Course Curriculum

(Course Structure and Syllabi)

for

Bachelor of Technology

in

Civil Engineering

(Second Year Onwards)

Department of Civil Engineering

National Institute of Technology Hamirpur

Hamirpur – 177 005 (India)

Second Year												
3rd Semester							4th Semester					
SN	Code	Subject	L	T	P	Credits	SN	Code	Subject	L	T	P	Credits
1	MA-203	Engineering Mathematics-III	3	1	0	4	1	HS-203	Organizational Behaviour	3	0	0	3
2	CE-211	Determinate Structures	3	1	0	4	2	CE-221	Indeterminate Structures	3	1	0	4
3	CE-212	Fluid Mechanics	3	1	0	4	3	CE-222	Water Resource Engineering-I	3	1	0	4
4	CE-213	Engineering Geology and Rock Mechanics	3	0	0	3	4	CE-223	Soil Mechanics	3	1	0	4
5	CE-214	Surveying	3	1	0	4	5	CE-224	Building Materials and Construction	3	1	0	4
6	CE-215	Engineering Geology Lab	0	0	2	1	6	CE-225	Building Materials Lab	0	0	2	1
7	CE-216	Fluid Mechanics Lab	0	0	2	1	7	CE-226	Structural Lab	0	0	2	1
8	CE-217	Surveying Lab	0	0	2	1	8	CE-227	Building Construction Drawing	0	0	2	1
		Total Hours = 25				22			Total Hours = 25				22

Third Year												
5th Semester							6th Semester					
SN	Code	Subject	L	T	P	Credits	SN	Code	Subject	L	T	P	Credits
1	CE-311	RCC Design	3	1	0	4	1	CE-321	Steel Structure	3	1	0	4
2	CE-312	Water Supply and Treatment	3	1	0	4	2	CE-322	Water Resources Engineering-II	3	1	0	4
3	CE-313	Foundation Engineering	3	1	0	4	3	CE-323	Railways and Airports	3	1	0	4
4	CE-314	Highway Engineering	3	0	0	3	4	CE-324	Waste Water Treatment and Management	3	0	0	3
5	OET	Open Elective-I	3	0	0	3	5	OET	Open Elective-II	3	0	0	3
6	CE-315	Highway Engineering Lab	0	0	2	1	6	CE-325	Environmental Engineering Lab	0	0	2	1
7	CE-316	Soil Mechanics Lab	0	0	2	1	7	CE-326	Structural Drawing	0	0	2	1
8	CE-317	Computational Lab	0	0	2	1	8	CE-329	Seminar	0	0	2	1
		Total Hours = 24				21			Total Hours = 24				21

Fourth Year													
7th Semester							8th Semester						
SN	Code	Subject	L	T	P	Credits	SN	Code	Subject	L	T	P	Credits
1	HS-404	Engineering Economics & Accountancy	3	0	0	3	1	CE-421	Prestressed Concrete	3	0	0	3
2	CE-411	Design of Hydraulic Structures	3	0	0	3	2	CE-422	Quantity Surveying	3	0	0	3
3	DET	Professional Elective-I	3	0	0	3	3	DET	Professional Elective-III	3	0	0	3
4	DET	Professional Elective-II	3	0	0	3	4	DET	Professional Elective-IV	3	0	0	3
5	CE-418	Industrial Training Presentation	0	0	2	1	5	CE-428	General Proficiency	0	0	0	1
6	CE-419	Major Project (Stage-I)	0	0	12	6	6	CE-429	Major Project (Stage-II)	0	0	12	6
		Total Hours = 26				**19**			**Total Hours = 24**				**19**

Semester Wise Credits									
Semester	**1st**	**2nd**	**3rd**	**4th**	**5th**	**6th**	**7th**	**8th**	**Total**
Credits	24	24	22	22	21	21	19	19	**172**
Hours/week	28	28	25	25	24	24	26	24	**204**

Professional Elective Courses

Professional Elective-I (courses related to tools/techniques)

CE-430	Finite Element Method
CE-431	GIS and Remote Sensing
CE-432	Advanced Surveying Techniques
CE-433	CPM and PERT

Professional Elective-II (Structures)

CE-450	Earthquake Resistant Design of Structures
CE-451	Bridge Engineering
CE-452	Repair and Maintenance of structures
CE-453	Building Services

Professional Elective-III (Geotechnical/Transportation)

CE-440	Geo-synthetics
CE-441	Ground Improvement Techniques
CE-442	Urban Transportation Planning
CE-443	Harbor, Dock and Tunnel Engineering

Professional Elective-IV (Environmental/Water Resources)

CE-460	Solid waste management
CE-461	Environmental Impact Assessment
CE-462	Groundwater Engineering
CE-463	Hydro Power Engineering

Open Elective Courses

Open Elective-I / II

CE-306	CPM and PERT
CE-307	Disaster Management
CE-308	Air Pollution Control

Course Name: **Engineering Mathematics-III**
Course Code: **MA-203**
Course Type: **Core**

Contact Hours/Week: **3L + 1T** Course Credits: **04**

Course Objectives

- To introduce the fundamental concepts relevant to function of complex variable, numerical differentiation and integration and numerical solution of linear, non-linear and system of equations
- To have the idea of evaluation of real integrals using complex variable
- To understand the concept of approximating & interpolating polynomials and finding values of function at arbitrary point
- To impart knowledge of various numerical technique to solve ODE

Unit Number	Course Content	Lectures
UNIT-01	**Functions of Complex Variable** Applications of De Moivre's theorem, Exponential, Circular, Hyperbolic and Logarithmic functions of a complex variable, Inverse Hyperbolic functions, Real and imaginary parts of Circular and Hyperbolic functions, Summation of the series- 'C+iS' method. Limit and derivative of complex functions, Cauchy-Riemann equations, Analytic functions and its applications, Complex integration, Cauchy's theorem, Cauchy's integral formula, Series of complex function, Taylor series, singularities and Laurent's series, Cauchy's residue theorem and its application for the evaluation of real definite integrals.	**12L**
UNIT-02	**Interpolation** Least square curve fit and trigonometric approximations, Finite differences and difference operators, Newton's interpolation formulae, Gauss forward and backward formulae, Sterling and Bessel's formulae, Lagrange's interpolation.	**06L**
UNIT-03	**Numerical Integration** Integration by trapezoidal and Simpson's rules 1/3 and 3/8 rule, Romberg integration, and Gaussian quadrature rule, Numerical integration of function of two variables.	**05L**
UNIT-04	**Numerical Solution of Ordinary Differential Equations** Taylor series method, Picard's method, Euler's method, Modified Euler's method, Runge- Kutta method. Predictor corrector methods, Adam Bashforth and Milnes method, convergence criteria, Finite difference method.	**07L**
UNIT-05	**Numerical Solution of Linear and Non-Linear Equations** Non-Linear Equations: Bisection Method, Regula Falsi Method, Newton-Raphson Method, Iteration method. Linear Equations: Jacobi and Gauss Seidal Iteration methods, Relaxation method.	**06 L**

Course Outcomes

Upon successful completion of the course, the student will be able to

CO1: Understand and analyze the concept of Numerical Solution of Linear and Non-Linear Equations, Ordinary Differential Equations and Function of complex variable
CO2: Identify an appropriate technique to solve the linear, non-linear equations, ordinary differential equations
CO3: Formulate the problems on related topics and solve analytically
CO4: Apply the concepts of linear, non-linear equations, differential equations and complex analysis in various engineering problems
CO5: Demonstrate the concepts through examples and applications

Books and References

1. Complex variables and Applications by R. V. Churchill, T. J. Brown & R. F. Verhey, McGraw Hill.
2. A first course in complex analysis with applications by Dennis D. Zill & P. D. Shanahan, Jones and Bartlett.
3. Numerical Methods for Scientific and Engineering Computations by M. K. Jain, S. R. K. Iyenger and R. K. Jain, New Age International Publishers, New Delhi.
4. Numerical Methods for Engineers and Scientists by J D Hoffman, CRC Press.
5. Numerical Analysis Mathematics and Scientific computing by D. Kincaid and W. Cheney, American Mathematical Society.

Course Name: **Determinate Structures**
Course Code: **CE-211**
Course Type: **Core**

Contact Hours/Week: **3L+1T** Course Credits: **04**

Course Objectives

- To impart concepts of static and kinematic indeterminacy
- To introduce the fundamental concepts of analysis of determinate beams frames and trusses, Analysis of cables and three hinge arches, Finding slope and deflection of determinate structures.Moving load and concepts of influence lines.
- To enable the students to understand the concepts of analysis of determinate structures

Unit Number	Course Content	Lectures
UNIT-01	**Introduction** Structure, Loads, Response, and Method of analysis**.**	**03L**
UNIT-02	**Pin jointed Frames** Analysis Using Method of Joints, Method of Section, Graphical Method, and Tension co-efficient Methods.	**05L**
UNIT-03	**Cables and Arches** Analysis of Cables, and Three Hinged Arches	**05L**
UNIT-04	**Energy Methods** Strain Energy Due to Axial Force, Bending Moment, Shear Force and Torsion, Principle of Virtual Work, Betti's Law, Castigliano's Theorem I& II, and Dummy \Unit Load Method, Application of these Methods to Beams, Frames &Trusses.	**08L**
UNIT-05	**Slope and Deflection in beams**: Double integration method, Macaulay's method, Moment area Method, Conjugate beam Method and Strain energy method.	**07L**
UNIT-06	**Rolling/Moving loads and Influence lines diagrams for Determinate structures** Rolling loads, ILD for determinate beams, Gantry girders, Trusses and three hinged Arches.	**08L**

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Identify the concept of analysis of determinate structures
CO2: Analyse and determine slope and deflection of determinate trusses, beams and frames
CO3: Apply principles and algorithms for analysis of determinate structures
CO4: Assess the results obtained by solving above problems

Books and References

1. Structural Analysis by R.C.Hibbeler, Pearson.
2. Fundamentals of Structural Analysis by K.M.Leet,C.MingUan, G &A.M.Gilbert,Tata McGraw Hill Education.
3. Structural Analysis by DevdasMenon, Narsoa.
4. Theory of Structures Vol-I&II by G.S.Pandit,S.P.Gupta&R.Gupta, Tata McGraw Hill Education.
5. Structural Analysis by L.S.Negi&R.S.Jangid, TATA McGraw Hill education.
6. Theory of Structures by S.Ramamrutham&R.Narayan, DhanpatRai& Son.
7. Basic Structural Analysis by C.S.ReddyTATA McGraw Hill education.
8. Theory of Structures by B.C.Punmia.Ashok Kumar Jain&Arun Kumar Jain, Laxmi.
9. Structural Analysis I & II by S.S.Bhavikatti,Vikas.

Course Name: **Fluid Mechanics**

Course Code: **CE-212**

Course Type: **Core**

Contact Hours/Week: **3L+1T** Course Credits: **04**

Course Objectives

- To impart knowledge about the fluid properties and mechanics of fluid flow.
- To introduce the fundamental concepts relevant to fluid statics, kinematics, dynamics, fluid flow through pipes and open channels, and different types of flows.
- To enable the students to understand the factors characterizing fluid and flow behavior.

Unit Number	Course Content	Lectures
UNIT-01	**Introduction:**Flow characteristics, Classification, Fluid properties,Fluid pressure and its measurement, hydrostatic forces on submerged bodies, buoyancy and floatation.	**04L**
UNIT-02	**Fluid Kinematics and Dynamics:** Continuity equation, rotational and irrotational flow, circulation and vorticity, velocity potential and stream function, flow net**,** Euler's equation, Bernoulli's equation and its applications.	**10L**
UNIT-03	**Flow through pipes:** Darcy-Weisbach equation, energy losses in pipelines, equivalent pipes, multiple pipe systems, siphon, three reservoir problem**.**	**04L**
UNIT-04	**Laminar and Turbulent flows:** Reynolds experiment, Laminar flow between parallel plates, Laminar flow in pipes, characteristics of turbulent flow, Turbulent flow in smooth and rough pipe,Concepts of boundary layer, boundary layer thickness, momentum integral equation, boundary layer separation and its control.	**10L**
UNIT-05	**Dimensional analysis and similitude:** Dimensional homogeneity, Buckingham's π theorem, geometric, Kinematic and dynamic similarity, model studies**.**	**02L**
UNIT-06	**Open Channel Flow:** Types of open channels, classification of flows, continuity equation, concept of specific energy, critical depth, Chezy's and Mannings equation, roughness coefficients, equivalent roughness, Hydraulically efficient channel cross sections.	**06L**

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Identify basic properties of fluid and analyse fluid flow behavior.

CO2: Describe the problems involving fluid properties, continuity and bernoulli's equations, energy losses through pipes, turbulent flows, dimensional analysis, and flow through open channels.

CO3: Apply principles and fundamental relations to solve problems mentioned in CO2

CO4: Evaluate the results obtained by solving above problems.

Books and References

1. Fluid Mechanics and Machinery by Ojha, Berndtsson and Chandramouli,
2. Fluid Mechanics by A.K. Jain,
3. Hydraulics and Fluid Mechanics by P.N.Modi and S.M.Seth,
4. Fluid Mechanics by Wiley and Streeter,
5. Fluid Mechanics by F.M. White,
6. Flow in open Channels by K. Subramanya
7. Open Channel Flow by K.G. Rangaraju.

Course Name: **Engineering Geology and Rock Mechanics**

Course Code: **CE-213**

Course Type: **Core**

Contact Hours/Week: **3L** Course Credits: **03**

Course Objectives

- To impart knowledge about the earth, its structures, rocks and its strength, natural disasters and water resources.
- To introduce the fundamental concepts relevant to selection of sites, stable foundation and underground construction.
- To enable the students to understand the natural factors that causes the instability of mega engineering structures.

Unit Number	Course Content	Lectures
UNIT-01	**Introduction:** Dynamic Earth; Origin, Age, Interior, Materials of Earth; Silicate Structures and Symmetry Elements, Physical properties, Formation of Rocks; Igneous, Sedimentary and Metamorphic processes and structures, Characterisation; Weathering Processes; Geological Work of Rivers, Glaciers, Wind and Sea/Oceans, Deposits and Landforms; Formation of Soils; Engineering Properties of Rocks; Rock as Construction Material, Structural Features, Attitude of beds, True and apparent dips, Folds, Joints, Faults, Unconformities, Plate tectonics; Plate tectonics, Continental drift and sea floor spreading, Geological time scale, topographic maps, outcrops. Three point problems, Depth and thickness problems.	**10L**
UNIT-02	**Hydrogeology:** Ground water, zone of ground water, water table and perched water table, water bearing properties of rocks, occurrence of ground water, springs, selection of sites for well sinking and geophysical investigations (Electrical and Seismic methods).	**05L**
UNIT-03	**Earthquake and landslides:** Classification, causes and effects of earthquakes and landslides, seismic curve, seismograrphs, seismograms, accelograms, seismic problems of India, seismic zones of India, remedial measures to prevent damage for engineering structures, case histories.	**03L**
UNIT-04	**Geology of dams and reservoirs:** Types of dams, requirements of dam site, preliminary and detailed geological investigations for dam site, failures of dams and their causes, factors affecting seepage and leakage of the reservoirs and he remedial measures, silting of reservoirs.	**06L**
UNIT-05	**Rock Mechanics:** Rock Mechanics and its relationship with soil mechanics and engineering geology, application of rock mechanics to civil engineering problems. Index properties, Strength and failure criteria for rocks and rock masses, Insitu stresses in rocks and their measurement. Strength and deformation behavior of discontinuities in rocks. Deformation behaviour of rocks and rock masses. Time dependent behaviour of rocks. Application of Rock mechanics to Underground Structures, Slopes and Foundations. Improving the properties of insitu rock masses. Rockmass classifications, Terzaghi, RQD, RSR, RMR and Q classifications, Rating, Applications. Creep and cyclic loading. Weathered rocks.	**08L**
UNIT-06	**Tunneling:** Purpose of tunneling and geological problems connected with tunneling, Basic design and Principles of tunnels in rocks, Types and design of tunnel lining.	**04L**

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Identify the relevant construction material and project site for construction.
CO2: Describe the suitability of material and sites for construction.
CO3: Apply principles of natural processes on and within the earth.
CO4: Assess the impact of natural forces on civil engineering structures and other such projects.

