Department | Course No. | Course Title | Course Designation | Pre-Requisites | Course Type | Credit Hours | Contact Hours | Total Contact Hours |
---|---|---|---|---|---|---|---|---|
Civil Engineering | CEA-1110 | Environmental Studies | ESA | NIL | Theory | 3 | 3 | 3 |

**Course Assessment Method**

1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 2 Hour

**Course Objective**

To make the students conversant with the basic concept of ecology and environment

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Understand fundamental physical and biological principles that govern natural processes.
2. Communicate environmental scientific information to both professional and lay audiences.
3. Demonstrate an understanding of current environmental challenges.
4. Develop a basic fundamental background for the higher environmental engineering courses offered in civil engineering department

**Topics Covered**

**Unit I**

Multidisciplinary nature of environmental studies; components of environment-atmosphere, hydrosphere, lithosphere and biosphere. Scope and importance; Concept of sustainability and sustainable development. Land Resources and land use change; Land degradation, soil erosion and desertification. Deforestation: Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations. Water: Use and over-exploitation of surface and ground water, floods, droughts, conflicts over water (international & inter-state). Heating of earth and circulation of air; air mass formation and precipitation. Energy resources: Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies. Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture.

**Unit II**


**Unit III**


**Unit IV**

Environment Laws: Environment Protection Act; Air (Prevention & Control of Pollution) Act; Water (Prevention and control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act; International agreements; Montreal and Kyoto protocols and conservation on Biological Diversity (CBD). The Chemical Weapons Convention (CWC). Resettlement and rehabilitation of project affected persons; case studies. Environmental movements: Chipko, Silent valley, Bishnios of Rajasthan. Environmental ethics: Role of Indian and other religions and cultures in environmental conservation. Environmental communication and public awareness, case studies (e.g., CNG vehicles in Delhi).

**Field work:**

Visit to an area to document environmental assets; river/forest/flora/fauna, etc.

Visit to a local polluted site – Urban/Rural/Industrial/Agricultural.

Study of common plants, insects, birds and basic principles of identification.

Study of simple ecosystems-pond, river, Delhi Ridge, etc.

**Text Books / Reference Materials**


**Additional Learning Source**

Web resources
Civil Engineering  
CEA1120 Strength of Materials  
ESA None Theory  
3 2 1 0 3

**Course Assessment Method**

1. Assignments (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 2 Hour

**Course Objective**

1. To develop an appreciation of forces, stresses and strains on normal and inclined planes, principal stress and principal strains.
2. To develop basic understanding of various types of stress conditions viz. shear, bending and torsion in structural members.
3. To develop understanding of basic principles and methods of structural analysis and its application to the determinate structures.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Develop basic concepts of forces acting on simple structural elements and also the concept of combined stresses (2D stress state) in materials used in Civil Engineering.
2. Understand the behavior of simple structural elements under shear, bending and torsion.
3. Understand the fundamental principles used for the analysis of the determinate structures.
4. Analyze determinate arches and trusses.

**Topics Covered**

**Unit 1** Analysis of stress and strain: Mechanical properties, analysis of simple state of stress and strains, elastic constants, example of state of tension, compression and shear. Analysis of two dimensional stresses and strains, Principal stress and Principal strain, Mohr’s circle.

**Unit 2** Analysis of determinate structures: Concept of bending and shear forces in simple beams, Relationship between load, bending moment and shear force. Bending moment and shear force diagram for simple beams and cantilevers.

**Unit 3** Bending shear and torsion: Bending and shear stresses in simple beams, concepts of torsion in circular shafts.

**Unit 4** Analysis of statically determinate trusses and arches.

**Text Books and/or Reference Materials**


**Additional Learning Source**

1. Web links to e-learning: nptel
Course Assessment Method

1. Assignments (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 2 Hour

Course Objective

This is the first basic course of fluid mechanics. The main objective of this course is to understand the fundamentals of the fluid mechanics such as fluid and flow properties, fluid behavior at rest and in motion and fundamental equations like mass, energy and momentum conservation of the fluid flow. Applications of these basic equations have been highlighted for flow measurements through orifice, mouth piece, weirs, Venturimeter, sluice gates etc. The whole course has been divided in four units as described herein.

Course Outcomes

Upon successful completion of this course, it is expected that students will be able to:

1. Understand the basic properties of fluids, mechanics involved in fluid flow and to designate the types of flow based on dominant fluid property and space and time.
2. Understand the significance of basic principles of floatation and stability of floating bodies like boats, ships, naval vessels etc.
3. Apply fundamental concepts of fluid statics in analysing the forces on hydraulic structures such as water tanks, retaining walls, lock gates, sluice gates, dams etc and also check their stability.
4. Apply fundamental concepts of fluid dynamics in solving problems like computation of force exerted by water jet on various types of vanes used in pelton wheel turbines.
5. Apply fundamental concepts of fluid mechanics in solving fluid flow problems like computation of discharge through pipes using orifice meter, venturimeter, and bend meter and through canals using weirs, sluice gates etc.

Topics Covered

Unit 1  Kinematics of fluid flow: Introduction, Fluids Properties and classification; Concept of viscosity, Compressibility and Elasticity, Surface tension and capillarity. Flow Classification, Stream lines, Streak lines, Continuity equation, Velocity, Tangential, Normal, Local and Convective Accelerations, Types of fluid motions, rotation, Circulation, Velocity potential, Stream function, Flownet.


Unit 3  Equation of Motion: Bernoulli’s equation, Energy correction factor, Coefficients of contraction, velocity and discharge, Differential head meters, Analysis of frees liquid Jet, Cavitations’. Linear momentum equation, Force on pipe junctions and bends, Forces on moving plates and vanes due to fluid flow, Angular momentum.

Unit 4  Flow Measurement: Orifices, Mouth pieces, Weirs, Flow under sluice gates. Time of emptying tanks with or without inflow, Flow of liquid from one vessels to another.

Text Books and/or Reference Materials

2. R.J. Garde, “Fluid Mechanics” RPH, Roorkee, India.

Additional Learning Source

1. Web links to open courseware materials by Henderson, “Open channel flow”
2. Web links to e-learning: nptel
Department | Course No. | Course Title | Course Designation | Pre-Requisites | Course Type | Credit Hours | Contact Hours | Total Contact Hours
--- | --- | --- | --- | --- | --- | --- | --- | ---
Civil Engineering | CEA2140 | Engineering Geology | ESA | None | Theory | 4 | 3 | 1 | 0 | 4

**Course Assessment Method**

1. Assignments and Oral Quizzes (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 2 Hour

**Course Objective**

1. To emphasize basic understanding of Earth System Science to understand exogenous and endogenous environments and forces in context to and with application in Civil Engineering.
2. To impart the basic knowledge about natural earth material i.e. minerals and rocks with their inherent properties as well as deformation features as building material.
3. To know about the spatial distribution of rocks, their ages and geotectonic setup of India to understand the seismic vulnerability and to identify regions akin to natural geological hazards.
4. To make students aware of the groundwater system in soil and rocks and to highlight the importance of water conservation and sustainability.
5. To help the students in comprehending geotechnical properties of rock masses as founding ground for mega engineering structures such as bridges, tunnels, dams and reservoir and geological and geotechnical considerations and investigations.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Realize the importance of the subject within the framework of fundamental concepts of basic sciences and practical understanding of earth processes with which the civil engineers and the structures made by them come across with in the design life of structure.
2. Know about different earth materials with respect of their availability, its optimum utilization and need of conservation, particularly resources like groundwater for sustainable development.
3. Identify and quantify physical and mechanical properties of rocks through experimentation and to understand the importance of ground investigation for mega construction projects in terms of behavior of founding ground and to build necessary database, required for design and construction.
4. Produce technical reports for effective communication amongst stakeholders to comprehend complex problems and accordingly employ state of the art technologies.

**Topics Covered**

**Unit 1 General Geology:**

Introduction to the Earth Sciences, Elementary idea about the internal structure of the earth. Elementary knowledge of the physical properties of the common rock forming minerals. Introduction to the major group of rocks, mode of origin classification and properties.

**Unit 2 Structural Geology and Geomorphology:**

Deformation of the rocks. Dip, strike and structural features including fold, fault, joint and unconformity and their engineering significance. Fundamental concepts of study of landforms. Elementary idea of the geological work of glacier, river, sea waves and wind and their engineering significance.

**Unit 3 Stratigraphy, Hydrogeology and Geological Hazards:**

Geological Time Scale. Fundamentals of Stratigraphy. Geotectonic divisions of India. Distribution of rocks of different ages in India.

Unit 4 Geotechnical properties of Rocks, Rock Masses and Site Investigations: Rocks as construction material. Common tests, occurrence and distribution of the building stones, road and rail ballast in India. Engineering properties and engineering classification of rock mass. Factors in site selection, alignment and construction of dam, reservoir, bridge and tunnel.

Text Books and/or Reference Materials

Additional Learning Source
1. Websites related to Geology and Engineering Geology i.e. NPTEL
2. Epatshala of UGC Basic Sciences>Geology>P-10 Hydrogeology and Engineering Geology> Module 9-15

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Course Assessment Method
1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 2 Hour

Course Objective
1. To develop basic understanding of Civil Engineering Drawings, measurement of quantities of construction materials used and their estimate in Civil Engineering projects.
2. To develop knowledge of specification of different items in construction projects, methods of rate analysis, preparing detailed estimates and contract documents.

Course Outcomes
Upon successful completion of this course, it is expected that students will be able to:
1. Understand and interpret civil engineering construction drawings.
2. Prepare Bill of Quantities (BOS), Bill of Materials (BOM) and Labor statements strictly adhering to the specifications and the construction drawing.
3. Develop insight in tendering of new projects and related contract documents.

Topics Covered
Unit 1 Plan, elevation and sectional elevation of building drawing, Key or Index Plan, Parts and types of stair cases, Exposure to AutoCAD. Quantity Survey and its requirements, types of estimates, methods of estimates, Principle and units of measurements, rules of measurements.
Unit 2 Analysis of rates, Purpose and requirements of rate analysis, Factors affecting rate analysis,
Analysis of rates for main items. Abstract of Cost.

**Unit 3** Specifications – Definition and Types of specifications, Specifications of main items, Different areas in a building, Capital cost of a project, Material Statement, Area requirements for different functions, building by-laws.


**Text Books and/or Reference Materials**
1. Civil Engineering Contracts and Estimates by B.S Patil, Orient Longman
2. Estimating and Costing by B.N Dutta
3. Text and documents published by various professional bodies & CED like CPWD

**Additional Learning Source**
2. Web links to e-learning:nptel

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**Course Assessment Method**
1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 2 Hour

**Course Objective**
1. To learn about the properties of commonly used natural civil engineering materials and manufacturing of different construction materials and composites like cement, steel, concrete, bricks, masonry.
2. To understand basic principles of planning of building, building laws and types of different components of buildings.
3. To develop understanding of different construction techniques.

**Course Outcomes**
1. Understand the basic properties and use commonly used construction material
2. Gain knowledge of Building by laws, basic principles of planning of building and purpose & geometry and shape of different components as per need including effect of environment on the buildings.
3. To have basic ideas of different construction techniques used in Civil Engineering projects.

**Topics Covered**


Unit 4: Construction Techniques: Excavation, dewatering, shoring, underpinning and scaffolding, drilling, blasting, well sinking and pile driving, cofferdams, form work-fabrication and use. Construction techniques for special structures such as high-rise buildings, road construction, dams bridges, offshore platforms.

Text Books and/or Reference Materials
1. Naville, A.M., “Properties of Concrete”, Longman,
2. Gambhir, M.L., “Concrete Technology”, TMH, New Delhi, India
3. Singh, S., Engineering Materials”, Konark, Delhi, India,
5. Sing, G. “Building Construction Engineering”

Additional Learning Source
2. Web links to e-learning: nptel

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Course Assessment Method
1. Assignments (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 2 Hour

Course Objective
1. To emphasize on advancement in the water and its quantity required for per capita demand.
2. To explain rigorously complete details about impurities in water and their sanitary significance together with respective types of treatment and water distribution system
3. To deal with water supply and distribution, design and operation of conventional water treatment plants for ground and surface water, advance water treatment options
4. To discuss the concept of water demand, water quality and water treatment systems

Course Outcomes
Upon successful completion of this course, it is expected that students will be able to:
1. learn to deal with technical aspects of drinking water treatment and distribution in an integrated way, paying attention to the choice of technologies and tools, ranging from low cost to advanced options
2. understand the structure of drinking water supply systems, including water transport, treatment and distribution
3. understand water quality criteria and standards, and their relation to public health and environment
4. design water treatment and distribution systems
5. understand importance of stream water chemistry in assessment of fate of pollutants and to assess self-purification capacity of receiving waters

Topics Covered
Unit I  Water requirements, water demand estimation, Methods of Population Forecasting, Distribution of water- Conveyance and distribution systems, Leakages and control, Sources of water supply, Intake structures, Rural, Institutional and industrial water supply, Equivalent Pipe Method, Hardy Cross Method
Unit II  Units of measurement, Material and Energy Balance, Water Quality, Waterborne diseases, Water quality standards, Stream Pollution, Dissolved oxygen deficit and its computation
Unit III Basic unit processes and operations for water treatment, Treatment Flow sheets, Water
### Text Books and/or Reference Materials

1. Peavy, Rowe and Tchobanoglous, “Environmental Engineering” McGraw-Hill, Delhi, India
2. Sawyer and McCarty, “Chemistry for Environmental Engineering” McGraw-Hill Delhi, India

### Additional Learning Source
1. Web links to e-learning - nptel

### Course Assessment Method
1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 2 Hour

### Course Objective
1. To learn the different techniques applicable for measurements of distances, directions and elevations, using simple survey equipments.
2. To understand the procedures of preparations of topographical maps of the areas, layout of curves.
3. To learn about the process of establishment of horizontal control points necessary for carrying out survey of the area.
4. To learn about the principles and techniques involved in modern surveying instruments.

### Course Outcomes
Upon successful completion of the course, it is expected that students shall be able to:
1. Prepare the plan, elevation & sectional detail for different Civil Engineering projects.
2. Calculate qualities of materials used including earth work required in different Civil Engineering projects.
3. Apply knowledge of surveying & use survey instruments in layout of roads, railways line & sewers etc. Including curves and execution of works with required accuracy.
4. Establish levels, bench mark and position of salient features in Civil Engineering works.

### Topics Covered

#### Unit 1
Introduction to conventional surveying methods like chain surveying, compass survey and plane table survey and use of EDM instruments.

#### Unit 2
Levelling; definition, instruments, methods of levelling, theory of direct levelling, spirit levelling, differential levelling, curvature and refraction, reciprocal levelling, profile levelling, cross-sectioning, Barometric levelling; Sensitiveness of bubble tube, permanent adjustment of level. Triangulation, classification of triangulation system, triangulation figures, signals and towers, phase of signal, inter visibility and height of stations.

#### Unit 3
Curves – Study of simple, compound, reverse, transition and vertical curves.

#### Unit 4
Theodolite and traverse surveying; essential parts of transit theodolite, temporary and permanent adjustment of transit theodolite; Measurement of horizontal and vertical angles; Methods of traversing, closing error, balancing of traverse, traverse table, omitted measurements. Tachometry,
stadia system, influence of staff tilt, anallactic lens, tangential and subtense systems. 
Base line measurement between triangulation stations, corrections to measured length; Measurement 
of horizontal angles; satellite stations, reduction to centre.

**Text Books and/or Reference Materials**

**Additional Learning Source**
1. Web links to e-learning: nptel

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**Course Assessment Method**
1. Assignments (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 2 Hour

**Course Objective**
1. To develop an appreciation of forces, analyze and examine stability in simple determinate structures like trusses, dams, retaining wall and chimneys etc.,
2. To develop basic understanding of three dimensional state of stress in materials and structures.
3. To develop understanding of basic principles and methods of analysis, apply differential equations, semi graphical method, energy methods and useful theorems for analyzing simple beams and frames.

**Course Outcomes**
Upon successful completion of this course, it is expected that students will be able to:
1. Develop basic concepts of forces acting on simple structural elements and also the concept of combined stresses (3D stress state) in materials used in Civil Engineering.
2. Understand the behavior of simple structural elements under applied forces.
3. Understand the basic principles used in the analysis of structural members.
4. Recognize and be able to apply fundamental principles to check the stability of structural elements.
5. Generate an ability to apply the knowledge of stress state in the design of structural elements.

**Topics Covered**

**Unit 1** Analysis and stability of dams, retaining walls and chimneys; Columns; structural stability, Euler’s formula, end conditions and effective length factor, Columns with eccentric load.

**Unit 2** Generalized state of stress and strain: Stress and strain tensor, Generalized Hooke’s Law, Principal Stresses, Yield criteria and theories of failure; Tresca, Von-Mises stress criteria. Stress analysis of thin, thick and compound cylinders.

**Unit 3** Deflection of beams; Load deflection relationship, Deflection calculation by double integration, moment area and conjugate beam methods, Unsymmetrical bending and shear centre.

**Unit 4** Deflections using energy methods; Concept of strain energy, Strain energy of axially loaded bars, simple beams in bending, shear and torsion; General energy theorems, Castigliano’s theorem, Maxwell Betti’s reciprocal theorem; Virtual work and unit load method for deflection, Application to problems of simple beams and frames.

**Text Books and/or Reference Materials**
Additional Learning Source

3. Web links to e-learning: nptel

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<tr>
<td>Civil Engineering</td>
<td>CEH2210</td>
<td>Construction Management-I</td>
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Course Assessment Method

4. Assignments (15%)
5. Mid-Semester Examination (25%)- 1 Hour
6. End Semester Examination (60%)- 2 Hour

Course Objective

1. To understand fundamentals of construction project management, Cost of projects and Time management
2. To known basic ideas regarding machinery and equipment used in construction industry
3. To learn basics of human managements related to construction industry.

Course Outcomes

On completion of courses the students are expected to have ideas regarding:

(i) construction project management, Cost of projects and Time management
(ii) machinery and equipment used in construction industry
(iii) human managements related to construction industry

Topics Covered

UNIT 1 Fundamental of construction management: Need, importance, inherent nature and status in India. Opportunities in construction sector. Fundamentals of project management, Project life cycle, Theory of interest, Capital theory. Economics of production, consumption and planning.

UNIT 2 Cost concepts: Types of project cost, cost time relationships cost slopes, conducting a crash programme, determining the minimum total cost of a project. Various types of costs, Social cost benefit analysis, life cycle costing, Cost management, Fundamentals of contract management, Total quality management, Equipment management, Depreciation, Specification, Materials management. Case Studies and examples.

UNIT 3 Machinery& Equipment’s: Tractors & related equipment, bulldozers, scrapers, Power shovels, dragline, hoes etc. Construction Equipment: Grading / proportioning, batching mixing, types of mixers, concrete pumps, placing & compacting concrete. Hoisting & Transporting Equipment: Hoists, winches, cranes, belt conveyors, truck etc. Tunneling machinery etc.


Text Books and/or Reference Materials

Civil Engineering CEC2190 Hydrology DC None Theory 4 3 1 0 4

Course Assessment Method
1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 2 Hour

Course Objective
The aim of this course is to develop a concept of the hydrologic cycle, evapotranspiration, infiltration, analysis of surface runoff and knowledge of ground water movement & recharge.

Course Outcomes
Upon successful completion of this course, it is expected that students will be able to:
1. Understand and solve the everyday problems related to hydrologic cycle.
2. Understand the significance of various hydrological parameters, types and forms of precipitations.
3. Evaluate the problems related to planning, designing and management of surface water resources.
4. Address the problems related to ground water problems, such as ground water recharge/ harvesting, recharge of wells and ground water pollution.

Topics Covered
Unit 1 Scope and applications of hydrological cycle, Hydrology applied in Engineering, Precipitations types and measurement, Rain gauge, Network analysis of rainfall data, Probable maximum Precipitation, Probable maximum flood.

Unit 2 Evaporation, Evapo-transpiration, Consumptive use, infiltration and percolation, methods of determination, factors affecting, Stream gauging and stage discharge relationship.

Unit 3 Surface runoff, factors affecting, measurement of runoff, Analysis of runoff data, Hydrographs, Mass curve, Reservoir capacity, Flow duration curve, Concept of Unit Hydrograph, Methods of Estimation of Unit Hydrograph, Derivation and application. Synthetic hydrograph, peak flood.

Unit 4 Ground Water Hydrology, Definitions, Types of Aquifers and Wells, Occurrences, Distribution, Darcy’s law and its limitations, Well hydraulics. Flood routing, Flood estimation.

Text Books and/or Reference Materials

Additional Learning Source
2. Web links to e-learning: nptel
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<td>Design of Concrete Structures-I</td>
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**Course Assessment Method**
1. Assignments and quizzes (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 2 Hour

**Course Objective**
1. To introduce basic principles of analysis and design of reinforced concrete elements.
2. To develop understanding of design procedures and behavior of reinforced concrete components and systems subjected to static loads.
3. To understand specifications and procedures of design and analysis as per relevant BIS codes.

**Course Outcomes**
Upon successful completion of this course, it is expected that students will be able to:
1. Recognize the design philosophy of the reinforced concrete structures (Po’s: e).
2. Understand the structural behavior of different reinforced concrete structural elements (Po’s: a, e).
3. To learn procedures of analysis and design of different elements of reinforced concrete structural elements (Po’s: a, c, e).
4. Use the techniques, skills, and modern engineering tools necessary for design and detailing (Po’s: a, e, f, i).
5. To learn the basic recommendations of standard Codes of Practices with special emphasis to Indian codes (Po’s: a, c, e, f, i).

