plant) - Existing and prototype equipment for construction – case study (concrete placement and finishing), final product design session

Module 3: Introduction to building automation systems – components– Heating, ventilation, and air conditioning (HVAC)– Lighting – Electrical systems water supply and sanitary systems– Fire safety – security -Communication and office automation system -Water pump monitoring & control - Control of Computerized HVAC Systems

Module 4: Data networking– IBMS system and its components – Centralized control equipment's – substation and field controllers – Gamma building control – energy-efficient building and room automation.

Module 5: Automation and robotic technologies for customized component, module and building prefabrication- Elementary technologies and single – Task construction robots - Site automation-robotic on site factories.

Selecting robot- Activated concrete cutting robot, concrete floor finishing robot- Ceiling panel positioning robot- Exterior wall painting robot-safety and training- case studies.

References:

1. Javad Majrouhi Sardroud, (2011),"Automated Management of Construction Projects" LAP Lambert Academic Publishing.

2. Wang Shengwei, (2010), "Intelligent Buildings and Building Automation" Taylor & Francis Group.

3. Majrouhi Sardroud Javad, (2014), "Automation in Construction Management" Scholars' Press.

4. HongleiXu and Xiangyu Wang, (2014), "Optimization and Control Methods in Industrial Engineering and Construction (Intelligent Systems, Control and Automation: Science and Engineering)" Springer.

CONSTRUCTION TECHNIQUES OF DEEP FOUNDATIONS

Course Objective:

1.To understand the various types of deep foundations.

2.To know the various methods and techniques involved in construction of deep foundations

3.To know the various equipment involved in construction of deep foundation.

4. To understand the management and safety requirements in construction of deep foundations

5.To know the concept of sheet piles, coffer dams and reinforced earth walls.

Course Contents:

Module 1: Introduction- Preliminary investigations, subsurface exploration, data interpretation and estimation of various sub-soil properties; Types of deep foundations; Requirements for deep foundations; Codal provisions on safety requirements for deep foundations.

Module 2: Classification of bored piles; Construction methods and construction sequences of bored piles; Equipment's used for boring, drilling and concreting; Piling supervision and quality assurance;Design considerations and pile capacity

Module 3: Classification of driven piles; Selection of type of piles and method of installation; Pile driving equipment's; Construction and quality assurance of driven piles; Advantages and disadvantages of driven piles; Pile damages and pile integrity test; Design considerations and pile capacity

Module 4:Types of wells or caissons; Different shapes of well; Drilled shafts and caissons; Methods and construction sequences; Design procedure; Advantages and disadvantages of well foundation. Deep excavations and protection systems; Applications of diaphragm wall; Diaphragm wall construction methods; Design procedure; Advantages and disadvantages.

Module 5: Sheeting and bracing systems in shallow and deep open cuts in different soil types – Cantilever sheet piles, Anchored sheet piles; Construction methods and sequences; Design procedure; Merits and demerits. Types of Coffer dams; Coffer dams components and construction sequences; design procedure for cellular coffer dam; merits and demerits

References:

1. Bowles, J. E., (2011), Foundation Analysis and Design, 7th Edition, McGraw Hill Book Co., New York.

2.Das. B. M., (2010), Principles of Foundation Engineering, CL Engineering.

3.Huang A.B., Yu H.S, (2018) Foundation Engineering Analysis and Design, CRC Press, Taylor & Francis group.

4.Fang. H.Y.,(2012), Foundation Engineering Handbook, Springer Science and Business Media.

5.Varghese. P. C., (2009), Design of Reinforced Concrete Foundations, Prentice Hall of India, New Delhi.

6.Tomlinson M and Woodward J. (2008). Pile Design and Construction Practice" 5th Edition. Taylor and Francis.

7.BIS 2911 (Part 1/Sec 1, Sec 2, Sec 3 and Sec 4) (2010) Design and construction of pile foundations-code of practice (Driven cast in-situ concrete piles), Bureau of Indian Standards, New Delhi.

CONSTRUCTION TECHNIQUES OF STEEL AND CONCRETE COMPOSITE STRUCTURES

Course Objective:

1. To introduce the concept of steel-concrete composite construction and their applications in engineering

2. To understand the various types of connections in steel & steel-concrete composite construction

3.To learn the methodology, construction sequence & techniques of framed industrial structures

4.To equip students withbasic concept of sandwich construction

B.Tech Civil Engineering Departmental Elective

Course Contents:

Introduction to Steel - Concrete Composite Construction - Theory of Composite Structures - Introduction to Steel - Concrete - Steel - Sandwitch Construction - Behaviour of composite beams and columns

Types of steel structures, grades of structural steel, various rolled steel sections, relevant IS specifications such as IS:800-2007, IS:808-1989, IS:875 part I to III, SP: 6(1), SP: 6(6), SP38. IS:4000- 1992, codes for welded connections , Philosophy of limit state design for strength and serviceability, partial safety factor for load and resistance, design load combinations.

Bearing type joints - Unstiffened and stiffened seat connections - Moment resisting connection of brackets-Bolted and welded-semi-rigid connections - Types of weldings – Types of rivets.