Books and References

1. Engineering Geology by Parbin Singh.
2. Engineering Geology by A. Parthasarathy, V. Panchapakesan, R. Nagarajan.
3. Geological Engineering by Luis I. Gonzalez de Vallejo, Mercedes Ferrer.
4. Rock Mechanics for Engineers by B.P.Verma.
5. Rock Mechanics Design in Mining and Tunneling by Z.T. Bieniawski.
6. Practical H.B. for Underground Rock Mechanics by Rotterdam Rudd T.R. Stay, A.A Balkema Publishers.

Course Name: **Surveying**
Course Code: **CE-214**
Course Type: **Core**

Contact Hours/Week: **3L + 1T** Course Credits: **04**

Course Objectives

- To impart knowledge about the importance, objective and basic principles of surveying a
- To introduce the fundamental concepts of linear measurement, vertical measurements, and measurement of directions and use of surveying equipment to collect data needed to develop topographical maps, traverses, and profiles.
- To enable the students to Collect, analyze, and adjust field measurements; create horizontal and vertical control networks; and prepare a topographic map

Unit Number	Course Content	Lectures
UNIT-01	**Basics of surveying:** Introduction, concept of Geoids and reference spheroids, coordinate systems, plane and geodetic surveys, methods of location of a point, errors in measurements, surveying instruments, maps, scales and uses, topographic maps, map layout.	**04L**
UNIT-02	**Distance measurements:** Direct and indirect methods, Chain and tape measurements, Optical methods- tacheometers, sub tense bar, Electronic methods- EDMs.	**03L**
UNIT-03	**Leveling:** Methods of height determination, levels and staves, booking and reduction of data, classification and permissible closing error, profile leveling and cross sectioning, errors, reciprocal leveling.Contours- characteristics, uses and methods of contouring.	**04L**
UNIT-04	**Measurement of directions:** Bearings and angles, compass surveying, magnetic bearings, declination, local attraction errors and adjustments, theodolites- types, uses, methods of observation and booking of data, total station.	**04L**
UNIT-05	**Traversing and Triangulation:** Compass and theodolite traverses- balancing and adjustment of traverses, computation of coordinates, omitted measurements Triangulation- network, strength of figures, selection of stations, inter-visibility, satellite stations, measurements and computations.	**05L**
UNIT-06	**Plane tabling: A**ccessories, orientation and resection, methods, three point problem and solutions, errors in plane tabling.	**03L**
UNIT-07	**Curves** Simple circular curves, compound and reverse curves, transition curves and vertical curves	**03L**
UNIT-08	**Earthwork** Area of a traverse**,** determining area from plans, area of X-section, volume from X-section, corrections, mass haul diagram	**03L**
UNIT-09	**Modern Surveying methods:** Aerial Photogrammetry, geometry of aerial photograph, stereoscopy, GPS principles, Satellite navigation System, GPS segment, Receivers, Static, Kinematic and Differential GPS, remote sensing/GIS techniques and application in mapping.	**07L**

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1 Acquire a sound and fundamental understanding of the scientific, mathematical, and engineering principles underlying surveying;
CO2 Understand and use surveying equipment ordinarily employed in surveying practice
CO3 Design the appropriate combination of equipment and procedures for a data gathering task that will ensure that the gathered data meets the quality requirements of relative positioning.
CO4 Have an understanding of and are able to implement basic field and office survey procedures to complete a simple, but meaningful, civil engineering mapping problem
CO5 Plan, design and set out engineering works

Books and References

1. Surveying–Vol 1 & 2 by K.R.Arora.
2. Plane Surveying by A. M.Chandra.
3. Surveying: Principle and Applications by Barry F. Kavanagh.
4. Engineering Survey by W. Schofield.
5. Surveying: Theory and Practice by J.M. Anderson and E.M. Mikhail.

Course Name:	**Engineering Geology Lab**
Course Code:	**CE-215**
Course Type:	**Core**
Contact Hours/Week: **2P**	**Course Credits: 01**

Course Objectives

- To train the students for preparation of rock specimens for testing in the laboratory.
- To provide skills for determining rock properties in laboratory and in the field.
- To enable the students to assess design rock parameters.
- To make the students determine the safe bearing capacity of soil and rock.
- To train the students for identification of rock and mineral samples.
- To train the students for drawing profile and sections of given geological maps.

Course Content

List of Experiments

1. Study of mineral in hand specimen and under microscope.
2. Drawing profile and sections of given geological maps.
3. Study of three point problems of given geological maps.
4. Determination of specific gravity porosity and water absorption of different rock samples..
5. Direct shear test on rock sample.
6. Measurement of dip and strike of joints in rock outcrops using Brunton compass.
7. Electrical Resistivity using Vertical Electrical sounding method.
8. Triaxial shear test of the given rock sample
9. Determination of bearing capacity of rock foundations.
10. Study of rocks in hand specimen and under microscope
11. Topographical maps and Structural Geological maps.
12. Field and laboratory testing of rocks and rock masses

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Identification of rock specimens.
CO2: Preparation of soil and rock specimens for determining the engineering properties.
CO3: Assess design soil and rock parameters.
CO4: Determinatyion of safe bearing capacity of soil and rock
CO5: Understand the orientation of geological map and various lithological elements in the map.

Course Name:	**Fluid Mechanics Lab**
Course Code:	**CE-216**
Course Type:	**Core**
Contact Hours/Week: **2P**	Course Credits: **01**

Course Objectives

- To compare the results of analytical models introduced in Lectures to the actual behavior of real fluid flows.
- To discuss and practice standard measurement techniques of fluid mechanics and their aplications.
- To learn and practice writing technical reports and enable the students to work on small design projects.

List of Experiments

1. To determine the metacentric height of a ship model
2. To Verify Bernoulli's theorem
3. To calibrate a venturimeter and to determine its coefficient of discharge
4. To calibrate an orifice meter and to determine its coefficient of discharge
5. To study the flow over V-notch (weir) and Rectangular notch and to find their coefficient of discharge
6. To determine the coefficient of discharge of a mouth piece.
7. To determine the coefficient of friction of pipes of different diameters.
8. To determine the form losses in a pipe line
9. To obtain the surface profile on the total heads distribution of a forced vortex
10. To obtain the surface profile on the total heads distribution of a free vortex
11. Flow measurement using Rotameter.
12. To verify Darcy's law.

Note: *The concerned Course Coordinator will prepare the actual list of experiments/problems at the start of semester based on above generic list.*

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Identify and characterize flow patterns and regimes.
CO2: Demonstrate practical understanding of principles, equations and instruments of fluid flow related phenomena.
CO3: Discuss the differences among measurement techniques, their relevance and applications.
CO4: Demonstrate the ability to produce a working model through hands-on experience in fluid mechanics design.
CO5: Demonstrate the ability to write clear lab reports and understand ethical issues associated with decision making and professional conduct.

Course Name:	**Surveying Lab**
Course Code:	**CE-217**
Course Type:	**Core**
Contact Hours/Week: **2P**	Course Credits: **01**

Course Objectives

- To provide skills for using surveying equipment ordinarily employed in surveying practice

List of Experiments

1. To determine the difference in elevation of two given points.
2. Profile levelling and cross sectioning of a given route.
3. To measure the horizontal angle by the method of reiteration and repetition, theodolite traversing and error adjustment.
4. To prepare the contour map of an area by the method of radial lines.
5. Determination of tacheometric constant and determination of height and distance using Stadia tacheometry
6. Plane tabling by the method of radiation and intersection.
7. Solution of Three point problem in plane tabling
8. Setting out of simple circular curve by offsets from long chord and by successive bisection of long chord.
9. Setting out of simple circular curve by radial and perpendicular offsets.
10. Setting out of simple circular curve by one theodolite and by two theodolite method.
11. Topographic survey using total station.

Note: *The concerned Course Coordinator will prepare the actual list of experiments/problems at the start of semester based on above generic list.*

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Design the appropriate combination of equipment and procedures for a data gathering task that will ensure that the gathered data meets the quality requirements of relative positioning (horizontally or vertically or in three dimensions simultaneously)

CO2: Have an understanding of and are able to implement basic field and office survey procedures to complete a simple, but meaningful, civil engineering mapping problem

Course Name: **Organizational Behaviour**
Course Code: **HS-203**
Course Type: **Core**

Contact Hours/Week: **3L** Course Credits: **03**

Course Objectives

- To impart knowledge about the behavioural aspects related to professional organizations
- To introduce the fundamental concepts relevant to understanding of individual & group behavior in the organization
- To enable the students to understand the applied organizational themes like perception, motivation, interpersonal relationships, group dhynamics, leadership theories, role of power & politices in organizational context, conflict and negotiation, organizational diversity, dynamics of personality, attitude and job satisfaction, etc.

Unit Number	Course Content	Lectures
UNIT-01	**Organizational Behavior (OB):** Concept, nature, characteristics, conceptual foundations, determinants and importance, management functions, role & skills, disciplines that contribute to the field of OB, Challenges & Opportunities for OB, diversity in Organizations, attitudes & Job satisfaction.	**04L**
UNIT-02	**Perception**: Concept, nature, process, importance, management and behavioral applications of perception. Personality: concept, nature, types and theories of personality shaping. Learning; concept and theories of learning.	**08L**
UNIT-03	**Motivation:** concept, principles, theories-content, process & contemporary, Monetary and non-monetary motivation, applications of motivation. Leadership: Concept, functions, styles, and theories of leadership- trait, behavioural, and situational.	**06L**
UNIT-04	**Group and Interpersonal Relationship:** Analysis of Interpersonal Relationship, developing interpersonal relationship, Group Dynamic: Definition of Group, stages of Group Development, Punctuated Equilibrium Model, Group Structure, Group Decision Making, understanding work teams.	**05L**
UNIT-05	**Organizational Power and Politics:** concept of power, structure of power, classification of power, contrasting leadership & power, dependence a key to power, causes & consequences of political behaviour. Organizational conflict: view of conflict, conflict process, negotiation & bargaining strategies.	**06L**
UNIT-06	**Conflict and Negotiation:** conflict definition in conflict thought: Traditional view, the Human relation view, interactionist view. Functional versus dysfunctional conflict, conflict process. Negotiation Bargaining strategies, the negotiation process and issues in negotiation.	**07L**

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Identify the challenges of the present organization
CO2: Describe the organizational system
CO3: Apply the principles of organizational behavior to inculcate the habit of team work and which is essential for the organization
CO4: Assess the role of psychological and social principal in improvement of efficiency as well as quality of empoyee life

Books and References

1. Organizational Behavior by Robbins, S.P., Prentice Hall of India.
2. Organizational Behavior by Luthans F., McGraw-Hill.
3. Human Behavior at Work: Organizational Behavior by Davis K., Tata McGraw-Hill.

Course Name: **Indeterminate Structures**
Course Code: **CE-221**
Course Type: **Core**

Contact Hours/Week: **3L + 1T** Course Credits: **04**

Course Objectives

- To impart knowledge about the analysis of the statically and kinematically indeterminate structures
- To introduce the fundamental concepts relevant to force methods, displacement methods and influence lines
- To enable the students to understand the factors that cause such behavior of the indeterminate structure.

Unit Number	Course Content	Lectures
UNIT-01	**Introduction:** Static and kinematic indeterminacy.	**03L**
UNIT-02	**Statically indeterminate structures:** Force methods, Three-moment equation, Method of consistent deformation, Approximate method of analysis (Portal Frame, Cantilever, Substitute Frame Method)	**15L**
UNIT-03	**Kinematically Indeterminate Structures**: Displacement Methods- slope deflection method, moment distribution method, Kani's Method.	**9L**
UNIT-04	**Influence lines for In-determinate structures**: Muller-Breslau Principle for Influence lines diagram of indeterminate structures: Beams, frame, trusses and two hinged & fixed arches.	**9L**

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Identify the load displacement response of the indeterminate structures

CO2: Describe the bending moment, shear force and axial force variations along with the curvature, slope and deflection of the indeterminate structures.

CO3: Apply principles of basic structural analysis

CO4: Assess thethe response of structure to the different types of loads.

Books and References

1. Structural Analysis by R.C.Hibbeler, Pearson.
2. Fundamentals of Structural Analysis by K.M.Leet,C.MingUan, G &A.M.Gilbert,Tata McGraw Hill Education.
3. Structural Analysis by DevdasMenon, Narsoa.
4. Theory of Structures Vol-I&II by G.S.Pandit,S.P.Gupta&R.Gupta, Tata McGraw Hill Education.
5. Structural Analysis by L.S.Negi&R.S.Jangid, TATA McGraw Hill education.
6. Theory of Structures by S.Ramamrutham&R.Narayan, DhanpatRai& Son.
7. Basic Structural Analysis by C.S.ReddyTATA McGraw Hill education.
8. Theory of Structures by B.C.Punmia.Ashok Kumar Jain&Arun Kumar Jain, Laxmi
9. Structural Analysis I&II by S.S.Bhavikatti,Vikas.

Course Name: **Water Resources Engineering-I**
Course Code: **CE-222**
Course Type: **Core**

Contact Hours/Week: **3L + 1T** Course Credits: **04**

Course Objectives

- To impart knowledge about the water resources and components of hydrological cycle.
- To introduce the fundamental concepts relevant to water budget, watershed, runoff estimation, hydrograph analysis, flood and groundwater hydrology.
- To enable the students to understand the factors responsible for different processes in hydrological cycle.

Unit Number	Course Content	Lectures
UNIT-01	**Introduction:** Hydrological cycle, Water budget equation, Watershed.	**04L**
UNIT-02	**Abstractions**: Precipitation- Types, Measurement, Computation of average rainfall over a basin, Evaporation, transpiration, infiltration, Φ-index, weather systems.	**06L**
UNIT-03	**Runoff:** Factors affecting, runoff computation, rainfall-runoff correlation, flow mass curve, flow duration curve**.**	**06L**
UNIT-04	**Hydrographs:** Flood hydrograph, base flow separation, Unit and S-hydrograph, Unit Hydrograph from simple and complex storms, synthetic and instantaneous unit hydrograph**.**	**06L**
UNIT-05	**Floods:** Flood discharge estimation, flood control, reservoir and channel routing.	**08L**
UNIT-06	**Groundwater Hydrology:** Darcy's Law – concept and applications**,** Well Hydraulics – Steady and unsteady state.	**06L**

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Identify different problems related to hydrology and water resources.

CO2: Describe problems related to water budget, hydrological processes, hydrographs of complex storms, flod estimation and routing, and groundwater hydrology related problems.

CO3: Apply principles, theory and equations to solve problems mentioned in CO2

CO4: Assess the results obtained by solving above problems.

Books and References

1. Engineering Hydrology by K. Subramanya,
2. Engineering Hydrology by Ojha, Berndtssson and Bhunia,
3. Water Resources Engineering by R.K. Linsley and J.B. Franzini, McGraw-Hill Inc, 2000.
4. S.K.Sharma by Design of Irrigation Structures,
5. Groundwater by H.M Raghunath
6. Grounwater Hydrology by B.R. Chahar.