**Topics Covered**

**Unit 1**
Load and stresses, load combinations, RC design philosophies: working stress, ultimate stress and limit state approach, a comparative study. Concept of axial loads, bending, shear, bond and torsional stresses in RC sections. Analysis and design of RC sections in bending – Rectangular and T-sections (singly and doubly reinforced).

**Unit 2**

**Unit 3**
Design of compression members, Short column, Columns with uni-axial and bi-axial bending; Long columns, use of design charts. Design for torsion in beams and columns.

**Unit 4**
Design of foundation: Wall footing, Isolated and combined footing for columns.

**Self Learning**
Design of Circular slab and Voided slab, Design of masonry columns, walls and footings.

**Text Books / Reference Materials**
3. Pillai and Menon “Reinforced Concrete Design”, TMH, New delhi, India.
4. Verghese, P. C. “Advanced Reinforced Concrete Design” PHI, Delhi, India

**Selected B. I. S Codes/Design aids**
IS Codes: 456 (2000); 875 (1987); 1893 (1984); 4326 (1993); 13920; 1343 (1980); SP-16: 24: 34. India.

**Additional Learning Source**
Web links to e-learning: npetel; Study through refereed National and International Journals
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**Course Assessment Method**

1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 2 Hour

**Course Objective**

1. To develop an appreciation of soil as a vital construction material, so that it may subsequently be used in the design and construction of foundation for civil engineering structures.
2. To develop an understanding of the relationships between physical characteristics and mechanical properties of soils.
3. To inculcate the basic knowledge of classification and engineering properties of soil and its suitability as a foundation/subgrade material.
4. To understand the experimental methods for physical and mechanical soil properties.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

2. Apply fundamental soil mechanics principles in common Civil Engineering applications.
3. Build the necessary theoretical background for design and construction of foundation systems with utmost safety and economy.
4. Develop the understanding of various BIS and ISO standards for design of foundations of structures.

**Topics Covered**


**Unit 2** Permeability and Seepage: Soil water, effective and neutral stress. Darcy’s law, factors affecting permeability of soil. Laboratory determination of permeability of soil. Permeability of stratified soils. Seepage, quick sand conditions, and liquefaction of soil. Flownet and inverted filters.

**Unit 3** Compressibility and Consolidation: Definition of the terms. Virgin compression curve. Terzaghi’s one dimensional consolidation theory. Laboratory consolidation test, height of solids and change in voids ratio methods. Determination of coefficient of consolidation by log of time fitting and square root of time fitting methods. Consolidation settlement.

**Unit 4** Shear Strength of Soil: State of stress at a point, Mohr’s stress circle. Mohr-Coulomb failure envelops. Shear strength of soil, Direct, Triaxial, Unconfined and Vane shear tests, principles of drained and undrained tests. Stress path.

**Text Books / Reference Materials**

4. Som and Das, “Theory and Practice of Foundation Design”, PHI, Delhi, India.

**Additional Learning Source**

2. Web links to e-learning: nptel
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**Course Assessment Method**

1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 2 Hour

**Course Objective**

The overall aim is

1. to give deeper knowledge in the problems and possibilities of waste management from a national and global perspective.
2. to discuss both wastewater and municipal solid waste issues.
3. to explain the design concept of sewer lines and waste treatment plants
4. to employ a holistic view on solutions as well as technical aspects.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Understand the fundamental principles of existing and emerging technologies for the treatment of waste and recovery of value from waste
2. Able to design the wastewater collection and disposal systems
3. Apply the design principles for the treatment of municipal wastewater
4. Understand underlying principles of processes involved in municipal solid waste handling and management

**Topics Covered**

**Unit 1** Design Principles of Wastewater Collection Systems- Wastewater Generation, Separate, Combined and Semi-Combined Sewers, Sewer Pipe Hydraulics, Sizing of Pipes and Design, Pumping Station, Manhole Chambers, Design of Sewerage Systems, Sewer Appurtenances

**Unit 2** Wastewater Characterization, Batch Reactor, Completely Mixed Reactor, Plug Flow Reactor, Wastewater treatment- Primary Treatment, Screens, Grit Removal, Sedimentation,

**Unit 3** Wastewater Treatment- Secondary Treatment, Activated Sludge Process, Trickling Filter, UASB Reactor, Stabilisation Ponds, Septic Tank, Nitrogen and Phosphorus Removal and Sludge Treatment – Anaerobic digestion

**Unit 4** Municipal Solid Waste- Characteristics, Solid Waste Management - Collection, Disposal, Land filling, Incineration, Composting, Noise Pollution- Concept, Health Effects, Noise Measurement and Control

**Text Books and/or Reference Materials**

1. Howard S. Peavy, et. al, “Environmental Engineering” McGraw-Hill, Delhi, India

**Additional Learning Source**

1. NPTEL course material from IITs
2. CPHEEO, Manual on Sewerage and Sewage Treatment , Ministry of Urban Development, Delhi.
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**Course Assessment Method**

1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 2 Hour

**Course Objective**

1. To develop the fundamental concept for methods of dimensional analysis and models studies.
2. To develop an understanding of the viscous flow and its governing equations.
3. To understand the basic concepts of boundary layer and theory of boundary layer flow.
4. To develop an understanding of the turbulent flow and its governing equations.
5. To apply the theories of laminar and turbulent flow to solution of some typical pipe flow problems in the field and boundary layer theory to estimate the drag and lift for various shapes of the objects.
6. To understand the design philosophy of turbines and pumps.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Apply laminar and turbulent flow theories for solution of flow field problems and carry out model studies of various hydraulic structures.
2. Apply the theory of boundary layer flow to estimate the lift and drag on various shapes of the objects and develop the turbulent flow theory.
3. Apply the theories of laminar and turbulent flow to solution of typical pipe flow problems.
4. Design various types of turbines and pumps.

**Topics Covered**

**Unit 1** Laminar flow, Navier's-Stokes equation of motion for laminar flow; Laminar flow between two parallel plates, laminar flow through pipes, Dimensional Analysis & Modal Studies. Velocity distribution in turbulent flow; shear stress due to turbulence, turbulent flow in circular pipes, resistance of smooth and artificially roughened pipes, General resistance diagram.

**Unit 2** Boundary Layer Theory: Introduction, Development of boundary layer over a flat plate, boundary layer thickness, displacement, momentum and energy thicknesses, Application of momentum equation to boundary layer flow, local and mean drag coefficients, Hydro-dynamically rough and smooth surfaces, boundary layer separation and its control, Forces on Immersed bodies: Drag and lift, drag on flat plate, sphere, cylinder and disc, development of lift, Magnus effect and circulation, theoretical lift on rotating cylinder.


**Unit 4** Hydro-electric Power plant, Components and functions, Turbines: classification of turbines, Impulse and Reaction turbines, characteristic curves, draft tubes, Pumps: classification of pumps, Reciprocating and centrifugal pumps, efficiency and power, Output of centrifugal pumps, characteristics curves.

**Text Books / Reference Materials**


**Additional Learning Source**

2. Web links to e-learning: nptel
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**Course Assessment Method**

1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 2 Hour

**Course Objective**

1. To develop an understanding of the behavior and stability of special structures such as arches, cables and suspension bridges and their methods of analysis under static loads.
2. To learn various special procedures/ theorems of analysis like Mohr’s theorem, method of consistent deformation, reciprocal theorem, Betti’s theorem, energy theorem etc. for statically indeterminate structures.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Apply fundamental concepts of mathematics, statics, mechanics of deformable bodies, and principle of dynamics to the solution of fundamental civil engineering structural analysis problems.
2. Apply structural codes and standards such as IS 1875 (part-2&3) and IS: 1893 (Part-I) to model dead, live, snow, wind, and earthquake loads on structures.
3. Understand the deformations of structures under loading and be able to apply various methods to determine the deformations.
4. Solve statically indeterminate structures using classical methods.

**Topics Covered**

**Unit 1** Indeterminate structures; Static and kinematic indeterminacy, Analysis of indeterminate beams, moment area method, Effect of yielding of supports, Consistent deformation method, Three moment theorem.

**Unit 2** Displacement methods; Slope deflection method, Moment distribution method, Application to continuous beam, non-sway and sway frames.

**Unit 3** Analysis of indeterminate pin jointed perfect and redundant frames.

**Unit 4** Analysis of cables and suspension bridges, Two hinged and three hinged stiffening girders

**Text Books / Reference Materials**

1. Reddy, C. S., “Basic Structural Analysis” TMH, Delhi, India.
2. Vazirani and Ratwani, “Basic structural analysis” Khanna, Delhi, India.

**Additional Learning Source**

2. Elements of Structural Analysis by N C Sinha (New Central Book Agency).
3. Web links to e-learning: nptel
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**Course Assessment Method**

1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 2 Hour

**Course Objective**

1. Develop concepts of analysis and design of structural elements not covered under 1st course on the subject i.e. CEC3110 and some new structural components such as continuous beam, tanks, pre-stressed concrete structures, bridges, staircases and retaining walls etc.
2. To enable the students execute the drawing with adherence to specification mentioned.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:
1. Apply basic design and analysis concepts in the design of RC structural elements ordinarily used in every day construction. Identify the various types of deformations in different structures e.g. compression tension hoop occurring at a particular structure at least qualitatively.
2. Develop the wisdom of structural engineering i.e. the application of the knowledge in that area which was not taught specifically in the course. Explain the deformation/structural action of any constructed, field, monumental structure
3. Diagnose the damaging cause/ lapses happened leading the structure unfit for the use. Comment on the overall performance of the structure and can predict useful life of the structure.
4. Prepare models for engineering solution of any problem qualitatively and this knowledge acquired by the student can be used directly and indirectly developing/repairing of any household product.

**Topics Covered**

**Unit 1**
Design of continuous beams and building frames; Moment redistribution; Estimation of wind and seismic loads, Desirable features of earthquake resistant construction, Detailing for earthquake resistant construction – ductility criteria.

**Unit 2**
Water tank and staging; Introduction, Design criteria, Design of rectangular and circular water tank, Design of Intze tank, Staging for overhead tank.

**Unit 3**
Introduction to bridge engineering, Investigation for bridges, IRC loadings, Design of slab culvert. Design of cantilever and counter-forte type retaining wall.

**Unit 4**
Pre-stressed concrete, Introduction, pre-stressing system, losses in pre-stress, Design of simple span girders, Design of end block; Design of staircases.

**Text Books and/or Reference Materials**

2. Raju, N.K. “Pre-Stressed Concrete” TMH, Delhi, India.

**Reference Books:**

1. Karve and Shah Limit State Theory and Design of reinforced Concrete VGP, Pune, India
2. Pillai and Menon “Reinforced Concrete Design” TMH, New Delhi, India
3. Verghese, P.C. “Advanced Reinforced Concrete Design” PHI, Delhi, India
5. Evans and Cook ‘Reinforced and Pre-stressed Concrete’ TN, London, UK

**Additional Learning Source**

1. Web links to e-learning: nptel

**Selected B.I.S. Codes/Design aids**

IS Codes: 456 (2000); 875 (1987); 1893 (1984); 4326 (1993); 13920; 1343 (1980); SP-16: 24: 34. India.
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**Course Assessment Method**

1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 2 Hour

**Course Objective**

1. To give an insight about the design of Highway, Railway and Airport engineering problems.
2. To describe the criteria, standards and engineering procedures used to design principal elements of the highway alignment, and highway cross sections.
3. To understand the process of collecting information necessary for successful design of flexible and rigid pavements, including traffic data, material properties and other environmental factors.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:
1. Develop technical skills for road pavement material testing and construction.
2. Understand the basic concepts of Highway geometric and pavement design by applying fundamental concepts of Mathematics and Laws of Mechanics.
3. Propose a feasible solution to fundamental railway engineering analysis/design problems.
4. To understand traffic engineering problems and airport planning and design problems
5. Develop the understanding of various BIS, IRC and ISO standards and to design the highways in conformity with these codes.

**Topics Covered**

**Unit 1** Highway Material and Construction: Properties of sub-grade and pavement component material, tests on stone aggregates and bituminous materials. Highway construction – WBM, WMM, bituminous and cement concrete pavements.


**Unit 3** Railway Engineering: Gauges, Rail failure and Ultrasonic Inspection, Rail joints and welding of rails, Wear of rails, Sleepers, Ballast and formation, Points and crossings, Station and yard, Tractive resistances, Hauling capacity of locomotive, Modernization of Railways.


**Text Books and/or Reference Materials**


**Additional Learning Source**

2. Web links to e-learning: nptel
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**Course Assessment Method**

1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 2 Hour

**Course Objective**

1. To introduce to students the theory and application of analysis and design of steel structures.
2. To develop students with an understanding of the behaviour and design of steel members and systems.
3. To prepare students for the effective use of the latest tables, design aids and computer software in the design of steel members.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. recognize the material properties of steel products [POs: e]
2. recognize the design philosophy of steel structures and have concept on limit state design [POs: a, e]
3. ability to design bolted and welded connections for tension and compression members and beams. [POs: a, e]
4. apply the principles, procedures and current code requirements to the analysis and design of steel tension members, beams, columns, beam-columns and connections, Girders[POs: a, c, d, e, i]
5. ability to obtain basic knowledge about the failure mode of steel structure. [POs: a, c, d]

**Topics Covered**

Unit 1 Properties of Structural Steel, I. S. Rolled Sections, I. S. Specifications, Built up sections, Design philosophy, Introduction to Plastic analysis; Simple cases of beams and frames

Unit 2 Type of Connections, Riveted, Bolted and Welded Connections, Strength, Efficiency and Design of Joints, Modes of Failure of a Joint, Advantages and Disadvantages of Welded Joints, Eccentric Connections.

Unit 3 Design of tension members, splicing of tension member, concept of shear lag, use of lug angles. Design of compression members, Beam-column connections.

Unit 4 Design of flexure members, Plate girder, Gantry Girder

**Text Books and/or Reference Materials**

2. Limit state Design of Steel Structures by Duggal. Tata Mc-Graw Hill, New Delhi
3. Arya and Ajmani “Design of Steel Structures”, NCB, Roorkee, India.
4. Ramamrutham “Design of Steel Structures” Dhanpat Rai, Delhi, India.

**Additional Learning Source**

Web links to e-learning: nptel and insdag.com

**Selected B.I.S. Codes/Design aids**

1. I. S.:800-2000-Code of Practice for General Construction in Steel, BIS, New Delhi, India.
2. I. S. Steel Tables containing Properties of Steel sections, BIS, New Delhi, India.
Course Assessment Method

1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 2 Hour

Course Objective

The main aim of this course is to understand the basic theories of open channel flows such as depth-energy relationship, uniform flow and its application to design of efficient channel sections of various shapes, hydraulic jump and its application to the energy dissipation devices, gradually varied flow and its application in computation of typical water surface profiles, unsteady flow and its practical application, model studies and their application in open channel flow etc.

Course Outcomes

Upon successful completion of this course, it is expected that students will be able to:
1. Apply fundamental concepts of Mathematics, Fluid Mechanics and Specific energy to the solution of critical flow and transition problems.
2. Design non-erodible channel and the most efficient channel section for carrying maximum discharge.
3. Understand the significance of critical flow and uniform flow and apply these concepts in gradually varied flow problems.
4. Develop models and perform studies for various hydraulic structures like dams, spillways, etc. and to analyze the R.V.U.F. problems.

Topics Covered

Unit 1 Basic Principles: open channel flow and its classifications, and properties, energy and momentum principles, Critical flow computation and its applications, transitions with sub critical and super critical flows.

Unit 2 Uniform flow, roughness coefficient, computation of uniform flow in prismatic channel, design of non-erodible channels for uniform flow, Most efficient channel section, compound sections.

Unit 3 Gradually varied flow: Theory and analysis, control sections, Analysis of flow profiles, gradually-varied flow computations in prismatic channels. Rapidly varied flow: Theory of hydraulic jump, evaluation of jump elements in rectangular and non-rectangular channel, location of jump on horizontal floor.

Unit 4 Application of model studies to free surface flow problems, waves and their classifications, celerity of a wave, surge formation, equation of motion, rapidly varied unsteady flows.

Text Books and/or Reference Materials

1. Subramanya, “Flow in Open channels”
2. K G Ranga Raju, “Flow through open channel”
3. V.T chow “Open channel Hydraulics”
4. Bakhmeteff, “Hydraulics of open channel”
5. Henderson, “Open channel flow”

Additional Learning Source

1. Web links to e-learning: nptel
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**Course Assessment Method**

1. Assignments and Oral Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 2 Hour

**Course Objective**

1. To develop an understanding of theory and application of the various advanced methods of structural analysis.
2. To understand the analytical procedure related to the analysis of building frame by some classical methods viz. Kani’s methods and approximate methods of analysis.
3. To understand matrix method and its application for computer based analysis of structure.
4. To develop the concept of influence line diagrams to deal with the problems of moving loads in the structures and their analysis techniques.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Apply fundamental concept of mathematics, statics and mechanics to understand the essentials of the advanced method of structural analysis. Understand the structural actions viz. rotations and displacements, especially in building frames subjected to vertical and lateral loadings.
2. Generate mathematical expressions involving all possible structural actions. Analyze building framing system and its components under the action of gravity and lateral loads and thereby developing database for the design of the structure.
3. Identify, formulate and solve engineering problems and effectively use and apply the computer friendly structural analysis techniques viz., stiffness and flexibility methods to the field problems. Deal with the problems of moving loads in the structures and their analysis techniques such as influence line diagram.
4. Use the techniques and modern engineering tools necessary for engineering practice. Recognize the importance of good written communication skill and to know how to compile the analysis results so that it can be effectively used for the design of the structure.

**Topics Covered**

Unit 1 Analysis of building frames; Kani’s method and Approximate methods
Unit 2 Stiffness and flexibility matrix method; Application to simple problems of beams and frames
Unit 3 Moving loads for determinate beams; Different load cases, Influence lines for forces for determinate and indeterminate beams using Muller Breslau principle.
Unit 4 Influence lines for pin jointed trusses, arches and stiffening girders.

**Text Books and/or Reference Materials**


**Additional Learning Source**

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**Course Assessment Method**
1. Class Work (60%)
2. End Semester Examination (40%)

**Course Objective**
1. To understand experimentally the behavior of conventional civil engineering materials such as cement, aggregate, fresh and hardened concrete.
2. To learn standard principles and procedures of testing materials & concrete mix design including field tests.
3. To learn practical applications of the tests and writing technical reports.

**Course Outcomes**
Learn test procedure prepare test specimen required tie for experiments.
1. Understand the behavior of cement, aggregate & fresh hardened concrete subjected to different structures state
2. Visualize the deformation and crack pattern in specimens subjected to different types of loads.
3. To learn working & collaborate in groups and feel responsibilities in among group members.
4. Analyze and interpret test results and prepare technical test reports.

**Topics Covered/List of Experiments**
- **Test on Cement**
  1. Normal Consistency of Cement
  2. Setting Time of Cement
  3. Compressive Strength of Cement
- **Test on Aggregate**
  1. Silt Content in Fine aggregate
  2. Bulking of Sand
  3. Particle Size Distribution of Coarse and Fine Aggregate by Sieve Analysis
- **Test on Fresh Concrete**
- **Test on Hardened Concrete**
- Effect of W/C Ratio on Crushing Strength of Concrete

**Text Books and/or Reference Materials**
1. Lab manual provided by the department
2. Neville, A.M., “Properties of Concrete”, Longman, India
4. Shetty, M.S., “Concrete Technology”, SCC Ltd., New Delhi

**Additional Learning Source**
1. Gambhir, M.L., “Concrete Technology”, TMH, New Delhi, India
2. Web links to e-learning: nptel
Civil Engineering CEC2920 Fluid Mechanics Lab DC None Lab 2 0 1 2 3

Course Assessment Method
1. Class Work (60%)
2. End Semester Examination (40%)

Course Objective
The main objective of this lab course is to make the students in better understanding of fluid mechanics phenomena such as variation of velocity and pressure, measuring head loss in terms of differential head, liquid jet forces acting on various type of vanes and measurement of flow rate by various devices such as orifice meter, weir etc.

Course Outcomes
Upon successful completion of this course, it is expected that students will be able to:
1. Design intricacies of hydraulic structures such as dams, spillways, weirs, sluice gate etc.
2. Design water and waste water disposal system.
3. Design and select appropriate rotodynamic system.
4. Use appropriate type of flow measuring devices.

Topics Covered/List of Experiments
1. Flow over weirs and notches
2. Verification of Bernoulli’s Theorem
3. Discharge through an Orifice
4. Centre of Pressure
5. Impact of Liquid jets
6. Head losses through sudden contraction and enlargement

Text Books and/or Reference Materials

Additional Learning Source

Civil Engineering CEA2930 Engineering Geology Lab& Camp ESA None Lab 2 0 1 2 3

Course Assessment Method
1. Class Work (60%)
2. End Semester Examination (40%)

Course Objective
1. To supplement theoretical knowledge and to give hands on training to identify common rock forming minerals and rocks on the basis of their physical properties.
2. To understand contour patterns for identifying landforms and topography of an area on topographic map.
3. To understand and interpret geological maps and to have an idea of spatial rock distribution
4. The field work in Engineering Geology Camp will help in identifying various rock outcrop patterns and
to identify and measure various properties of rocks and rock masses in the natural setting.
5. To use basic instruments in the field and to generate data base for rock mass characterization.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:
1. Learn about the ground surface features based on map patterns of contour within the framework of fundamental concepts of basic sciences with emphasis on practical application in civil engineering.
2. Know about different minerals and rocks and their application in day to day engineering use.
3. Identify field characters of rock mass and shall be able to model rock mass properties.
4. Produce technical reports based on database generated in the field, supplemented by lab tests for effective communication amongst stakeholders and to comprehend problems for specific civil engineering structure, to be founded on or inside the rocky ground.