Industrial buildings- construction techniques of braced and unbraced - Gable frames with gantry-Rigid industrial frames – Fixing and assembly of steel structures.

Introduction to steel-concrete compsite structures - construction techniques for composite structures – composite beam – column construction - shear connectors – behaviour – flextural stress – longitudinal shear transfer – transfer shear.

Basic design concept of sandwich construction – Materials used for sandwhich construction – Failure modes.

Various open and closed mould process – fibers types – resins types – properties and application – composite structures – maintenance and repair.

References:

1. Johnson R.P. (2012), Composite Structures of Steel and Concrete: Beams, Slabsm Columns and Frames for Buildings, Wiley India Pvt Ltd.

2. Brian Uy and Zhong Tao (2018), Behaviour and Design of Composite Steel and Concrete Building Structures ,CRC Press.

3. Panchal D R, (2014), Composite Steel-Concrete Structures, Scholars Press.

ESTIMATING TENDERING & BIDDING

Course Objective:

1. To understand the various types of estimates and process involved in sanction of budget for a project.

2. To study about analysis of rate and standard methods followed by different organizations.

3. To attain the knowledge about the specification and its importance in a project.

4. To know the about the tendering and its process in construction.

5. To attain the knowledge about contracts, types of contracts, contract documents and roles and functions of participants to the contract.

6.To obtain the knowledge about the conditions of contract, Bidding and Bidding models.

Course Contents:

Project cost estimation - Approximate Estimate and administrative approval - expenditure sanction - Detailed Estimate.

Rate analysis - standard methods as followed by government organizations for tendering purposes - as followed by contractor organizations for bidding Purposes.

Definitions, relationship with drawings, purpose, benefits, organization of specification, rafting/writing the specifications, types of specifications.

Preparation of tender documents estimating, pre-qualification, bid evaluation, award of contract, project financing and contract payments, contracts close out and completion, E-tendering.

Contracts, types of construction contracts, Evaluation of contract documents, need for documents, present stage of national and international contract documents, roles and functions of participants to the contract.

Clarification by parties to contract, obligations and responsibilities of the parties, protection and indemnification, bonds and insurance, subsurface conditions, inspection of work, change of work, rejected work and deficiencies.

Bidding models and bidding strategies, Owner's and contractor's estimate - Overhead charges - Internationally adopted formulae. Enlistment of contractors.

Refrences:

1. Jimmie Hinze, (2013) , Construction Contracts, McGraw Hill, New Delhi

2.Will Hughes, Ronan Champion, John Murdoch, (2015), Construction Contracts: Law and Management, Routledge.

3.Construction Specifications Institute, (2011), The CSI Construction Contract Administration Practice Guide,Wiley. Brian Greenhalgh, (2016). Introduction to Construction Contract Management, Routledge

FORMWORK FOR CONCRETE STRUCTURES

Course Objectives:

1. To develop the conceptual understanding of design, construction and erection of formwork.
2. To impart the knowledge about different types of form work used for special structures.

Module 1: Introduction –Types of Form work- Forms for foundations, columns, beams walls etc., General objectives of formwork building - Detailed planning - Calculation of labour constants Scaffold frames - Framed panel formwork Lumber - Types - Finish - Sheathing boards working stresses - Repetitive member stress - Plywood - Types and grades - Jointing Boarding - Textured surfaces and strength - Reconstituted wood - Steel – Aluminum

Module 2: Formwork Accessories -Hardware and fasteners - Nails in Plywood - Allowable withdrawal load and lateral load. Pressures on formwork - Examples - Vertical loads for design of slab forms - Uplift on shores - Laterals loads on slabs and walls.

Design Principles - Allowable stresses - Design of Wall forms - Slab forms - Beam forms - Column forms - Design Tables for Wall formwork - Slab Formwork - Column Formwork - Slab props - Stacking Towers - Free standing and restrained - Rosett Shoring - Shoring Tower - Heavy Duty props.

Module 3: Carpentry Shop and job mill - Forms for Footings - Slab form systems - Sky deck and Multiflex - Customized slab table - Standard Table module forms - Swivel head and uniportal head - Assembly sequence - Cycling with lifting fork - Moving with table trolley and table prop. Various causes of failures - ACI - Design deficiencies - Permitted and gradual irregularities.

Module 4: Hemispherical, Parabolic, Translational shells - Typical barrel vaults - Folded plate roof details - Forms for Thin Shell roof slabs design considerations - Strength requirements - Tunnel forming components - Curb forms invert forms - Arch forms - Concrete placement methods - Cut and cover construction - Bulk head method - Pressures on tunnels - Continuous Advancing Slope method - Form construction - Shafts.

Module 5: Slip Forms - Principles -Types - Advantages - Functions of various components - Planning -Desirable characteristics of concrete - Common problems faced - Safety in slip forms special structures built with slip form Technique - Types of scaffolds - Putlog and independent scaffold -Single pole scaffolds - Truss suspended - Gantry and system scaffolds.

References:

1.Oberlender G.D and Peurifoy R. L. (2010), Formwork of Concrete Structures, 4th Edition McGraw Hill Education, New Delhi.