Course Name: **Soil Mechanics**
Course Code: **CE-223**
Course Type: **Core**

Contact Hours/Week: **3L + 1T** Course Credits: **04**

Course Objectives

- To impart knowledge about the engineering properties of soils
- To introduce the fundamental concepts relevant to the behaviour of soils
- To enable the students to understand the factors that control the behaviour of the soils

Unit Number	Course Content	Lectures
UNIT-01	**Soil properties:**Soil mechanics, rock mechanics ,foundation engineering, soil formation, soil structure, soil map of India. Basic definitions phase diagram, water content, specific gravity, void ratio, porosity, unit weight, weight volume relationships, index properties of soil and their determination, classification of soils, degree of saturation, density index.	**08L**
UNIT-02	**Permeability, Seepage:** Darcy's law and its validity, seepage velocity, discharge velocity, constant and variable head permea-meter, pumping in & out tests, permeability of stratified soils, factors affecting permeability, laplace's equation, flow potential flow net and its properties, different methods of drawing flownets, seepage pressure, quick sand, exit gradient, piping, design of filter, principle of total and effective stresses, capillarity conditions in soil, effective and pore pressures.	**06L**
UNIT-03	**Stress Distribution:** Effective and pore pressures,Effective stess principle.Stress distribution in soil, assumptions in elastic theories, Boussinesq's equation for point, line, circular and rectangular loads, Westergaad's formula for point load, comparison of Boussinesq's and Westergaard's equation, concept and use of pressure bulbs, principle and use of New mark's influence chart, contact pressure.	**06L**
UNIT-04	**Compaction:** Mechanism of compaction, objective of compaction, measurement of compaction, factors affecting compaction, optimum moisture content, Standard Proctor test, Modified Proctor test, effect of moisture content and compactive effort on dry density, zero air void curve, compaction of cohesionless soils, field compaction, field control of compaction.	**04L**
UNIT-05	**Consolidation:** Mechanism of consolidation, e-log)p) curves, basic definitions, estimation of pre consolidation pressure, normally consolidation and over consolidation ratio, Terzaghi's theory of one dimensional consolidation, assumptions, governing equation, standard solution, laboratory determination of consolidation properties of soil, magnitude and rate of consolidation, settlements, secondary consolidation, compression characteristics of clays and settlement analysis.	**06L**
UNIT-06	**Shear strength:** Normal, shear and principal stresses, Columb's equation, Mohr's stress circle, Mohr-Columb failure criteria, laboratory determination of shear parameters of soil by direct shear tests, triaxial test, unconfined compression test, Vane shear test, Consolidated drained, consolidated undrained and unconsolidated undrained shear test, pore pressure parameters, Lambe's p-q diagram	**06L**

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Identify index properties of soil and to classify the soils
CO2: Describe the behaviour of the soils
CO3: Apply principles of soil mechanics to civil engineering problem

Books and References

1. Soil Mechanics and Foundations by B.C. Punmia, Laxmi Publications, New Delhi.
2. Geotechnical Engineering by C.Venkatramaiah, New Age International Publishers, New Delhi.
3. Principles of soil mechanics Addison-Wesley by Ronald F. Scott, Massachusetts.
4. Soil mechanics: Principles and Practice by Graham Barnes, Palgrave Macmillan, New York
5. Principles ofGeotechnical Engineering by Brij Mohan Das, CENGAGE Learning
6. Basic and applied soil mechanics by Gopal Ranjon & ASR Rao, New Age International Pvt Ltd Publishers
7. Modern Geotechnical Engineering by Alam Singh, Cbs Publishers & Distributors

Course Name: **Building Materials and Construction**
Course Code: **CE-224**
Course Type: **Core**

Contact Hours/Week: **3L + 1T** Course Credits: **04**

Course Objectives

- To impart knowledge about the building material and construction
- To introduce the fundamental concepts relevant to properties of building materials and it application
- To enable the students to understand the factors that differentiate the building materials and accordingly its application

Unit Number	Course Content	Lectures
UNIT-01	**Basic Structural Building Materials** - Principle properties of Engineering materials: Physical & Mechanical, Clay product - Clay Brick and Tiles: Classification, tiles. Limes: Classification and applications. Cement: Composition, types, manufacturing of Ordinary Portland Cement, rate of hydration, special types, Fine and Coarse aggregate: Source, Impurities, Classification, Characteristics. Timber: Classification, seasoning, defects, wood product and its applications.	**09L**
UNIT-02	**Transformed Material** - Mortars: classification, characteristics, functions of ingredient, Cement concrete and Special concrete: Types, physical properties	**03L**
UNIT-03	**Service Material** - Ceramic products: classification, refractories, glass, properties of ceramic materials. Ferrous and non-ferrous Metals and alloys: Properties, uses. Paints, Distemper & Varnishing: Basic constituents, types, composition, defects, application.	**03L**
UNIT-04	**Structural Components of building and building specification:** Foundation: Type, application, Masonry: Stone, Brick and Confined, Types, Bonds, defects. Walls: Design Consideration, constructional details, types of load bearing and non-load bearing walls, Floor and Roofs*:* type, Ground/Upper: Flat /Slopped. Beam/Band-Plinth, Sill, Lintel -Types and details, Stairs, Ramps - classification, application. Form work: Requirements, Load applied, Scaffolding.	**12L**
UNIT-05	**Non Structural Components of building and building specification** Plastering, Pointing: Type, methods, defects. Doors and Windows, Ventilators: Locations, sizes, types. Dampness and Water Proofing: Causes, Prevention Methods, damp-proofing treatment, Materials used	**03L**
UNIT-06	**Building Service:** Plumbing- Fitting, Fixture, System, Termite Proof: Materials used and Method of application. Fire Protection: Fire safety requirement, fire extinguishing equipment. Thermal Insulation**:** Basic definitions, Materials used, methods. Acoustics & Sound Insulation: characteristics, sound insulation, acoustical design. Ventilation: Functional requirement, Systems	**06L**

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Identify and Describe construction material, structural and non-structural components
CO2: Apply principles of compatibility of material and construction methods
CO3: Assess the suitability and functional aspect of the materials and construction methodology

Books and References

1. Building Materials by S.K. Duggal, New Age Int. Publishers.
2. Building Materials by P.C.Varghese, PHI
3. Engineering Materials by R.K. Rajput, S. Chand Publishers
4. Building Construction by B.C.Punmia Ashok Kumar Jain &Arun Kumar Jain, Laxmi Publication

Course Name:	**Building Materials Lab**
Course Code:	**CE-225**
Course Type:	**Core**
Contact Hours/Week: **2P**	Course Credits: **01**

Course Objectives

- To provide skills for testing of materials
- To developed understanding of Indian Standard for testing of materials
- To enable the students to carry out good construction practice

List of Experiments

1. Test For Cement : Finess of Cemen (Sieve Analysis, Air Permeability Test), Standard Consistency, Initial and Final Setting Time, Soundness, Compressive Strength, Specific Gravity.
2. Test for Fine Aggregate: Specific Gravity (FA), Bulking of Fine Aggregate, Fineness Modulus, gradation.
3. Test for Course Aggregate: Specific Gravity and Water Absorption, Fineness Modulus and Gradation.
4. Test for Fresh &Hard Concrete: Workability Test (Slump Test, Compaction Factor Test, Vee Bee Test), Cube and Cylinder Strength of Concrete, Flexural Tensile Strength.
5. Test for Brick & Stone: Water Absorption/Efflorescence, Compressive Strength.

Note: The concerned Course Coordinator will prepare the actual list of experiments/problems at the start of semester based on above generic list.

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Identify the various test procedures carried out for a building materials

CO2: Design and develop the materials for construction

CO3: Determine appropriateness of the material

Course Name:	**Structural Lab**
Course Code:	**CE-226**
Course Type:	**Core**
Contact Hours/Week: **2P**	Course Credits: **01**

Course Objectives

- To impart concepts and skills of structural Analysis
- To introduce the fundamental concepts of analysis of determinate structures and validation of the experimental results with the theoretical results
- To enable the students to understand the skills and concepts of analysis of structures

List of Experiments

1. To verify the Betti's Law& Maxwell law of reciprocal displacements.
2. Study of a three hinged arch experimentally for a given set of loading and compare with analytical results.
3. To obtain experimental influence line diagram for horizontal thrust in a three hinged arch and compare with theoretical value.
4. To determine the flexural rigidity of a given beam.
5. To study the behavior of different type of struts.
6. To verify moment area theorem for slopes and deflections of a beams
7. To find the deflection of a pin-connected truss and to verify the results by calculation and graphically.
8. To determine the carry over factors for beam with rigid connections.
9. To determine the rotational stiffness of a beam when far end is (a) fixed (b) pinned.
10. Determine experimentally the horizontal displacement of the roller end of a two hinged arch for a given set of loading and to compare the results with those obtained analytically.
11. To obtain experimental influence line diagram for horizontal thrust in a two hinged arch and compare with theoretical value.
12. To study tensile stress and strain on different materials

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Identify the conceptualise the fundamentals of analysis of determinate structures

CO2: Analyse and determine slope and deflection of determinate trusses, beams and frames

CO3: Apply principles and algorithms for analysis of structures

CO4: Assess the results obtained by solving theoretical problems and validating it experimentally

Course Name:	**Building Construction Drawing**
Course Code:	**CE-227**
Course Type:	**Core**
Contact Hours/Week: **2P**	Course Credits: **01**

Course Objectives

- To develop skills for making drawings for building construction
- To develop understanding of conventions for building construction drawing
- To enable the students to carry out construction practice with the assistance of drawing

List of Drawing Sheet

1. Conventional Representation– Drawing size, layout, title block, scales, lettering and dimensioning
2. Conventional Signs and symbols- Alphabetic, Sanitary, Plumbing, Drains and Pipes, Doors, windows
3. Masonry: Brick- Bonds- English, Flemish- 1/1.5 brick, stone-coursed random rubble, Ashlar, Brick Spread Foundations
4. Damp Proof Course: DPC in external/internal wall, basement, cavity wall
5. Floors – Ground floor level with plinth beam / band, Upper Floor - RCC slab on wall, section through a wall
6. Arches and Lintel – Semicircular / Relieving arch, RCC lintel
7. Doors and Windows – Aluminium/Steel paneled glazed door, Glazed window, steel, aluminium section
8. Stairs – Elevation/Plan – Dog legged
9. Plumbing– Single Stack/ two pipe system Sewerage – Manhole, Septic tank , seepage pit
10. Building Plan/ Elevation/section: Residential
11. Building Plan/ Elevation/section: Residential on Drafting software

Note: *The concerned Course Coordinator will prepare the actual list of experiments/problems at the start of semester based on above generic list.*

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Develop knowledge about the convention used for generating drawing

CO2: Convert the design parameter into drawing for construction

CO3: Develop understanding of Drawing based construction

Course Name: **RCC Design**
Course Code: **CE-311**
Course Type: **Core**

Contact Hours/Week: **3L + 1T** Course Credits: **04**

Course Objectives

- To impart knowledge about the analysis, behavior and design of simple structural elements.
- To introduce the fundamental concepts of design and detailing in the Reinforced cement Concrete.
- To enable the students to understand importance of design and detailing.

Unit Number	Course Content	Lectures
UNIT-01	**Introduction:** Type of loads and load combinations, Properties of concrete and reinforcing steel, design philosophies, limit state, ultimate load method, working stress method.	**03L**
UNIT-02	**Design of Flexural members (Beam and Slab) by Limit state method:** Design of Beams: Singly reinforced, doubly reinforced, rectangular, Flanged beams and lintels. Design of Slabs: One way, two way, Flat Slab.	**15L**
UNIT-03	**Design of Columns by limit state method:** Design of short and long columns Subjected to eccentric and axial loading.	**06L**
UNIT-04	**Design of Stair Cases:** Types terms used, design of stairs spanning, horizontally & longitudinally, Circular/spiral doglegged, Open well stair.	**06L**
UNIT-05	**Design of Footings:** isolated and Conbined footings.	**06L**

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Develop an understanding of design philosophies, basic concepts and principals of design, loading standards, materials and behavior of individual structural members.

CO2: Design the individual components of the buildings, like beams, columns, slabs, footings, stairs, retaining structures, etc as per the Indian standards.

CO3: Design large structures integrating the principles of design and become familiar with professional and contemporary issues in design and detailing of reinforcement.

CO4: Read and execute the drawings and detailing of reinforcement for the designed structures in the field.

Books and References

1. Limit state design of reinforced concrete by Varghese, P. C.:, Prentice-Hall, New Delhi
2. Reinforced concrete design by Pillai, S, Unnikrishna, MenonDevdas:, Tata McGraw-Hill, New Delhi
3. Fundamentals of reinforced concrete design by M.L. Gambhir,:, Prentice-Hall, New Delhi.
4. Design of R.C.C. structural elements by S.S. Bhavikatti:, New Age International Publishers, New Delhi.
5. Reinforced Concrete (Limit state design) by A K Jain:
6. Reinforced Concrete Structures by B.C.Punmia:, Luxmi Publications
7. IS 456 2000: Code of Practice for Plain and Reinforced Concrete
8. Design of reinforced Concrete Structures by N Subramanian, Oxford university Press
9. Design of Concrete Structures by Arthur H Nilson, David Darwin, Charles W Dolan, Tata McGraw Hill
10. Reinforced Concrete Design by N Krishna Raju and R N Pranesh,New Age Publishers
11. Design of Concrete Structures , J N Bandopadhyay,PHI
12. Limit State Design of Concrete Structures by Ram Chandra and VirendraGehlot,SP

Course Name: **Water Supply and Treatment**
Course Code: **CE-312**
Course Type: **Core**

Contact Hours/Week: **3L + 1T** Course Credits: **04**

Course Objectives

- Introduction to Environment and its components.
- To Understand the necessity of environmental engineering.
- To Know the basic of water quality & the concept of implementing standards.
- How to forecast future population of an area.
- To Understand & analyze various requirements of water.
- To Understand & analyze various sources of water.
- To Analyze and design the intake structures.
- To Analyze in detail every component of a water treatment plant.
- To Analyze the concepts of pumps & pipelines in water supply
- To Analysis of water distribution system.
- To Understand all the requirements for house supply
- To understand and analyse all the concepts of water supply required for a rural area.

Unit Number	Course Content	Lectures
UNIT-01	**Introduction:**Scope and importance of Environmental Engineering and Management - Introduction to Environmental pollution - Impact on human health -, Significant water quality parameters for Municipal Water Supplies. Standards and guidelines for Water Quality Parameter.	**06L**
UNIT-02	**Demand and Sources of Water:** Water demand - Population forecast - Water quality requirements - Sources and its yield for water requirements- Intake structures – Water quality parameters and their significance in domestic use.	**06L**
UNIT-03	**Water Treatment:**Design of treatment units such as aeration, sedimentation, coagulation and flocculation, filtration, Disinfection, water softening- Advanced water treatment methods.	**09L**
UNIT-04	**Water Distribution Systems:** Pumps and pumping system – Pipes - Pipe appurtenances - Testing of water main – Distribution reservoirs - Distribution methods - Pipe network analysis - Planning of water supply project	**09L**
UNIT-05	**Plumbing and Fittings For Water Supply:** House water connection, Design consideration for water piping system and storage of water in building.	**03L**
UNIT-06	**Rural Water Supply and Treatment:**Water demand and treatment techniques for rural area, water problems and remedial measures.	**03L**

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Understand the basic concepts and analyze the requirements of a water supply project.
CO2: Experimentally analyze the water quality of an area and understand the need of safe and pure water.
CO3: Design a water treatment plant and understand the application of various treatment techniques in a water supply project.
CO4: Plan a water distribution system including its design etc.
CO5: Understand the importance of environment and its application in our day to day life.

Books and References

1. Water Supply Engineering by S.K. Garg, Khanna Publishers.
2. Water Supply & Pollution Control by Warren ViessmanJr, Mark J. Hammer &Elizabeth Perez, PHI
3. Water & Wastewater Technology by Mark J. Hammer & Mark J. Hammer Jr., PHI
4. Water Works Engineering by Syed R. Qasim, Edward M. Motley, GuangZhu,PHI
5. Processes for Water Quality Control by Weber W. Physicochemical Wiley-Interscience, New York, 1972.
6. Manual on Water Supply Treatment 3rd Ed by Ministry of Urban Development,Central Public Health&Environmental.