**Topics Covered/List of Experiments**

1. Topographic and Geological Maps.
5. Geological Sections of Faulted Rocks.
6. Identification of Minerals on the basis of physical properties.
7. Identification of Rocks on the basis of physical properties.

**Text Books and/or Reference Materials**

2. C. D. Gribble (1991), Rutley’s Element of Mineralogy, CBS Publishers and Distributers, Delhi

**Additional Learning Source**

1. Websites related to Geology and Engineering Geology

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<td>CEC2940</td>
<td>Structural Mechanics Lab</td>
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**Course Assessment Method**

1. Class Work (60%)
2. End Semester Examination (40%)

**Course Objective**

1. To understand characteristic of selected Civil Engineering Material like metals, Bricks, Blocks, Timber etc. under different loading condition.
2. To learn standard principles and procedure of testing materials & prepare specimens for tests.
3. To learn practical applications of the tests and writing technical reports.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:
1. Learn test procedure for testing material under different loading conditions.
2. Know the practical significance of each experiment.
3. Visualize the behaviour of material at different stress levels and failure pattern under different type of
loads.
4. Infer results and prepare test reports.

**Topics Covered/List of Experiments**

Experiment No. 1: To understand the behaviour of a mild steel bar under tension by plotting stress-strain curve
Experiment No. 2: To determine the modulus of elasticity of a steel bar subjected to transverse loading
Experiment No. 3: To determine the buckling load on columns for different end conditions
Experiment No. 4: Verification of bending moment and shear force in beams
Experiment No. 5: To determine the shear modulus by plotting the torque twist diagram for a circular shaft
Experiment No. 6: To determine the Brinell’s Hardness number for different materials
Experiment No. 7: To determine the impact value of the standard specimens by Izod impact testing machine

**Text Books and/or Reference Materials**

1. Lab manual provided by the Department

**Additional Learning Source**

1. Mechanics of material by B. C. Punmia
2. Solid Mechanics by S.M.A. Kazmi
3. Web links to e-learning: nptel

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<td>Surveying Lab</td>
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**Course Assessment Method**

1. Class Work (60%)
2. End Semester Examination (40%)

**Course Objective**

1. To understand the measurement techniques and equipments used in conventional methods of surveying.
2. To gain an appreciation of recent changes in survey procedures and equipments.
3. To use techniques, skills, and modern engineering tools necessary for engineering practice and working as a team.
4. To understand the importance of professional licensure to protect the public in the practice of cadastral surveying.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:
1. Learn use of simple instruments used in land survey.
2. Use of modern survey equipment including understanding of the principles and operation of Total Station.
3. Improve ability to function as a member of a survey team in completing the assigned field work.
4. Prepare topographical maps of areas, volume of building materials used in civil engineering projects.

**Topics Covered/List of Experiments**

1. Conventional method of measuring horizontal distances
2. Plane tabling by (i) radiation method, (ii) intersection method and (iii) solution of two and three point problems by resection method
3. Differential Levelling
4. Longitudinal levelling and Cross sectioning
5. Measurement of horizontal and vertical angles with a theodolite
6. Determination of gradient of a line using stadia and tangential theodolite
7. Analytical solution of three point problem and determination of the omitted portion of a base line
8. Determination of the height of an object by trigonometrical observations
9. Setting out of a simple curve
10. Setting out of a Building
11. Total station surveys (control establishment and detail plotting)

**Text Books and/or Reference Materials**


**Additional Learning Source**

1. Web links to e-learning: nptel

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<td>CEC-2180</td>
<td>Field Camp</td>
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<td>6-day field visit</td>
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**Course Assessment Method**

1. Class Work (60%)
2. End Semester Examination (40%)

**Course Objective**

1. To work on a real problem of land survey in a chosen field
2. To get knowledge of the different field-based problems related to the survey of the area and to propose solutions
3. To understand the field problems related to the preparation of topographical map of an area and work in groups

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:
1. Assess the nature of the field area, for the planning and construction of any engineering project
2. Acclimatize with a variety of survey instruments
3. Prepare detailed topographical map of the area that would be helpful in planning of engineering works
4. Estimate the volume of earthwork required and to plan the layout of engineering projects like roads, canals, sewers etc.
5. Recognize the importance of time management in achieving a targeted work

**Course Contents**

- Traversing by theodolite and tacheometer
- Latitude and departure
- Plane table survey
- Differential levelling
- Longitudinal and cross sectioning
- Contouring
- Total-station based survey

**Additional Learning Source**

Web links to e-learning: nptel
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**Course Assessment Method**
1. Class Work (60%)
2. End Semester Examination (40%)

**Course Objective**
1. To introduce soil mechanics laboratory techniques to civil engineering undergraduate students.
2. To familiarize students with common geotechnical test methods, test standards and technology.
3. To understand, interpret and properly apply laboratory results obtained using standardized method for construction of structures.
4. To understand the analytical techniques for understanding (a) Darcy’s law for permeability and seepage (b) Stoke’s law for hydrometer analysis of particle size distribution of cohesive soils (c) Mohr-Coulomb’s analysis for shear strength parameters of soils.
5. Enable students to prepare professional reports for design projects and data presentation skill and to use computers and some computer graphics.

**Course Outcomes**
Upon successful completion of this course, it is expected that students will be able to:
1. Classify the soils and predict its behavior in terms of mechanical properties i.e. strength, compressibility and permeability.
2. Predict behavior of soil under field loading for safe design of structures over or under the soil.
3. Quantify the mechanical properties of soil based on standardized laboratory tests.
4. Analyse and Design a variety of geotechnical engineering structures including foundations, piles, retaining walls, slopes and interpret data for different laboratory/field conditions.

**Topics Covered/List of Experiments**
1. Specific gravity of the soil by Density Bottle and Pycnometer methods.
2. Field density by Core Cutter method
3. Field density by Sand Replacement method
4. Liquid limit and plastic limit of soil by Casagrande Apparatus method
5. Liquid limit and plastic limit of soil by Cone Penetrometer test method
6. Shrinkage limit of soil by Mercury method
7. Grain size analysis of soil by Mechanical and Hydrometer methods
8. Permeability of the soil by Constant head method
9. Permeability of the soil by Falling head method
10. Standard Proctor’s compaction test.
11. Direct shear test for shear strength parameters of soil.
12. Triaxial shear test for shear strength parameters of soil.

**Text Books / Reference Materials**

**Additional Learning Source**
Civil Engineering  

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**Course Assessment Method**
1. Class Work (60%)
2. End Semester Examination (40%)

**Course Objective**
1. To learn the handling of different equipments related to water and wastewater analysis
2. To learn about the preparations of stock and standard solutions, their handling, storage, etc.
3. To understand the different experiments involved in water and wastewater analysis.
4. To learn more about the titration techniques of chemical analysis
5. To develop skills related to report writing.

**Course Outcomes**
Upon successful completion of this course, it is expected that students will be able to:
1. Characterize water and wastewater samples
2. Predict the quality of treated water and wastewater samples
3. Evaluate the efficiencies of the water and wastewater treatment plants.
4. Make decisions regarding dosing of different chemicals involved in water treatment processes and to select the appropriate technologies for wastewater treatment.

**Topics Covered/List of Experiments**
1. Determination of pH and Alkalinity of Water and Synthetic solution.
3. Determination of optimum Alum Dose by Jar Test Apparatus.
4. Determination of available Chlorine in Bleaching Powder
5. Determination of Residence time for PFTR
6. Determination of Oxygen Transfer Capacity of the Laboratory aeration system
7. Determination of BOD
8. Determination of COD
9. Determination of Sulphates

**Text Books and/or Reference Materials**
1. Laboratory Manual of Environmental Engineering provided by the department

**Additional Learning Source**
1. Web links related to Environmental Engineering and Environmental Engineering Lab

Civil Engineering  

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**Course Assessment Method**
1. Class Work (60%)
2. End Semester Examination (40%)

**Course Objective**
1. To study the law of resistance and estimate the pipe friction factor
2. To train the students to calibrate flow measuring instruments
3. To apply the concepts of viscous flow theory in the field of viscometer
4. To visualize various types of flow in pipe
5. To apply the concepts of normal and tangential acceleration in pipe bend for flow measurement

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Solve the laminar and turbulent pipe flow problems
2. Calibrate any flow measuring devices
3. Apply Stokes law and laminar flow for development of viscometer
4. Apply the visualization technique in understanding of mechanics of flow

**Topics Covered/List of Experiments**

1. Flow through pipes
2. Flow through Venturimeter
3. Determination of viscosity by capillary tube viscometer
4. Determination of viscosity by falling sphere viscometer
5. Flow visualization using Reynolds apparatus
6. Flow through bend meter

**Text Books / Reference Materials**


**Additional Learning Source**

2. Web links to e-learning: nptel

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**Department**  
**Course No.**  
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**Course Designation**  
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**Course Type**  
**Credit Hours**  
**Contact Hours**  
**Total Contact Hours**

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**Course Assessment Method**

1. Class Work (60%)
2. End Semester Examination (40%)

**Course Objective**

1. To learn where to load the unsymmetrical sections.
2. To learn how to find forces in different members of the truss.
3. To learn how to use compatibility equations & compare the deflections in perfect & redundant trusses.
4. To learn how to find modulus of elasticity for brittle materials.
5. To learn how a beam deflects in pure bending under one & two point loading.
6. To learn how to make use of non-destructive testing methods.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Load the unsymmetrical sections at proper locations to avoid shear stresses
2. Know different methods of finding forces in the members of a truss
3. Know that redundant trusses carry more loads in comparison to the perfect trusses
4. Plot stress strain diagram and find modulus of elasticity by offset method
5. Find deflections at different locations of the beam
6. Use PUNDIT and rebound hammer for finding compressive strength of concrete

**Topics Covered/List of Experiments**

Experiment No. 1: To determine the shear centre for unsymmetrical sections.
Experiment No. 2: Study of stress in pin jointed trusses.
Experiment No. 3: Verification of compatibility equation and comparison of deflections of a Perfect and
Redundant truss.

Experiment No. 4: Determination of modulus of elasticity of mild steel bar by simple tensile test.
Experiment No. 5: Load deflection test on simply supported MS I section under flexure.
Experiment No. 6: Assessment of strength of concrete cubes using non-destructive tests.

Text Books / Reference Materials
1. Lab manual provided by the department

Additional Learning Source
1. Basic Structural Analysis by C.S. Reddy
2. Mechanics of materials by B. C. Punmia
3. Structural Analysis (Vol.1 & 2) by Vazirani and Ratwani

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<td>CAD Lab-I</td>
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Course Assessment Method
1. Class Work (60%)
2. End Semester Examination (40%)

Course Objective
1. To introduce computer aided analysis and design of reinforced concrete and steel structures, using simple examples of structural elements.
2. To understand interpretation of results obtained from software package.
4. To compare results obtained with computer aided analysis and design and manual methods of analysis & design.

Course Outcomes
Upon successful completion of this course, it is expected that students will be able to:
1. Understand basics and commands of computer based design & analysis.
2. Better understand and compare the behavior of different structural member under gravity loads.
3. Prepare design reports interpret results obtained with computer aided analysis and design.

Topics Covered/List of Experiments
1. To analyze and design reinforced concrete structural members like beams, slab, foundation, simple frame and stair case etc. using computer aided analysis and design software(s).
2. Validation of results obtained with computer aided design software and conventional methods of analysis and design.

Text Books / Reference Materials
1. Web link: bentley.institute@bentley.com
2. Examples on YouTube
3. Manual/Help provided with software packages

Additional Learning Source
1. Web links to e-learning: nptel and insdag
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<td>Transportation Engineering Lab</td>
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**Course Assessment Method**

1. Class Work (60%)
2. End Semester Examination (40%)

**Course Objective**

1. To carry out tests on construction materials for their suitability and economic utilization.
2. To identify and classify the pavement materials into different groups according to their characteristics.
3. To make aware the students about the classification, suitability, strength and stability of pavement materials.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:
1. Monitor and maintain road pavements.
2. Develop insight for characterization of materials for highways and railways.
3. Develop Job mix for various types of bituminous constructions such as WMM, SDBC, BC, DBM and BM etc.
4. Develop technical skills for pavement and rail construction.
5. Prepare the testing reports related to highway engineering works.
6. Develop the understanding of various BIS, IRC and ISO standards and to design the highways in conformity with these codes.

**Topics Covered/List of Experiments**

1. California bearing ratio test on sub grade soil sample.
2. Determination of hardness of stone aggregates by Los Angeles abrasion test.
4. Specific gravity and water absorption of stone aggregate.
5. Flakiness and Elongation indices tests on stone aggregate.
6. Soundness test on stone aggregates.
7. Deval attrition test on stone aggregates.
8. Crushing strength test on stone aggregates.
9. Ductility test on bitumen.
10. Softening point test on bitumen.
11. Flash and Fire point test on bitumen.
12. Penetration needle test on bitumen.
13. Viscosity test on bitumen.

**Text Books and/or Reference Materials**


**Additional Learning Source**

Civil Engineering  

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<td>Foundation Engineering</td>
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Course Assessment Method

4. Assignments and Quizzes (15%)
5. Mid-Semester Examination (25%)- 1 Hour
6. End Semester Examination (60%)- 2 Hour

Course Objective

The objectives of the course are as follows:
1. To introduce the theory and application for analysis and design of earth retaining structures, slope stability analysis, shallow and deep foundations and machine foundations.
2. To understand the behavior and design of rigid, flexible walls and pile foundations of the structures subjected to static and dynamic loads.
3. To develop an understanding to perform site investigations and to determine the soil parameters needed to carry out foundation design.
4. To learn the subsurface exploration techniques and apply them to design the foundations and retaining walls.
5. To enable students to prepare professional reports for design projects and data presentation skill and to use computers and some computer graphics.

Course Outcomes

Upon successful completion of this course, it is expected that students will be able to:
1. Apply fundamental concept of mathematics, statics and mechanics to understand the essentials of the method of bearing capacity and stability analysis.
2. Analyze and design a variety of geotechnical engineering structures including foundations, piles, retaining walls, slopes and interpret data.
3. Recognize behavior of soils in slopes, behind retaining structures and phenomena affecting foundation capacity and settlement.
4. Determine allowable bearing pressures and load carrying capabilities of different foundation systems.
5. Evaluate appropriate bearing capacity correction factors and apply related equations in design.
7. Identify the appropriate deep foundation type for different soil profiles.
8. Specify pile material types for various applications and calculate side/tip capacity of driven piles in clay and sand.

Topics Covered

Unit 1 Earth Pressures and Retaining Walls: Active, passive and pressure at rest, Rankine’s and Coulomb’s theories; influence of surcharge, layered soil and water table. Rebhann’s and Culmann’s graphical constructions of active pressure for cohesionless soil. Simplified procedure for design of sheet pile walls and anchored bulk heads.

Unit 2 Stability of Slopes: Infinite slopes and their stability, total and effective stress analysis, concepts of factors of safety. Method of slices, Friction circle and Bishop’s simplified methods. Taylor’s stability number, Effect of steady seepage; Sudden draw down and submergence.


Unit 4 Deep Foundations and Site Investigation: Boring and sampling techniques and sampling disturbances. Introduction to pile foundations. Load carrying capacity of piles by Engineering News and Hilley’s formulae. Bearing capacity of single pile and pile groups by static formulae.

Text Books and/or Reference Materials

Delhi, India.

Additional Learning Source
4. www.ce.washington.edu/~geotech/courses/cee523/manuals/
7. www.dfi.org/

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Course Assessment Method
1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 2 Hour

Course Objective
The main theme of this course is to understand the theory and design of irrigation structures in the Indian sub-continents. The course covers the major topics such as assessment of water requirement for various crops, design of canals, headwork, regulation works, cross drainage works and river training works etc. Various types of irrigation and the related problems such as water alkalinity and water logging are also highlighted.

Course Outcomes
Upon successful completion of this course, it is expected that students will be able to:
1. Realize the importance of optimal water use for growing the crops and apply methods for saving land from water logging.
2. Apply knowledge for efficient design methods for rapid conveyance of water with lesser loss in irrigation canals.
3. Apply the silt control devices in canals and natural channels for long life of irrigation schemes i.e. Silt excluders, Silt ejectors, Sediment transport in alluvial channels and reduction of channel resistance due to silt deposition on the bed and sides of canals.
4. Apply the knowledge in the design of hydraulic structures to be constructed at junction of natural and manmade channels with obstruction free flow.
5. Formulate irrigation networks across the country to make itself self reliant in food grain production.
6. Emancipate the need of water resource conservation and management to overcome the natural calamities such as drought.

Topics Covered
Unit 1: Irrigation development in India, present status of irrigation in India, methods of irrigation, silt control in canal, canals outlets. Water requirements of various crops and land leveling, Irrigation schedule.
Unit 2: Canal losses, water-logging drainage, sodic soils, lining of canals; Regime theories for the design of earthen channels, elementary ideas about sediment transport theory, incipient motion of sediment. Modes of sediment transport.
Unit 3: Theory of uplift pressure, canal headwork, river training works.
Unit 4: Canal regulation and cross drainage works.
Text Books and/or Reference Materials
1. P.N. Modi, “Irrigation Water Resources and Water Power”
2. Bharat Singh, “Irrigation Engineering”

Additional Learning Source
1. Web links to e-learning: nptel

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Course Assessment Method
1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 2 Hour

Course Objective
The course emphasizes on the basic design principle of the gravity dam, earthen dam, arch and buttress dam, spillways and energy dissipaters etc.

Course Outcomes
Upon successful completion of this course, it is expected that students will be able to:
1. Understand the fundamental concepts of dam engineering, its necessity and importance.
2. Apply the knowledge in selecting a suitable materials, site and a suitable dam for the given site conditions.
3. Understand the significance of various forces acting on gravity dams.
4. Estimate forces acting on dams under various design conditions and earthquake zones.
5. Design the economical section for a gravity dam corresponding to a given full reservoir level.
6. Create the necessary theoretical background for design of water resources projects.

Topics Covered
Unit 1: Types of Dam, merits and demerits, dam site selection, selection of dam, Forces acting on gravity Dam, Methods of analysis of gravity Dam, Modes of failure and stability requirements, Design criteria and factor of safety.

Unit 2: Elementary profile of a gravity dam, Low and high gravity dams, Zoning of dams, Galleries in dams, Temperature control in mass concrete; gravity dams subjected to earthquakes.

Unit 3: Buttress and Arch dams, Types, selection, merits and demerits, Elementary design Principles of Arch and Buttress dams

Unit 4: Earth Dam their component and functions, causes of failure. Factors influencing the design of an earth dam. Design criteria for Earth Dam. Elementary idea of design for spillway and energy dissipaters.

Text Books and/or Reference Materials
1. R.S. Varshney “Concrete Dams”, by 1982, NCB, Roorkee
3. Design of Swell Dams, USBR 1960, Calcutta, Oxford and IBH

Additional Learning Source
NPTEL course materials from different IITs.
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<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
<th>Contact Hours</th>
</tr>
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<tbody>
<tr>
<td>Civil Engineering</td>
<td>CEE4590</td>
<td>Industrial Pollution Control</td>
<td>DE</td>
<td>CEA 1110</td>
<td>Theory</td>
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</table>

### Course Assessment Method
1. Assignments and Oral Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 2 Hour

### Course Objective
1. To teach essential principles used in industrial pollution abatement.
2. To impart fundamental training and knowledge about the science & engineering of the industrial pollution
3. To develop basic understanding about the pollution types, its effects on the environment & human health, and their control measures.
4. To give students an in-depth importance and understanding of the severity of the industrial pollution and processes involved in the treatment of wastewater, and control of air pollution.
5. To train the students to present a case of any industry and its environmental management programme to build a direct transition in between the theory and practical.

### Course Outcomes
Upon successful completion of this course, it is expected that students will be able to:
1. analyze the characteristics of industrial wastewaters and the effects of disposal of industrial wastes
2. identify and design treatment options for handling industrial wastewater
3. understand different types of wastes generated in an industry,
4. understand the different unit operations and unit processes involved in treatment
5. understand the atmospheric dispersion of air pollutants, and operating principles, design calculations of particulate control devices

### Topics Covered
**Unit 1** Characterization of liquid waste survey, sampling and material balance, segregation and equalization; Disposal of waste in environmental, effects on land receiving waters, standards.
**Unit 2** Overview of wastewater treatment, Wastewater reclamation and reuse in industry, Pollution abatement in major industries: Textile, paper and Pulp, Steel, Sugar, Distillery, Petroleum Refinery.
**Unit 3** Sources and generation of gaseous pollutants, Effects on materials, health and plants, Air quality monitoring. Dispersion of air pollutants
**Unit 4** Air pollution control, methods for removal of particulates and gaseous pollutants, design principles.

### Text Books and/or Reference Materials

### Additional Learning Source
Course Assessment Method
1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 2 Hour

Course Objective
1. To introduce students with the responsibilities and ethics of traffic engineering profession.
2. To familiarize students with the basic mathematical models employed for trip forecasting and transportation planning and level of service.
3. To expose students with the design of various traffic engineering components, like traffic signs and signals, and control devices, parking, highway lightings, etc.
4. To introduce students with various traffic studies, their importance, procedures, data collection, and interpretation.
5. To explain established standards and engineering procedures for the design of intersections on the basis of data obtained from traffic studies.

