College of Engineering, Pune

(An Autonomous Institute of Govt. of Maharashtra, Permanently Affiliated to S.P. Pune University)

Department of Civil Engineering

Curriculum Structure & Detailed Syllabus (UG Program)

Final Year B.Tech.

(Revision: A.Y. 2016-17, Effective from: A.Y. 2018-19)

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Program Educational Objectives (PEOs)

The Undergraduate students will demonstrate…

I. Have successful career in the diversified sectors of the engineering Industry and / or higher studies by acquiring knowledge in mathematical, scientific and engineering fundamentals.

II. Analyze and design Civil engineering systems with social awareness and responsibility.

III. Exhibit professionalism, ethical approach, communication skills, team work in their profession and adapt to modern trends by engaging in lifelong learning.

Program Outcomes (POs)

The Undergraduate students will demonstrate…

(a) Apply knowledge of mathematics, science and engineering to civil engineering problems.

(b) Identify, formulate, research literature and solve complex civil engineering problems.

(c) Design various structures or particular system that meets desired specifications and requirements.

(d) Design and conduct experiments, interpret and analyze data, synthesize the information to provide conclusion.

(e) Select and use appropriate engineering techniques and software tools to analyze civil engineering problems with understanding of limitations.

(f) Assess local and global impact of societal issues on civil engineering profession.

(g) Able to understand the impact of engineering solutions on society and demonstrate the knowledge of, and need for sustainable development.

(h) Demonstrate their professional and ethical responsibilities.

(i) Able to function as a member or a leader on engineering and science laboratory teams, as well as on multidisciplinary teams.

(j) Communicate effectively in both verbal and written forms.

(k) Understand engineering and management principles and apply to their work as a member and/ or leader in a team to manage projects.

(l) Adapt transform in industry by understanding the need of independent and lifelong learning.

Correlation between the PEOs and the POs

Program Educational Objectives	Program Outcomes											
	a	b	c	d	e	f	g	h	i	j	k	l
I	✓	✓			✓						✓	
II		✓	✓	✓	✓				✓			
III						✓	✓	✓	✓	✓	✓	✓

Note: The cells filled in with ✓ indicate the fulfilment/correlation of the concerned PEO with the PO.

List of Abbreviations

Abbreviation	Title
S.P. P.U.	**Savitribai Phule Pune University**
A.Y.	**Academic Year**
BSC	**Basic Science Course**
EFC	**Engineering Foundation Course**
MLC	**Mandatory Learning Course**
ILOE	**Institute Level Open Elective Course**
SLC	**Self Learning Course**
HSMC	**Humanities/Social Sciences / Management Course**
LLC	**Liberal Learning Course**
SBC	**Skill Based Course**
PCC	**Program Core Course**
DEC	**Department Elective Course**
LC	**Laboratory Course**

Semester VII

Sr. No.	Course Type	Course Name	Teaching Scheme			Credits
			L	T	P	
1	MLC	Intellectual Property Rights	1	0	0	0
2	LLC	Liberal Learning Course	1	0	0	1
3	ILOE	Institute level Open Elective [**of type Science/Technology/Engg.**] [To be offered to other Departments]	3	0	0	3
4	PCC	Waste Water Engineering	3	0	0	3
5	PCC	Introduction to Earthquake Engineering	3	0	0	3
6	LC	Waste Water Engineering Lab	0	0	2	1
7	DEC	Department Elective-I [Option among minimum 3 courses]	3	0	0	3
8	LC	Department Elective -I Lab	0	0	2	1
9	SBC	Project Stage-I	0	0	8	4
		Total	**14**	**0**	**12**	**19**
		Total Academic Engagement and Credits	**26**			**19**

- ONE Minor course [To be offered to the Students from Other Departments]
- ONE Honor course [To be offered to Students of Host Department]
- **Institute level Open Elective**: Environmental Pollution/ Applied Finite Element Analysis.