Course Name: **Foundation Engineering**
Course Code: **CE-313**
Course Type: **Core**

Contact Hours/Week: **3L + 1T** Course Credits: **04**

Course Objectives

- To impart knowledge about the stability of slopes, retaining structures, shallow and deep foundations.
- To introduce fundamental concepts relevant to slope stability, earthpressure, analysis of shallow and deep foundations.
- To enable the students to assess the stability of slopes and design retaining structures, shallow, pile and well foundations.

Unit Number	Course Content	Lectures
UNIT-01	**Stability Analysis:** Stability of finite and infinite slopes, types of failure, different factors of safety, determination of factor of safety by method of slices, Swedish circle, friction circle, Bishop' method, Morgenstern Price method, Taylor's stability number, location of critical circle, stability analysis of earth dam slopes for different conditions, design of filters and rock toe.	**06L**
UNIT-02	**Earth Pressure:** Different types of earth pressure, sates of plastic equilibrium, Rankine's theory and Coulomb's theory, influence of water table, surcharge, wall friction and deformation on earth pressure, application of Rankine's theory and Coulomb's theory to cohesionless and cohesive soils, Culmann's graphical method, stability considerations for retaining walls, effect of earthquakes, design of retaining walls.	**06L**
UNIT-03	**Sheet Pile Walls:** Different types of sheet pile walls, fixed and free earth support, design principles of anchored bulkheads, arching in tunnels, open cut strutting and sheeting.	**03L**
UNIT-04	**Foundations:** Different types of loads on foundations, types of shallow and deep foundations, footings, rafts, piles, wells, selection of foundation type, dewatering of foundations, types of explorations, methods of boring, soil samples and sampling.	**04L**
UNIT-05	**Shallow Foundations:** Bearing capacity, Terzaghi's theory, effect of foundation size, shape, ground water table, determination bearing capacity from building codes, plate load test, penetration test, static and dynamic cone tests, Housel's approach, bearing capacity of sands and clays, settlement analysis of foundation, permissible settlements, design principles, depth of foundation, principles of floating raft, foundations on non-uniform soils.	**07L**
UNIT-06	**Pile Foundations:** Types of pile based on function, materials and methods of construction, friction and end bearing piles, static formulae, Engineering News and Hiley's formula, group action, block failure, settlement of pile groups in sand and clays, pile load test, negative skin friction, under-reamed piles.	**06L**
UNIT-07	**Well Foundations:** Elements, forces on well, lateral stability analysis, problems in sinking of wells and remedial measures.	**04L**

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: To learn slope stability analysis and different methods of determining the factor of safety.
CO2: To assess the stability of retaining wall with respect to sliding,overturning and its design considering lateral earth pressure.
CO3: To design sheet pile wall and anchored bulk heads and open cut strutting and sheeting.
CO4: To know different types of foundations, their general requirements and loads imposed.
CO5: To estimate the ultimate bearing capacity of shallow foundations and their settlement behavior as well as design shallow foundations.
CO6: To determine pile load capacity and elastic settlement of piles.
CO7: To understand the well foundation types, their design and stability analysis.

Books and References

1. Priciples of Foundation Engineering by B.M. Das.
2. Theory and Practice of Foundation Design by Som & Das.
3. Geotechnical Engineering by C. Venkatramaiah.
4. Soil Mechanics & Foundation Engg. by Purushotam Raj.
5. Design of Sub-structures by Swami Saran.
6. Foundation Engineering by P.C Varghese.

Course Name: **Highway Engineering**
Course Code: **CE-314**
Course Type: **Core**

Contact Hours/Week: **3L** Course Credits: **03**

Course Objectives

- To impart knowledge about the Roadway development of India
- To introduce the fundamental concepts of roadway geometric designs and construction procedures
- To enable the students to understand the factors considered in pavement design

Unit Number	Course Content	Lectures
UNIT-01	**Road Development and Planning:** Necessity of transportation planning, Classification of roads, Road patterns, Planning surveys, Highway planning and development in India	**03L**
UNIT-02	**Highway Location and Alignment:** Ideal alignment and factors controlling, Engineering survey for highway location, Drawing and reports, Highway projects	**03L**
UNIT-03	**Highway Geometric Design:** Highway cross-section elements, Sight distances, Design of horizontal alignment, Transition curves and vertical alignment, Design aspects of hill roads.	**08L**
UNIT-04	**Traffic Engineering:** Traffic characteristics, Traffic operation, Traffic studies and data collection, Design of intersections & rotaries, Signaling, Road markings and parking facilities	**06L**
UNIT-05	**Pavement Design:** Design factors, Pavement materials and their characteristics, Design of flexible pavement by CBR method, Group index and Burmister methods, Design of rigid pavements	**08L**
UNIT-06	**Construction of Roads:** Construction of water-bound macadam roads, Bituminous pavements, Cement concrete roads, Constructions of joints in cement concrete pavement	**05L**
UNIT-07	**Highway Maintenance:** Pavement failures, maintenance techniques, evaluation and strengthening of existing pavements	**03L**

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Design the cross-sectional, horizontal, vertical and intersection elements of roadway
CO2: Estimate the roadway capacity
CO3: Design pavement layers

Books and References

1. Highway Engineering by Khanna, S. K. & Justo, C. E. G., Nem Chand & Bros, Roorkee, U.K., India.
2. Traffic Engineering and Transport Planning by Kadiyali, L. R., Khanna Publishers.
3. Highway and Traffic Engineering, Saxena, S. C., CBS Publishers and Distributors.

Course Name:	**Highway Engineering Lab**
Course Code:	**CE-315**
Course Type:	**Core**
Contact Hours/Week: **2P**	Course Credits: **01**

Course Objectives

- To provide skills for testing coarse aggregates used in road construction
- To provide skills for testing bitumen used in road construction
- To provide skills for conducting different traffic studies

List of Experiments

1. To determine the impact value of aggregate sample
2. To determine the crushing value of aggregate sample
3. To determine the flakiness and elongation index of aggregate sample
4. To perform Los Angeles Abrasion test on aggregate sample
5. To determine the CBR value of a given soil sample
6. To carry out the grain size analysis of course and fine aggregates
7. To perform penetration test on bitumen sample
8. To determine the softening point of bitumen sample
9. To determine the specific gravity and water absorption of aggregate sample
10. To determine the ductility value of a bitumen sample
11. To determine the bituminous content in a bituminous mix.
12. To carry out traffic survey on a road stretch

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Conduct different tests on road construction materials like bitumen & coarse aggregate

CO2: Identify weather a batch of materials is suitable for road constructions

CO3: Measure traffic parameters in the field

Course Name:	**Soil Mechanics Lab**
Course Code:	**CE-316**
Course Type:	**Core**
Contact Hours/Week: **2P**	Course Credits: **01**

Course Objectives

- To provide skills for the determination of the properties of the soils

List of Experiments

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

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Student will be able to have the skill to determine the soil properties as per the codal provisions.

Course Name:	**Computational Lab**
Course Code:	**CE-317**
Course Type:	**Core**
Contact Hours/Week: **2P**	Course Credits: **01**

Course Objectives

- To provide skills for designing flowcharts and writing algorithms
- To provide skills for analyzing and designing structural elements
- To provide skills for building drawing
- To provide skills for solving Geotechnical and Transportation Engg. related problems

List of Experiments

1. MATLAB - Fundamentals of Matlab Programming, Application to Engineering problems
2. AutoCAD – Building drawing using AutoCAD
3. STAAD Pro -Modeling for truss, plane and space frames, loadings, Design,
4. STRUDS – Modeling, analysis and design of framed structures
5. ANSYS, SAP2000, & NISA – Modeling and analysis of structures using FEM
6. GEO 5, Plaxis 3D - Geotechnical problems that can be solved using software
7. PTV VISSIM – To simulate Traffic Stream.

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Identify and abstract the programming task involved for a given problem

CO2: Design and analyze structural elements

CO3: Solve geotechnical problems through software

CO4: Simulate a traffic stream based on given conditions

Course Name: **Steel Structure**
Course Code: **CE-321**
Course Type: **Core**

Contact Hours/Week: **3L + 1T** Course Credits: **04**

Course Objectives

- To impart concepts of design of steel structures.
- To introduce the fundamental concepts of design of tension, compression flexure members in steel structures, design of column bases plate girders and connections in steel structures.
- To enable the students to understand the factors that cause the design of steel structures

Unit Number	Course Contents	Lecturess
Unit-1	**Design of connections in steel structures**: Bolted and welded connections, assumptions, Different types of joints, design of various types of bolted and welded connections subjected to direct loads and Eccentric Loads.	**04L**
Unit-2	**Design of tension members**: Selection of section, I.S. specifications, design of axially loaded tension members, design of members for axial tension and bending, end connections, design of lug angles and tension splices.	**04L**
Unit-3	**Design of compression members:** Theory of buckling, design of column, cross section (single and built up sections), design of angle struts, eccentrically loaded columns, column splices, lacings and battens.	**06L**
Unit-4	**Design of beams:** Lateral stability, design of single and built up beams, plated beams and curtailment of flange plates.	**06L**
Unit-5	**Design of column bases and column footings:** Slab base, gusseted base, and Grillage Foundation subjected to Axial& Eccentric Loads.	**04L**
Unit-6	**Design of roof trusses:** Types of trusses, roofs and side coverage, types of loadings and load combinations, design of members and connections.	**04L**
Unit-7	**Design of Plate Girder and Gantry Girder:** Design of section, stiffeners, splices, design of built up Gantry Girder	**08L**

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Identify the concept of design of steel structures
CO2: Design the various components of steel structures like beam column, beam, truss etc.
CO3: Apply principles and algorithms for steel structures design
CO4: Assess the results obtained by solving above problems

Books and References

1. Design of Steel Structures by Subramanian,N, Oxford University Press, New Delhi
2. Design of Steel Structures by Duggal , S.K., Tata Mcgraw-Hill, New Delhi
3. Design of Steel Structures by Limit State Method As Per Is 800-2007, Bhavikatti,S.S., I.K.InternationalPublishing House, New Delhi
4. Limit State Design in Structural Steel by M.R.Shiyekar, PHI
5. Design of Steel Structures by K.S.Sai Ram, Pearson.
6. IS 800-2007 General Construction in Steel-Code of Practice, BIS
7. IS 801-1995 Use of cold deformed light gauge steel structural members in general BC.

Course Name: **Water Resources Engineering -II**
Course Code: **CE-322**
Course Type: **Core**

Contact Hours/Week: **3L + 1T** Course Credits: **04**

Course Objectives

- To impart knowledge about the water resources and components of hydrological cycle.
- To introduce the fundamental concepts relevant to flow in open channels, GVF, RVF, energy dissipation, soil moisture, irrigation requirement, canals and water resources management.
- To enable the students to understand the factors responsible for different processes in open channel hydraulics and irrigation sciences.

Unit Number	Course Content	Lectures
UNIT-01	**Open Channel Flow:** Types of open channels, classification of flows, continuity equation, concept of specific energy, critical depth, Chezy's and Mannings equation, roughness coefficients, equivalent roughness, Hydraulically efficient channel cross sections.	**08L**
UNIT-02	**Gradually Varied Flow**: Equations of GVF, Slope Profiles, Computations of GVF Profiles.	**02L**
UNIT-03	**Rapidly Varied Flow**: Hydraulic Jump – Concept and computations, Principles of energy dissipation, Jump as Energy dissipaters, tail water rating curve and jump height curves.	**06L**
UNIT-04	**Irrigation:** Water requirements of crops: Soil moisture and crop-water relations, Consumptive use of water, duty and delta, irrigation efficiencies, computation of channel and reservoir capacity based on crop water requirements, Irrigation methods, Irrigation scheduling**.**	**06L**
UNIT-05	**Canals:** Canal classification, Design of stable channels, regime theory and design of unlined canals. Water logging: causes, preventive and curative measures.	**08L**
UNIT-06	**Water Resources Management:** Water resources availability and demand; Water use sectors – Domestic, Industries and Agriculture; Sustainable water resources development; Integrated Water Resources Management (IWRM).	**06L**

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Identify different problems related to open channel flow and irrigation engineering.

CO2: Describe problems related to uniform flow, gradually and rapidly varied flow in open channels, water requirement of crops, irrigation scheduling, canal design and some aspects of water management.

CO3: Apply principles, theory and equations to solve problems mentioned in CO2

CO4: Assess the results obtained by solving above problems.

Books and References

1. Engineering Hydrology by K. Subramanya.
2. Engineering Hydrology by Ojha, Berndtssson and Bhunia.
3. Fundamentals of Irrigation Engineering by Bharat Singh.
4. Water Resources Engineering by R.K. Linsley and J.B. Franzini, McGraw-Hill.
5. S.K.Sharma by Design of Irrigation Structures.
6. Irrigation Engineering and Hydraulic Structures by S.K. Garg.
7. Flow in open Channels by K. Subramanya.
8. Open Channel Flow by K.G. Rangaraju.

Course Name: **Railways and Airports**
Course Code: **CE-323**
Course Type: **Core**

Contact Hours/Week: **3L+1T** **Course Credits: 04**

Course Objectives

- To impart knowledge about the planning and design of railways and airports
- To introduce the fundamental concepts relevant to railway and airport engineering
- To enable the students to understand the factors affecting the design of airports and railways

Unit Number	Course Content	Lectures
UNIT-01	**Planning of Railways:** Significance of Road, Rail, Air and Water transports Coordination of all modes to achieve sustainability, Route alignment surveys, Soil suitability analysis, Railway stations and yards, passenger amenities	**09L**
UNIT-02	**Railway Design:** Elements of permanent way Rails, Sleepers, Ballast, rail fixtures and fastenings, Track Stress, coning of wheels, creep in rails, signaling and interlocking, Geometric design of railways, gradient, super elevation, Points and Crossings	**09L**
UNIT-03	**Airport Planning:** Air transport characteristics-airport classification-air port planning: objectives, components, layout characteristics, criteria for airport site selection and ICAO stipulations, Typical airport layouts, Parking and circulation area, Airport Zones, Passenger Facilities and Services	**09L**
UNIT-04	**Airport Design:** Runway Design: Orientation, Wind Rose Diagram, Runway length, Geometric design of runways, Configuration and Pavement Design Principles, Elements of Taxiway Design, Runway and Taxiway Markings and lighting.	**09L**

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Identify factors affecting airports and railways design
CO2: Describe the process of planning railways and airports
CO3: Apply principles of railways and airport planning
CO4: Assess the effect of proper airport and railways planning

Books and References

1. A Course in Railway Engineering by Saxena Subhash C and Satyapal Arora, Dhanpat Rai and Sons.
2. Airport Planning and Design by Khanna S K, Arora M G and Jain S S, Nemchand and Brothers, Roorkee.

Course Name: **Waste Water Treatment and Management**
Course Code: **CE-324**
Course Type: **Core**

Contact Hours/Week: **3L** Course Credits: **03**

Course Objectives

- To Estimate the sewage generation rate.
- To Analyze the sewage quality and its importance.
- To Design of a sewage treatment unit primary, secondery& tertiary.
- To Understanding various environment friendly low cost sewage disposal techniques which can be generally used in rural areas.
- To Understand all the requirements for sewage disposal.
- To Analyze & design sludge treatment and disposal facility.