Course Outcomes
Upon successful completion of this course, it is expected that students will be able to:
1. Understand the transportation planning process and develop basic transportation forecast models.
2. Execute traffic studies, analyze and interpret the obtained data, and understand their application
3. Design various transportation facilities including traffic signs, signals, other control devices, traffic islands, road markings, highway lightings, and parking
4. Understand the type of intersection to be provided on a given road junction and design it on the basis of data obtained from traffic studies

Topics Covered
Unit 1 Traffic and Transportation Planning: Object, scope and function of traffic engineering. Traffic and transportation planning process – inventories, trip generation, trip distribution, traffic assignment, plan preparation and evaluation, the traffic problems.

Unit 2 Traffic Characteristics: Road user and vehicular characteristics. Traffic flow characteristics, traffic volume, Origin & Destination study, speed and delay study. Accident studies and safety, methods for the reduction in accident rates. Environmental effects on highway traffic noise and pollution.

Unit 3 Traffic Facilities Design: Design of intersections – principles of intersection design, rotary intersections, grade separated intersections, grade separation structures. Design of parking facility. Highway lighting, design of highway lighting system.


Text Books and/or Reference Materials

Additional Learning Source
Web links to Traffic Engineering, Nptel etc.
## Civil Engineering

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Course Title</th>
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<th>Credit Hours</th>
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<tbody>
<tr>
<td>CEE4660</td>
<td>Pre-stressed Concrete</td>
<td>DE</td>
<td>CEC 3110 CEC 3160</td>
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</table>

### Course Assessment Method

1. Assignments and Oral Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 2 Hour

### Course Objective

1. To introduce students to the fundamental principles about the structural behaviour and design criteria of prestressed concrete Structures as per the codal provisions.
2. To present the fundamental mechanics to define the internal forces and to review the current technology available to prestressed concrete structures and to derive the formulae to estimate the initial and time-dependent losses.
3. To present the serviceability limit states critical for the design of conventional prestressed concrete structures.

### Course Outcomes

Upon successful completion of this course, it is expected that students will be able to:

1. Obtain the internal forces due to the prestressing in a prestressed concrete structure, being able to identify the primary and secondary components of the total internal forces
2. Evaluate the initial and time-dependent losses
3. Propose an appropriate system to prestress a particular structure
4. Design the prestressing layout and the prestressing force that fulfils the relevant limit states

### Topics Covered

<table>
<thead>
<tr>
<th>Unit</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit 1</td>
<td>Pre-stressed concrete, basic concept; pre-stressing material and pre-stressing systems; losses of pre-stress, end anchorage and cable layouts.</td>
</tr>
<tr>
<td>Unit 2</td>
<td>Analysis and design of pre-stressed concrete flexure members, simply supported beam and slabs.</td>
</tr>
<tr>
<td>Unit 3</td>
<td>Analysis and design for shear, bond and bearing. Analysis and design of pre-stressed concrete continuous beams.</td>
</tr>
<tr>
<td>Unit 4</td>
<td>Analysis and design of pre-stressed concrete compression and tension members.</td>
</tr>
</tbody>
</table>

### Text Books and/or Reference Materials

4. I.S.:1343-2012 Code of Practice for Pre-Stressed Concrete, BIS, New Delhi, India

### Additional Learning Source

<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
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<tr>
<td>Civil Engineering</td>
<td>CEE4730</td>
<td>Elements of Earthquake and Wind</td>
<td>DE</td>
<td>None</td>
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</table>

**Course Assessment Method**

1. Assignments and Oral Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 2 Hour

**Course Objective**

1. To gain knowledge on basic seismology like the causes of occurrence of earthquake and its characterization hazards and its consequences, earthquake measurement and instrumentation.
2. To develop an understanding of structural dynamics of simple systems subject to harmonic, impulse and/or arbitrary loading
3. To develop an understanding of construction of eigen value solution algorithms
4. To impart knowledge of analysis for lateral loads and codal provisions for earthquake resistant design of structures as per Indian Standards
5. To impart knowledge on different types of damages caused due to earthquake and retrofitting techniques

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Suggest possible causes for the movements of the plates and different types of plate boundaries.
2. Describe elastic rebound theory as it is related to seismic activity.
3. Distinguish between earthquake magnitude and earthquake damage (intensity).
4. Understand why earthquakes occur, how they are measured and categorized and the effect they may have on engineering structures.
5. Understand the concepts of seismic forces and how they relate to structures.
6. Develop an understanding of structural dynamics of simple systems subject to harmonic, impulse and/or arbitrary loading and predict its response.
7. Construct eigenvalue solution algorithms.
9. Apply the basic codal provisions for earthquake resistant design of structures as per Indian standards.
10. Understand the concepts retrofitting of structures.

**Topics Covered**


**Unit 4** Earthquake damages in buildings and its remedies as per IS codes: Introduction, salient features of IS:13935 and IS:4326; Identification of damage in RC buildings: soft storey failure, plan and mass irregularities, poor quality of construction material and corrosion of reinforcement, pounding of buildings; damages to structural and non-structural components; damage to water tank, parapets and staircase. Effect of structural irregularities on buildings: introduction; vertical irregularities: vertical discontinuities in load path, irregularities in strength and stiffness, mass irregularities, vertical
geometric irregularities, proximity of adjacent buildings, plan configuration problems.
Provision of different types of bands in masonry buildings. Salient features of IS:13920

**Text Books and/or Reference Materials**

2. Dynamics of Structures - Application to Earthquake Engineering by A. K. Chopra
5. David Key, 'Earthquake Design Practice for Buildings', Thomas Telford, London,
7. Pankaj Agarwal and Manish Shrikhande, 'Earthquake Resistant Design of Structures', PHI,
8. I.S. Codes No. 1893, 4326, 13920 etc.

**Additional Learning Source**

Web links related to Earthquake and Wind Engineering

<table>
<thead>
<tr>
<th>Department</th>
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<tbody>
<tr>
<td>Civil Engineering</td>
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<td>Bridge Engineering</td>
<td>DE</td>
<td>CEC 3110 CEC 4910</td>
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</table>

**Course Assessment Method**

1. Assignments and Oral Quizzes (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 2 Hour

**Course Objective**

1. To introduce different types of highway and railway bridges, Types and materials used
2. Introduction to different types of loads standardized by Indian Road Congress (IRC) and Indian Railway Standard Code of Practice for Bridges.
3. To learn selecting a specific type of concrete/steel bridge to be constructed at a particular location
4. Understand different methods of analyses and their application for designing concrete bridges and steel bridges.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:
1. Relate different design philosophies of the highway and railway bridges.
2. Understand the structural behaviour of different components of a reinforced concrete and steel bridge.
3. Analyze and design different components of a highway and railway bridge, to meet desired needs within realistic constraints such as economy, environment friendly, safety, viable construction and its sustainability under loads as per Indian Road Congress (IRC) and Indian Railway Standard Code of Practice for Bridges respectively and submit the designs in complete and concise manner.
4. Use the techniques, skills, and modern engineering tools and softwares necessary for design and detailing.
5. Analyze and interpret the results using analytical tools and further plan, design and detail different bridges using relevant and upcoming BIS standards.

**Topics Covered**

**Unit 1** General; classification, site selection, Geometric and hydraulic design consideration, loading standards for highway and railway bridges, general design consideration

**Unit 2** Concrete bridges; Introduction, T-beam bridge, balanced cantilever bridge, cable stayed bridge, arch bridge.

**Unit 3** Steel bridges Introduction, plate girder bridge, truss bridge, suspension cable bridge, cable stayed bridge
Unit 4 Substructure; design of piers and abutments, Pile and well foundation, Bearings, Seismic design considerations

Text Books and/or Reference Materials

1. Victor “Essentials of Bridge Engineering”, Oxford, New Delhi, India
2. Arya & Ajmani “Design of Steel Structures”, Nem Chand, Roorkee, India
4. Standard Specifications and Code of Practice for Road Bridges
   b. Section II, Loads and Stresses, IRC:6-2000
   c. Section III, Cement Concrete (Plain and Reinforced Concrete), IRC:21-2000
   e. Section IX, Foundations and Substructure, IRC:78-2000
   f. Section VII, Steel Road Bridges, IRC:24-2001
5. Standard Specifications and Code of Practice for Railway Bridges
   a. Indian railway Standard Code of Practice for the Design of Steel or Wrought Iron Bridges carrying Rail, Road or Pedestrian Traffic, Govt. Of India, Ministry of Railways, 1962
7. I.S: 1893 2002- Indian Standard Code of Practice for Structural Safety of Structures, BIS, New Delhi, India
8. S.P.:34- Handbook on Concrete Reinforcement and Detailing, BIS, New Delhi, India

Additional Learning Source

1. NPTEL course materials from different IITs.
2. Study through Journal Papers

<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
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<tr>
<td>Civil Engineering</td>
<td>CEE4570</td>
<td>Rock Engineering</td>
<td>DE</td>
<td>CEA2140</td>
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</table>

Course Assessment Method

1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 2 Hour

Course Objective

Geo-engineering of Rocks and Rock Mass, has been designed to give emphasis more on the engineering aspect as compared to geology and to act as the bridge course for the students offered M. Tech. by different IITs on “Underground Construction” or “Rock Mechanics”. It will help in developing:

1. Concepts of rock mass properties governed by deformation of rocks and development of discontinuity features.
2. Insight to presence of in-situ and forced stresses in rock mass, their measurement will be able to solve engineering problems.
3. Safe excavation techniques for construction of underground structures.
4. Knowledge of ground improvement techniques with special reference to rock mass.

Course Outcomes

Upon successful completion of this course, it is expected that students will be able to:

1. Understand geotechnical properties of rocks within the framework of fundamental concepts of basic
sciences and with emphasis on their practical utility in civil engineering.

2. Learn about various natural inherent weaknesses in rocks and rock masses, their quantification and its use in designing.

3. Justify importance of residual stresses in rock mass and to model the redistribution of stresses during loading and unloading.

4. Model physical and mechanical properties of rocks and rock mass through quantification.

5. Identify and predict future behavior of founding ground and accordingly build necessary database for design and construction.

6. Interact with stakeholders in mega construction project and to be aware of more advanced techniques and state of the art technology available for unusual problems.

7. Recognize the importance of good written communication skills, and know how to write professional, clear, concise technical reports and letters to clients and colleagues.

**Topics Covered**

**Unit 1** Rocks and its Physical Properties: Genetic and mineralogical classification of rocks, Mode of occurrence, form, and structure of rocks, Rock textures, grain size parameters and petrological fabric of rocks, Effect of physical, chemical weathering and deterioration of rocks

**Unit 2** Natural Forces and Deformation of Rocks: Genesis of natural forces and theory of plate tectonics, Mechanics, classification and effects of folding, faulting and joints. Shear zones, rock cleavage and discontinuities in rocks and rock mass fabric

**Unit 3** Mechanical Properties of Rocks and Tests: Factors controlling the mechanical properties of rocks Density, porosity, sorption and permeability of rocks, Elasticity, compressive, shear and tensile strength of rocks, Engineering performance of rocks

**Unit 4** Methods of Rock Mass Investigation and Improvement: Interstitial water and seepage flow in rock mass, Residual stresses, In-situ tests for deformability and strength of rock mass, Geomechanical classification and geotechnical description of rock mass, Rock mass problems in slopes, excavations and underground openings, Rock mass improvement, grouting, guniting and rock bolting , Geological mapping and engineering geology maps, Exploration pits, trenches, drifts and drilling

**Text Books and/or Reference Materials**

7. M. Masroor Alam (2013), Fundamental of Engineering Geology and Geo-engineering, Axioe books, India

**Additional Learning Source**

1. Websites related to Mega Engineering Projects

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**Department | Course No. | Course Title | Course Designation | Pre-Requisites | Course Type | Credit Hours | Contact Hours | L | T | P | Total Contact Hours**

| Civil Engineering | CEO4810 | Disaster Management | OE | None | Theory | 4 | 3 1 0 | 4 |

**Course Assessment Method**

1. Assignments and Oral Quizzes (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 2 Hour

**Course Objective**

1. To create awareness amongst students to basic issues of natural and manmade disasters.
2. To ensure the understanding of the disaster management cycle and relationship amongst vulnerability, preparedness, prevention and mitigation.
3. To invoke minimum ability and sensitivity amongst students to respond to disasters in their area of living and working.
4. To develop technical prowess and to mitigate the effects of disasters by capacity building amongst engineering fraternity towards formulation and implementation of disaster management strategies.
5. To relate amongst the basic approaches adopted in disaster risk reduction and institutional mechanism adopted in country towards creating resilient society.

<table>
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<tr>
<th>Course Outcomes</th>
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<tbody>
<tr>
<td>Upon successful completion of this course, it is expected that students will be able to:</td>
</tr>
<tr>
<td>1. Understand genesis and causes of natural and manmade disaster within the framework of fundamental concepts of basic sciences and engineering.</td>
</tr>
<tr>
<td>2. Perceive the vulnerability of their living and working places and level of preparedness within the existing setup of disaster management.</td>
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<tr>
<td>3. Analyze and critically examine the vulnerability of a region and to employ adequate strategy and tools of intervention.</td>
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<tr>
<td>4. Build capacity to use specialized problem solving skills, methodologies and technology.</td>
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<tr>
<td>5. Setup priorities to develop coherent and adaptable disaster management plan.</td>
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<tr>
<td>6. Produce technical reports and database for effective communication amongst stakeholders to comprehend the problems of disaster management and to device improved technologies for future interventions.</td>
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<tr>
<th>Topics Covered</th>
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<tbody>
<tr>
<td>Unit 1 Natural and Man Made Disasters: Meaning and nature of natural disasters, their types and effects. Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Climatic change and extreme climate. Global warming, Sea level rise, ozone depletion. Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, Pollution and environmental degradation. Road, rail, sea and air accidents.</td>
</tr>
<tr>
<td>Unit 4 Disaster Preparedness and Mitigation: Human behavior and response. International and National Strategies for disaster reduction. Concept of disaster management. National disaster management framework. Central, state, district and local administration; Armed forces, police, NDRF in disaster response, rescue and relief. Role of NGOs, community based organizations and media. Role of different engineering disciplines in preparedness, response, rescue, rehabilitation recovery, prevention and mitigation.</td>
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<table>
<thead>
<tr>
<th>Text Books and/or Reference Materials</th>
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</thead>
</table>

Additional Learning Source
1. https://www.ndma.gov.in
2. https://www.nidm.gov.in
3. https://www.nicee.org
4. http://nptel.iitk.ac.in/

<table>
<thead>
<tr>
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</table>

Course Assessment Method
1. Assignments and Oral Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 2 Hour

Course Objective
1. To make the student familiar with project, non project activity and various types of project, diversified application of project management knowledge.
2. To make the student conversant with fundamentals of management knowledge and various frontiers of project management
3. To make the student conversant with notion of cost and cost accounting
4. To make the student conversant with the phrase estimate is an opinion price is policy and cost is a fact
5. To make the student conversant with the realm of Net-work Analysis, Statistical Analysis and basic Research Methodology
6. To make the student conversant with principles of purchasing, pricing policy, value analysis and specification writing
7. To make the student conversant with the importance of human capital, wage concepts, human resource planning and development

Course Outcomes
Upon successful completion of this course, it is expected that students will be able to:
1. Distinguish between project and non project activity, should be able to prepare Work Break-Down Structure of simple projects
2. Identify need specific project estimate
3. Analyze various types of cost involved in project
4. Apply principles of Research Methodology
5. Apply basic principles of Purchase Management and Pricing Theory
6. Apply coordinal principles of wage policy and Human Resource Management

Topics Covered
Unit-1 Management Fundamentals
Introduction to realm of management and concept of project and project managements, definition of project and epistemology of project management knowledge, inherent characteristic of project, project life cycle and various phases
of project in detail, classification of projects, introduction of cost, classification of cost and its application, uses of cost data, recording of cost and its importance, types of estimates and accuracy, concept of Ceiling Limit, case studies and professional practice

**Unit 2 Network Analysis**
Introduction to pictorial presentation of data, merits and demerits of various techniques, work breakdown structure, network analysis like CPM and PERT, critical path and crashing, overview of statistics, application of statistics in management, model building and uses of model in management, theory of knowledge and research methodology in management, case studies and professional practice

**Unit 3 Materials Management**
Introduction to purchase management, objectives of purchasing activity, specification, fundamentals of materials management, pricing theory and general economic considerations, principles of negotiations, discount and quality assurance, different types of purchasing, make or buy decision, value analysis, process of standardization and patenting, BS and ISO standards, case studies and professional practice

**Unit 4 Human Resource Management**
Introduction and importance of human capital, dynamics and dualism in the labour market in India, labour supply, participation rates, and working hours, wage concept, various types of wages, wage fixation, punishment, rewards and benefits for human resource, history of HR in India, HRP role and effectiveness, HR planning, HRM Information system, performance measurements and employee carrier, strategic HRP in project management, case studies and professional practice

**Text Books and/or Reference Materials**


**Additional Learning Resources:**

1. Publication of Construction Industry Institute, CII, www.construction-institue.org
2. Publication of RIBA, England
3. Publication of FIDIC, France
4. Publication of AGC, America
5. Publication of PMI, America
6. Publication of NIDM, New Delhi
Civil Engineering

CEO4820

Advanced Environmental Engineering

OE

None

Theory

Credit Hours: 4

Contact Hours: 3 1 0

Total Contact Hours: 4

Course Assessment Method

1. Assignments and Oral Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 2 Hour

Course Objective

1. To impart fundamental training and knowledge about this coveted field of engineering & sciences for students of other disciplines as well (like Electrical, Electronics, Mechanical, Petro-Chemical, Architecture etc.)
2. To develop basic understanding about the pollution control measures for water, air and land coupled with application in the industry of any nature.
3. To provide students an in-depth importance and understanding of the physical, chemical, and biological processes involved in the treatment of water, wastewater, air pollution control and disposal of solid wastes.
4. To develop a basic foundation for higher studies and research in both basic and applied environmental disciplines and provides a direct transition to the post-graduate engineering programmes.

Course Outcomes

Upon successful completion of this course, it is expected that students will be able to:
1. Differentiate between environmental sciences and engineering
2. Address the importance of the environment in general and may apply fundamental concepts of Environmental Engineering & Sciences in any field of their career.
3. Capable to face challenges and apply their knowledge in the areas of infrastructure development schemes, industry, and environmental remediation.
4. Hands-on basic design procedure, field studies, and trips provide an understanding of the problems at hand and thus make them capable to undertake any relevant task independently or as a team.
5. Motivate and create some awareness about the environment.

Topics Covered

Unit 1 Fundamentals of chemistry concept in environmental engineering: Water and Wastewater Quality Parameters, their units, laboratory techniques for measurement, significance and adverse impact on environment and human health

Unit 2 Fundamentals of microbiology in environmental engineering: Role of microorganisms in environmentally relevant processes including bioremediation of pollutants, biological treatment systems like activated sludge process, UASB etc.


Unit 4 Mass balance and energy balance approach: Material Balance, Types of Reactors, Reactor Kinetics, Steady-State Condition, Introduction to Air Pollution, their sources, standards, health effects, Introduction to Solid Waste Management and Noise Pollution and its control.

Text Books and/or Reference Materials


Additional Learning Source

2. NPTEL course material from IITs
<table>
<thead>
<tr>
<th>Department</th>
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<tbody>
<tr>
<td>Civil Engineering</td>
<td>CEO4840</td>
<td>Water Resources and Watershed Management</td>
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</table>

**Course Assessment Method**

1. Assignments and Oral Quizzes (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 2 Hour

**Course Objective**

The basic aim of this course is to understand the surface water resources and its management including environmental impact assessment, project economics, water quality management planning, and design of water resources systems etc.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:
1. Apply fundamental concepts of water and land resources management to solve water shortage problems.
2. Understand the importance of optimal water use and to disseminate knowledge in society to keep water resources unpolluted and its judicious uses.
3. Implement collection and storage of water through rainwater harvesting for sustainable development in the perspective of increasing population and changing life styles of the society.
4. Solve the dual problems i.e. shortage of water in drought prone areas and safety of area against floods due to flood prone rivers.
5. Apply the knowledge in the management and development the water resources and to be able understand the importance of water quality and water born diseases to solve the health and environmental hazards problems.

**Topics Covered**

**Unit 1:** Types of watershed and their characteristics. Purpose of planning of watershed projects, Guidelines for project formulation, Management strategies, system concept, systems components and constraints.

**Unit 2:** Hydrologic cycle and its effect on man’s activity, erosion process and sediment yield, conservation practices, water resources and environmental problems, water quality management planning, Design of water resources systems

**Unit 3:** Environmental impact assessment, adverse effects of dams and reservoir on environment, watershed management with multiple use concepts.

**Unit 4:** Project economics: pattern of financing and credit, cost benefit analysis, Economic evaluation, project implementation and management, problems of execution and management.

**Text Books and/or Reference Materials**

2. S. K. Garg, “Irrigation Engineering”

**Additional Learning Source**

1. Web links to e-learning: Nptel
2. Web pages related to water resources engineering and management
<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
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<tr>
<td>Civil Engineering</td>
<td>CEE-4510</td>
<td>Concrete Technology</td>
<td>DE</td>
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<td>Theory</td>
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### Course Assessment Method

Assignments and Oral Quizzes (15%)
Mid-Semester Examination (25%)- 1 Hour
End Semester Examination (60%)- 2 Hour

### Course Objective

The objectives for this course are:

1. To understand the properties of concrete ingredients i.e. cement, sand, coarse aggregates, water by studying and conducting different tests.
2. To learn mix design procedure as per standard codes.
3. To understand the factors affecting the properties of fresh and hardened concrete and new forms of concrete.
4. To learn the application of admixtures in order to improve the properties of concrete.
5. Infer the test results as per relevant IS provisions.