List of Department Electives

Sr.No.	Department Elective-I with Lab
1	Design of Hydraulic Structures
2	Matrix Analysis of Structures
3	Green Building Practices
4	Advanced Surveying
5	Foundation Engineering
6	Structural Health Monitoring and Retrofitting

Semester VIII

Sr. No.	Course Type	Course Name	Teaching Scheme			Credits
			L	T	P	
1	PCC	Quantity Surveying and Valuation	3	0	0	3
2	LLC	Liberal Learning Course	1	0	0	1
3	LC	Quantity Surveying and Valuation- Lab	0	0	2	1
4	DEC	Department Elective-II [Option among minimum 3 courses]	3	0	0	3
5	LC	Department Elective-II (lab)	0	0	2	1
6	DEC	Department Elective-III [Option among minimum 3 courses]	3	0	0	3
7	SBC	Project Stage-II	0	0	12	6
		Total	**10**	**0**	**16**	**18**
		Total Academic Engagement and Credits	**26**			**18**

- ONE Minor course [To be offered to the Students from Other Departments]
- ONE Honor course [To be offered to Students of Host Department]

List of Department Electives

Department Elective-II with Lab (Sem VIII)	**Department Elective-III (Sem VIII)**
Water Resources Planning and Management	Industrial Waste Water Treatment
Special Concretes	Prestressed Concrete Structures
Appropriate Technology in Construction	Advanced Foundation Engineering
Introduction to Finite Element Analysis	Advanced Plumbing Services
Advanced Environmental Engineering	Watershed Management
Computer Aided Structural Design	Human Resource Management in Construction
Advanced Fluid Mechanics	Tunnels, Docks and Harbour Engineering
Industry offered course- Building Information Modelling	Operations Research
	Geospatial Technologies for Water Resources Engineering
	Applied Hydrology

Distribution of Minor and Honors courses of Civil Engineering Department

Semester	Minor	Honors (Any one course in each semester)
V	Construction Materials and Building Design	1. Advanced Structural Mechanics 2. Advanced Building Design
VI	Fundamentals of Geomechanics	1. Advanced Mechanics of Materials 2. Advanced Geotechnical Engineering
VII	Structural Analysis	1. Project Management 2. Advanced Structural Design 3. Ground Water Engineering 4. Any M. Tech Elective Course
VIII	Basics of Transportation Engineering	1. Advanced Transportation Engineering 2. Geotechnical and Structural Design of Foundations 3. Infrastructure Management 4. Advanced Irrigation Engineering 5. Any M. Tech Elective Course

Semester VII

Intellectual Property Rights

Teaching Scheme | **Examination Scheme**

Lectures:1 hrs/week | End-Sem Exam- 50

Course Outcome:

1. Understood the importance of IPR.
2. Understood how IPR are regarded as a source of national wealth and mark of an economic leadership in the context of global market scenario.

Unit 1 **[2 Hrs]**

Introduction

Nature of Intellectual Property, Patents, Designs, Trademarks and Copyrights, Process of patenting and Development-technological research, Innovation, patenting, development.

Unit 2 **[2 Hrs]**

International Scenario

International cooperation on Intellectual Property, Procedure for grants of patents, patenting under PCT.

Unit 3 **[3 Hrs]**

Patent Rights

Scope of Patent Rights, Licensing and transfer of technology, Patent information and databases, Geographical Indications.

Unit 4 **[3 Hrs]**

New developments in IPR

Administration of Patent system, New developments in IPR, IPR Biological systems, Computers, Software etc., Traditional knowledge, Case studies, IPR and IIT's objectives towards learning IPR.

Unit 5 **[3 Hrs]**

Trademark and patenting

Registered and unregistered trademarks, designs, concepts, idea patenting.

Text Books

1. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd., 2nd ed. 2007.

Reference Books

1. Robert P. Merges, Peter S. Meneil, Mark A. Lemley, "Intellectual Property in New Technological Age", Aspen Publishers, 4th ed., 2007.

[ILE-18005] Environmental Pollution

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
Test 1 and 2 – 20 Marks each
End-Sem Exam- 60 Marks.