Unit Number	Course Content	Lectures
UNIT-01	**Wastewater Generation, Collection & Conveyance:** Wastewater Quantity - Classification of wastewater - Sewerage system for domestic wastewater and storm water - Collections, and appurtenances - Design and layout of sewerage systems - Maintenance of sewerage systems - Physical, Chemical & Biological characteristics and their significance.	**09L**
UNIT-02	**Primary Treatment of Wastewater :** Objectives of Wastewater treatment- Treatment methods: Unit Operations and Processes Design criteria -Design of primary treatment System.	**06L**
UNIT-03	**Secondary Treatment of Wastewater:** Concepts of Biological treatment and removal mechanism – Aerobic and Anaerobic systems - Design of suspended and attached growth processes – Introduction to extended aeration processes and waste stabilization pond - Design of anaerobic system.	**09L**
UNIT-04	**House Drainage & Environmental Sanitation:** General principles - House drainage system - traps and sanitary fitting - Low cost sanitation system.	**03L**
UNIT-05	**Wastewater Disposal:** Alternative disposal methods - Self purification of stream - Standards for disposal alternatives, natural purification of polluted streams.	**04L**
UNIT-06	**Sludge Handling:** Quantity and quality of sludge, Methods of sludge treatment: sludge digestion and drying beds – Disposal of sludges.	**05L**

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Understand the basic concepts and analyze how to dispose off the sewage in an environment friendly manner.

CO2: Experimentally analyze the sewage quality of an area and understand the need of safe disposal of sewage.

CO3: Design a sewage treatment plant and understand the application of various sewage treatment techniques.

CO4: Plan an effective and efficient sewage disposal system for an area.

Books and References

1. Sewage Disposal & Air Pollution Engineering by S.K. Garg,Khanna Publishers.
2. Wastewater Engineering by Metcalf & Eddy, McGraw Hill.
3. Wastewater Treatment Plants by Syed R. Qasim, PHI.
4. Wastewater Treatment Concepts & Design Approach by G.L. Karia and R.A. Christian, PHI.
5. Manual for Sewage Treatment by Ministry of Urban Development, Govt of India.

Course Name:	**Environmental Engineering Lab**
Course Code:	**CE-325**
Course Type:	**Core**
Contact Hours/Week: **2P**	Course Credits: **01**

Course Objectives

- To introduce students to how the common environmental experiments relating to water and wastewater quality were performed.
- To Understand and use the water and wastewater sampling procedures and sample preservations
- To tests the sample with appropriate methods for given environmental problems,
- Able to interpret laboratorial results and write technical reports, and apply the laboratorial results to problem identification, quantification, and basic environmental design and technical solutions

List of Experiments

1. To find the test and odor of a given sample of water.
2. To find the turbidity, colour, PH, and conductivity of a given sample of water.
3. To find out total dissolved solid, settleable solids and suspended solids of the given sample.
4. To determine the carbonate, bicarbonate, and hydroxide alkalinity of a sample.
5. To find out the concentration of chlorides in the given sample of water.
6. To estimate the hardness of the given sample of water by standard EDTA method
7. To find the optimum amount of coagulant required to treat the turbid water by Jar Test.
8. To determine residual chlorine in a given sample of water.
9. To find the quantity of dissolved oxygen (DO) present in the given sample.
10. To determine biochemical oxygen demand (BOD) and Chemical oxygen demand (COD) of given waste water sample.
11. To determine MPN of coliforms of the given sample.
12. To determine the metal & metalloids of the given sample.

Note: *The concerned Course Coordinator will prepare the actual list of experiments/problmes at the start of semester based on above generic list.*

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Perform common environmental experiments relating to water and wastewater quality, and know which tests are appropriate for given environmental problems.

CO2: Statistically analyze and interpret laboratorial results.

CO3: Understand and use the water and wastewater sampling procedures and sample preservations

CO4: Demonstrate the ability to write clear technical laboratorial reports

Books and References:

1. Methods Of Sampling And Test (Physical And Chemical) For Water And Wastewater (IS:3025).
2. Standard Methods for the Examination of Water and Wastewater: APHA, AWWA.
3. Chemistry for Environmental Engg and Science: C.N. Sawyer, P.L. McCarty & G.F. Parkin.
4. Eaton, A. D. Standard Methods for the Examination of Water and Wastewater.

Course Name:	**Structural Drawing**
Course Code:	**CE-326**
Course Type:	**Core**
Contact Hours/Week: **2P**	Course Credits: **01**

Course Objectives

- To develop skills for making drawing for structural detail
- To developed understanding of convention
- To enable the students to carry out construction of structural element with assistance of drawings

List of Experiments

1. Reinforced concrete Structures: Beam, column, beam-column junction, slab, foundation detail.
2. Retaining wall: Counterfort retaining wall.
3. Water tanks drawing: R.C.C. rectangular, overhead water tank with staging.
4. Steel Structures: Typical connection details- welded and bolted, splice details, Lacing and battening, Column bases.
5. Roof trusses and connection details,
6. Bridge Superstructure : T beam bridge, Hollow girder deck bridge
7. Bridges Substructure : Bridge Piers, Abutment, wing wall and approaches, well foundation

Note: *The concerned Course Coordinator will prepare the actual list of experiments/problems at the start of semester based on above generic list.*

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Developing knowledge about the convention used for generating drawing

CO2: Converting the design parameter into drawing for construction

CO3: Drawing based construction

Course Name: **Engineering Economics and Accountancy**
Course Code: **HS-404**
Course Type: **Core**

Contact Hours/Week: **3L** Course Credits: **03**

Course Objectives

- To impart knowledge about the Economics and its applicability to the Engineers
- To introduce the fundamental concepts of economics
- To enable the students to understand the factors that causes the changes in economic conditions of the entrepreneur

Unit Number	Course Content	Lectures
UNIT-01	**Introduction to Engineering Economics:** Definitions, Nature, Scope and application; Difference between Micro Economics and Macro Economics; Theory of Demand & Supply: Meaning, Determinants, Law of Demand, Elasticity of demand, Demand Forecasting, Law of Supply, Equilibrium between Demand & Supply.	**06L**
UNIT-02	**Production and Cost**: Production functions, Isoquant, Least Cost combination, Laws of Returns to Scale. Economics and Diseconomies of Scale of production, Cost and Cost curves, Revenue and Revenue curve, Break even analysis.	**06L**
UNIT-03	**Costing and Appraisal:** Cost elements, Economic cost, Accounting cost, Standard cost, Actual cost, Overhead cost, Cost control, Criteria of project appraisal, Social cost benefit analysis	**05L**
UNIT-04	**Markets**: Meaning, Types of Markets, Characteristics (Perfect Competition, Monopoly, Monopolistic Competition, Oligopoly) Price and Output Determination; Product Differentiation; Selling Costs; Excess Capacity.	**05L**
UNIT-05	**Money**: Meaning, Functions, Types; Monetary Policy- Meaning, Objectives, Tools; Fiscal Policy:-Meaning, Objectives, Tools. **Banking:** Meaning, Types, Functions, Central Bank: its Functions, concepts CRR, Bank Rate, Repo Rate, Reverse Repo Rate, SLR.	**04L**
UNIT-06	**Depeciation:** Meaning of depreciation, causes, object of providing depreciation, factors affecting depreciation, Methods of Depreciation: Straight line method, Diminishing balance method, Annuity method and Sinking Fund method	**04L**
UNIT-07	**Financial Accounting:** Double entry system (concept only), Rules of Double entry system, Journal(Sub-division of Journal) , Ledger, Trial Balance Preparation of final accounts-Trading Account. Profit and Loss account, Balance Sheet.	**06L**

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Identify the challenges of the economy as entrepreneur/manufacturer as well as consumer
CO2: Describe the economic system at the micro and macro level
CO3: Apply principles of economics and accountancy in the professional, personal and societal life
CO4: Assess the role of engineering economics and accounting in attaining economic efficiency

Books and References

1. Principles of Micro Economics by Mceachern & Kaur, Cengage Publication.
2. Managerial Economics by Craig Peterson & W Cris Lewis, PHI Publication.
3. Modern Microeconomics by A. Koutsoyiannis, Macmillan.
4. Managerial Economics Theory and Applications by D. M.Mithani. Himalaya Publication House.
5. Fundamental of Managerial Economics Mark Hirschey, South Western Educational Publishing.
6. Engineering Economics by Degramo, Prentice Hall.
7. Financial Accounting–A Managerial Perspective by R. Narayanaswamy, PHI.
8. Introduction to Accounting by J.R. Edwards & Marriot, Sage Publication.
9. Cost Accounting by Jawahar Lal, Tata McGraw Hill.
10. Project Planning Analysis, Selection, Implementation and Review by Prasanna Chandra, Tata McGraw Hill

Course Name: **Design of Hydraulic Structures**
Course Code: **CE-411**
Course Type: **Core**

Contact Hours/Week: **3L** Course Credits: **03**

Course Objectives

- To impart knowledge about design and application of various hydraulic structures.
- To introduce the fundamental concepts relevant to reservoir operations, cross drainage works, dams, spillways and energy dissipators.
- To enable the students to understand the theoretical and practical application of these hydraulic structures.

Unit Number	Course Content	Contact Hours
UNIT-01	**Reservoir Planning:** Investigations, Layout, selection of site for hydraulic structures, life of Reservoir.	**02L**
UNIT-02	**Structures on Permeable foundations:** Bligh's creep theory, limitations, Khoslas's theory of independent variable, Khosla's corrections, Canal Head Works, Design of Weir and Barrages**.**	**11L**
UNIT-03	**Canal Structures:** Design of canal falls, Regulators, Cross drainage works: Selection, design aspects of aqueducts, siphon aqueducts, supper passages, canal siphon and level crossings**.**	**03L**
UNIT-04	**Earth Dams:** Types, causes of failure, soils suitability for earth dam construction, typical earth dam sections, estimation of seepage through and below the dam, seepage control, stability of slopes.	**11L**
UNIT-05	**Gravity dams:** Design Criteria, forces acting on gravity dams, elementary profile, Forces on gravity dams, stability analysis**.**	**03L**
UNIT-06	**Spillways and Energy dissipaters:** Purpose, different types, details of ogee, syphon, shaft, chute and side channel spillways, design aspects.Principles of energy dissipation, Energy dissipaters based on tail water rating curve and jump height curves.	**06L**

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Identify different problems pertaining to design and application of hydraulic structures.

CO2: Describe problems related to planning, site selection and design of reservoirs, canals, regulators, wiers, earth dams, gravity dams, spillways and energy dissipators.

CO3: Apply principles and design criterion to solve problems mentioned in CO2.

CO4: Assess the results obtained by solving above problems.

Books and References

1. Engineering for Dams (Volumes I, II & III) by Creager, Justin & Hinds.
2. Hydroelectric Hand Book by Creager.
3. Hydraulic Structures by Varshney.
4. Irrigation & Water Power Engg. By Punmia & Pandey B.B.Lal.
5. Water Power Engineering by Dandekar.

Course Name: **Prestressed Concrete**

Course Code: **CE-421**

Course Type: **Core**

Contact Hours/Week: **3L** Course Credits: **03**

Course Objectives

- To impart knowledge about the Principle of Prestressing, Prestressing materials and systems of Prestressing
- To enable the students to understand various losses in Prestressing
- To enable the students to understand the design concept of prestressed beam, tension and compression members
- To comprehend the principles of Circular prestressing

Unit Number	Course Content	Lectures
UNIT-01	**Introduction to prestressed concrete:** Materials to be used, steel and its properties, concrete and its requirements.	02L
UNIT-02	**General principles of prestressing:** Assumption, general principles, eccentric tendons, bent tendons and parabolic tendons. Analysis of prestressed beams, load balancing concept.	03L
UNIT-03	**Prestressing systems:** Classification of prestressed concrete members, externally and internally prestressed members, pretensioning and post tensioning.	03L
UNIT-04	**Losses in prestress:** Losses due to length effect, curvature effect, loss of stress at anchoring stage, due to shrinkage and creep of concrete, elastic shortening of concrete, relaxation of steel-temperature effects. **Design of prestressed beams:** Principle of design, I.S. Code provisions, design of rectangular and Isection and continuous beams. **Shear:** Shear stresses, principal tensile stresses, shear reinforcement, effect of vertical prestressing.	14L
UNIT-05	**Tension and compression members:** Design of tension members and compression members. **End-block:** Stress- analysis, transmission zones, bursting and spalling stresses, anchor plates placed symmetrically and eccentrically. Design problems. **Circular prestressing:** Introduction and General principles **Ultimate load design:** Assumptions, modes of failure of beam sections, under and over-reinforced beam sections. I.S. recommendations and design problems.	14L

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Design prestressed beam, compression and tesion members using relevant codes for industrial practice

CO2: Identify different losses in prestressing

CO3: Identify various materials required for prestressing and systems of prestressing

Books and References

1. Design of Prestressed Concrete by T.Y. Lin, Wiley
2. Prestressed concrete by N.K. Raju, Tata McGraw Hill.
3. Prestressed concrete by N. Rajagopalan, Narosa Publishing House
4. Standard Specifications and code of Practice for PSC.

Course Name: **Quantity Surveying**
Course Code: **CE-422**
Course Type: **Core**

Contact Hours/Week: **3L** Course Credits: **03**

Course Objectives

- To impart knowledge about the quanitity surveying
- To introduce the fundamental concepts relevant to estimation and costing
- To enable the students to understand the specifications

Unit Number	Course Content	Lectures
UNIT-01	**Estimate:** Principles of estimation, units, items of work, different kinds of estimates, different methods of estimation, estimation of materials in single room building, two roomed building with different sections of walls for foundation, floors and roofs, R.B. and R.C.C. works, plastering, white-washing, distempering, painting, doors and windows, and lump sum items, estimates of canals and roads.	**09L**
UNIT-02	**Specification of Works:** Necessity of specifications, types of specifications, general specifications, specification for bricks, cement, sand, water, lime, reinforcement; detailed specifications for earthwork, cement, concrete, brick work, floorings, D.P.C., R.C.C., cement plastering, white and colour washing, distempering, painting.	**09L**
UNIT-03	**Rate Analysis:** Purpose, preparation of rate analysis, procedure of rate analysis for items:- earthwork, concrete works, R.C.C. works, reinforced brick work, plastering, painting, white-washing and distempering.	**08L**
UNIT-04	**Valuation:** Gross income, net income, outgoings, scrap values, salvage value, obsolescence, annuity, sinking fund, depreciation, valuations of buildings.	**05L**
UNIT-05	**Public Works Account:** Regular and work charge establishment, earnest money, security money, retention money, muster roll, measurement book, cash book, examination and payment of bills, first and final bills, administrative sanction, technical sanction.	**05L**

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Estimate quantities in the various items of work in the civil engineering,
CO2: Understand the specifications and their need of in the civil engineering works,
CO3: Understand calculation of rates of various items of the works in the civil engineering,
CO4: Estimate the fair price or value of civil engineering property,
CO5: Understand the documentation in the public work departments.

Books and References

1. Estimating & Costing in Civil Engineering: Theory and Practice by.B.N. Dutta.
2. Estimating and Costing for Building & Civil Engineering Works by P.L. Bhasin.
3. Costing & Specification in Civil Engineering by M. Chakarborty, Estimating.
4. Building Construction Estimating by George H. Cooper.

Course Name: **Finite Element Method**
Course Code: **CE-430**
Course Type: **Professional Elective-I**

Contact Hours/Week: **3L** Course Credits: **03**

Course Objectives

- To impart knowledge about the Finite Element Analysis
- To introduce the fundamental concepts relevant to structural analysis by Finite Element Method.
- To enable the students to understand the factors that cause the economy and optimization of the structural design and construction.