### Course Outcomes

Students who successfully complete the course will demonstrate the following outcomes:

1. Know the materials and methods used to make concrete, including their sources, production and properties.
2. Explain the properties of fresh and hardened concrete.
3. Design normal concrete mixes and apply statistical quality control techniques to concrete quality.
4. Identify, describe and chose suitable form of concrete for a particular use at site.

### Topics Covered

**Unit 1**
Constituent Materials of Concrete:- Types, Properties and Tests as per code.
Production of Concrete:- Properties and Quality Control, Equipments and method for mixing, Compaction, curing
Mix Design:- Concepts, Methods, Sample Problems using IS Code Method

**Unit 2**
Admixtures and Construction Chemicals:- Types, Method of Mixing, Effect on different Properties of Concrete, Behavior of Concrete in Extreme Climate Permeability & Durability, Temperature Problems in Concreting, Saline Environment, sulfate & Acid Attacks, Fire Resistance.

**Unit 3**
Testing of Concrete:- Tests on Fresh & Hardened Concrete, Non Destructive Test.

**Unit 4**
Special Concretes:- Self Compacting Concrete, Lightweight Concrete, High Density Concrete, Pre-Placed aggregate Concrete, Fiber-Reinforced Concrete, Ferro-cement, Polymer Concrete, Air Entrainment Concrete

### Text Books and/or Reference Materials

1. Neville, AM “Properties of Concrete”, Longman, India
2. Neville, AM & Brooks J.J. “Concrete Technology”, Longman, India
3. Shetty, M.S., “Concrete Technology”, SCC Ltd., New Delhi
4. IS: 456-2000- Code of Practice for Plain and Reinforced Concrete
5. SP:16- Design aids for Reinforced Concrete to IS:456-2000
6. SP:23- Handbook on Concrete Mixes

### Additional Learning Source

- IS: 456-2000- Code of Practice for Plain and Reinforced Concrete
- S.P.:16- Design aids for Reinforced Concrete to IS:456-2000
- IS:10262 – 2009 - Recommended Guidelines for Concrete Mix Design
- S.P.:23- Handbook on Concrete Mixes
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**Course Assessment Method**

4. Assignments and Quizzes (15%)
5. Mid-Semester Examination (25%)- 1 Hour
6. End Semester Examination (60%)- 2 Hour

**Course Objective**

6. To introduce students with the responsibilities and ethics of traffic engineering profession.
7. To familiarize students with the basic mathematical models employed for trip forecasting and transportation planning and level of service.
8. To expose students with the design of various traffic engineering components, like traffic signs and signals, and control devices, parking, highway lightings, etc.
9. To introduce students with various traffic studies, their importance, procedures, data collection, and interpretation.
10. To explain established standards and engineering procedures for the design of intersections on the basis of data obtained from traffic studies.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

5. Understand the transportation planning process and develop basic transportation forecast models.
6. Execute traffic studies, analyze and interpret the obtained data, and understand their application
7. Design various transportation facilities including traffic signs, signals, other control devices, traffic islands, road markings, highway lightings, and parking
8. Understand the type of intersection to be provided on a given road junction and design it on the basis of data obtained from traffic studies

**Topics Covered**

**Unit 1 Traffic and Transportation Planning:** Object, scope and function of traffic engineering. Traffic and transportation planning process – inventories, trip generation, trip distribution, traffic assignment, plan preparation and evaluation, the traffic problems.

**Unit 2 Traffic Characteristics:** Road user and vehicular characteristics. Traffic flow characteristics, traffic volume, Origin & Destination study, speed and delay study. Accident studies and safety, methods for the reduction in accident rates.

**Unit 3 Traffic Facilities Design:** Design of intersections – principles of intersection design, rotary intersections, grade separated intersections, grade separation structures. Design of parking facility. Highway lighting.

**Unit 4 Traffic Signals and Vehicle Safety:** Traffic regulations, controls on vehicles, drivers and flow, one way street, basics of traffic control devices, traffic signs. Traffic signals and their design. Traffic islands and markings.

**Text Books and/or Reference Materials**


**Additional Learning Source**

Web links to Traffic Engineering, Nptel etc.
**Course Assessment Method**

1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 2 Hour

**Course Objective**

To educate the student on the working principles, theories and design of various physical and chemical treatment systems for water and wastewater.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:
1. learn about water and wastewater characteristics and, fundamentals of water and wastewater treatment
2. identify and understand the common physical and chemical unit operations encountered in treatment processes
3. select optimized dose of chemicals and evaluate removal efficiencies of physicochemical treatment unit
4. explain the principles of physicochemical processes and apply the knowledge in the process design of water and wastewater treatment

**Topics Covered**

**Unit I**

**Unit II**
Flocculation-Velocity Gradient, Kinetics, Baffled and Paddle Wheel Flocculation, Sedimentation-Discrete, Flocculent and Hindered Settling, Ideal Horizontal Flow Reactor, Up flow Reactor, Design Parameters, Tube Settlers

**Unit III**
Granular Media Filtration-Rapid and Slow Sand Filter, Particle Removal Mechanisms and Head Loss, Filter Run and Breakthrough, Constant and Declining Rate Filtration, Filter Backwashing, Dissolved Air Flotation-Design Considerations, Water Fluoridation, Iron and Manganese Removal, Advanced Oxidation Process

**Unit IV**

**Text Books /Reference Materials**


**Additional Learning Source**

2. Web based sources.
<table>
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<th>Department</th>
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<th>Course Type</th>
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<td>Air Pollution and Control</td>
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**Course Assessment Method**

1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 2 Hour

**Course Objective**

To educate the students about the causes, dispersion and control of air pollutants.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Understand the nature of major air pollutants and their effects on humans and property.
2. Apply the concepts of meteorology for the dispersion of air pollutants.
3. Evaluate the selection of different control units for particulates and gaseous pollutants.
4. Design the different control equipment's used for air pollution.

**Topics Covered**

**Unit I**
Classification, Sources and Effects of air pollutants, Sampling Methods and Measurements of Air Pollutants, Measurement and analyses of primary air pollutants $\text{SO}_2$, $\text{NO}_x$ and SPM using high volume sampler, Ambient Air Quality Standards, Emission Standards, Air Quality Index, Air Quality Monitoring, Photochemistry and its effects on atmospheric stability

**Unit II**
Basic Meteorology, Transport, Dispersion and Transformation of pollutants in Air, Adiabatic Lapse Rate, Atmospheric Stability, Dispersion of Pollutants, Air Pollution Dispersion Models, Point, Line and Area Source Models, Inversions, Plume Behaviour, Mixing Height, Plume Rise, Stack Emissions and Design

**Unit III**
Air Pollution Control Techniques, Control of Particulate Matter, Theory and description of control devices and their applications, Equipments and their Design, Selection of Control Equipments, Engineering Control Concepts Gravity Settling Chamber, Cyclone, Fabric Filter, Electrostatic Precipitator

**Unit IV**
Control of Gaseous Pollutants-Oxides of Nitrogen and Sulphur, Sources and effects of noise pollution, Kinetics of noise, Measurement and control of noise pollution, Climate Change, Odour Removal, Atmospheric Chemistry, Photochemical Smog, Global Change-Greenhouse Effect and Global Warming, Ozone Layer Depletion, Acid Rain, Air Emissions from Wastewater Treatment Facilities and their Control

**Text Books / Reference Materials**


**Additional Learning Source**

- http://nptel.ac.in/courses/105102
- http://mjcetenvsci.blogspot.in/2013/11/air-pollution-causes-effects-and.html
Department | Course No. | Course Title | Course Designation | Pre-Requisites | Course Type | Credit Hours | Contact Hours | Total Contact Hours |
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**Course Assessment Method**

1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 2 Hour

**Course Objective**

The objective of Biological Treatment Process is to prepare students to learn the fundamentals related to the design of biological treatment systems applied in wastewater treatment.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. To understand the principles of behaviour of microorganisms in the treatment of municipal and industrial wastewaters.
2. To apply the concepts of kinetics and mass balance in the design of biological treatment systems for wastewater.
3. To analyse the problems related to troubleshooting of the wastewater treatment plant and to apply the corrective measures for the same.
4. To evaluate the effect of various factors responsible for the biodegradation of organics including toxicants.

**Topics Covered**

**Unit I**

Principles of Biological Treatment, Types of Reactors, Mass Balance concepts for reactor kinetics, Kinetics and hydraulics of Plug Flow and Completely mixed reactors.

**Unit II**


**Unit III**


**Unit IV**

Anaerobic Treatment processes, Nutrient requirement and toxicity considerations, High rate anaerobic treatment systems, Upflow Anaerobic Sludge Blanket – design and operation, Anaerobic sludge digesters – types and design

**Text Books and/or Reference Materials**


**Additional Learning Source**

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**Course Assessment Method**
1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 2 Hour

**Course Objective**
Understanding of problems of municipal waste, industrial waste etc. Knowledge of legal, institutional and economic aspects of management of solid wastes. Become aware of Environment and health impacts solid waste mismanagement Understand engineering, financial and technical options for waste management

**Course Outcomes**
Upon successful completion of this course, it is expected that students will be able to:
1. Explain municipal solid waste management systems with respect to its physical properties, and associated decisive considerations in view of emerging technologies
2. Outline sources, types and composition of solid waste with methods of handling, sampling and storage of solid and hazardous waste.
3. Select the suitable method for solid waste collection, transportation, redistribution and disposal.
4. Describe safe and engineered methods of disposal of municipal solid waste and hazardous waste

**Topics Covered**

**Unit I**

**Unit II**

**Unit III**
Hazardous Waste- Definition, Generation and Classification, Storage, Transportation, Processing and Handling, Waste Minimisation and Recovery Alternatives, Toxicology, Pollution Prevention, Hazards in Processing and Treatment, Hazardous Waste Treatment Processes- Physical separation, Chemical treatment, Thermal Treatment, Stabilization and Solidification

**Unit IV**

**Text Books/ Reference Materials**

**Additional Learning Source**
Manual on Solid Waste Management (CPHEEO), Ministry of Urban Development, Government of India
<table>
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<th>Department</th>
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<td>Environmental Analysis Lab</td>
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**Course Assessment Method**

1. Periodic Assessment of reports and Viva Voce (60%)
2. End Semester Examination (40%)

**Course Objective**

To aware the students with the analysis of water quality and wastewater characterization parameters using state of the art instruments.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. to evaluate the characteristics of wastewater and quality of water
2. to analyze the wastewater samples for critical parameters using sophisticated instrumentation facilities
3. to understand the operation of state-of-the-art instrumentation facilities
4. to apply the concepts gained in the monitoring of performance evaluation of water and wastewater treatment plants

**Topics Covered**

1. Water quality parameters including basic and advanced parameters like TKN, Ammonia nitrogen, Phosphorous, Fluoride, MPN, etc
2. Wastewater Characterization parameters including COD, Solids, VFA, Heavy Metals, etc

**Text Books and/or Reference Materials**

1. Standard Methods for Examination of water and wastewater, APHA/AWWA/WPCF Washington DC

**Additional Learning Source**

1. Web based learning
Civil Engineering  

CEC-6932  

Environmental Engineering Processes Lab  

PC  

NIL  

Laboratory  

2  

0 1 2 3

Course Assessment Method
1. Periodic Assessment of reports and Viva Voce (60%)
2. End Semester Examination (40%)

Course Objective
To provide hands-on experience with unit operations and processes commonly applied in modern environmental engineering research and practice.

Course Outcomes
Upon successful completion of this course, it is expected that students will be able to:
1. to develop the skill for conducting studies on various unit operations and processes using laboratory scale models
2. to model and design systems using analytical tools from engineering practice
3. to design and conduct experiments, and analyze and interpret the experimental data
4. to summarize, interpret, and present experimental information in formal reports and via oral presentations.

Topics Covered
1. Experiments on Discrete, Flocculant and Zone Settling for design of clarifiers
2. Sludge Thickening experiments
3. Coagulation/Flocculation Studies for the treatment of Industrial Wastewaters
4. Studies on Advanced Oxidation Processers
5. Determination of kinetic parameters of biological treatment
6. Methanogenic Activity Test for Anaerobic Sludges
7. Adsorption Studies
8. Air Monitoring Studies for SPM, SOx and NOx
9. Characterization of Solid Waste

Text Books and/or Reference Materials
1. Standard methods for Examination of water and wastewater, APHA/AWWA/WPCF Washington DC
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<td>Civil Engineering</td>
<td>CEC-6939</td>
<td>Project</td>
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</table>

**Course Assessment Method**

1. Periodic Assessment of reports and Viva Voce (60%)
2. End Semester Examination (40%) 

**Course Objective**

To familiarize the students with different assignments on polluting industries including EIA studies and design of Effluent treatment plants including zero effluent discharge practices.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. To understand the different manufacturing processes involved in industries and to assess the pollution caused by each unit.
2. To understand the environment impact of the industries.
3. To propose a design for the effluent treatment plant.
4. To apply the principles of different unit operations for the control of pollution caused by industries.

**Topics Covered**

1. Manufacturing processes of different industries responsible for causing major environmental pollution.
2. Parameters involved in Environmental Impact Assessment and Auditing.
3. Design of Effluent Treatment Plants for different industries.
4. Industrial visits.

**Text Books / Reference Materials**


**Additional Learning Source**

1. Comprehensive Industry Document Series, Central Pollution Control Board, New Delhi, India.
2. Web based sources.
**Department** | **Course No.** | **Course Title** | **Course Designation** | **Pre-Requisites** | **Course Type** | **Credit Hours** | **Contact Hours** | **Total Contact Hours**
--- | --- | --- | --- | --- | --- | --- | --- | ---
Civil Engineering | CEE-6410 | Environmental Chemistry | PE | NIL | Theory | 4 | 3-1-0 | 4

### Course Assessment Method
1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 2 Hour

### Course Objective
To appraise the students of the applications of principles of chemistry in water and wastewater treatment and to prepare them as experts in optimising the chemistry-based water and wastewater treatment processes.

### Course Outcomes
- Upon successful completion of this course, it is expected that students will be able to:
  1. To understand the essential theoretical background of the principles of chemistry applied to the solutions of environmental problems.
  2. To apply the principles of chemistry in solving water and wastewater treatment problems.
  3. To analyse the chemistry related issues in water and wastewater treatment.
  4. To evaluate the characteristics of raw water, treated water, products of biodegradation of wastewaters and the performance of different units of water and wastewater treatment.

### Topics Covered
**Unit I**
Basic Principles, Chemical Kinetics, Reaction Rates, Oxidation-Reduction reactions, Redox Stoichiometry, Applications of redox Chemistry

**Unit II**
Chemical Equilibria, Basic concepts from Equilibrium Chemistry, Solubility Product, Common Ion Effect, Solubility Equilibria, Precipitation-Dissolution, Acid-Base Equilibria, Strong and Weak Acids, Carbonate System, pH, Buffers and Buffer Intensity

**Unit III**
Complex Formation, Log Concentration Diagrams, Metal Hydroxide Precipitation, Metal Speciation, Water stabilization, Langlier Saturation Index, Cadwell-Lawrence Diagram

**Unit IV**
Organic Chemistry, Aquatic chemistry, Atmospheric chemistry, Toxic Compounds, Organic Solvents, Pesticides, Dioxins, PCBs and PAHs, Surfactants, Laboratory practice for determination of ions and solids

### Text Books / Reference Materials

### Additional Learning Source
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**Course Assessment Method**

1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 2 Hour

**Course Objective**

Students will be able to apply the knowledge of wastewater treatment unit operations and processes, hydraulics and waste management & planning to prepare one full size treatment plant with all units and detailed engineering.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Understanding of different unit operations involved in water and wastewater treatment.
2. To Know about the design criteria and suitability of unit operations involved.
3. To analyse the suitability of treatment schemes for a variety of input parameters
4. To apply the knowledge of design principles in the design of water and wastewater treatment Plants

**Topics Covered**

**Unit I**

Water Treatment flowsheets, Treatment Plant Hydraulics, Head Loss Types and Calculations, Manifold Hydraulics, Intake Facilities, Design of Aeration Systems, Design of Chemical Mixing, Chemical Precipitation

**Unit II**


**Unit III**

Wastewater treatment flowsheets, Screens- Design and Hydraulics, Grit Chamber, Proportional Weir, Sedimentation Tanks- Inlet and Outlet Design

**Unit IV**

Biological Waste Treatment- Activated Sludge Process, Extended Aeration, Biofilter, UASB Reactor, Fluidised/Expanded Bed System, Ponds and Lagoon Design, Sludge Digestion and Drying Beds

**Text Books and/or Reference Materials**


**Additional Learning Source**

Online Design Courses/NPTEL/MOOCS
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<th>Department</th>
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<td>Industrial Wastewater Management</td>
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**Course Assessment Method**

1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 2 Hour

**Course Objective**

To provide knowledge on sources, characteristics and treatment options for specific pollutants in wastewater arising out of industrial processes.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. understand about sampling, quantification and analysis of industrial wastewater
2. identify and apply basic concepts of wastewater treatment for handling industrial wastewater
3. understand processes in industries and pollutional effects of industrial waste on environment
4. demonstrate the process of developing an overall treatment strategy for an industrial waste stream through case studies

**Topics Covered**

- **Unit I**

- **Unit II**

- **Unit III**

- **Unit IV**
  Identification of treatment flowsheets and wastewater treatment for selected industries- Distillery, Brewery, Paper and Pulp Industry, Dairy, Slaughterhouse, Edible oil and Petroleum Refinery

**Text Books / Reference Materials**


**Additional Learning Source**

1. Comprehensive Industry Document Series, Central Pollution Control Board, New Delhi, India.
2. Web based sources
### Course Assessment Method

1. Assignments and Quizzes (15%)  
2. Mid-Semester Examination (25%) - 1 Hour  
3. End Semester Examination (60%) - 2 Hour

### Course Objective

Provide an overview of the ecology and interaction of biotic and biotic components in ecosystem. To understand how microbes, interact with members of their own species and with organisms of another species.

### Course Outcomes

Upon successful completion of this course, it is expected that students will be able to:

1. Know the behaviour of different ecosystems and their interface with different natural cycles.  
2. Recognize, name and predict important properties of key classes’ organic compounds.  
3. Understand the diversity of microbial biochemical reactions and pathways.  
4. To evaluate and estimate the impact of microorganisms on natural and engineering processes.

### Topics Covered

**Unit I**
Principles of ecology, Ecosystems, Biotic and Abiotic Components, Trophic Levels, Material and Energy Flow in Ecosystems, Nutrient Cycles, Food chain and Biomagnification, Ecology of Population

**Unit II**
Historical roots of microbiology. Microbiological Concepts - cells, classification and characteristics of living organisms, Waterborne Pathogens, Bacteria, Fungi, Yeast, Algae, Protozoa Characterisation Techniques, Microbial Metabolism, Basic metabolic models, Chemistry of carbohydrates, proteins, fats and lipids, Nucleic acids and amino acids DNA structure, replication, and manipulation. Protein and its structure,

**Unit III**
Population Dynamics, Microbial Growth Kinetics, Role of Microorganisms in biogeochemical cycles Chemical Composition of Biomass, Enzymes and Co enzymes, Enzyme Kinetics. Microbial energetics, Oxidation-reduction NAD, energy-rich compounds and energy storage. Glycolysis Respiration, Citric-acid cycle, Catabolic Alternatives, Phototrophy, Chemolithotrophy, anaerobic respiration (Nitrate and Sulfate reduction; Acetogenesis; Methanogenesis; Metal, Chlorate, and organic electron acceptors).

**Unit IV**
Application of microbiology for pollution control and environmental engineering. Bioremediation and wastewater microbiology, Bioremediation examples. Microbiology of Anaerobic Digesters, aerobic process and Solid waste microbiology, drinking water microbiology, Drinking water microbiome and treatment Microbiological Analysis, Laboratory Practice

### Text Books / Reference Materials


### Additional Learning Source

NPTEL/MOOCS Course IIT Roorkee
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**Course Assessment Method**

1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 2 Hour

**Course Objective**

The object of this course is to provide a working knowledge of current environmental impact assessment regulations, methods and practice.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. understand the different tools used for the evaluation of EIA of different projects
2. apply the methods involved in the assessment and analysis of tools required for impact assessment.
3. evaluate the suitability of different tools and models of EIA.
4. Prepare EIA reports and environmental management plans.

**Topics Covered**

**Unit I**
Environmental Impact Assessment - Definitions and Concepts, Rationale and Historical Development of EIA, Organisation, Scope and Methodologies of EIA, Basic Steps in EIA Process, Public Participation in Environmental Decision Making and Management Dimensions

**Unit II**
Project Screening and Scoping for EIA, Use of Risk Analysis in EIA, Environmental Risk Management, Health Risk Assessment, Risk Characterization, Socioeconomic Impact Assessment, Environmental Setting, Disposal of pollutants in environment and their effects, Socioeconomic environment, Methods of impact analysis, EIA techniques for industrial facility construction and operation, Legal aspects - Legislation in the Indian context, Acts related to air and water, Case Studies

**Unit III**
Prediction and Assessment of Impacts on the Air Environment, Prediction and Assessment of Impacts on the Surface Water Environment, Prediction and Assessment of Impact on the Groundwater Environment and Land Environment, Air and water quality criteria, standards, framework for environmental assessment, Prediction and assessment of impact on air water and biological environment

**Unit IV**

**Text Books / Reference Materials**


**Additional Learning Source**

1. www.epa.ie/monitoringassessment/assessment/eia/
<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
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<tr>
<td>Civil Engineering</td>
<td>CES-6100</td>
<td>Applied Numerical Methods</td>
<td>ES</td>
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</table>

**Course Assessment Method**

1. Assignments and Oral Quizzes (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 2 Hour

**Course Objective**

Students will be able to apply the numerical methods in the analysis / designing of structures using tools like MATLAB and Microsoft Excel.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Be aware of the mathematical background for the different numerical methods introduced in the course.
2. Understand the different numerical methods to solve for the roots of the algebraic equations and to solve system of linear and non-linear equations.
3. Understand the different numerical methods for interpolation, differentiation, integration and solving set of ordinary and partial differential equations.
4. Use the built in functions in MATLAB and EXCEL.