2.Christopher Souder , (2014), Temporary Structure Design, Wiley Publications, London.

3.Kumar. NeerajJha, (2017), Formwork for Concrete Structures, McGraw Hill Education, New Delhi.

4.Leonard Koel , (2015), Concrete Formwork, American Technical Publisher, USA.

5.ACI 347R-14: Guide to Formwork for Concrete, ACI Committee 347, American Concrete Institute.

CONSTRUCTION ECONOMICS

Course Contents:

Module 1: Role of Civil Engineering in Industrial Development - Support matters of Economy as related top Engineering- Market demand and supply - Quality control and Quality Production - Audit in economic law of returns, governing production.

Module 2: Time value of money, Quantifying alternatives for decision making, Cash flow diagrams, Equivalency - Single payment in the future - Present payment compared to uniform series payments - Future payment compared to uniform series payments - Arithmetic gradient, Geometric gradient.

Comparison of alternatives: Present, future and annual worth method of comparing alternatives, Rate of return, Incremental rate of return, Break-even comparisons, Capitalized cost analysis, Benefit-cost analysis.

Module 3: Real Estate - Investment Property, Equipment Replace Analysis, Depreciation – Tax before and after depreciation – Value Added Tax (VAT) – Inflation.

Module 4: Financial statements – Profit and loss, Balance sheets, Financial ratios, Working capital management, Inventory valuation, Mortgage Financing - International financial management- foreign currency management.

Module 5: Cost estimating: Types of Estimates, Approximate estimates – Unit estimate, Factor estimate, Cost indexes. Fixed contract Pricing- Cost plus pricing- Escalation clause-Construction cost control, Personnel costs, Equipment costs, Job in directs and markup.

Balance sheet and Profit and Loss accounts – ratios analysis, Fund flow statement, Cash flow statement, Working Capital Management, Financial Control - Management accounting.

References:

1. Anthony Higham,Carl Bridge, Peter Farrell, (2016), Project Finance for Construction, Routledge.

2.Steven J. Peterson , (2012), Construction Accounting & Financial Management, Pearson, USA

3.Senthil, L. Madan and N. Robindro Singh (2011), Engineering Economics and Cost Analysis, Lakshmi Publications, New Delhi.

4.Karl E. Case , Ray C. Fair and Sharon E. Oster (2017), Principles of Economics, Pearson, New Delhi.

5.Leland Blank and Anthony Tarquin, (2017), Engineering Economy, 7th Edition, McGraw Hill Education, New Delhi.

INFRASTRUCTURE VALUATION

Concepts: Introduction, History of value engineering, Value, Function, Cost, Worth, Case Study Discussions.

General Techniques in Infrastructure Valuation: General Techniques -Brainstorming Technique, The Gordon Technique, Feasibility Ranking, The Morphological Analysis Technique, ABC Analysis, Probabilistic Approach, Make or Buy Technique, Case Study Discussions.

Special Techniques in Infrastructure Valuation: Special Techniques - Function – Cost – Worth Analysis, Function Analysis System Technique - Technically oriented FAST and Customer-oriented FAST, Weighted Evaluation Method - Equal Importance Method, Descending Order of Importance Method, Numeric Analysis - Forced Distribution Technique, Quantitative Method, Predetermined Minimum Method, Evaluation Matrix, Break-even Analysis, Life Cycle Cost (LCC), Case Study Discussions.

Applications of Infrastructure Valuation: Team Dynamics - Team Structure and Team Building, Definition of the creative and structured phases of value engineering, The workshop approach to achieving value, Target setting, Time management, Case Study Discussions.

References:

1. Anil Kumar Mukhopadhyaya, Value Engineering Concepts, Techniques and Applications, Response Books, 2013.

2. Anil Kumar Mukhopadhyaya, Value Engineering Mastermind from Concept to Value Engineering Certification, Response Books, 2009.

3. Lawrence D. Miles, Techniques of Value Analysis and Engineering, McGraw-Hill Book Company, 2009.

4. M.R.S. Murthy, Cost Analysis for Management Decisions, Tata McGraw-Hill Publishing Company Ltd., 1988.

B.Tech Civil Engineering Departmental Elective

STRUCTURAL MASONARY

Introduction: Masonry construction-National and International perspective- Historical development, Modern masonry, Principles of masonry design, Masonry standards: IS 1905 and others.

Material Properties: Masonry units: clay and concrete blocks, Mortar, grout and reinforcement, Bonding patterns, Shrinkage and differential movements.

Masonry in Compression: Prism strength, Eccentric loading, Kern distance.

Masonry under Lateral loads: In-plane and out-of-plane loads, Analysis of perforated shear walls, Lateral force distribution -flexible and rigid diaphragms.

Behavior of Masonry: Shear and flexure- Combined bending and axial loads-Reinforced and unreinforced masonry- Cyclic loading and ductility of shear walls for seismic design - Infill masonry.

Structural design of Masonry: Working and Ultimate strength design- In-plane and out-of-plane design criteria for load-bearing -and in fills, connecting elements and ties- Consideration of seismic loads-Code provisions. Seismic evaluation and Retrofit of Masonry: In-situ and non-destructive tests for masonry- properties-Repair and strengthening of existing masonry-structures for seismic loads.