Unit Number	Course Content	Lectures
UNIT-01	**Introduction to Finite Element Analysis:** Background of Finite Element Analysis, Numerical Methods, Concepts of Elements and Nodes, Degrees of Freedom.**Basic Concepts of Finite Element Analysis**: Discretization of Technique Basic, Concepts of Finite Element Analysis, Advantages of FEA, Disadvantages of FEA, Limitations of the FEM, Errors and Accuracy in FEA. **Introduction to Elasticity:** Strain-Displacement Relations, Linear Constitutive Relations,*Two-Dimensional Stress Distribution*: Plane Stress Problem, Plane Strain Problem, Axisymmetric Problem.	**06L**
UNIT-02	**Finite Element Formulation Techniques:** Virtual Work and Variational Principle, Galerkin Method, **Finite Element Method:** Displacement Approach, Choice of Displacement Function, Shape Function, Degree of Continuity, Isoparametric Elements, Various Elements. **Stiffness Matrix and Boundary Conditions:** Element Stiffness Matrix, Global Stiffness Matrix, Boundary Conditions	**06L**
UNIT-03	Natural Coordinates, Triangular Elements, Rectangular Elements, Lagrange and Serendipity Elements, Solid Elements, Isoparametric Formulation, Stiffness Matrix of Isoparametric Elements, Numerical Integration: One Dimensional, Two and Three Dimensional.	**06L**
UNIT-04	**Analysis of Frame Structures:** Stiffness of Truss Members, Analysis of Truss, Stiffness of Beam Members, Finite Element Analysis of Continuous Beam, Plane Frame Analysis, Analysis of Grid and Space Frame	**06L**
UNIT-05	**FEM for Two and Three Dimensional Solids:** Constant Strain Triangle, Linear Strain Triangle, Rectangular Elements, Numerical Evaluation of Element Stiffness, Computation of Stresses, Geometric Nonlinearity and Static Condensation, Axisymmetric Element, Finite Element Formulation of Axisymmetric Element, Finite Element Formulation for 3 Dimensional Elements	**06L**
UNIT-06	**FEM for Plates and Shells:** Introduction to Plate Bending Problems, Finite Element Analysis of Thin Plate, Finite Element Analysis of Thick Plate, Finite Element Analysis of Skew Plate, Introduction to Finite Strip Method,Finite Element Analysis of Shell.	**04L**
UNIT-07	**Additional Applications of FEM:** Finite Elements for Elastic Stability, Finite Elements in Fluid Mechanics, Dynamic Analysis.	**02L**

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Identify the uses Finite Element Analysis in civil engineering
CO2: Describe different technipues and procedure of the Finite Element Analysisin civil engineering.
CO3: Apply principles of different Finite Element Formulation Techniques.
CO4: Assessthe Applications of FEM in in civil engineering.

Books and References

1. Finite element methods, Vol I &Vol II by O.C. Zienkiewicz and R.L. Taylor, McGraw Hill, 1989, 1992.
2. Finite element procedures by K. J. Bathe, PHI Ltd 1996.
3. Concepts and applications of finite element analysis, Third edition by R.D. Cook, D.S. Malkus and M.E. Plesha, , John Wiley and Sons, 1989.
4. Fundamental Finite Element Analysis and Applications: with Mathematica and Matlab Computations by Bhatti, MA., , Wiley, 2005.
5. An Introduction to the Finite Element Method, 3rd Edition, McGraw-Hill Science/Engineering/Math by Reddy, J. N., 2005.
6. A First Course in the Finite Element Method by Logan D. L., Thomson- Engineering, 3rd edition, 2001.

Course Name: **GIS and Remote Sensing**
Course Code: **CE-431**
Course Type: **Professional Elective-I**

Contact Hours/Week: **3L** Course Credits: **03**

Course Objectives

- To impart knowledge about the electromagnetic spectrum and its interaction with various earth surface features
- To introduce the fundamental concepts relevant to computer processing of remotely sensed imagery image
- To understand geographic information systems, data models in GIS, database management in GIS, spatial analysis and other GIS tools and techniques

Unit Number	Course Content	Lectures
UNIT-01	**Remote Sensing:** Remote sensing system; Physics of remote sensing, EMR characteristics and interaction in atmosphere and with ground objects, spectral properties of water bodies, vegetation, soil etc, resolution, sensors and platforms, types of resolution, image processing, classification; geometric and radiometric distortions, geo-referencing, digital image processing, image enhancement, transformations and classification; visual interpretation techniques, applications of remote sensing for earth resource management; applications of optical and microwave remote sensing techniques in Civil Engineering.	**20L**
UNIT-02	**Geographic Information System:** Introduction to GIS, spatial data models, databases and database management systems, coordinate systems and georeferencing, GIS analysis functions, statistical modeling, digital elevation models and their applications, data visualization methods, exporting data; modern trends in GIS, applications of GIS	**16L**

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Understand the concept of electromagnetic radiation, its interaction with matter, particularly the land surface, the oceans and the atmosphere to Infer valid information from remote observations (e.g., of electromagnetic spectra).

CO2: Apply the principles, techniques and practice of the quantitative analysis and image processing of digital satellite imagery.

CO3: To relate observations from remote sensing satellite data to models (mathematical, computational and conceptual) and mapping

CO4: Synthesize and integrate fundamental concepts of GIS theory and apply the tools and techniques of GIS such as data models, data structures, topology, spatial data representation, georeferecing to perform spatial analysis, network and 3-D analysis and modeling using GIS.

Books and References

1. Concepts & Techniques of GIS by C.P.Lo Albert, K.W. Yonng.
2. Remote sensing and Image interpretation by T. M. Lillesand and R. W. Keifer.
3. Remote Sensing and GIS by B. Bhatta.
4. Fundamentals of Remote Sensing by George Joseph.

Course Name: **Advanced Surveying Techniques**
Course Code: **CE-432**
Course Type: **Professional Elective-I**

Contact Hours/Week: **3L** Course Credits: **03**

Course Objectives

- To impart knowledge about the coordinate systems, Global positioning system and surveying using LiDAR
- To introduce the fundamental concepts relevant to GPS and Lidar scanning

Unit Number	Course Content	Lectures
UNIT-01	**Coordinate system:** Geodetic reference systems, Geodetic datums, Earth ellipsoid, basic geometric geodesy, Coordinate systems and transformation, Map projections, geoid and geoidal heights and undulations	**6L**
UNIT-02	**Global Navigation Satellite System:** Overview of GNSS and introduction to GPS, GLONASS, GALILEO, COMPASS, IRNSS systems, GPS basic concepts and measurements, Errors and biases in GPS measurements, accuracy of navigation position, Differential GPS, Space based augmentation systems (e.g., SBAS, GAGAN) and Ground based augmentation systems (e.g., WASS, EGNOS), signal differencing, double and Triple Differencing in GPS measurements. Doppler effect on GPS signals, GPS data processing, surveying with GNSS, GIS and GPS integration, GNSS applications to Earth Systems.	**15L**
UNIT-03	**Laser Scanning:** Physics of laser, spectral characteristics of laser, laser interaction with objects, Airborne AltimetricLiDAR, topographic and bathymetric LiDAR, Components of a LiDAR system, INS technology, INSGPS integration, measurement of laser range, calibration, Flight planning, LiDAR geo-location models, Accuracy of various components of LiDAR and error propagation, error analysis of data and error removal, Data classification techniques, raw data to bald earth DEM processing,, LiDAR data integration with spectral data, LiDAR applications and LiDAR data visualization.	**15L**

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Identify and select the appropriate coordinate system and coordinate system transformations (either on a 3D space, on the ellipsoid, on the conformal mapping plane or with respect to vertical datums) to be used in the support of geodetic applications.

CO2: Plan and execute a large scale topographical survey for engineering development by designing the appropriate combination of equipment and procedures for a data gathering task that will ensure that the gathered data meets the quality requirements of relative positioning.

Books and References

1. Engineering Satellite-Based Navigation & Timing: GNSS, Signals, & Receivers by John W. Betz
2. Understanding GPS: Principles and Applications by E. Kaplan and C. Hegarty
3. Topographic Laser Ranging and Scanning: Principles and Processing, by Jie Shan, and Charles K. Toth
4. LiDAR Remote Sensing and Applications by Pinliang Dong and Qi Chen

Course Name: **CPM and PERT**
Course Code: **CE-433**
Course Type: **Professional Elective-I**

Contact Hours/Week: **3L** Course Credits: **03**

Course Objectives

- To impart knowledge about types, merit, and demerits of construction contracts,
- To introduce the fundamental concepts relevant to CPM and PERT, and
- To enable students to understand organizational structures in the construction industry

Unit Number	Course Content	Lectures
UNIT-01	**Construction Management**: Significance, objectives and functions, resources for construction industry, stages in construction, Civil Engineering drawings, ork breakdown structure, pre-tender stage planning, contract stage planning, scheduling, bar charts, limitations of bar charts, milestone charts, preparation of material, equipment, labour, and finance schedule..	**08L**
UNIT-02	**Construction Contracts & Specifications**: Types of contracts, contract document, specifications, important conditions of contract, arbitration.	**08L**
UNIT-03	**Construction Organization**: Principles of organization, communication in organization, types of organizations, temporary services, job layout.	**04L**
UNIT-04	**Critical Path Method:** 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.	**08L**
UNIT-05	**Cost-Time Analysis:** Cost versus time, direct cost, indirect cost, total project cost, optimum duration, contracting network for cost optimization.	**03L**
UNIT-06	**Programme Evaluation and Review Technique**: Probability concept in network, optimistic time, pessimistic time, most likely time, variance, standard deviation, slack, central limit theorem, probability of achieving completion time.	**05L**

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Understand purpose, types, merit, and demerits of construction contracts,
CO2: Develop organizational structures in the construction industry,
CO3: Develop critical path method based network and estimate various times and floats, and
CO4: Develop PERT network and find probability of completion of a project in specified duration.

Books and References

1. Construction Planning and Management by P.S. Gehlot and B.M. Dhir.
2. Project Planning and Control with PERT and CPM by B.C. Punmia and K.K. Khandelwal.
3. Construction Planning Equipments and Methods by R.L. Peurify.
4. PERT and CPM -Principles and Applications by L.S. Srinath.
5. Construction Project Management: Planning, Scheduling and Control by K.K. Chitkara.
6. Project Management with CPM, PERT and Precedence Diagramming by J. Moder, C. Phillips and E. Davis.
7. Project Management Technique in Planning and Controlling Construction Projects by H.N. Ahuja.

Course Name: **Earthquake Resistant Design of Structures**
Course Code: **CE-450**
Course Type: **Professional Elective-II**

Contact Hours/Week: **3L** Course Credits: **03**

Course Objectives

- To impart knowledge about the Earthquake resistant construction
- To introduce the fundamental concepts relevant to designing lateral force resistant Construction
- To enable the students to understand the factors that cause the failure of structure during earthquake

Unit Number	Course Content	Lectures
UNIT-01	**Introduction: Seismic design Philosophy**- Earthquake ground motions, inelastic seismic response.	**03L**
UNIT-02	**Theory of vibrations** - Conversion of Structures into equivalent mathematical model for vibration analysis, Vibration of single, two and multi storey building frames	**09L**
UNIT-03	**Earthquake resistant Reinforced concrete buildings**Codal provisions for design against earthquake IS:1893-2016, IS:13920-2016.	**12L**
UNIT-04	**Earthquake resistant masonry buildings**: Behaviour of masonry during earthquakes, codal provisions for earthquake resistant masonry, IS:4326-2013, IS:3827-1993, IS:13828-1993.	**12L**

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Identify earthquake resistant features
CO2: Describe methodology to carry out earthquake resistant design and construction
CO3: Apply principles of analysis and design
CO4: Assess the specific feature of earthquake resistant construction

Books and References

1. Earthquake resistant design of structuresby Agarwal , Pankaj , Shrikhande , Manish ,Prentice-Hall, New Delhi.
2. Dynamics of structures: theory and applications to earthquake engineering by Chopra, Anil K., Prentice-Hall, New Delhi.
3. Elements of earthquake engineering by Krishna,Jai, South Asian Publishers, New Delhi.
4. IS: 1893 (Pt1) 2016, Criteria for earthquake resistant design of structures by Bureau of Indian Standards, New Delhi
5. IS: 4326-2013, Earthquake resistant design and construction of building-code of practice by Bureau of Indian Standards, New Delhi.
6. IS: 13827 1993, Indian standards improving earthquake resistance of earthen buildings by Bureau of Indian Standards, New Delhi.
7. IS: 13828 1993, Improving earthquake resistance of low strength masonary buildings-guidelines by Bureau of Indian Standards, New Delhi.

Course Name: **Bridge Engineering**

Course Code: **CE-451**

Course Type: **Professional Elective-II**

Contact Hours/Week: **3L** Course Credits: **03**

Course Objectives

- To develop an understanding of and appreciation for basic concepts in proportioning and design of bridges in terms of aesthetics, geographical location and functionality.
- To help the student develop an intuitive feeling about the sizing of bridge elements, ie. develop a clear understanding of conceptual design.
- To understand the load flow mechanism and identify loads on bridges.
- To carry out a design of bridge starting from conceptual design, selecting suitable bridge, geometry to sizing of its elements

Unit Number	Course Content	Lectures
UNIT-01	**Elements of bridge engineering:** Definitions, components of a bridge, classification, importance and Site Selection, water way.Site selection, data drawing, design discharge linear water way, economical span, location of piers and abutments, vertical clearance above HFL scour depth. Traffic projection, investigation report choice of bridge type, selection of Bridge cross-section and longitudinal form, Characteristics of each type. Introduction to bridge codes, Design loads for Road and Railway bridges; General design consideration.	**06L**
UNIT-02	**Culverts:** Design of R.C.C slab culvert (Design of deck slab), Pipe culvert and Box culvert based on variety of IRC vehicle loading.	**05L**
UNIT-03	**RC Slab and Tee Girder Bridges:** Design of solid deck slab, Longitudinal beam and Cross beam based on variety of IRC vehicle loading	**12L**
UNIT-04	**Bridge Piers, Abutments, wing-wall and approaches:** Types and stability analysis of piers and abutments, Loads, abutments and wing wall design.	**06L**
UNIT-05	**Bridge Foundations:** Types of Bridge foundations, Pile and well foundations.	**04L**
UNIT-05	**Bridge Bearings and expansion joints:** Necessity of bearings, Types of bearings and expansion joints, Design of Elastomeric Bearings, Necessity and types of expansion joints	**03L**

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Develop an understanding of different types of bridge loadings, design of super& sub structure.

CO2: Describe the design features integrating the principles of design and become familiar with professional and contemporary issues in design and detailing of reinforcement.

CO3: Apply principles of analysis and design to the different types of bridges

CO4: Read and execute the drawings and detailing of reinforcement for the designed Bridges in the field.

Books and References

1. "Essentials of Bridge Engineering", 6th Edition by Johnson Victor, D. (2008), Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
2. "Design of Bridges" by Krishna Raju, N. (2006), 3rd Edition, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
3. "Bridge Superstructure" by N. Rajgopal (2006), Narosa Publishing House, New Delhi
4. "Concrete bridge Practice: Analysis by V. K. Raina(2002, Design and Economics", TMH.
5. "Design of concrete bridges" by Aswani, M.G., Vazirani, V.N. and Ratwani, M.M (1975), Khanna publishers.
6. "Bridge Engineering" by Ponnuswamy S. (1996), Tata McGraw-Hill, New Delhi.
7. "Design of Bridge structures" by T.R.Jagadish and M. A. Jairam, Prentice hall of India, New Delhi
8. "Bridge Engineering" by Phatak D.R. (1990), SatyaPrakashan, New Delhi.
9. "Bridge Analysis Simplified" by Bakht,B. and Jaegar, L.G.(1985 McGraw-Hill, New Delhi.
10. "Dynamics of Railway Bridges" by L. Fryba(1996), Thomas Telford.
11. Indian Standard Codes and IRC codes related to bridges.