Pre-requisite: No

Course Outcomes:
After completion of the course Student will be able to:

1. Identify local and global effects of pollution and suggest control measures.
2. Identify atmospheric stability conditions and relate them to transport of air pollutants & design stack under given conditions
3. Collect data and analyze the problem of noise, odor pollution & solid waste management
4. Understand importance & preparation stages of Environmental Impact Assessment
5. Determine the flow diagram of water and waste water treatment process and decide domestic wastewater treatment processes.

Unit 1 **[5 Hrs]**

Environment and its interaction with human activities : Environmental imbalances, Factors Contributing to Urban Pollution in India.

Air pollution: Definition, sources of air pollution, types and classification of air pollutants, Primary and Secondary air pollutants and their importance, Atmospheric stability, mixing heights.

Control of Pollution: By process modification, Change of raw materials, Fuels, process equipment and process operation by use of air pollution control equipments, for particulate pollutants, Air Pollution control by using Equipments.

Land use planning: As a method of air pollution control.

Unit 2 **[5 Hrs]**

A) Chemistry of air pollution: Photochemistry of air pollution, Photochemical smog reactions involved in its formation, Factors influencing its reactions.

B) Effects of Air Pollution: Effects on man, animals, vegetation and property, Economics of loss due to pollution, Episodes, Global effects of air pollution.

Unit 3 **[7 Hrs]**

Meteorological Aspects:

Parameters influencing air pollution, measurement of parameters plume behaviour, transport, and diffusion. Formulae for stack heights, Gaussian diffusion models for finding ground level concentration.

Design problems of height of chimney and ground level concentration**.**

Unit 4 **[7 Hrs]**

A) Solid waste Management: Sources, classification issues related to SWM, treatment techniques.

B) Odors: Sources, measurement and control.

Unit 5 **[7 Hrs]**

A) Noise Pollution Sources, Noise characteristics, measurement of noise, Effects of noise, Control of noise.

B) Environmental Impact Assessment: Definition, Broad Goals, Objectives, Phases in EIA, Contents of Application form, Advantages & Disadvantages of EIA, Environmental management plan, Environmental Impact of Industries, Urbanization and Agricultural activities. Case studies.

Unit 6 **[9 Hrs]**

Water and Wastewater treatment

Sources of water, Physical, Chemical and biological quality of water, Standards for drinking water, flow diagram of water treatment process, Classification of wastewater treatment, Aerobic and anaerobic treatment, Biological and chemical treatment, flow diagram of wastewater treatment process, Centralized sewage treatment systems, Consequences of centralized wastewater treatment, Objectives of small and decentralized wastewater treatment systems Advantages of Decentralized Wastewater Treatment, Applications of decentralized wastewater management.

Reference Books:

1. M.N. Rao , Air Pollution, Tata McGraw hill 1989 edition.
2. Perkins , Air Pollution, McGraw-Hill Edition 2000.
3. Muralikrishna, K. V. S. G., Air Pollution and Control, Kaushal & Co., Kakinada, AP, 1995.
4. Canter, L., Environmental Impact Assessment. Second edition. McGraw Hill, 1996.
5. J. G. Rau, D. C. Wooten, Environment Impact Analysis Handbook, McGraw Hill, New York.
6. Manual on sewerage & sewage Treatment published by Ministry of Urban Development Govt. of India Msy-2000. 35 PDOP-4-59-85-97 ...Ministry of Urban development.
7. Metcalf and Eddy, Wastewater Engineering, Tata McGraw Hill, 1996.

[ILE-18019] Applied Finite Element Analysis

Teaching Scheme
Lectures : 3 hrs / week

Examination Scheme
Internal Test 1: 20 marks
Internal Test 2: 20 marks
End Sem. Exam: 60 marks

Course Outcomes:
Students will be able to:

1. Solve Ordinary differential equations using Finite Element Method.
2. Solve simple Engineering problems using Finite Element Analysis.
3. Use the commercial Finite Element software to build Finite Element models and solve a selected range of engineering problems

Unit 1: Introduction **[6 Hrs]**
Introduction to Finite Element Method, General Procedure of Finite Element Analysis, History of the Finite element Method, Examples of Finite Element Analysis.

Unit 2: Truss Structures **[6 Hrs]**
Bar Element, Nodal Equilibrium Equations, Element Transformation, Assembly of Global Stiffness Matrix, Boundary conditions, Element Strain and Stress.