**Topics Covered**

**Unit 1**
Types of errors, General formula for errors, order of approximation. Nonlinear equations: Classification of Methods, Approximate values of roots, Bisection Method, Regula Falsi Method, Newton Raphson Method, Fixed Point iteration, Mullers Method. Use built in functions in MATLAB software to solve problems

**Unit 2**

**Unit 3**

**Unit 4**

**Text Books / Reference Materials**

1. Numerical Analysis: Goel& Mittal
2. Applied Numerical Analysis: Gerald & Wheatley
3. Numerical Methods for Engineers: Chapra & Canale
4. Introductory Methods of Numerical Analysis: Sastry

**Additional Learning Source**

1. Numerical Methods: Jain and Jain
<table>
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<th>Department</th>
<th>Course No.</th>
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<th>Course Designation</th>
<th>Pre-Requisites</th>
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<tr>
<td>Civil Engineering</td>
<td>CEC-6010</td>
<td>Theory of Elasticity and Plasticity</td>
<td>PC</td>
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</table>

**Course Assessment Method**
1. Assignments and Oral Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 2 Hour

**Course Objective**
1. To make the students understand the concepts of elasticity and equip them with the knowledge to independently handle the problems of elasticity.
2. To enhance the competency level and develop the self confidence through quality assignments in theory of Elasticity.
3. To inculcate the habit of researching and practicing in the field of elasticity.
4. To understand the concepts of plasticity, yield criteria, plastic flow etc.,

**Course Outcomes**
Upon successful completion of this course, it is expected that students will be able to:
1. Derive equations of equilibrium in 3D state of stress and expression for principal stresses and their planes in 3D state of stress
2. Solve elasticity problems using Airy’s stress function.
3. Derive twisting moment and warping displacement of a non-prismatic bars subjected to torsion.
4. Define yield criterions based on various failure theories. Understanding the plastic deformations of metals and its mechanism

**Topics Covered**

**Unit 1** Theory of stresses, infinitesimal and finite strain, strain-displacement relationships, elastic constants

**Unit 2** Stress and displacements functions, plane problems in Cartesian and polar co-ordinates

**Unit 3** Elements of plasticity, failure and yield criteria, flow rule

**Unit 4** Velocity field, plastic stress-strain relationships, incremental plasticity.

**Text Books / Reference Materials**

**Additional Learning Source**
3. Plasticity for Structural Engineers by Chen & Han, Cengage Learning.
<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
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<th>Course Designation</th>
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<tr>
<td>Civil Engineering</td>
<td>CEC-6020</td>
<td>Advanced Structural Analysis</td>
<td>PC</td>
<td>NIL</td>
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</table>

**Course Assessment Method**
1. Assignments and Oral Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 2 Hour

**Course Objective**
The objective of the course is to have an insight into the behavior of structural systems and to build up technical competence to model and analyze indeterminate structures using analysis computer software and manually using matrix method of analyses.

**Course Outcomes**
Upon successful completion of this course, it is expected that students will be able to:
1. Develop an understanding of indeterminate structures.
2. Apply matrix method of analysis and develop stiffness and flexibility matrices for indeterminate structures viz., Continuous beams, pin jointed structures and rigidly jointed plane frames etc.
3. Analyze the indeterminate structures using matrix displacement method and matrix force method Find the redundants of the indeterminate structure and construct shear force and bending moment diagrams. Thereby, developing an understanding of the behavior of the structure.

**Topics Covered**

**Unit 1** Introduction to Matrix methods in skeletal structural analysis: force and displacement methods

**Unit 2** Application of force method to plane and space frames problems

**Unit 3** Application of displacement method to plane and space frames problems

**Unit 4** Analysis of Frames, Organization of computation, programming considerations. Non-linear analysis due to plasticity in frames.

**Text Books / Reference Materials**

**Additional Learning Source**
1. Web links to e-learning: nptel
2. Web based learning, Journal papers, etc.
<table>
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<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
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<tr>
<td>Civil Engineering</td>
<td>CEC-6030</td>
<td>Structural Dynamics</td>
<td>PC</td>
<td>NIL</td>
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</table>

**Course Assessment Method**

1. Assignments and Oral Quizzes (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 2 Hour

**Course Objective**

The aim of this course is to provide the fundamental understanding of the structural dynamics and the problem solving ability for dynamic response in Civil Engineering design, analysis and research. Understanding the analytical methods and procedures in a way that emphasize physical insight. Ability to apply the structural dynamics theory to real-world problems.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. An ability to apply knowledge of mathematics, science, and engineering by developing the equations of motion for vibratory systems and solving for the free and forced response.
2. Ability to identify, formulate and solve engineering problems. This will be accomplished by modifying, remodeling and analyzing the vibratory structures in order to achieve specified requirements.
3. Understanding professional and ethical responsibilities. This will be accomplished by emphasizing the importance of understanding how structural vibrations may affect safety and reliability of engineering systems.
4. An ability to use the techniques, skill and modern engineering tools necessary for engineering practice will be accomplished by giving students realistic problems which will require professional softwares for solutions.

**Topics Covered**

**Unit 1** Types of Vibration and Ground motions, Undammed and Damped Single Degree of Freedom System, Response of SDOF System to Harmonic Loading.

**Unit 2** Response to General Dynamic and Impulsive Loading, Duhamel's Integration, Fourier Analysis and Response in the Frequency Domain.


**Unit 4** Principle of Virtual Work, Rayleigh's and Modified Rayleigh's Method, Dynamic Analysis of Systems with Distributed Properties.

**Text Books / Reference Materials**

3. Elements of Earthquake Engineering and Structural Dynamics by Andre Filiatrault, Presses Inter Polytechnic.

**Additional Learning Source**

1. Web links to e-learning: nptel
2. Web based learning, Journal Papers, etc.
Department                Course No.          Course Title                  Course Designation  Pre-Requisites  Course Type  Credit Hours  Contact Hours  Total Contact Hours
Civil Engineering         CEC-6040          Finite Element Analysis       PC  NIL          Theory        4            3   1   0   4

**Course Assessment Method**
1. Assignments and Oral Quizzes (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%) - 2 Hour

**Course Objective**
1. To provide the fundamental concepts in the theory of finite element analysis.
2. To analyze problems related to bar, truss, beam and plane elements using finite element approach.
3. To develop basic understanding in modeling considerations related to finite element programming

**Course Outcomes**
Upon successful completion of this course, it is expected that students will be able to:
1. Understand the basic concepts, significance and application of finite element analysis.
3. Recognize the difference between conventional and FE method of analysis.

**Topics Covered**

**Unit 1 Introduction**
Finite element method and other classical methods, historical background, advantages &
disadvantages, finite element modeling – discretisation, nodes, elements types and shapes.
Basic equations in elasticity –stress and strain vectors, Hooke’s law, strain-displacement relationship,
equilibrium equations, generalized compatibility equations.

**Unit 2 Finite element analysis of one dimensional problem**
Generation of stiffness matrix by displacement and energy method, energy and variational approaches
(Rayleigh-Ritz method), numerical solutions.

**Unit 3 Isoparametric elements and shape functions**
Co-ordinate systems, Element shapes, Strain displacement matrix, Higher order elements: 1D, 2D and
3D.

**Unit 4. Finite element analysis of two dimensional problems**
Symmetry, Plane stress and plane strain problems, Bending of thin plates, Introduction to nonlinear FE
analysis.

**Text Books / Reference Materials**

**Additional Learning Source**
<table>
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<th>Department</th>
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<tr>
<td>Civil Engineering</td>
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</table>

**Course Assessment Method**
1. Assignments and Oral Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 2 Hour

**Course Objective**
To develop understanding of methods of designing typical structures not covered under basic course of concrete design at undergraduate level and also to introduce advanced method of analysis which give insight about the behavior of concrete members.

**Course Outcomes**
Upon successful completion of this course, it is expected that students will be able to:
1. To develop understanding of the structural behavior, safety and serviceability of RC structures under bending, shear and torsion.
2. To visualize failure characteristics and the required strength of RC slab with different edge support conditions.
3. To analyze pre-stressed concrete members like beams and simple frames.
4. To design and prepare steel detail of pre-stressed concrete members for required strength.

**Topics Covered**

**Unit 1**
Limit state design: Basic concepts and philosophies, design of RC members in flexure, shear and torsion, members subjected to combined stresses, slender column, safety and serviceability, control of cracks and deflections, design of RC framed structures with ductile detailing.

**Unit 2**
Yield line analysis of slabs, yield line mechanism, equilibrium and virtual work methods, Hillerberg’s strip method.

**Unit 3**
Pre-stressed Concrete, Design of pre-stressed members for bending, shear, torsion and bond, End blocks.

**Unit 4**
Prestressed continuous beams and frames, slab and grid floor, tension and compression members, circular pre-stressing, pipes, tanks and special structures.

**Text Books / Reference Materials**
1. Karve and Shah “Limit State Theory and Design of reinforced Concrete” VGP, Pune, India.
2. Pillai and Menon “Reinforced Concrete Design” TMH, New Delhi, India.
3. Verghese, P. C. “Advanced Reinforced Concrete Design” PHI, Delhi, India.
5. Evans and Cook “Reinforced and Pre-stressed Concrete” TN, London, U.K.

**Additional Learning Source**
2. Raju, N.K. “Pre-Stressed Concrete” TMH, Delhi, India.
<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Pre-Requisites</th>
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<td>Civil Engineering</td>
<td>CEE -6220</td>
<td>Tall Buildings</td>
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**Course Assessment Method**

1. Assignments and Oral Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 2 Hour

**Course Objective**

1. To develop an understanding of structural systems used for tall structures
2. Learn to have an understanding of wind loads on Tall Structures
3. Gain knowledge of earthquake effects on Tall Structures
4. Concept of providing Structural Wall in high rise structures

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Utilize effective structural system for high rise building.
2. Calculate dead load, imposed load and wind load on Tall Structures as per Indian Standards.
3. Determine earthquake load on Tall Structures as per Indian Standards.
4. Analyze and design structural wall for high rise structures.

**Topics Covered**

**Unit 1 Structural Systems**

Types of structural systems; types of loads; methods of analysis; stability of tall structures; selection of foundation for tall buildings

**Unit 2 Wind Effects on Tall Structures**

Bluff body aerodynamics; aero-elastic phenomena; wind directionality effects; structural response and design considerations; standard provisions for wind loading.

**Unit 3 Earthquake Effects on Tall Structures**

Introduction to earthquake engineering and earthquake resistant design of buildings; earthquake motion and response; general principles and design criteria for buildings; codal provisions; aseismic design of structures; dynamic analysis; effect of torsion; design of stack like structures; earthquake forces in tall buildings.

**Unit 4 Shear Walls**

Shear in buildings; need of shear walls; location of shear walls in buildings; analysis and design of shear walls.

**Text Books / Reference Materials**

2. Elements of Earthquake Engineering, Jai Krishna and A. R. Chandrasekaran, SaritaPrakashan, Meerut.
5. Analysis of Shear-walled Buildings, S. M. A. Kazimi and R. Chandra, Tor Steel Research Foundation in India, Calcutta.
7. IS: 1893 (Part 1) - 2002 – Criteria for Earthquake Resistant Design of Structures, BIS.
8. IS: 13920- 1993 – Code of Practice for Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces, BIS.

**Additional Learning Source**

### Civil Engineering

<table>
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<th>Course No.</th>
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<tr>
<td>CEE-6230</td>
<td>Plates and Shells</td>
<td>PE</td>
<td>NIL</td>
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#### Course Assessment Method

1. Assignments and Oral Quizzes (15%) 
2. Mid-Semester Examination (25%) - 1 Hour 
3. End Semester Examination (60%) - 2 Hour

#### Course Objective

1. To introduce the classical structural mechanics approximations of Membrane, Plate and Shell theories.
2. To understand the limitations and differences of plate/shell theories.
3. To apply plate and shell theory to problems involving various geometries and boundary conditions.
4. To design typical Plate and Shell structures.

#### Course Outcomes

Upon successful completion of this course, it is expected that students will be able to:

1. Develop understanding of the complex behavior of plate and shell structures.
2. Apply theories to find closed form solutions to plate elements.
3. Perform analysis using membrane and bending theories for shell structures.
4. Make use of tables and charts in the analysis and design of shell structures.

#### Topics Covered

**Unit 1: Background and basic concepts**
- Basic concepts, governing equations and boundary conditions of plates.

**Unit 2: Solution of Plates**
- Solution of rectangular and circular plates by classical methods: Navier’s and Levy’s methods.

**Unit 3: Membrane theory of cylindrical shells**
- Introduction, types of shell surface, classification, basic concepts, equations of equilibrium, application of Fourier series for membrane stresses, numerical solutions, limitations of membrane theory.

**Unit 4: Bending theory of cylindrical shells**
- Flugge’s differential equation, Donnell’s theory, D-K-J characteristic equation, Schorer’s theory, shell analysis using tables, design consideration.

#### Text Books / Reference Materials


#### Additional Learning Source

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<th>Department</th>
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<tbody>
<tr>
<td>Civil Engineering</td>
<td>CEE-6250</td>
<td>Advanced Steel Design</td>
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</table>

**Course Assessment Method**

1. Assignments and Oral Quizzes (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 2 Hour

**Course Objective**

To inculcate theoretical aspects with examples of design of actual steel structures such as steel chimney, microwave tower, etc., including various structural components using design provisions from B.I.S. Codes. A broader understanding of the behavior of steel structures as systems, in opposition to individual elements only, is to be achieved through this course. Also to develop in-depth understanding of advanced structural principles of stability, strength and serviceability in structural design.

**Course Outcomes**

After successful completion of the course students are expected to analyze and design the all the individual component of the whole steel structures. Each topic is supported by tutorial problems and the outcome is assessed.

1. An understanding of the relationship between structural analysis and design provisions.
2. An understanding of the background to the design provisions for hot-rolled and cold-formed steel structures, including the main differences between them.
3. Proficiency in applying the provisions of various codes for the design of steel chimney, water tank, microwave and transmission lines tower, steel bridges etc.
4. An understanding of the use of the efficient modern tubular sections and plastic design and various types of failures.

**Topics Covered**

**Unit 1**
Steel Bridges; Loads, Classification and Design Procedures; Plate Girder Bridges and Truss Girder Bridges

**Unit 2**
Analysis and Design of Steel Chimneys and Elevated Steel Water Tanks.

**Unit 3**
Analysis and Design of Transmission Line and Microwave Towers.

**Unit 4**
Structural Behavior of Tubular sections; Analysis and Design of Tubular Sections; Brittle Fracture and Fatigue in Steel Structures; Plastic Design of Framed Steel Structure.

**Text Books / Reference Materials**

1. Design of Steel Structures Vol - II, Dr. Ram Chandra and V. Gehlot, Scientific Publishers, India.
2. Unified Design of Steel Structures, Luis F. Greschwindner, John Wiley and Sons.
3. Ductile design of Steel Structures, Michel Bruneau, Chia-Ming Uang, Rafael E. Sabelli, McGraw Hill Professional.
5. Design of Steel Structures, M. Raghupati, TMH Pub., New Delhi.
12. IS: 805 - 1968, Code of Practice for Use of Steel in Gravity Water Tanks

**Additional Learning Source**

1. Web links to e-learning: nptel
2. Web based learning, Journal Papers, etc.
<table>
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<tr>
<th>Department</th>
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<tr>
<td>Civil Engineering</td>
<td>CEE-6280</td>
<td>Earthquake Resistant Design of Structures</td>
<td>PE</td>
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**Course Assessment Method**

1. Assignments and Oral Quizzes (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 2 Hour

**Course Objective**

1. To provide a comprehensive exposure to earthquake engineering.
2. To introduce fundamentals of structural dynamics relevant to earthquake resistant design.
3. To analyze and design of R.C. and masonry buildings subjected to earthquake forces.
4. To give exposure to seismic retrofitting and strengthening strategies of masonry and R.C. buildings as per relevant Indian Standards.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Get a diverse knowledge of earthquake engineering practices applied to real life problems.
2. Evaluate earthquake forces for R.C. and masonry structures as per relevant Indian standards.
3. Design and ductile detailing of R.C. and masonry structures for earthquake resistance as per Indian standards.
4. Apply methods of retrofitting and strengthening of earthquake affected structures.

**Topics Covered**

**Unit 1** Characteristics of earthquakes: earthquake terminology, magnitude, intensity, measurement of ground motion, frequency-magnitude relationship, liquefaction. Strong ground motion: Acceleration-time histories, peak parameters (peak ground acceleration/velocity/displacement), response spectrum, site effects.

**Unit 2** Earthquake analysis of structures: Idealization of structures, response spectrum analysis, equivalent force concepts, torsionally coupled systems. Concept of earthquake resistant design: Objectives, ductility, ductility reduction factor, over-strength, response reduction factor, design response spectrum, lateral stiffness, building configuration, base isolation, concept of structural control, analysis and design of reinforced concrete structures.

**Unit 3** Analysis, design and detailing for reinforced concrete and masonry buildings, tests on masonry units and assemblage.

**Unit 4** Retrofitting and strengthening of structures building codes: Performance of buildings in past earthquakes, historical perspective of code development, provisions of Indian Standard codes i.e. IS: 1893, IS: 13920, IS: 13935, IS: 4326, IS: 13827, IS: 13828.

**Text Books / Reference Materials**

7. Guidelines for Earthquake Resistant Non-Engineered Construction, The International Association for Earthquake engineering, Tokyo, Japan.

**Additional Learning Source**

1. http://www.nptel.iitm.ac.in
2. http://www.cdeep.iitk.ac.in/nptel
### Course Information

**Civil Engineering**

<table>
<thead>
<tr>
<th>Course No.</th>
<th>Course Title</th>
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<tr>
<td>CEE-6290</td>
<td>Disaster Mitigation and Management</td>
<td>PE NIL Theory</td>
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**Course Assessment Method**

- Assignments and Oral Quizzes (15%)
- Mid-Semester Examination (25%)- 1 Hour
- End Semester Examination (60%)- 2 Hour

**Course Objective**

1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Differentiate the types of disasters, causes and their impact on environment and society.
2. Assess vulnerability and various methods of risk reduction measures as well as mitigation.
3. Draw the hazard/vulnerability profile of India, disaster damage assessment and management in the Indian context.
4. Acquainting with disaster response command system in respective states and application of best practices from case scenario studies in India.

**Topics Covered**

**Unit 1** INTRODUCTION TO DISASTERS- Disaster: definition, factors and significance; difference between hazard and disaster; natural and manmade disasters: difference, nature, types and magnitude; economic damage, loss of human and animal life, destruction of ecosystem. Natural disasters: earthquakes, volcanisms, cyclones, tsunamis, floods, droughts and famines, landslides and avalanches, man-made disaster: nuclear reactor meltdown, industrial accidents, oil slicks and spills, outbreaks of disease and epidemics, war and conflicts; post-disaster diseases and epidemics.

**Unit 2** APPROACHES TO DISASTER RISK REDUCTION (DRR)- Disaster cycle - Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural measures, Roles and responsibilities of- community, Panchayati Raj Institutions/Urban Local Bodies (PRIs/ULBs), States, Centre, and other stake-holders- Institutional Processes and Framework at State and Central Level State Disaster Management Authority(SDMA) – Early Warning System – Advisories from Appropriate Agencies

**Unit 3** DISASTER PREPAREDNESS AND RISK ASSESSMENT- Preparedness: Monitoring of phenomena triggering a disaster or hazard; evaluation of risk: application of remote sensing, data from meteorological and other agencies, media reports: governmental and community preparedness. Disaster risk: concept and elements, disaster risk reduction, global and national disaster risk situation. Techniques of risk assessment, global co-operation in risk assessment and warning, people’s participation in risk assessment. Strategies for survival.

**Unit 4** DISASTER MANAGEMENT AND MITIGATION- Meaning, concept and strategies of disaster mitigation, emerging trends in mitigation. Structural mitigation and non-structural mitigation, programs of disaster mitigation in India. Case studies & field work.

**Text Books / Reference Materials**


**Additional Learning Source**

Government of India e-resources: Disaster Management Act; National Disaster Management Policy, New Delhi.
Civil Engineering

CEC-6911 Advanced Construction Material Testing Lab

Course Designation: PC
Pre-Requisites: NIL
Course Type: Lab
Credit Hours: 2
Contact Hours: 0 1 2 2
Total Contact Hours: 2

Course Assessment Method
1. Internal Assessment (60%)
2. End Semester Examination (40%)

Course Objective
1. To let students, understand experimentally the behavior of conventional civil engineering materials and structural component by testing on them.
2. To let students, learn standard principles and procedures of testing materials & concrete mix design including field tests.
3. To learn practical applications of the tests and writing technical reports.

Course Outcomes
Upon successful completion of this course, it is expected that students will be able to:
1. Learn test procedure, specimen preparation required for experiments. Understand the various non-destructive techniques and the objectives achieved by testing in the field and existing structures.
2. Visualize the deformation & crack pattern, techniques to achieve the extent of crack.
3. To learn working & collaborate in groups and feel responsibilities in among group members.
4. Analyze and interpret test results and prepare technical test reports.