References:

1. Drysdale, R. G. Hamid, A. H. and Baker, L. R. Masonry Structures: Behavior & Design, Prentice Hall (1994).

2. Hendry, A. W., Structural Masonry, Mc Millan, UK, 2nd edition. (1998)

3. Hendry, A. W., Sinha, B. P. and Davies, S. R., Design of Masonry Structures, E&FN Spon, UK, (1997)

4. Schneider, R. S. and Dickey, W. L., Reinforced Masonry Design, Prentice Hall, 3rdedn. (1994)

5. Paulay, T. and Priestley, M. J. N., Seismic Design of Reinforced Concrete and Masonry Buildings, John Wiley. (1992)

ENVIRONMENTAL SCIENCES		
Unit	**Topics**	**No. of Lectures**
I	**Multidisciplinary nature of Environmental Science**: Definition, Scope, Importance and Need of Public Awareness. Structure of Environment.	8
II	**Ecosystem:** Concept of ecosystem, structure and function of ecosystem, food chain food web and ecological pyramid. Different types of ecosystems (Forest, Grassland & Pond).	8
III	**Natural Resource and associated problems:** Use and over exploitation of forest resource, deforestation. Mining and their effects. Use and Overutilization of surface and ground water, Effect of modern agriculture.	8
IV	**Environmental pollution and their effects:** Water pollution, Air Pollution, Noise pollution, Soil pollution, Solid waste management.	8
V	**Environmental Protection:** Environmental Laws, Role of individual and NOG's in environmental protection, Sustainable development.	8

References:

1. Bharucha Erach, The biodiversity of India, Mapin Publishing Pvt. Ltd. Ahmedabad.
2. Cunninghum, W. P., Cooper, T. H., Gorhani, E and Hepworth, M.T. 2001. Environmental encyclopedia, Jaico Publ. House, Mumbai.
3. Miller, T. G. Jr Environmental Science system and solution, Web enhanced edition.

Engineering Geology

Course Objectives: The course aim to develop the learner's ability to understand application of the geological sciences to engineering projects i.e., geological factors regarding the location, design, construction, operation and maintenance of engineering works

Course Outcomes:

After completing the course, student:

Will learn origin of solar system and Earth
Will understand internal structure of Earth
Will understand interpretation stress-strain imprinted in earth, Interpretation of deformed structure and its application in civil engineering
Will learn the minerals, Rocks and it types, the crystal formation, form and occurrences and its application in civil engineering
Will learn the engineering properties of the rocks and soils
Will understand the construction of dam, tunnel and safety of roads in hilly regions

Unit	Topics	No. of Lectures
I	Origin of Earth, Age of Earth, Internal Structure and composition of Earth, Geological work of natural agencies and engineering considerations.	06
II	Introduction to structural geology; Primary and secondary structures; Fold and folding, Fault and faulting; Joint and jointing; Engineering considerations.	18
III	Study of minerals and rocks; Its engineering importance. Laws of crystallography; Crystal morphology; Crystallographic axes; Elements of symmetry; Crystallographic notations; Crystal system Definition of mineral; Physical properties of minerals Brief introduction to rocks belonging to igneous, sedimentary and metamorphic	12
IV	Engineering properties of the rocks and soils; Soil and Soil groups of India	12
V	Geological consideration for geo-engineered structures; Dams and reservoir; Tunnels and Road cuts; Improvement of sites	12

Suggested Readings:

1. L.D. Leet, S. Judson and M.E. Kauffman, (1982): Physical Geology. Prentice-Hall Inc. 629p.
2. Ghosh, S. K., 1993. Structural Geology: Fundamentals, and modern developments.

Pergamon Press

3. Berry, L.G., Mason, B. and Dietrich, R.V. (1985): Mineralogy: Concepts, Descriptions, and determinations. C.B.S. publishers.
4. Nesse, William D. (2012): Introduction to mineralogy (2nd Edition). Oxford University Press.
5. Phillips, F.C (1971): Introduction to Crystallography. Longman Group Publication.
6. Sands, Donald E. (1975): Introduction to crystallography.Dover Publications, Inc. New York.
7. Krynine D.P. and Judd W.R., 1957. Principles of Engineering Geology & Geotechnics. McGraw-Hill.
8. Winter, J. D. 2001. Igneous and Metamorphic Petrology. Prentice Hall.
9. Petti john, F. J. (1975): Sedimentary Rocks (3rd Edition). Harper and Row Publisher.
1. Kesavulu, N.C., 2009. A text book of engineering geology. Macmillan P publishing India Ltd.
2. Bell, F.G., 1983. Fundamentals of Engineering Geology. Butterworth and Co

B.Tech Civil Engineering Open Elective

OPEN ELECTIVES

S.NO	SUBJECT	SUBJECT CODE
1.	Environmental Impact Assessment	OCE 001
2.	Disaster Management	OCE 002
3.	Project Appraisal & Development management	OCE 003
4.	Project Planning & scheduling	OCE 004
5.	Artificial Intelligence	OCE 005
6.	Internet of Things & 5G	OCE 006
7.	Climate Change: Impact	OCE 007
8.	Industrial Disasters and Safety	OCE 008
9.	Hydrological Data Collection, Processing and Analysis	OCE 009
10.	Disaster Induced Risks	OCE 010

B.Tech Civil Engineering Open Elective

ENVIRONMENTAL IMPACT ASSESSMENT

Course Objectives: To acquire knowledge

- To understand the concepts of ecology, sustainable development and EIA.
- To explore current EIA process in India.