Unit 3: Flexure Elements **[6 Hrs]**
Elementary Beam Theory, Beam Element, Beam Element Stiffness Matrix, Element Load Vector, Flexure Element with Axial Loading.

Unit 4: Method of Weighted Residuals **[7 Hrs]**
Method of Weighted Residuals, The Galerkin finite Element Method, Application of Galerkin's Method to Structural Elements.

Unit 5: Interpolation Functions **[8 Hrs]**
Compatibility and Completeness Requirements, Polynomial forms, Triangular Elements, Rectangular Elements, Three-Dimensional Elements, Isoparametric Formulation, Axi-symmetric elements, Numerical Integration, Gaussian Quadrature.

Unit 6: Applications in Solid Mechanics **[7 Hrs]**
Plane Stress, Plane Strain, Axi-symmetric Stress analysis, General Three-dimensional Stress Elements, Strain and Stress Computation.

Reference Books:

1. T.R. Chandrupatla and A. D. Belegundu, "Introduction to Finite Elements in Engineering", Prentice Hall Publication, 4/e, 2011.

2. D. V. Hutton, “Fundamentals of Finite Element Analysis”, McGraw Hill Publication, 10/e, Pearson Publication, 2017.
3. P. Seshu, “ Textbook of Finite Element Analysis”, Tata McGraw Hill Publishing Company Limited.,2004
4. D.L. Logan , “A First Course in the Finite Element Method”, Cengage Publications , 2012.

[CE-18001] Waste Water Engineering

Teaching Scheme
Lectures : 3 hrs / week

Examination Scheme
Internal Test 1 : 20 marks
Internal Test 2 : 20 marks
End Sem. Exam: 60 marks

Course Outcomes:
Students will be able to:

1. overcome/minimize the river pollution problem.
2. make decisions regarding the design of storm water line and sewer line.
3. design the various primary waste water treatment units their effectiveness.
4. design the various aerobic secondary waste water treatment units their effectiveness.
5. understand the various anaerobic secondary units their design criteria and applicability.
6. demonstrate a firm understanding of various emerging treatment and their suitability in order.
7. to provide effective, efficient and economical treatment process.

Unit 1 **[7 Hrs]**

Introduction: Objective, advantages of treated wastewater, Water carriage sewerage, and important definition related with sewage, Pattern of collection system, various flow diagrams of wastewater treatment, Design period, Significance of physical, chemical and biological characteristics of wastewater. Wastewater sampling. River Sanitation: Self-purification of natural streams, Theory of BOD reaction, Theoretical oxygen demand, Streeter-Phelps equation, Oxygen Sag Curve, Effluent standards.

Unit 2 **[7 Hrs]**

Storm water: Factors affecting the storm water discharge, Estimation of storm water runoff, Sources of sewage, Variations in sewage flow, Hydraulic design of sewer, Shield expression for self cleansing velocity, Minimum size of sewer, velocities in sewers and gradient of sewers. Various shapes of sewer, Sewer appurtenances i.e. manhole, drop manhole, Lamp hole, Clean-outs, street inlet, Catch basin, Flushing tank, Grease and oil taps, Inverted siphon and storm regulator, Vent pipes etc. pumping of sewage, types of pumps for sewage pumping.

Unit 3 **[7 Hrs]**

Classification of treatment method, Primary treatment: Screens: Types of screens, design of screen chamber, disposal of screenings. Grit Chamber: Sources of grit, Velocity control in grit chamber, Design of grit chambers. Disposal of grit, Sources of oil and grease, Importance of removal, Methods of oil and grease removal, Design of skimming tanks. Primary Sedimentation: Necessity, design of PST with inlet and outlet details, Primary Sludge and its disposal. Other primary treatment such as equalization, flocculation and pre-aeration.