Topics Covered

▶ Destructive Tests on Concrete
1. Poisson’s ratio
2. Mix Design and Cube Strength
▶ Non-destructive Tests on Concrete
3. Rebound Hammer
4. Portable Ultrasound Non-Destructive Digital Indicating Tester (PUNDIT)
5. Bar Size & bar position and depth of cover by Digi-cover
▶ Depth of Cracks Measurement
6. Vertical Crack
7. Inclined Crack
▶ Tests on Timber
8. Strength of various section of timber in pure bending and shear
▶ Tests on Steel bar
9. Tensile test on TMT bars and bent test
▶ Test on Steel Plate
10. Distribution of stress and strain around a hole in a plate

Text Books / Reference Materials
1. Lab manual provided by the department
2. Neville, A.M., “Properties of Concrete”, Longman, India
4. Shetty, M.S., “Concrete Technology”, SCC Ltd., New Delhi

Additional Learning Source
1. Web links to e-learning: nptel
<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
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<tr>
<td>Civil Engineering</td>
<td>CEC-6912</td>
<td>Computational Lab</td>
<td>PC</td>
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**Course Assessment Method**
1. Internal Assessment (60%)
2. End Semester Examination (40%)

**Course Objective**
1. To let students, understand the behavior of civil engineering problems by numerical analysis using software packages.
2. To let students, learn standard principles and procedures of numerical modeling, verification and validation.
3. To learn practical applications of the simulations and report writing.

**Course Outcomes**
Upon successful completion of this course, it is expected that students will be able to:
1. Understand basics of computer based simulations and numerical analysis.
2. Learn individual working & collaborate in groups.
3. Analyze and interpret numerical results, and prepare reports.

**Topics Covered**
1. To analyze and design reinforced concrete structural elements and/or, problems related to building energy modeling.
2. Learn how to use spread sheets for analysis and/or result interpretation.
3. Verification/validation of results with available data.

**Text Books / Reference Materials**
1. Web link: bentley.institute@bentley.com ; https://www.ansys.com
2. Manual/Help provided with software packages
3. Examples on YouTube and/or on websites of available software packages

**Additional Learning Source**
1. Web links to e-learning: nptel and insdag
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<th>Pre-Requisites</th>
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<td>Project</td>
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**Course Assessment Method**

1. Internal Assessment (60%)
2. End Semester Examination (40%)

**Course Objective**

Provide Civil Engineering students with the basic knowledge to carry out field investigations and evaluation of the existing structures. Finding demerits and shortcomings in the existing structures. Analytically solving the day to day multistory buildings and steel structures usually encountered in the design of structures.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. The student will be able to handle a specific problem in non-destructive testing individually.
2. The student can detect shortcomings and problems in the existing structures and its solution.
3. The student will be familiar to model the prototype structures and can visualize the behavior through model testing.
4. The students can analyze and design the complicated structures individually using professional software like STAAD Pro, E-TAB and SAP etc. under static and dynamic loadings.

**Topics Covered**

1. To calculate the depth of the vertical crack in a beam with the help of Portable Ultra Sonic Non-destructive Testing Indicator (PUNDIT).
2. To calculate the length of the inclined crack in a beam with the help of Portable Ultra Sonic Non-destructive Testing Indicator (PUNDIT).
3. To calculate the strength of the cube by testing under destruction and non-destructive testing by PUNDIT.
4. To calculate the Poisson's ratio and modulus of elasticity of the concrete.
5. To study the behavior of timber section under pure bending.
6. To calculate stiffness, damping and logarithmic decrement of the spring system both in series and parallel.
7. To work on mini project.

**Text Books / Reference Materials**

1. Lab manual.
2. Web based learning

**Additional Learning Source**
<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Pre-Requisites</th>
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<td>Construction Planning and Management</td>
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**Course Assessment Method**

1. Assignments and Oral Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 2 Hour

**Course Objective**

1. Enable students to develop their project as well as general management skills.
2. Focus upon project planning and control methods within the construction project management process.
3. Extend knowledge of innovative tools, techniques and methodologies in the resolution of complex problems.
4. Provide the opportunity for students to complete a range of modules that are relevant to their working environment and general interest in the context of international project management.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Select appropriate decision-making and information management tools for project planning and project control.
2. Principles of leadership in business and management including advanced construction management practices, complex project decision making, and associated risk management.
3. Demonstrate high-level advanced knowledge and skills in civil engineering and construction management practice related to design, construction, operation and maintenance of buildings and civil infrastructure.
4. Investigate, analyze and synthesize complex information, perceptions, problems, concepts and theories of civil engineering practice to provide rational solutions to composite problems using critical thinking and team-based/independent judgment in the project-based construction industry.

**Topics Covered**

- Unit 1 Management Concept and Organization of Construction Company
- Unit 2 Materials and Construction Equipment Management
- Unit 3 Contract Management and Construction Accounting
- Unit 4 Capital Management

**Text Books / Reference Materials**


**Additional Learning Source**

1. Publication of NIDM, New Delhi [nidm.gov.in/books.asp]
2. Publication of Construction Industry Institute , CII, [www.construction-institue.org]
3. Publication of RIBA, England [https://www.architecture.com/]
Programme Cores

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<td>Civil Engineering</td>
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<td>Advanced Foundation Engineering</td>
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Course Assessment Method
1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 2 Hour

Course Objective
1. To familiarise the students with different load and field conditions.
2. To decide the type of foundation for a specific project.
3. To evaluate the pile group capacity and settlement.
4. To deal with problematic soils.

Course Outcomes
Upon successful completion of this course, it is expected that students will be able to:
1. Understanding the bearing capacity of the soil under different field conditions.
2. Evaluate the importance of raft foundation and principles of design for buildings.
3. Analyse and design of pile foundations.
4. Overcome the problems faced by foundations in expansive soils.

Topics Covered
Unit 1 Design Principles of Foundations
Factors considered in foundation design; Total and differential settlements; Load calculation on footings; Proportioning and design of different types of footings; Methods of estimating bearing capacity.

Unit 2 Design of Shallow Foundations:
Eccentrically loaded foundations; Meyerhof’s useful width concept; Foundations on layered soils, landfill sites, near or on slopes, permafrost. Influence of adjacent footing. Design of raft foundation.

Unit 3 Deep Foundations:
Necessity of pile group. Load carrying capacity of pile groups in cohesive and cohesionless soils—shear and settlement criteria. Pile Loading test. Introduction to well foundation.

Unit 4 Foundations in Expansive Soil:
Properties of expansive soil. Providing foundations in expansive soil. Design and construction of under reamed pile foundation as per IS: 2911 (Part 3).

Text Books / Reference Materials
5. IS 2911 (Part 1-5), Bureau of Indian Standards for Pile Foundations.

Additional Learning Source
1. Web links to e-learning: nptel
2. L.C. Reese, Single piles and pile groups under lateral loading, Taylor & Francis, 2000
Department | Course No. | Course Title | Course Designation | Pre-Requisites | Course Type | Credit Hours | Contact Hours | Total Contact Hours
--- | --- | --- | --- | --- | --- | --- | --- | ---
Civil Engineering | CEC-6160 | Earth and Earth Retaining Structures | PC | NIL | Theory | 4 | 3 | 1 | 0 | 4

**Course Assessment Method**
1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 2 Hour

**Course Objective**
1. To understand lateral earth pressure theories for analysis and design of earth retaining structures.
2. To understand the stability analysis and design of retaining wall.
3. To design sheet pile wall anchored bulkheads by different methods.
4. To understand pressure envelops and design of various components in braced cuts, cofferdams and earth dams.

**Course Outcomes**
Upon successful completion of this course, it is expected that students will be able to:
1. Determine the earth pressures on retaining structures.
2. Compute stability of slopes and earthen embankment in the presence of ground water seepage and earthquake forces.
3. Understand the design concepts of flexible and rigid earth retaining structures.
4. Design retaining walls, anchored bulkheads, braced cuts, cofferdams and earth embankments.

**Topics Covered**

**Unit 1 Earth Pressure**
Basic concepts, Rankine and Coulomb earth pressure theories, Graphical methods, Fundamental relationships between the lateral pressures and the strain with a back fill, Consideration of surcharge, earthquake, stratification, saturated and partially saturated backfills. Effect of wall friction and adhesion.

**Unit 2 Retaining wall**
Uses, types, materials and methods of construction of retaining wall, Forces acting on retaining wall, Stability analysis and design aspects, Application of theory of elasticity in analysis of earth pressure distribution, settlement and tilting.

**Unit 3 Sheet Pile wall**
Types, materials used in construction, Free earth and fixed earth system, Selection of soil parameters, Analysis and design of cantilever and anchored sheet pile walls, Dead man and continuous anchors, Diaphragm and bored pile walls.

**Unit 4 Braced excavations and earth dam**
Lateral pressure distribution in sands and clays, Braced cuts and cellular cofferdams, Earth pressure against bracings in cuts, Heave of the bottom of cut in soft clays, Soil arching and open cuts, Recent advances in earth retaining structures, Embankment construction materials and construction, Slope protection, Grouting techniques.

**Text Books / Reference Materials**

**Additional Learning Source**
1. Web links to e-learning: nptel, Swayam portal
<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-requisites</th>
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<tr>
<td>Civil Engineering</td>
<td>CEC-6170</td>
<td>Dynamics of Soils and Foundations</td>
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**Course Assessment Method**

1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 2 Hour

**Course Objective**

1. To familiarize with the vibration theory and the various terminologies to study the behavior of soil due to the effects of dynamic loads.
2. To understand the soil behavior under dynamic and cyclic loading, the nature of wave propagation through soil and liquefaction.
3. To study the dynamic soil properties and determination by field and laboratory tests and familiarize with general principles of analysis and design of machine foundation.
4. To understand the soil structure interaction under dynamic load conditions and guidelines of design codes.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:
1. Understand the vibration theory.
2. Understand the soil properties and suitable remedial measures to improve their behavior.
3. Design of foundation and retaining structures under dynamic loads.
4. Analyze different geotechnical structures using Mass-Spring Dashpot models.
5. Understand about the importance of designing machine foundation for reciprocating and impact machines.

**Topics Covered**

**Unit 1 Theory of Vibration**

Introduction, Nature of dynamic loads, Vibration of elementary systems, Degrees of freedom (SDOF and MDOF systems), Equation of motion for SDOF system, Types of vibrations, Earthquake excitation, Free and forced vibration under damped and undamped cases, Critical damping, Decay of motion, Constant force and rotating mass oscillators, Dynamic magnification factor, Transmissibility ratio, Arbitrary, impact and other types of forced vibrations, Duhamel’s integral, Vibration isolation, Vibration measuring instruments.

**Unit 2 Soil Behaviour under Dynamic and Cyclic Loading**

Elastic response of continua, Wave equation, Response of non-plastic and plastic soils under cyclic loading, Stress-strain models (elastic, visco-elastic, nonlinear elastic, plasticity), Stresses in soil element, Stress-strain behavior of cyclically loaded soils, Liquefaction, Simplified procedure for liquefaction estimation and remediation.

**Unit 3 Dynamic Soil Properties and design of machine foundation**

Determination of dynamic soil properties, Field tests, Laboratory tests, Estimation of shear modulus, Damping ratio, Linear, ranges and applications of dynamic soil tests, Cyclic plate load test, Factor of safety, Cyclic stress ratio, Cyclic resistance ratio, Correlations with SPT, CPT, SASW test values. Design criteria for machine foundation, Foundation for reciprocating machines, Block foundation.

**Unit 4 Dynamic Soil Structure Interaction**

Dynamic earth pressures, Force and displacement based analysis, Pseudo-static and pseudo-dynamic analysis, Guidelines of design codes, Dynamic analyses of various geotechnical structures like retaining wall, Soil slope, Railway subgrade and ballast using MSD model.

**Text Books / Reference Materials**


**Additional Learning Source**

1. Web links to e-learning: [nptel](https://nptel.ac.in/), Swayam portal
<table>
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<tr>
<th>Department</th>
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<td>Civil Engineering</td>
<td>CEC-6180</td>
<td>Ground Improvement and Geosynthetics</td>
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**Course Assessment Method**

1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 2 Hour

**Course Objective**

1. To inculcate the basic knowledge of problems in week soil and its appropriate engineering solution.
2. To learn basic concepts and applications of ground improvement methods.
3. To evaluate the different properties of geosynthetics including through laboratory tests.
4. To analyze the functions of geosynthetic and its suitability for different civil works.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Recognize the problems regarding use of week soil and apply soil mechanics principles to obtain the solution of geotechnical engineering problems.
2. Understand the various in-situ methods and their significance for different ground improvement techniques, applicable to different soil type.
3. Understand the manufacturing processes of different geosynthetics and their functions.
4. Compute different properties of geosynthetics and their use in civil works.

**Topics Covered**

**Unit 1 Stabilization by admixtures**


**Unit 2 In situ soil treatment methods**

Drainage- Ground Water lowering by well points deep wells, vacuum and electro-osmotic methods. Soil nailing, rock anchoring, micro-piles, design methods, construction techniques, case studies of ground improvement projects.

**Unit 3 Manufacture and Functions**

Historical Development; Materials used; Types of Geosynthetics (Geotextiles; Geogrids; Geonets; Geomembranes; Geocomposites) and manufacturing methods. Functions of geosynthetics (Reinforcement; Separation; Filtration; Drainage; Barrier).

**UNIT 4 Properties and Applications**

Physical properties (Mass per unit area; Thickness; Specific gravity); Hydraulic Properties (Apparent opening size; Permittivity; Transmissivity); Mechanical Properties (Uniaxial Tensile Strength; Burst and Puncture Strength); Soil Geosynthetic friction tests; Durability : Abrasion resistance – Ultraviolet resistance. Use of geosynthetics in Civil Engg. works

**Text Books / Reference Materials**

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<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
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**Course Assessment Method**

1. Course Work (60%)
2. End Semester Examination (40%)

**Course Objective**

1. To develop an understanding of the relationship between strength and deformation characteristics of soils and to comprehend experimental measurement of the physical and mechanical properties of soil and rock commonly used in engineering practice.
2. To develop geotechnical report writing and data presentation skills.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Understand the significance of the properties of soils, and also the experimental methods used to measure them.
2. Understand both the applications and limits of engineering methods commonly used to solve soil mechanics problems in Civil Engineering.
3. Develop improved design methodologies in the area of geotechnical engineering.
4. Recognize the importance of good written communication skills, and know how to write professional, concise technical reports and letters to clients and colleagues.
5. Understand the suitability of rock as a structural member and foundation/subgrade material.

**List of Experiments**

1. Relative Density Test
2. Swelling Index Test
3. Direct Shear and Triaxial Shear Strength Tests
4. Consolidation Test
5. Plate Load Test
6. Vane Shear Test
7. Standard Penetration and Dynamic Cone Penetration Tests
8. Point Load Index of rock specimen
9. Tensile and compressive strength tests of rock samples
10. Tests for characterization of pavement materials

**Text Books/ Reference Materials**


**Additional Learning Source**

1. Web links to e-learning: nptel
2. Virtual Laboratory: [http://www.vlab.co.in/](http://www.vlab.co.in/)
## Course Assessment Method

1. Class Work (60%)
2. End Semester Examination (40%)

## Course Objective

1. To prepare students for geotechnical report writing skills using advanced features of MS office.
2. To develop the software skills in students for analysis, design, simulation and modeling of geotechnical engineering problems.

## Course Outcomes

Upon successful completion of this course, it is expected that students will be able to:

1. Prepare the reports related to geotechnical engineering works.
2. Recognise advance features of MS office for preparing geotechnical reports.
3. Develop insight for modelling, analysis and design of geotechnical engineering problems.
4. Apply the knowledge of geotechnical Software (GEO Studio, GEO5, OptumG2, etc) for modeling, analysis and design.

## List of Experiments

1. Preparation of Index, references and charts/graph using MS Office
2. Introduction to programming in MS Excel
3. Introduction to basics of Geo Studio
4. Slope stability analysis using Geo Studio
5. Modeling and simulation of Soil-structure interaction problems using software (GEO5, OptumG2 etc.)
6. Analysis and design of geotechnical engineering problems using software (GEO5, OptumG2 etc.)

## Text Books / Reference Materials


## Additional Learning Source

1. Web links to e-learning: [nptel]
2. Video lectures at https://www.youtube.com/channel/UCTK_crr8Pn94p4R0_10d8Ug
3. Video lectures at https://www.youtube.com/user/GEO5 software
4. Virtual Laboratory: [http://www.vlab.co.in/](http://www.vlab.co.in/)
Department | Course No. | Course Title | Pre-Requisites | Course Type | Credit Hours | Contact Hours | Total Contact Hours |
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Civil Engineering | CEC-6949 | Project | NIL | Lab | 4 | 0 3 0 | 3 |

**Course Assessment Method**
1. Class Work (60%)
2. End-Semester Exam (40%)

**Course Objective**
1. To utilize the expertise in geotechnical engineering to solve industry’s geotechnical issues.
2. To become innovative and professional in technology development using softwares.
3. To prepare professional reports for designing projects and data presentation skills.
4. To understand, interpret and properly apply project results for design of civil infrastructures.

**Course Outcomes**
Upon successful completion of this course, it is expected that students will be able to:
1. Design and conduct experiments to determine index properties of founding ground and to analyze and interpret data so obtained.
2. Design a foundation system and their components to meet desired needs within realistic, economic, environmental constraints.
3. Identify, formulate and solve problems by interacting with other streams of civil engineering to manage geotechnical issues and to write professional and concise technical reports.
4. Use techniques, skills, modern engineering tools necessary for engineering practice within ethical and professional responsibility.

**Topics**
The project work will be carried out in the following major subject areas:
1. Foundation Design
2. Highway Engineering
3. Ground Improvement
4. Rock Material and Rock Mass Characterization
5. Slope Stability
6. Underground Space Excavation and Stability
7. Numerical Modeling

**Text Books/Reference Materials**

**Additional Learning Source**
1. Journals related to Geotechnical Engineering
3. www.wiley.com/college/kalinski
Programme Electives

<table>
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<tr>
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<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
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<td>CEE-6540</td>
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**Course Assessment Method**

1. Assignments and Oral Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 2 Hour

**Course Objective**

Advanced Rock Engineering has been designed to give knowledge of civil engineering issues in construction and safety of slopes, underground excavations, tunnels and foundation of structures especially dams in rocky terrains and to:

1. Impart knowledge of mechanical behaviour of intact rock and rock mass.
2. Make understand problems encountered in rock mass due to the geological features.
3. Develop idea of rock slope failure and their stability analysis.
4. Use available codes and standards in design of underground excavations, rock foundations and tunnel support systems.

**Course Outcomes**

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

1. Understand engineering behaviour and testing procedures for rocks as constructional material and rock masses as founding ground.
2. Adopt pertinent exploration techniques and analyze different geotechnical issues in rock engineering.
3. Identify and predict behavior of founding ground due to loading, unloading and residual stresses and accordingly build necessary database for design and construction.
4. Produce technical reports and database for effective communication amongst stakeholders to comprehend and manage the problems of rock engineering.

**Topics Covered**

**Unit 1 Rock and Rock Mass Properties:** Classification of rocks and rock masses, Deformation Structures, Quantitative Description of Discontinuities in Rock Masses, Engineering Classification of Rock Masses, Terzaghi Rock Load Theory, RQD, RMR, RMQ and GSI.

**Unit 2 Strength Behaviour of Rocks:** Compression, Tension and Shear strength of rocks, Stress-Strain relationships, Static - Elastic constants of rocks, Failure Criterion: Coulomb’s, Mohr’s, Griffith theory of brittle strength and other strength criteria. Residual Stresses.


**Unit 4 Foundations on Rocks:** Requirements for satisfactory performance of foundations on rocks, Effect of structural planes on rock foundations, Possible modes of failure of foundations on rock masses, Field tests and determination of Bearing capacity for rock foundations, Foundation of Dams, Pile Foundation on rock mass.

**Text Books / Reference Materials**


**Additional Learning Source**

1. NPTEL
2. MOOC Courses
3. Websites related to Mega Engineering Projects
Civil Engineering

<table>
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<tr>
<th>Department</th>
<th>Course No.</th>
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Course Assessment Method

1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 2 Hour

Course Objective

1. To describe pavements design objectives, constraints and controlling factors.
2. To make students understand successful design procedure of flexible and rigid pavements, Aircraft runways and F1-race tracks including traffic data, material properties and other environmental factors.
3. To describe the various defects and their remedial measures in pavement.

Course Outcomes

Upon successful completion of this course, it is expected that students will be able to:
1. Understand the basic concepts of pavement design by applying fundamental concepts of Mathematics and Laws of Mechanics.
2. Proposes a feasible solution to fundamental highway engineering analysis/design problems.
3. Apply condition monitoring and maintenance of road pavements.
4. Develop technical skills for road pavement construction.
5. Design flexible and rigid pavements, aircraft runway and F1/car race tracks.
6. Develop the understanding of various standards (BIS, IRC & ISO) for pavements design and maintenance.

Topics Covered

Unit 1 General Consideration
Types of pavement, Approaches to pavement design, vehicle and traffic considerations, behaviour of road materials under repeated loading, stresses and deflections in layered system, IRC design guidelines for flexible pavements, Comparison of flexible and rigid pavements highway and airport pavement.

Unit 2 Design Method of Rigid Pavements
Analysis of stresses in concrete pavements due to various wheel loads, IRC design guidelines for rigid pavements, Design of distributed steel reinforcement, design of dowels and tie bars, Design of spacing of joints. Introduction to pavement modeling.