Course Outcomes:

1. To demonstrate a knowledge of ecology, and sustainable development.
2. To demonstrate a knowledge of EIA
3. Apply knowledge for efficient drafting of EIA report.

Unit	Topics	No. of Lectures
I	Environmental management- problems and strategies - Review of political, ecological and remedial actions - future strategies - multidisciplinary environmental strategies decision making and concepts of sustainable development. Concept of environmental audit - Life Cycle Analysis (LCA) - Environmental Management System - Introduction to ISO 14000, OSHA and Clean Development Mechanism (CDM) & Carbon credits.	8
II	Introduction to various major natural disasters – flood, tropical cyclone, droughts, landslides, heat waves, earthquakes, fire hazards, tsunami etc., Factors for disaster – climate change, global rise in sea level, coastal erosion, environmental degradation, large dams, Legislative responsibilities of disaster management. Environmental legislation of Air, Water & Hazardous Waste	8
III	Environment Protection Act-1986 - Regulatory standards of CPCB / GPCB / BIS - EIA need and Notification - Environmental clearance.	8
IV	Introduction and Planning: Evolution of Environmental Impact Assessment - concepts of EIA - EIA methodologies screening and scoping - rapid and comprehensive EIA - General framework of EIA - characterization and site assessment - Environmental inventory - Prediction and assessment of impact - Impact assessment methodologies like adhoc method, checklist, overlap, network, model and index method. Decision methods of evaluation of alternatives - development of decision matrix - Public participation in environmental decision making - Objective of public participation -Technique for conflict management and dispute resolution- Verbal communication and Public Hearing in EIA studies - Status of EIA in India - Some typical case studies of EIA industrial and infrastructure projects.	16

Suggested Readings:

1. Environmental Impact Analysis by Urban and Jain.
2. Environmental Impact Analysis by Canter.
3. Environmental Impact Assessment Methodologies by Y Anjaneyulu, and ValliManikkam, BSP Books PVT Ltd
4. Environmental Impact Assessment by Anji Reddy, BSP Books PVT Ltd.

B.Tech Civil Engineering Open Elective

DISASTER MANAGEMENT

Course Objectives

- To impart knowledge about the disaster Management
- To introduce the fundamental concepts relevant to various aspect of disaster
- To enable the students to understand the factors that causes the disaster.
- To be able to assess risk and vulnerability for natural and man made hazard

Course Outcomes

After learning the course the students should be able to:

1: Understand disasters, disaster preparedness, role of IT, remote sensing, GIS and GPS,

2: Understand Rehabilitation, Reconstruction And Recovery,

3: Apply knowledge Disaster Response And Management, Risk Assessment and Vulnerability Analysis.

4: Understand Disaster Mitigation.

Unit	Topics	No. of Lectures
I	Introduction to Natural & Man-made Disasters : Understanding Disasters, Geological and Mountain Area Disasters, Wind and Water Related Natural Disaster, Man Made Disasters	10
II	Technologies for Disaster Management Role of IT in Disaster Preparedness, Remote Sensing, GIS and GPS, Use and Application of Emerging Technologies, Application of Modern Technologies for the Emergency communication, Application and use of ICT for different disasters. Rehabilation, Reconstruction and Recovery Introduction & Basic concept	14
III	Disaster Response And Management: Introduction to Response Essential Components, Stakeholders Co-ordination in Disaster Response, Human Behaviour and Response Management and Relief Measures Behaviour and Response Management and Relief Measures	10
IV	Disaster Mitigation : meaning and concept, Disaster Mitigation Strategies, Emerging Trends in Disaster Mitigation, Mitigation management, Role of Team and Coordination.	06

Suggested Readings:

1. Natural Hazards by Bryant Edwards, Cambridge University Press, U.K.
2. Disaster Management by Carter, W. Nick, Asian Development Bank, Manila.
3. Disaster Mitigation Experiences and Reflections by Sahni, Pardeepet.al., Prentice Hall of India, New Delhi.
4. Space Technology for Disaster management: A Remote Sensing & GIS Perspective by Roy, P.S., IIRS (NRSA) Dehradun.
5. Natural Disaster by Sharma, R.K. & Sharma, G, APH Publishing Corporation, New Delhi.
6. Disaster Management in the Hills by Singh Satendra, Concept Publishing Company, New Delhi.
7. Disaster Management through Panchayati Raj by Tanti, K. Concept Publishing Company, New Delhi.