Course Name: **Repair and Maintenance of Structures**

Course Code: **CE-452**

Course Type: **Professional Elective-II**

Contact Hours/Week: **3L** Course Credits: **03**

Course Objectives

- To impart knowledge about the repair materials
- To introduce the fundamental concepts relevant to repair and maintenance of structures
- To enable the students to understand the factors that cause the generation of maintenance requirement

Unit Number	Course Content	Lectures
UNIT-01	**Maintenance Principles:** Importance of repair and maintenance; Preventive maintenance, functional requirement of building, Causes of distress, evaluation methods for condition, strength, serviceability.	**03L**
UNIT-02	**Repair Materials:** Types, characteristics and properties, selection criteria, techniques for repair, damp proof systems	**9L**
UNIT-03	**Maintenance Problem –** Evaluation for causes and remedies for cracks in buildings, seepage and dampness, works - plastering, painting, wood, flooring, roofing and drainage, water supply and	**12L**
UNIT-05	**Materials and equipment's Methodologies for restoration and retrofitting**: For walls, roofs, slabs, columns and foundation of building in stones, brick, reinforced concrete structures or structural steel, improper load path, Retrofit techniques required in structures resulting from change in function, loading, and seismic forces.	**12L**

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Identify repair material

CO2: Describe repair and maintenance requirement

CO3: Apply principles of compatibility of structural element and material

CO4: Assess the deficiency in the functional requirement of the buildings

Books and References

1. Building Repair and Maintenance Management by P S Gahlot and Sanjay Sharma CBS Publisher & Distributor Pvt. Ltd.
2. Practical Handbook on Building Maintenance by M K Gupta, Nabhi Publications
3. A manual on maintenance engineering ; repair and maintenance of civil works and structures, by B S Nayak, Delhi: Khanna Publishers
4. Maintenance repair and rehabilitation and minor works of buildings by P C Varghese, New Delhi: PHI Learning Private Limited
5. Handbook on Seismic Retrofit of Building by CPWD, IBC, IIT Madras, Narosa Publishing House.

Course Name: **Building Services**
Course Code: **CE-453**
Course Type: **Professional Elective-II**

Contact Hours/Week: **3L** Course Credits: **03**

Course Objectives

- To impart knowledge about the building services
- To introduce the fundamental concepts relevant to functional requirement of building.
- To enable the students to understand the factors that cause the variation in the building service requirement

Unit Number	Course Content	Lectures
UNIT-01	**Planning of building services-** Classification of Buildings base on Occupancy, Consideration in Building Design, Standard of Accommodation	**03L**
UNIT-02	**Plumbing**- Common Sanitary Fixtures, Layout of Sanitary Fixtures, Water Pipe Sizing in Buildings, Foul Water Drainage in Buildings, Building Services Detailing	**09L**
UNIT-03	**Lift and Escalator**- Classification (Types), Lift codes and Rules, Structural Provisions, Design Features of Escalator	**03L**
UNIT-04	**Acoustics and Ventilation**- Material properties, acoustical design of assembly halls and buildings, noise and its control, measuring equipment Ventilation- Ventilation systems, health and comfort ventilation, natural ventilation and its measurement. Fire protection and equipment	**06L**
UNIT-05	**Illumination**- Laws and principles of illumination, artificial and day lighting, Energy conservation in buildings. Electrical Wiring- Requirements in domestic, office and commercial buildings, Electric light sources – brief description, characteristics,	**06L**
UNIT-06	**Thermal Aspects of Building Services**- Thermal environment in a building and its control, factors involved, heat transfer through building fabric, thermal properties of building and insulation materials, air conditioning systems, types, design, installation, Solar passive building planning	**09L**

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Identify aspects related to building services
CO2: Describe the building service requirement
CO3: Apply principles of appropriate construction practice
CO4: Assess the implementation of buildings services

Books and References

1. Hand book of Designing and Installation of Services in High Rise Building Complexes, by V.K. Jain, Khanna Publishers.
2. Building Science & Planning by S.V. Deodhar, Khanna Publishers.
3. Design and Practical Hand Book on Plumbing by C.R Mohan, VivekAnand, Standard Publishers Distributors.

Course Name: **Geo-synthetics**
Course Code: **CE-440**
Course Type: **Professional Elective-III**

Contact Hours/Week: **3L** Course Credits: **03**

Course Objectives

- To impart knowledge about the geosynthetic materials
- To introduce the fundamental concepts relevant to application of geosynthetics to the civil engineering problems
- To enable the students to design civil engineering structures with geosynthetics

Unit Number	Course Content	Lectures
UNIT-01	**Introduction:**Geosynthetics, Types, Advantage and Disadvantage, Basic characteristics, Raw materials, Manufacturing processes, Functions, Selection, Physical properties, Mechanical properties, Hydraulic properties, Endurance and degradation properties, Test and allowable properties.	**08L**
UNIT-02	**Applications:** Retaining walls, Embankments, Shallow foundations, Roads, Unpaved roads, Paved roads, Railway tracks, Filters and drains, Slopes, Erosion control, Stabilization, Containment facilities, Landfills, Ponds, reservoirs, canals, Earth dams, Tunnels, Installation survivability requirements.	**07L**
UNIT-03	**Analysis and design concepts:**Design methodologies, Retaining walls, Embankments, Shallow foundations, Roads, Unpaved roads, Paved roads, Railway tracks, Filters and drains, Slopes, Erosion control, Stabilization,Containment facilities, Landfills, Ponds, reservoirs, canals, Earth dams, Tunnels.	**10L**
UNIT-04	**Application guidelines:** General guidelines, Care and consideration, Geosynthetic selection, Identification and inspection, Sampling and test methods, Protection before installation, Site preparation, Geosynthetic installation, Joints/seams, Cutting of geosynthetics, Protection during construction and service life, Damage assessment and correction, Anchorage, Prestressing, Maintenance, Certification, Handling the refuse of geosynthetics, Specific guidelines related to Retaining walls, Embankments, Shallow foundations, Unpaved roads, Paved roads, Railway tracks, Filters and drains, Slopes – erosion control, Slopes – stabilization, Containment facilities and Tunnels.	**07L**
UNIT-05	**Quality Field Performance Monitoring and Economic Analysis:** Concepts of quality and its evaluation, Field performance monitoring, Economic evaluation- Concepts of cost analysis, Experiences of cost analyses, Selected case studies.	**04L**

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Identify the various geosynthetic materials

CO2: Learn about their manufacturing processes

CO3: Applycocepts to the designing with geosynthetics of various civil engineering structures

Books and References

1. Geosynthetics and Their Applications by S. K. Shukla and J.H Yin.
2. Geotextiles and Geomembranes in Civil Engg by Gerard P.T.M. Van Santvrot, A.A. Balkema,Oxford and IBH publishing company,New Delhi.
3. Reinforced Soil and Geotextiles byJ.N. Mandal, proceedings FIGC- 1988, Oxford and IBH publishing company private Ltd.,New Delhi.
4. Geosynthetics: Application, Design and Construction by R.J. Tarmat, proceedings First EuropianGeosynthetics Conference, Netherland .A.A.Balkema, Publisher-Brookfield, USA.
5. Geosynthetics World by J.N. Mandal,Willey Eastern Limited, New Delhi.

Course Name: **Ground Improvement Techniques**
Course Code: **CE-441**
Course Type: **Professional Elective-III**

Contact Hours/Week: **3L** Course Credits: **03**

Course Objectives

- To impart knowledge about the various ground improvement techniques
- To enable the students to understand the factors that control the choice of ground improvement technique as per the field condition.

Unit Number	Course Content	Lectures
UNIT-01	**Dewatering**: Need and objectives of Ground Improvement, Classification of Ground Modification Techniques - suitability and feasibility, Emerging Trends in ground improvement, methods of de-watering- sumps and interceptor ditches- single, multi stage well points - vacuum well points- Horizontal wells-foundation drains-blanket drains- criteria for selection of fill material around drains – Electro-osmosis.	**06L**
UNIT-02	**Grouting:** Chemical grouting, commonly used chemicals, grouting systems, grouting operations, applications, compaction grouting, application and limitations, plant for preparing grouting materials, jet grouting, jet grouting process, geometry and properties of treated soils and applications**.**	**08L**
UNIT-03	**Compaction:** Principles of compaction, Engineering behaviour of compacted clays, fieldcompaction techniques static vibratory, impact, Earth moving machinery, Compaction control, application to granular soils, cohesive soils, depth of improvement, environmental considerations, induced settlements, compaction using vibratory probes, vibro techniques, vibro equipment, vibro compaction and replacement process, vibro systems and liquefaction, soil improvement by thermal treatment, preloading techniques, surface compaction, introduction to bio technical stabilization.	**08L**
UNIT-04	**Stabilisation:** Introduction to soil improvement by adding materials, lime, flyash, cement and other chemicals and bitumen, sand column, stone column, sand drains, prefabricated drains, lime column, soil-lime column, stabilization of soft clay or silt with lime, bearing capacity of lime treated soils, settlement of lime treated soils, improvement in slope stability, control methods.	**08L**
UNIT-05	**Expansive soils:** Problems of expansive soils – tests for identification – methods of determination of swell pressure. Improvement of expansive soils – Foundation techniques in expansive soils – under reamed piles.	**06L**

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Student will be able to understand the basic mechanics of the various ground improvement techniques

CO2: Apply the appropriate ground improvement technique to the field situation

Books and References

1. Ground Improvement by Blackie Moseley.
2. Grouting in engineering Practice by R.Boweven.
3. Soil Reinforcement with Geotextiles by R.A.Jewell.
4. Soil Improvement Technique and their Evolution by W.E. Van Impe.

Course Name: **Urban Transportation Planning**
Course Code: **CE-442**
Course Type: **Professional Elective-III**

Contact Hours/Week: **3L** Course Credits: **03**

Course Objectives

- To impart knowledge about traffic engineering
- To introduce the fundamental concepts of urban transport planning
- To enable the students to understand the application of probability and statistics in transport planning

Unit Number	Course Content	Lectures
UNIT-01	**Elements of Traffic Engineering:** road user, vehicle and road way. Vehicle characteristics, Design speed, volume. Highway capacity and levels of service, PCU concept and its limitations, Road user facilities – Parking facilities, Cycle tracks and cycleways, Pedestrian facilities.	**08L**
UNIT-02	**Traffic Volume Studies:** Traffic volume studies, origin destination studies, speed studies, travel time and delay studies, Parking studies, Accident studies	**04L**
UNIT-03	**Traffic Regulation and Control:** Signs and markings - Traffic System Management - Design of at-grade intersections, Channelisation, Design of rotaries, Traffic signals.	**06L**
UNIT-04	**Urban Transportation Planning:** Trip generation, Trip distribution, Modal split, Traffic assignment.	**06L**
UNIT-05	**Public Transportation:** Role and design concept of various modes of public transportation within an urban area	**04L**
UNIT-06	**Application of probability and Statistics in Transportation Planning:** Common probabilistic and statistical distribution functions, Concept of Traffic flow modeling and simulation	**04L**
UNIT-07	**Introduction to ITS:** Benefits of ITS, ITS Data collection techniques – Detectors, Automatic Vehicle Location (AVL), Automatic Vehicle Identification (AVI), Geographic Information Systems (GIS), video data collection.	**04L**

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Design the road user facilities in urban areas
CO2: Design various modes of public transportation
CO3: Collect and analyze relevant data for urban transportation planning

Books and References

1. Highway Engineering by Khanna, S. K. & Justo, C. E. G., Nem Chand & Bros, Roorkee, U.K., India.
2. Traffic Engineering and Transport Planning by Kadiyali, L. R., Khanna Publishers.
3. Transportation Engineering , C. J. Khisty and B. K Lall, PHI.

Course Name: **Harbor Dock and Tunnel Engineering**
Course Code: **CE-443**
Course Type: **Professional Elective-III**

Contact Hours/Week: **3L** Course Credits: **03**

Course Objectives

- To impart knowledge about the planning and design of tunnels and ports
- To introduce the fundamental concepts relevant to tunnel and port engineering
- To enable the students to understand the factors affecting the design of ports and tunnels

Unit Number	Course Content	Lectures
UNIT-01	**Planning of Harbor:** Classification of harbors, major ports in India, administrative set up, harbor economics, Harbor components, ship characteristics, characteristics of good harbor, and principles of harbor planning, size of harbor, site selection criteria and layout of harbors.	**04L**
UNIT-02	**Natural Phenomena:** Wind, waves tides and currents phenomena, their generation characteristics and effects on marine structures, silting, erosion and littoral drift.	**04L**
UNIT-03	**Marine Structures:** General design aspects, breakwaters - function, types general design principles, wharves, quays, jetties, piers, pier heads, dolphin, fenders, mooring accessories-function, types, suitability, design and construction features.	**06L**
UNIT-04	**Docks and Locks:** Tidal basin, wet docks-purpose, design consideration, operation of lock gates **and** passage, repair docks - graving docks, floating docks, marine railway.	**04L**
UNIT-05	**Port Amenities:** Ferry, transfer bridges, floating landing stages, and transit sheds, ware houses, cold storage, aprons, cargo handling equipments, purpose and general description.	**04L**
UNIT-06	**Navigation Aids:** Channel and entrance demarcation, buoys, beacons, light house electronic communication devices.	**04L**
UNIT-07	**Harbor Maintenance:** Costal protection-purpose and devices, dredging-capital and maintenance dredging, purpose, methods, dredgers-types, suitability, disposal of dredged material	**04L**
UNIT-08	**Tunneling:** Alignment, drainage, methods of construction, lighting and ventilation	**06L**

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Identify factors affecting ports and tunnel design
CO2: Describe the process of planning tunnel and ports
CO3: Apply principles of tunnel and port planning
CO4: Assess the effect of proper port and tunnel planning

Books and References

1. R. Srinivasan and S. C. Rangwala, Harbour, Dock and Tunnel Engineering, 1995, Charotar Pub. House, Anand.
2. S. P. Bindra, A Course in Docks and Harbour Engineering, 1992, DhanpatRai& Sons, New Delhi.
3. Alonzo Def. Quinn, Design and Construction of Ports and Marine Structure, McGraw - Hill Book Company, New York.

Course Name: **Solid Waste Management**
Course Code: **CE-460**
Course Type: **Professional Elective –IV**

Contact Hours/Week: **3L** Course Credits: **03**

Course Objectives

- Understand the concept of waste management.
- Analyze the characteristics & Composition of waste.
- Analyze the waste generation rate.
- Analyze various methods of storage, collection, transport, treatment & disposal of waste.
- Understand the various ways in which we can reduce the volume of waste, recycle & reuse the waste for the benefit of the society.
- Understand the concept of hazardous waste management.
- Analyze the characteristics & Composition of hazardous waste.
- Analyze various methods of storage, collection, transport, treatment & disposal of hazardous waste.

Unit Number	Course Content	Lectures
UNIT-01	**Evolution of Solid Waste Management:** Introduction: Solid waste –A consequence of life Municipal Solid Waste: Generation, Rate Variation, Characteristics (Physical, Biological & Chemical);	**04L**
UNIT-02	**Engineering Principles:** Management Options for Solid Waste, Waste Reduction at the Source, Collection Techniques, Materials and Resources Recovery / Recycling.	**06L**
UNIT-03	**Waste Handling and sepration:** Transport of Municipal Solid Waste, Routing and Scheduling, Treatment, Transformations and	**06L**
UNIT-04	**Disposal of Solid waste and Residue matter:** Disposal Techniques (Composting, Vermi Composting, Incineration, Refuse Derived fuels, Landfilling).	**06L**
UNIT-05	**Sources,Types and Properties of hazardous Waste:** Hazardous Solid Waste: Generation, Rate Variation, Characteristics (Physical, Biological & Chemical);	**06L**
UNIT-05	**Hazardous Waste Management:** Hazardous waste management: Exposure and risk assessment, environment legislation, characterization and site assessment, waste minimization, incineration, transportation, storage, landfill disposal.	**08L**

Course Outcomes

Upon successful completion of the course, the students will be able to

CO 1: Understand the importance & basic concepts of waste management.
CO 2: Analyze how to dispose off the waste in an environment friendly manner.
CO 3: Understand & analyze the concepts & importance of hazardous waste management.
CO 4: Understand & analyze the concepts of air pollution and its control techniques.
CO 5: Understand the importance of environment and need for its safety.