Unit 3 Pavement Evaluation and Strengthening
Method of pavement evaluation, Pavements Performance: Evaluation of performance of the flexible and rigid pavements, IRC guidelines Design of various types of overlays for flexible and rigid pavements, pavement maintenance, Pavement for sustainable development, Recycling of pavement.

Unit 4 Advanced Pavements
Considerations for the design of: aircraft runways and taxiway pavements, Formula-1/car racetracks.

Text Books /Reference Materials


Additional Learning Source

2. Web links to e-learning : nptel
Department | Course No. | Course Title | Pre-requisites | Course Type | Credit Hours | Contact Hours | Total Contact Hours
--- | --- | --- | --- | --- | --- | --- | ---
Civil Engineering | CEE-6320 | Earth and Rockfill Dams | PE | NIL | Theory | 4 | 3 1 0 | 4

**Course Assessment Method**
1. Assignments and Quizes (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 2 Hour

**Course Objective**
The course is aimed to train the students in planning and designing of earth and rockfill dams and inculcate the knowledge of construction, maintenance and safety of these dams.

**Course Outcomes**
Upon successful completion of this course, it is expected that students will be able to:
1. Plan and design earthen dams and adopt suitable measures for its safety.
2. Assess the seepage discharge and adopt suitable measures for its control.
3. Plan and design rockfill dams and adopt suitable measures for its safety.
4. Adopt appropriate methods of river diversion, monitor quality control during and after construction using proper instrumentation.

**Topics Covered**

**Unit 1** Basic design aspects, Classification of embankment dams, Criteria for safe design, Free board, Upstream and downstream slope protection, Cracking of earth dams, Hydraulic fracturing, Causes of cracking, Preventive and remedial measures.

**Unit 2** Seepage theory, Determination of free surface and seepage discharge through dams for isotropic as well as anisotropic soils. Flow net for earth dam under steady seepage condition, Various methods of seepage control, Selection of core materials, Drainage of embankments, Design of transition filters, Use of geo-textiles.

**Unit 3** General characteristics of Rock fill dams, Materials for rock fill dams, testing of rockfill material, Design of dam section, Types of membrane, Rock fill placement, Deformation of rock fill dams, Flow through and over rockfill dam, Concrete faced rockfill dam.

**Unit 4** Stability analysis, Method of slices, Graphical method, Foundation exploration for Earth and Rock fill dams, Treatment of foundations, Quality control and instrumentation, River diversion during construction of dam.

**Text Books / Reference Materials**
2. Bharat Singh, Embankment Dam Engineering, Nemchand& Bros Roorkee.

**Additional Learning Source**
1. Web links to e-learning: npTEL
<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
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<td>Civil Engineering</td>
<td>CEE-6040</td>
<td>Finite Element Analysis</td>
<td>PE NIL Theory</td>
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</table>

**Course Assessment Method**
1. Assignments and Oral Quizzes (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%) - 2 Hour

**Course Objective**
1. To provide the fundamental concepts in the theory of finite element analysis.
2. To analyze problems related to bar, truss, beam and plane elements using finite element approach.
3. To develop basic understanding in modeling considerations related to finite element programming.

**Course Outcomes**
Upon successful completion of this course, it is expected that students will be able to:
1. Understand the basic concepts, significance and application of finite element analysis.
3. Recognize the difference between conventional and FE method of analysis.

**Topics Covered**

**Unit 1 Introduction**
Finite element method and other classical methods, historical background, advantages & disadvantages, finite element modeling – discretisation, nodes, elements types and shapes.
Basic equations in elasticity –stress and strain vectors, Hooke’s law, strain-displacement relationship, equilibrium equations, generalized compatibility equations.

**Unit 2 Finite element analysis of one dimensional problem**
Generation of stiffness matrix by displacement and energy method, energy and variational approaches (Rayleigh-Ritz method), numerical solutions.

**Unit 3 Isoparametric elements and shape functions**
Co-ordinate systems, Element shapes, Strain displacement matrix, Higher order elements: 1D, 2D and 3D.

**Unit 4. Finite element analysis of two dimensional problems**
Symmetry, Plane stress and plane strain problems, Bending of thin plates, Introduction to nonlinear FE analysis.

**Text Books / Reference Materials**

**Additional Learning Source**
# Programme Cores

<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
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<tr>
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<td>CEC-6050</td>
<td>Hydraulic Structures</td>
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</table>

## Course Assessment Method

1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 2 Hour

## Course Objective

This course is aimed to develop the understanding of basic principles and concepts of analysis and design of hydraulic structures such as weirs and barrage, regulation works, spillways, canals and various river training works and to provide the detailed insight into the theories of sub-surface flow.

## Course Outcomes

Upon successful completion of this course, it is expected that students will be able to:

1. optimize the effective usage of water resources for irrigation purposes and comprehend to the basic design principles for the development of efficient irrigation system.
2. understand and manage the hydraulic structures project evaluation under various conditions of data availability and field constraints.
3. gain the in-depth knowledge on various types of spillways used in dams and their design guidelines.
4. evaluate the essential requirements of the most widely used spillways and design of efficient stilling basins by following U.S.B.R. and I.S. recommendations.

## Topics Covered

### Unit 1
Principles of design of hydraulic structures on permeable foundation, design of barrage.

### Unit 2
Design of regulation works, silt excluding devises, guide banks and spurs.

### Unit 3
Theory of Spillways: types and design of Ogee spillway and Syphon spillway.

### Unit 4
Energy Dissipaters: Energy dissipation downstream of hydraulic structures, Hydraulic jump, Jump height curve and Tail water curve, Stilling basins (U.S.B.R. type), design of roller bucket type energy dissipators.

## Text Books / Reference Materials

4. Irrigation Engineering and Hydraulic structures by S. K.Garg

## Additional Learning Source

1. Irrigation and Water Power Engineering by P. N. Modi
2. Web links to e-learning: [nptel](#) and [ePathshala](#)
### Course Title: Advanced Engineering Hydrology

**Course Details**

<table>
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<th>Department</th>
<th>Course No.</th>
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<th>Pre-Requisites</th>
<th>Course Type</th>
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<td>Advanced Engineering Hydrology</td>
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</table>

**Course Assessment Method**

1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 2 Hour

**Course Objective**

The course is aimed to provide concept of hydrologic analysis and design of the hydraulic engineering system.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. apply the knowledge of the hydrograph analysis for rainfall-runoff modeling of the watershed
2. assess design flood properly with consideration of economy and safety for water resources projects
3. apply at site and regional flood frequency analysis for the assessment of flood peak and its frequency for major water resource projects and utilize the knowledge of the reservoir and channel flood routing for the reservoir planning and flood forecasting.
4. utilize the concept of the random variable and its analysis, theory of probability and statistical methods in the planning and design of water resource projects

**Topics Covered**

**Unit 1**
- Hydrograph analysis, Separation of stream flow components, Unit Hydrograph, Synthetic Unit Hydrograph, Instantaneous unit hydrograph, Dimensionless unit hydrograph, Distribution graph

**Unit 2**
- Reservoir planning, Various zones of reservoirs, Area-elevation & Storage elevation curve, Design storm, Probable Maximum Precipitation (PMP), Spillway Design Flood (SDF), Standard Project Flood (SPF), Probable Maximum Flood (PMF). Guidelines for selecting design flood

**Unit 3**
- Peak flood estimation, At site flood Frequency analysis, Selection of design return period, Annual and partial duration series, Regional flood frequency analysis, Reservoir and channel flood Routing.

**Unit 4**

**Text Books / Reference Materials**


**Additional Learning Source**

2. Web links to e-learning: [nptel](#)
<table>
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<tr>
<th>Department</th>
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<th>Pre-Requisites</th>
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<td>Advanced Open Channel Hydraulics</td>
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**Course Assessment Method**

1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 2 Hour

**Course Objective**

The aim of the course is to impart knowledge regarding the advanced topics on steady, unsteady, spatially varied flows and dispersion of pollutants in natural streams.

**Course Outcomes**

Upon successful completion of the course the students are supposed to

1. Compute back water and drawdown profiles for various Gradually Varied Flow situations and to assess the stage and discharge in channel during flood and dam break catastrophe.
2. Plan and design various types of weirs for discharge measurement as well as special types such as Labyrinth and Piano key weirs for passing high discharges safely during floods.
3. Plan and design special types of diversion works in hydraulic structures for mountainous region.
4. Assess the impact of aeration in providing suitable free board in hydraulic structures and to assess the impact of pollution caused by disposal of domestic and industrial waste in natural streams.

**Topics Covered**


**Unit 2** Rapidly Varied flow: thin plate weirs, special types of weirs such as linear proportional weir, Labyrinth weir, Piano key weir. Hydraulic jump in non-rectangular channels.

**Unit 3** Spatially Varied Flow: Side channel spillway, side weir, De Marchi equation, uniformly discharging side weir, Trench weir.

**Unit 4** Design of subcritical canal transitions: Hind’s method, Vittal and Chiranjeevi’s method, diffusion and dispersion in open channels.

**Text Books / Reference Materials**


**Additional Learning Source**

1. Web links to e-learning: npTEL
<table>
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<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
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<tr>
<td>Civil Engineering</td>
<td>CEC-6080</td>
<td>Fluvial Hydraulics</td>
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**Course Assessment Method**

1. Assignments (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 2 Hour

**Course Objective**

To understand the behavior of sediment transport in alluvial channels, design the stable alluvial channel and solve various civil engineering problems encountered in fluvial hydraulics.

**Course Outcomes**

After the successful completion of the course, a student is expected to

1. Understand the basic concepts of sediment movement and regimes of flow in alluvial channels.
2. Get in-depth knowledge of various predictors of bed load and suspended load.
3. Compute the total sediment load carried in alluvial channel and to design the stable channels.
4. To have an understanding of alluvial river models and sediment transport through pipes.

**Topics Covered**

**Unit 1** Sediment properties, Reservoir sedimentation, types of reservoirs, site selection, incipient motion of sediment, competent velocity, lift concept, critical tractive force of cohesionless and cohesive materials, regimes of flow, ripple and dune regimes, anti-dune regime, importance and prediction of regimes of flow.

**Unit 2** Resistance to flow and velocity distribution in alluvial streams, Bed load equations based on dimensional considerations and semi theoretical equations, suspended load, general considerations about sediment distribution equation, prediction of reference concentrations.

**Unit 3** Total load transport, microscopic and macroscopic methods based on a single size and fraction wise size calculations, Sediment samplers and sampling, bed load and suspended load sampling. Design of stable channels in alluvium: variables in channel design, general comments on regime and tractive force methods of channel design.

**Unit 4** Bed level variation in alluvial streams, local scour, degradation, aggradation, silting of reservoir, estimation of silt, distribution of sediment in reservoir, life of reservoir, sediment flow through pipes.

**Text Books / Reference Materials**

8. **A J Raudkivi**, Loose Boundary Hydraulics, CRC Press, Taylor & Francis, USA.

**Additional Learning Source**

1. Web links to e-learning: nptel
2. Web based learning, Journal papers, etc.
<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
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<td>Lab</td>
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</table>

**Course Assessment Method**

1. Class Work (60%)
2. End Semester Examination (40%)

**Course Objective**

To prepare students for hydraulic and water resources report writing skills using advanced features of MS office.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Prepare the reports related to water resources engineering.
2. Recognise advance features of MS office for preparing hydraulic and water resources engineering reports.
3. Ability to plot different types of graphs using MS Excel.
4. Ability to prepare and present Power Point Presentation.

**Syllabus**

2. Introduction to MS Excel and programming in MS Excel.
3. Visual display of data using MS Excel.
4. Writing, preparation and training for presenting Power Point Presentation

**Text Books / Reference Materials**


**Additional Learning Source**

1. Web links to e-learning: nptel
2. Video lectures at [https://www.youtube.com/watch?v=NYJSUMwf-Ce](https://www.youtube.com/watch?v=NYJSUMwf-Ce)
# Programme Electives

<table>
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<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
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<td>Civil Engineering</td>
<td>CEE-6310</td>
<td>Rigid Dams</td>
<td>PE</td>
<td>NIL</td>
<td>Theory</td>
<td>4</td>
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</table>

**Course Assessment Method**

1. Assignments and Quizzes (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 2 Hour

**Course Objective**

The course is aimed to train the students in planning and designing of various types of rigid dams such as gravity dam, arch dam and buttress dam.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:
1. Plan, analysis and design of gravity dam.
2. Assess the various stresses at key points in general and galleries, monitor quality control and behavior of dam during and after construction using proper instrumentation.
3. Plan, analysis and design of arch dam.
   - Plan, analysis and design of buttress dam.

**Topics Covered**

**Unit 1**

- Dam: types, characteristics, relative merits and demerits, site investigations and selections, foundation grouting, forces acting on dam,
- Gravity dams: stability requirements, modes of failure and factor of safety, elementary profile of gravity dam, methods of analysis, zoning of gravity dams, design criteria.

**Unit 2**

- Stress analysis in gravity dams, normal and shear stresses, principal stresses, internal stresses, galleries in dams, stress concentration around openings, joints in dams, construction of gravity dams, instrumentation in gravity dam.

**Unit 3**

- Arch Dam: General consideration, types and characteristics, Forces acting on Arch dams, Design criteria, Cylinder theory and elastic theory of design, Construction of arch dams.

**Unit 4**

- Buttress dam: Merits, Types and characteristics, Forces acting, design of deck, buttresses, Unit column theory, Construction of buttress dam.

**Text Books / Reference Materials**

1. **R.S. Varshney** “Concrete Dams”, by 1982, NCB, Roorkee
2. Design of Small Dams, USBR 1960, Calcutta, Oxford and IBH

**Additional Learning Source**

NPTEL course materials from different IITs.
Department: Civil Engineering  
Course No.: CEE-6320  
Course Title: Earth and Rockfill Dams  
Course Designation: PE  
Pre-Requisites: NIL  
Course Type: Theory  
Credit Hours: 4  
Contact Hours: 3  
L: 1  
G: 0  
P: 4  
Total Contact Hours: 4

Course Assessment Method
1. Assignments and Quizes (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 2 Hour

Course Objective
The course is aimed to train the students in planning and designing of earth and rockfill dams and inculcate the knowledge of construction, maintenance and safety of these dams.

Course Outcomes
Upon successful completion of this course, it is expected that students will be able to:
1. Plan and design earthen dams and adopt suitable measures for its safety.
2. Assess the seepage discharge and adopt suitable measures for its control.
3. Plan and design rockfill dams and adopt suitable measures for its safety.
4. Adopt appropriate methods of river diversion, monitor quality control during and after construction using proper instrumentation.

Topics Covered
Unit 1: Basic design aspects, Classification of embankment dams, Criteria for safe design, Free board, Upstream and downstream slope protection, Cracking of earth dams, Hydraulic fracturing, Causes of cracking, Preventive and remedial measures.
Unit 2: Seepage theory, Determination of free surface and seepage discharge through dams for isotropic as well as anisotropic soils. Flow net for earth dam under steady seepage condition, Various methods of seepage control, Selection of core materials, Drainage of embankments, Design of transition filters, Use of geo-textiles.
Unit 3: General characteristics of Rock fill dams, Materials for rock fill dams, testing of rockfill material, Design of dam section, Types of membrane, Rock fill placement, Deformation of rock fill dams, Flow through and over rockfill dam, Concrete faced rockfill dam.
Unit 4: Stability analysis, Method of slices, Graphical method, Foundation exploration for Earth and Rock fill dams, Treatment of foundations, Quality control and instrumentation, River diversion during construction of dam.

Text Books / Reference Materials
2. Bharat Singh, Embankment Dam Engineering, Nem chand & Bros Roorkee.

Additional Learning Source
1. Web links to e-learning: nptel
<table>
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<tr>
<th>Department</th>
<th>Course No.</th>
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<th>Course Designation</th>
<th>Pre-Requisites</th>
<th>Course Type</th>
<th>Credit Hours</th>
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<tr>
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<td>CEE-6450</td>
<td>Hydro-Power Engineering</td>
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**Course Assessment Method**

1. Assignments and Oral Quizzes (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 2 Hour

**Course Objective**

The main aim of this course is to provide an insight of planning and design of various components of hydro-power structures such as intakes, penstock, tunnels, surge tanks, and draft tubes etc. giving due consideration to safety measures. Further the focus is made on the appropriate selection and setting out of suitable turbines for various types of hydel plants.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be able to:

1. Gain knowledge regarding the various sources of energy available in nature, hydel power terminology and assess the power potential of a natural stream.
2. Plan and design various types of hydro power schemes as well as to assess their efficiency.
3. Plan and design the various components of hydro power plant such as intake, penstock, power tunnels, surge tank.
4. Select suitable turbine for various type of hydro power schemes, schematically plan, proper dimension and layout of power houses with all safety measures.

**Topics Covered**

**Unit 1** Sources of energy, role of hydropower in a power system, Estimation of power potential of stream, Storage and Pondage studies, load curve, load factor, capacity factor, utilization factor, diversity factor, load duration curve, firm power and secondary power.

**Unit 2** Hydro-power plants, Elements, general arrangement of various Hydel plants such as runoff river plants, valley dam plants, diversion canal plants, high head diversion plants, pumped storage power plants etc., Efficiency and Installed capacity of plants.

**Unit 3** Intakes, Types, losses, air entrainment, air vent. Tunnel, Penstocks, General classification, design criteria, economical diameter, Surge tanks, Classification, Analysis of simple surge, Water hammer.

**Unit 4** Selection, setting and cavitation in turbines, Draft tubes, classification, Dimensioning and laying of power houses, Safety measures during construction of power plants.

**Text Books / Reference Materials**

7. **Norwegian Inst. of Tech.: Hydropower Development**: Vols. 3, 4, 5 & 6, Division of Hydraulic Engg.

**Additional Learning Source**

1. NPTEL course materials from different IITs.
Department | Course No. | Course Title | Pre-Requisites | Course Type | Credit Hours | Contact Hours | Total Contact Hours |
--- | --- | --- | --- | --- | --- | --- | --- |
Civil Engineering | CEE-6360 | Irrigation and Drainage | PE | NIL | Theory | 4 | 3 1 0 | 4 |

**Course Assessment Method**

1. Assignments (15%)
2. Mid-Semester Examination (25%)- 1 Hour
3. End Semester Examination (60%)- 2 Hour

**Course Objective**

The main objectives of this course is to provide an insight of planning and design of various components of irrigation engineering system such as types and design of new irrigation system, drainage system and other irrigation related issues.

**Course Outcomes**

Upon successful completion of this course, it is expected that students will be

1. Gain knowledge regarding the various source and storage of irrigation water measurement of various soil related issue such as moisture content, consumption use etc.
2. Planning & design surface & subsurface irrigation system and study of various flow measuring techniques in open channels.
3. To study various devices which measures soil moisture and give insight for measuring the correct estimation of evapotranspiration.
4. To study the various drainage techniques water salt balance of root zone & teaching efficiencies of soil.

**Topics Covered**

Unit 1 Introduction, Sources and storage of Irrigation water, Basic Soil-water relations, measurement of soil moisture, consumption use of water, drainage requirement, irrigation efficiencies.

Unit 2 Surface and sub surface irrigation sprinkler’s and trickle irrigation, fluid measurement techniques, flow measurement flumes, weirs, irrigation events

Unit 3 Infiltration, infiltrometer, ponding methods, tensiometers, neutron probe, time domain reflectometer, evapotranspiration, crop coefficient, leaf area index, guide lines on evapotranspiration estimation.

Unit 4 Drainage principles, need for drainage, steady state equations, Hooghoudt, Kirkham, Dagan and Ernst equations. Salt balance, water and salt balance of the root zone, salt equilibrium equation and leaching requirement, leaching efficiency.

**Text Books / Reference Materials**

2. Drainage Principles and Applications, "International Institute for Land Reclamation and Improvement", Wageningen. 1973

**Additional Learning Source**

1. Web links to e-learning: nptel
2. Web based learning, Journal papers, etc.
<table>
<thead>
<tr>
<th>Department</th>
<th>Course No.</th>
<th>Course Title</th>
<th>Course Designation</th>
<th>Pre-Requisites</th>
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<td>Water Resources Engineering</td>
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### Course Assessment Method

1. Assignments (15%)
2. Mid-Semester Examination (25%) - 1 Hour
3. End Semester Examination (60%) - 2 Hour

### Course Objective

The objective of the course is to have an understanding of planning and management of water resources project, economic analysis of water resources project and knowledge of flood damage mitigation.

### Course Outcomes

After the successful completion of the course, a student is expected to

1. Develop an understanding of planning and management for water resources project,
2. Understand the engineering economic analysis of water resources project,
3. Apply the knowledge in assessment of floods and able to design the various component to have least damage due to flood,
4. Create the theoretical and mathematical knowledge of simplified river basin system.

### Topics Covered

**Unit 1** Objectives and Planning of water resources developments, Levels of planning, Project formulation and Evaluation, Environmental considerations, Functional requirements in Multiple-purpose projects.

**Unit 2** Engineering economy in water resources planning, Annual cost comparisons, Selection of an interest rate for an economy study, Economic design of hydraulic structures.

**Unit 3** Flood damage mitigation, Design floods, Flood mitigation reservoirs, Design of levees and flood walls, Flood ways, Channel improvement, Evacuation and flood proofing.

**Unit 4** Simplified river-basin system, Conventional planning process, Simulation analysis, Mathematical models.

### Text Books / Reference Materials

1. Linsley and Franzini, Water resource Engineering, McGraw-Hill

### Additional Learning Source

1. Web links to e-learning: nptel
2. Web based learning, Journal papers, etc.