B.Tech Civil Engineering Open Elective

PROJECT APPRAISAL & DEVELOPMENT MANAGEMENT		
Unit	Topics	No. of Lectures
I	Philosophy of project, Project goals, Project Formulation, Life Cycle Analysis, Feasibility and Impact Analysis, Effectiveness Analysis, Multi Criteria Evaluation Methods, Analytical Hierarchal Method, Decision Making Under Risk	10
II	Project Appraisals: Types of appraisals, Project cost, Project financing, Economic evaluation methods, Case Studies of Projects, Environmental Appraisal, Financing of transport infrastructure, Public – Private Partnership-BOT, BOOT etc., Risk & Sensitivity analysis, Break even analysis.	14
III	Philosophy of Management, Project Organisation, Management Techniques, Network approach, Project Planning Software applications, Safety management, Labour organization and labour laws, Project cost & time management, Management Case Studies.	10
IV	Development Management: Concepts, components, principles, organizational structures of urban Local Government, functions & responsibilities, related Municipal Corporation Act, Town Planning Act, case studies of organizational structures of metropolitan cities in India	06

Suggested Readings:

1. Nicholas, J., M., Project Management for Business & Technology, PHI (2002)
2. Mathur B.L., Project Management, Arihant publications House, Jaipur, 1994
3. Ghosh S., Project Management & Control, New Central Book Agency Ltd., 1997
4. Goel B.B., Project Management, Deep & Deep Publication, New Delhi, 1987
5. Municipal Corporation Act and Town Planning Act.

B.Tech Civil Engineering Open Elective

PROJECT PLANNING & SCHEDULING

Course Objectives

- Understanding the need of project planning,
- Understanding concept of bar-chart,
- Understanding planning and scheduling using critical path method,
- Understanding planning and scheduling using PERT and PDM, and
- Understanding scheduling of repetitive construction.

Course Outcomes

Upon successful completion of the course, the students will be able to
1: Plan and schedule by bar-chart,
2: Understand the principles of critical path method,
3: Apply PERT and PDM to solving problems of Civil Engineering planning, and
4: Apply LOB to solving problems of repetitive construction planning

Unit	Topics	No. of Lectures
I	Construction Planning: Objectives and functions, stages in construction, work breakdown structure, pre-tender stage planning, contract stage planning, methods of scheduling, bar charts, limitations of bar charts, milestone charts, preparation of material, equipment, labour, and finance schedule.	8
II	Critical Path Method (CPM): Network techniques, element of a network, rules for developing networks, development logics, numbering events, time computations, activity floats, network updating. Resources profile, resources smoothing and resources leveling. Cost versus time, direct cost, indirect cost, total project cost, optimum duration, contracting network for cost optimization.	8
III	Programme Evaluation and Review Technique (PERT): Probability concept in network, optimistic time, pessimistic time, most likely time, variance, standard deviation, slack, central limit theorem, probability of achieving completion time.	8
IV	Precedence Diagram Method (PDM): Precedence networks fundamentals, advantages, logic and precedence networks applications, PDM versus CPM.	8
V	Line of Balancing (LOB) technique in the construction scheduling: Line of balance methods of scheduling repetitive construction	8

Suggested Readings:

1. 1. Construction Project Management, Planning scheduling and controlling, Chitkara, K.K, Tata McGraw-Hill Education.
2. Project Management with CPM and PERT, and precedence diagramming by Moder J.J. Philips, C.R. and Davis, E.W.
3. Project Cost Control in Construction by Pilcher, R., Brien J.J. CPM in "Construction Management", Mc. Graw Hill.

B.Tech Civil Engineering Open Elective

INTERNET OF THINGS & 5G		
Unit	Topics	No. of Lectures
I	Introduction to the IoT:What is the Internet of Things, Technology drives, Business drivers, TypicalsIoT applications, Trends and implications.	8
II	IoT Architecture: Architecture for IoT, Elements of an IoT Architecture, Architectural design considerations.	8
III	IoT Networks Protocols (MAC Layer):Wireless sensor networks (WSN) and power consumption, CSMA/CA and slotting, Centralized vs. distributed, state of the art MAC layer protocols for WSNs.	8
IV	Wireless technologies for IoT (Layer 1 & 3):Bluetooth/Bluetooth smart, Zigbee/Zigbee smart, UMB (IEEE 802.15.4), Proprietary systems.	8
V	IoT applications & 5G: Introduction to IoT device programming, IoT application development, overview of 5G, key parameters of 5G, Massive MIMO for 5G.	8

Suggested Readings:

1. McKinsey global institute report: "Unlocking the potential of the internet of things".
2. Karl, Holger, and Andreas Willig, Protocols and architectures for wireless sensor networks. John Wiley & Sons.
3. E.G. Larson and P. stoica, "5G Massive MIMO wireless coomunication", Cambridge university press 2008