Books and References

1. Iqbal H. Khan and Naved Ahsan, Text Book of Solid Wastes Management, CBS Publishers.
2. H.S. Peavy, D. R. Row and G. Tchobanoglous, Environmental Engineering, McGraw Hill.
3. Tchobanoglous, Theisen& Vigil, Integrated Solid Waste Management, McGraw Hill.
4. M. N. Rao & H. V. N Rao, Air pollution & Control, Tata McGraw Hill Publications.

Course Name: **Environmental Impact Assessment**

Course Code: **CE-461**

Course Type: **Professional Elective-IV**

Contact Hours/Week: **3L** Course Credits: **03**

Course Objectives

- To impart knowledge about the environment and causes of degradation.
- To introduce the fundamental concepts relevant to assessment of Impacts on the environment.
- To enable the students to understand the natural phenomenon and progress made by humans to minimise the impacts

Unit Number	Course Content	Lectures
UNIT-01	**Introduction:** Environment and its components; Concept of Ecological imbalances; Elements of Environmental Analysis; Current screening process in India; Carrying capacity and sustainable development; Evolution of environmental impact assessment (EIA), A step by-step procedure for developing EIA; Public consultation; Post monitoring; Impact Case studies of Industrial EIA and Water resources projects; Brief introduction about Environment legislation and Environmental Audit.	**08L**
UNIT-02	**Methodologies:** Criteria for the selection of EIA Methodology, EIA Methods, Predictive Models for Impact Assessment.	**03L**
UNIT-03	**Prediction and Assessment of Impacts on Soil and Ground Water Environment:** Soil and Ground Water, Methodology for the Predictive and Assessment of Impact on soil and Ground Water.	**03L**
UNIT-04	**Prediction and Assessment of Impacts on Surface Water Environment:** Sources which create Impact concern for the Surface water Environment, Systematic Methods for Evaluation of Impact of Various Developmental Activities on Surface Water Environment.	**03L**
UNIT-05	**Prediction and Assessment of Impacts on Biological Environment:** Methodology for the Assessment of Impacts on Biological Environment, Systematic Approach for Evaluating Biological Impacts.	**03L**
UNIT-06	**Prediction and Assessment of Impacts on Air Environment:** Sources of Air Pollution, Methods for Assessment of Air Pollution Impact.	**03L**
UNIT-07	**Prediction and Assessment of Impacts on Noise Environment:** Types of Noise,Measurement, Effects andMethods for Assessing Impact of Noise.	**03L**
UNIT-08	**Prediction and Assessment of Impacts of Socio-Economic and Human Health Impacts:** Social Assessment, Conceptual Frame Work for Socio Economic Assessment, Assessment of Impacts of Project Activities on Human Health, Methodology, Assessment of Impacts of Project Activities on Trafic and Transport Systems.	**04L**
UNIT-09	**Application of Remote Sensing and GIS for EIA:** Concepts of Environmental Remote Sensing, GIS Concept and Techniques, Applicatin of Environmental Remote Sensing for EIA, Application of GIS for EIA, GIS Environmental Impact Assessment; Possible Approaches, Resource Implications, GIS in Screening, Scoping and Baseline Studies, Databases for GIS.	**06L**

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Identify various activities leading to impacts on the environment and laws for control.
CO2: Describe the process for safe and legal aspect for sustaining industrial development.
CO3: Apply principles of natural processes for sustainable development.
CO4: Assess the activities leading to adverse impact on the environment.

Books and References

1. Environmental Impact Assessment; Y. Anjaneyulu, ValliManickam; BS Publications.
2. Environmental Impact Assessment for Developing Countries; Asit K. Biswas
3. Environmental Impact Analysis Handbook; G.J. Rau and C.D. Wooten
4. Environmental Impact Assessment; C.W. Canter
5. Environmental Impact Assessment Theory and practice; Peter Wathern

Course Name: **Groundwater Engineering**

Course Code: **CE-462**

Course Type: **Professional Elective-IV**

Contact Hours/Week: **3L** Course Credits: **04**

Course Objectives

- To develop knowledge and understanding of flow in groundwater.
- To introduce the student to the principles of Groundwater governing Equations and Characteristics of different aquifers.
- To understand the techniques of development and management of groundwater.

Unit Number	Course Content	Lectures
UNIT-01	**Hydrogeological Parameters:** Introduction – Water bearing Properties of Rock – Type of aquifers – Aquifer properties – permeability, specific yield, transmissivity and storage coefficient – Methods of Estimation– Ground water table fluctuation and its interpretations – Groundwater development and Potential in India.	**09L**
UNIT-02	**Well Hydraulics:** Objectives of Groundwater hydraulics – Darcy's Law – Groundwater equation – steady state flow – DupuitForchheimer assumption – Unsteady state flow – Theis method – Jacob method -Slug tests – Image well theory – Partial penetrations of wells.	**09L**
UNIT-03	**Groundwater Management:** Need for Management Model – Database for groundwater management –groundwater balance study – Introduction to Mathematical model – Conjunctive use – Collector well and Infiltration gallery.	**09L**
UNIT-04	**Groundwater Quality:** Ground water chemistry – Origin, movement and quality – Water quality standards – Health and aesthetic aspects of water quality – Saline intrusion – Environmental concern and Regulatory requirements.	**09L**

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Apply mathematical principles for the analysis of ground water flow problems.

CO2: Understand aquifer properties and its dynamics.

CO3: Understand design of well and solve practical problems of groundwater aquifers.

CO4: Understand the importance of artificial recharge and groundwater quality concepts.

Books and References:

1. Chow, V. T. (1959). Open-Channel Hydraulics. McGraw-Hill, New York, US.
2. Raghunath H.M., "Ground Water Hydrology", New Age International (P) Limited, New Delhi, 2010.
3. Bouwer, H. (1978). Groundwater Hydrology. McGraw-Hill, New York, US.
4. Fitts R Charles, "Groundwater Science". Elsevier, Academic Press, 2002.
5. Ramakrishnan, S, Ground Water, K.J. Graph arts, Chennai, 1998.

Course Name: **Hydro Power Engineering**

Course Code: **CE-463**

Course Type: **Professional Elective-IV**

Contact Hours/Week: **3L** Course Credits: **03**

Course Objectives

- To impart knowledge about the processes and machinery involved in hydo power generation.
- To introduce the fundamental concepts relevant hydraulic machines, hydropower projects, installation and development, economic analysis and issues related to hydropower projects.
- To enable the students to understand development and application of hydropower generation.

Unit Number	Course Content	Lectures
UNIT-01	**Turbo Machinery:**Governing Equations, Hydrodynamic forces of jets on vanes. Turbines: Classification, impulse and reaction turbines, characteristic curves, draft tubes, governing of turbines, specific speed, unit quantities concept, cavitation. Pumps: classification, work done, minimum starting speed, losses and efficiencies, specific speed, multistage pumps, Cavitation in pumps..	**08L**
UNIT-02	**Hydro Power Development:** Sources of energy and their comparative study, investigations and studies for hydropower development, estimation of available water power, flow and power duration curves, firm power and secondary power, plant capacity, installed capacity, constraints in hydropower development, operation and maintenance of hydropower plants, small hydropower development. Classification of hydro-power plants based on storage characteristics, operating head, load, capacity. Principal components of hydro-electric scheme. Storage and pondage, economic analysis of storage capacity, aspects of cost allocation for different purposes, reservoir operation using flow duration and flow mass curves..	**10L**
UNIT-03	**Hydroelectric Plants:** Layout of hydropower plants, types of power houses, various components, investigations and studies, safety requirements. Storages zones of a reservoir, reservoir sedimentation, trap efficiency, life of a reservoir, principles of desilting, design of desilting basins. Alignment and location of various types of intakes, trashracks, design of intake structures. Conveyance channels and tunnels, water hammer, surge tanks, design of surge tanks, penstocks classification and layout, hydraulic design of penstocks, hydraulic valves and gates, tail race channels**.**	**08L**
UNIT-04	**Economics of Hydro power installation:** Engineering feasibility, political consideration, economic feasibility, analysis of cost of hydro power, preparation of pre-feasibility report, detailed project report, cost and estimate report.	**10L**

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Identify the type of machinery and hydroelectric plant required for power generation.

CO2: Describe the problems involving turbines, pumps, classification and site selection for hydropower plant, losses in hydropower generation, reservoir operation, design and economic feasibility of plants.

CO3: Apply governing principles and fundamental relations to solve problems mentioned in CO2

CO4: Assess the results obtained by solving above problems.

Books and References

1. Fluid Mechanics and Hydraulic Machines by Modi, P.N., and Seth, S.M., Hydraulics, , Standard Book Home, New Delhi, 2005.
2. Text Book of Fluid Mechanics and Hydraulic Machinery by Rajput,R.K.,S. Chand & Company, Ltd., New Delhi, 2005.
3. Hydro-electrical Engineering by Creager and Justin
4. Water Power Engineering by Barrows
5. Water Power Development (Vol.-I and II) by Mosony L. Emil
6. Hydro –Electric and Pump storage Plants by MG Jog , Wiley Eastern Limited
7. Micro Hydroelectric Power Stations by L. Monition,
8. Hydro Power Plant Familiarization- NPTI Publication.
9. Water power engineering-The theory, investigation and development of water powers by Daniel W. Mead, Member ASCE, Mcgraw-Hill Book Co.

Course Name: **CPM and PERT**
Course Code: **CE-306**
Course Type: **Open Elective I / II**

Contact Hours/Week: **3L** Course Credits: **03**

Course Objectives

- To introduce the fundamental concepts relevant to project scheduling
- To impart knowledge about the basic principles of CPM and PERT
- To enable the students to find probability of completion of a project in a specified duration

Unit Number	Course Content	Lectures
UNIT-01	**Project Planning:** Work breakdown structure, scheduling by bar charts, limitation of bar charts, milestone charts, and multiple calendar date scheduling using bar chart.	**06L**
UNIT-02	**Network Techniques in Project Management-I (CPM):** Introduction with network techniques, classification of activities, rules for developing networks, network development-logic of network, numbering events, network analysis, determination of project schedules, critical path, floats in activities, updating, resources allocation, resources smoothing and resources leveling.	**12L**
UNIT-03	**Network Techniques in Project Management-II (PERT):** Probability concept in network, optimistic time, pessimistic time, most likely time, lapsed time, deviation, variance, standard deviation, slack critical path, probability of achieving completion time, central limit theorem.	**10L**
UNIT-04	**Cost-Time Analysis:** Cost versus time, direct cost, indirect cost, total project cost and optimum duration, contracting the network for cost optimization, steps in time cost optimization.	**08L**

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Develop bar-chart based schedule and understand its limitations,
CO2: Develop critical path method (CPM) based network and estimate various times and floats,
CO3: Understand the implementation of network technique,
CO4: Develop PERT based network and find probability of completion of a project in a specified duration, and
CO5: Understand time-cost relationship for projects.

Books and References

1. Project Planning and Control with PERT and CPM by B.C. Punmia and K.K. Khandelwal.
2. Project Management Technique in Planning and Controlling Construction Projects by H.N. Ahuja.
3. Construction Project Management: Planning, Scheduling and Control by K.K. Chitkara.
4. Project Management with CPM, PERT and Precedence Diagramming byJ. Moder, , C. Phillips and E. Davis.
5. PERT and CPM -Principles and Applications by L.S. Srinath.

Course Name: **Disaster Management**
Course Code: **CE-307**
Course Type: **Open Elective I / II**

Contact Hours/Week: **3L** Course Credits: **03**

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…

Unit Number	Course Content	Lectures
UNIT-01	**Understanding Disasters** :Understanding the Concepts and definitions of Disaster, Hazard, Vulnerability, Risk, Capacity – Disaster and Development, and disaster management Types, Trends, Causes, Consequences and Control of Disasters :Geological Disasters; Hydro-Meteorological Disasters, Biological Disasters and Man -made Disasters Global Disaster Trends – Emerging Risks of Disasters – Climate Change and Urban Disasters	**06L**
UNIT-02	**Disaster Management Cycle and Framework** :Disaster Management Cycle – Paradigm Shift in Disaster Management Pre-Disaster – Risk Assessment and Analysis, Risk Mapping, zonation and Microzonation, Prevention and Mitigation of Disasters, Early Warning System; Preparedness, Capacity Development; Awareness During Disaster – Evacuation – Disaster Communication – Search and Rescue – Emergency Operation Centre – Incident Command System – Relief andRehabilitation – Post-disaster – Damage and Needs Assessment, Restoration of Critical Infrastructure – Early Recovery – Reconstruction and Redevelopment; IDNDR, Yokohama Strategy , Hyogo Framework of Action	**12L**
UNIT-03	**Disaster Management in India** :Disaster Profile of India – Mega Disasters of India and Lessons Learnt Disaster Management Act 2005 – Institutional and Financial Mechanism National Policy on Disaster Management, National Guidelines and Plans on Disaster Management; Role of Government (local, state and national),Non-Government and Inter- Governmental Agencies	**06L**
UNIT-04	**Applications of Science and Technology for Disaster Management** :Geo-informatics in Disaster Management (RS, GIS, GPS and RS) Disaster Communication System (Early Warning and Its Dissemination) Land Use Planning and Development Regulations Disaster Safe Designs and Constructions Structural and Non Structural Mitigation of Disasters S&T Institutions for Disaster Management in India	**12L**

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: Identify the types of disaster
CO2: Describe disaster
CO3: Apply principles of management
CO4: Assess the solution for handling disaster

Books and References

1. Manual on natural disaster management in India by M C Gupta, NIDM, New Delhi
2. Encyclopedia of disaster management, Vol I, II and IIIL Disaster management policy and Administration by S L Goyal, Deep & Deep, New Delhi,
3. Management of Natural Disasters in developing countries by H.N. Srivastava & G.D. Gupta, Daya Publishers, Delhi,
4. Disaster Management Act 2005, Publisher by Govt. of India
5. Publication of National Disaster Management Authority (PNDMI) on Various Templates and Guidelines for Disaster Management

Course Name: **Air Pollution Control**
Course Code: **CE-308**
Course Type: **Open Elective Course I / II**

Contact Hours/Week: **3L** Course Credits: **03**

Course Objectives

- To understand the sources, characteristics and effects of air pollutants
- To know the methods of controlling air pollution

Unit Number	Course Content	Lectures
UNIT-01	**Sources and effects of air pollutants** - Classification of air pollutants – Particulates and gaseous pollutants – Sources of air pollution – Source inventory – Effects of air pollution on human beings, materials, vegetation, animals – global warming-ozone layer depletion, Sampling and Analysis – Basic Principles of Sampling – Source and ambient sampling – Analysis of pollutants – Principles	**10L**
UNIT-02	**Dispersion of air pollutants** - Elements of atmosphere – Meteorological factors – Wind roses – Lapse rate – Atmospheric stability and turbulence – Plume rise – Dispersion of pollutants – Dispersion models – Applications.	**10L**
UNIT-03	**Air Pollution Control -** Concepts of control – Principles and design of control measures – Particulates control by gravitational, centrifugal, filtration, scrubbing, electrostatic precipitation – Selection criteria for equipment – gaseous pollutant control by adsorption, absorption, condensation, combustion – Pollution control for specific major industries	**16L**

Course Outcomes

Upon successful completion of the course, the students will be able to

CO1: understand the nature and characteristics of air pollutants, noise pollution and basic concepts of air quality management
CO2: identify, formulate and solve air and noise pollution problems
CO3: design stacks and particulate air pollution control devices to meet applicable standards

Books and References

1. Anjaneyulu, D., “Air Pollution and Control Technologies”, Allied Publishers, Mumbai, 2002.
2. Rao, C.S. Environmental Pollution Control Engineering, Wiley Eastern Ltd., New Delhi, 1996.
3. Rao M.N., and Rao H. V. N., Air Pollution Control, Tata McGraw Hill, New Delhi, 1996.
4. Mahajan S.P., “Pollution Control in Process Industries”, Tata McGraw Hill Publishing Company, New Delhi, 1991.