Pune

ARTIFICIAL INTELLIGENCE
Topics
Introduction: Overview of AI problems, AI problems as NP, NP-Complete and NP Hard problems. Strong and weak, neat and scruffy, symbolic and sub-symbolic, knowledge-based and data-driven AI. Search Strategies: Problem spaces (states, goals and operators), problem solving by search, Heuristics and informed search, Minmax Search, Alpha-beta pruning. Constraint satisfaction (backtracking and local search methods). Knowledge representation and reasoning: propositional and predicate logic, Resolution and theorem proving, Temporal and spatial reasoning. Probabilistic reasoning, Bayes theorem. Totally-ordered and partially-ordered Planning, Goal stack planning, Nonlinear planning, Hierarchical planning. Learning: Learning from example, Learning by advice, Explanation based learning, Learning in problem solving, Classification, Inductive learning, Naive Bayesian Classifier, decision trees. Natural Language Processing: Language models, n-grams, Vector space models, Bag of words, Text classification. Information retrieval.
Suggested Readings: 1. Artificial Intelligence by Elaine Rich, Kevin Knight and Shivashankar B Nair, Tata McGraw Hill. 2. Introduction to Artificial Intelligence and Expert Systems by Dan W. Patterson, Pearson Education. 3. Artificial Intelligence: A Modern Approach by S. Russell and P. Norvig, Prentice

CLIMATE CHANGE: IMPACT		
Unit	**Topics**	**No. of Lectures**
I	Climate and Climate Change: Components, Phenomena, raditive forces, Energy budget and transport, atmospheric circulation, ocean circulation, land-surface process, carbon cycle.	8
II	Atmospheric Thermodynamics: Equation of state, Dalton's of partial pressure, Poisson's law, equivalent potential temperature, concept of air parcel, virtual temperature, dry adiabatic lapse rate and saturated adiabatic lapse rate, hydrostatic equilibrium equation, dispersion of air pollutants Physical processes: Conservation of momentum, equation of state, temperature equation, continuity equation, conservation of mass.	8
III	Climate Models: Introduction to GCM and RCM simulations, SRES, downscaling GCM outputs ENSO: El Niño basic, Tropical pacific climatology, El Niño mechanism, ENSO indices, predictions and teleconnections	8
IV	Greenhouse effects and climate feedbacks: Global energy model, greenhouse effect and global warming, climate feedback Climate Model scenarios for global warming: Greenhouse gases, aerosols forcing, global-average response to GhG warming scenarios on temperature, rainfall, sea ice/snow, extreme events	8
V	Extreme Events analysis of climatic parameters, Climate Change Impact Assessment on floods, droughts, Climate Change induced disaster-Case Studies	8

B.Tech Civil Engineering Open Elective

INDUSTRIAL DISASTERS AND SAFETY		
Unit	Topics	No. of Lectures
I	Introduction: Occupational Safety, Health and Environmental Safety Management – Principles & practices. Accident Prevention: Principle, Definition, Incident, accident, injury, dangerous, occurrences, unsafe acts, unsafe conditions, hazards, error, oversight, mistakes etc. Theories/ Models of accident occurrences. Principles of accident Prevention. Accident and Financial implication.	8
II	Safety in Different types of Industries: Chemical Industry, Construction Industry, Transport Industry, Mechanical Industry, Textile Industry, Plastic Industry. Preventive maintenance, periodic checks for safe operation. Associated hazards and their prevention. Safety in maintenance and use of machines.	8
III	Planning for Safety: Definition, purpose, nature, scope and procedure. Range of planning, variety of plans. Strategic planning and tools of implementation, Management by objectives and its role in Safety. Policy formulation and implementation. Safety Committee: Structure and functions, Monitoring for Safety, Employee Participation, Education and training towards safety	8
IV	Designs for Industrial Safety: Plant Design and Housekeeping, Role of preventive maintenance in safety and health. Importance of standards and codes of practice for plant and equipment. Industrial Lighting & Illumination, Ventilation and Heat Stress, Recommended values for air changes required for various areas as per Factories Act, 1948 and National Standards. IS: 3103-1975-Code of practice for Industrial Ventilation, National Building Code Part VIII. Noise and Vibration, Electrical Hazards, Chemical Hazards. Bureau of Indian Standards on Safety and Health: 14489 –1998 and 15001- 2000, ILO and EPA Standards.	8
V	Law and Legislation for Safety: ILO Convention and Recommendation concerning Occupational Health & Safety, The Factories Act, 1948 (Amended) and Rules, Indian Boilers Act, 1923 with allied Regulations, 1961. Indian Electricity Act, 2000 and Rules, Indian Explosives Act, 1984 and Rules. Petroleum Act and Rules. Gas Cylinders Rules. Calcium Carbide Rules. The Insecticides Act and Rules. Radiation Protection Rules. Hazardous Material Transportation Rules. Static and Mobile (Unfired) Pressure Vessel Rules, 1981 as amended in 2000. The Dock Workers (Safety, Health & Welfare) Act 1996. The Building and other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996, Fire Safety: International Standards of fire safety norms for Industrial, warehouses and residential areas. Indian norms of fire safety, Analysis of fire and explosion, Individual and societal risk analysis, case discussions of industrial disasters due to fire and explosion.	8
Suggested Readings: 1. C. R. Asfahl& D. W. Rieske, "Industrial Safety And Health Management", Pearson Higher Education 2010		

2. W. Hammer & D. Price, "Occupational Safety Management and Engineering", Prentice Hall 2001

3. B. O. Alli, "Fundamental Principles of Occupational Health and Safety", ILO 2008

4. L. M. Deshmukh, "Industrial Safety Management", Tata Mc-Graw Hill Publishing 2005

5. D. Peterson, "Techniques of Safety Management: A Systems Approach" Mc-Graw Hill Tokyo 2003 6 Masellis M. (Eds.), "The Management of Burns and Fire Disasters Perspective 2000", Kluwer Academic Publisher.

HYDROLOGICAL DATA COLLECTION, PROCESSING AND ANALYSIS		
Unit	Topics	No. of Lectures
I	Hydrologic Cycle, Types of hydrometeorological data and their importance, time oriented, space oriented and relational data, Observation of hydrometeorological data - rainfall, temperature, evaporation, discharge and other parameters, observational and instrumental errors and quality control. Guidelines of WMO, BIS & ISO.	8
II	Storage, transmission and retrieval of data, different formats adopted by IMD, CWC and WMO. Design and optimization of monitoring systems for rainfall, evaporation, gauge and discharge networks and groundwater data monitoring stations.	8
III	Estimation of missing data in rainfall, runoff and other parameters, record extension for rainfall and runoff data, interpolation and kriging techniques, statistical rainfall-runoff models. Development of stage discharge curves using graphical, physical and analytical methods for various Types of streams.	8
IV	Automatic weather stations - types, data storage and retrieval; Automatic water level recorders - types, data storage and retrieval. Analysis of randomness and trends in hydrometeorological data; Computation of statistical parameters and standards errors, components of time series, concepts of short and long term dependence in hydrometeorological data.	8
V	Estimation of extremes using frequency analysis, Graphical and analytical methods for normal, lognormal and Gumbel distributions. Case Studies	8

Suggested Readings:

1. Kottegoda N.T., "Stochastic Water Resources Technology", John Wiley & Sons, 1980.

2. Chow V. T., Maidment D. R. and Mays L. W., "Applied Hydrology", McGraw-Hill, 1988.

3. Maidment, D.R., "Handbook of Hydrology", McGraw Hill Inc. 1993.

4. Singh V. P., "Elementary Hydrology", Prentice-Hall of India Private, 1994.

5. Hornberger G. M., Raffensperger J. P., Woberg P. L and Eshleman K. N., "Elements of Physical Hydrology", The Johns Hopkins University Press, 1998.

6. S.K. Jain & V.P. Singh, "Water Resources Systems Planning and Management", Elsevier ISBN:8131205916 (HB), 2006.

7. Viessman W. and Lewis G. L. "Introduction to Hydrology", Pearson Education, 2007.

8. Subramanya K., "Engineering Hydrology", Tata McGraw Hill Lt, 2008.

B.Tech Civil Engineering Open Elective

DISASTER INDUCED RISKS		
Unit	**Topics**	**No. of Lectures**
I	Introduction and scope: Natural and anthropogenic disasters, Hazards and disasters emergencies, disasters and related concepts, nature-society interface, fragmented Vs systems thinking, concept of disaster systematics, simple and compound disaster.	8
II	Disasters Vs development: Disaster-development linkages, interaction of socio-economic developmental activities and disasters, development plans incorporating disaster risks; Human Development Index (HDI) Vs Disaster Risk Index (DRI), cross-cutting themes in Disaster-Development interface	8
III	Causes and effects of disasters: Hazards, vulnerability and risk; Risks taxonomy according to hazardous agents such as physical, chemical, and biological agents, natural forces, social-communicative hazards, and synergic (or complex) manmade-systems hazards: Risk patterns at the national and local levels, Disasters and climate change, Risk governance framework: Risk perception, pre-assessment, appraisal, Characterization and evaluation, analysis, assessment, communication, management and governance	8
IV	Risk assessment: Hazard identification and estimation, exposure vulnerability assessment, risk estimation: Risk characterization: Simple risk problems complexity-induced risk problems, uncertainty-induced risk problems, ambiguity-induced risk problems	8
V	Impacts of disasters: Impacts on the environment, critical infrastructure and socio-economic systems, factors affecting social vulnerability to hazards, short-term and long-term impacts, systemic resilience, emergency response: Disaster recovery and rehabilitation: Lessons learnt for better policies and programs to effectively mitigate and manage future disasters Present status and future directions in assessment and management of disaster-induced risks and impacts: Hazard specific risk profiles, risks in urban and rural settings, disaster indicators, disaster risk and impacts in the context of global change and technological advancement, mutti-hazard disaster risk and impact modeling: Integrated climate risk management	8

Suggested Readings:

1. Grossi, P. and Kunreuther, H. (eds.). Catastrophe Modeling: A New Approach to Managing Risk, Springer, 2005.

2. Kirschenbaum, Chaos Organization and Disaster Management, Alan Marcel Dekker, 2004.

3. MacDaniels T.L. and Small M.J. (eds.)Risk Analysis and Society: An Interdisciplinary Characterization of the Field, Cambridge University Press, 2001.

4. Jaeger.C., Renn.O., Rosa, E. and Webler, T., Risk, Uncertainty and Rational Action, Earthscan, 2001.

5. WBGU (WissenschaftlicherBeirat der BundesregierungGlobaleUmweltveränderungen). World in Transition: Strategies for Managing Global Environmental Risks, Spring