Unit 4 **[7 Hrs]**

Secondary treatment: Aerobic, Fixed film systems, suspended film system and lagoon systems, Metabolic process, Type of microbial metabolism, Growth of micro-organism under batch and continuous process, Nutrient requirements for microbial growth, Aerobic treatment: Activated sludge process and its modification, Trickling filters, Oxidation pond, Aerated lagoon and Oxidation ditch, Microbial growth kinetics for ASP, Design of aerobic treatment processes. Ecknfeder equation, Introduction to moving bed biofilm reactor and sequencing batch reactor, Biomass mass balance, Bulking of sludge, Sewage farming, Sludge volume index, Disposal sewage and reuse of treated effluent.

Unit 5 **[7 Hrs]**

Secondary treatment: Anaerobic Treatment, Septic tanks, Suitable conditions and situations, biological Principle, method of treatment and disposal of septic tank effluent and Design of septic tank, Anaerobic Digester, Principle of anaerobic digestion, Stages of digestion, Bio-gas production, its Characteristics and application, Factors governing anaerobic digestion, Sludge disposal methods, advantages and disadvantages. Introduction to various conventional treatment processes such as chemical precipitation, ion-exchange, reverse osmosis, adsorption, and electro dialysis.

Unit 6 **[7 Hrs]**

Emerging Technologies for Waste Water Treatment Centralized sewage treatment systems, Consequences of centralized wastewater treatment, Objectives of small and decentralized wastewater treatment systems Advantages of Decentralized Wastewater Treatment, Applications of decentralized wastewater management to Root zone Technology Principle, types of plants used, advantages, disadvantages, Constructed wastelands process description, advantages and disadvantages, Duckweed ponds process description, advantages and disadvantages, Fluidized aerobic bed technology Principle, process description, advantages Disadvantages, Up flow sludge Blanket Reactors (UASBR)- Principle, Design, advantages and disadvantages, Microbial Fuel Cells, Moving Bed Biofilm Reactor, Hybrid Reactor, Sequencing Batch Reactor.

Text Books:

1. Manual on sewerage & sewage Treatment published by Ministry of Urban Development Govt. of India Msy-2000. 35 PDOP-4-59-85-97. Ministry of Urban development.
2. Metcalf and Eddy, Wastewater Engineering, Tata McGraw Hill, 1996.
3. S.K.Garg, Wastewater Engineering, Khanna publication 2000.

Reference Books:

1. N. F. Gray, Water Technology, Butterworth-Heinamann 2002.
2. P. Venugopala Rao , Environmental Engineering - II., Tata McGraw Hill Publication, 2003.
3. Hammer and Hammer, Water and Wastewater Technology, Prentice Hall Publication, 2008.
4. Soli J. Arceivala, Wastewater Treatment for Pollution Control, 1999.

[CE-18002] Introduction to Earthquake Engineering

Teaching Scheme
Lectures : 3hrs / week

Examination Scheme
Internal Test 1 : 20 marks
Internal Test 2 : 20 marks
End Sem. Exam: 60 marks

Course Outcomes:

1. Students will be able to **explain** basic terminology in seismology, seismicity and will be able to **perform simple calculations** on recorded earthquake ground motions.
2. Students will be able to **apply** basics of structural dynamics in the analysis of structures subjected to earthquake induced vibrations (up to 2 Degrees of Freedom).
3. Students will be able to **analyse, design** and **draw** details of reinforcement of different structural members of two storey RC building, considering Earthquake induced forces as per the codal provisions.

Unit 1: Seismology **[5 Hrs]**

Seismic activities of different regions of India, local geology and soil condition, quantification, magnitude, energy and intensity of earthquake. Analysis of earthquake data, seismic zoning, causes of earthquake and subsequent damage, history of past earthquakes in the world.

Unit 2: Vibration Theory - Single Degree of Freedom System: **[7 Hrs]**

Dynamic equation of equilibrium, Free and forced vibration (Earthquake) with and without damping, Response to harmonic loading, Concept of response spectrum, time history analysis and performance based seismic design.

Unit 3: Vibration Theory – Multiple Degree of Freedom System **[7 Hrs]**

Two Degree of Freedom system, Concept of shear building, Free and forced (Earthquake and harmonic loading) vibration with and without damping.

Unit 4: Structural Form and Response to Earthquakes **[9 Hrs]**

Form of superstructure – regular and irregular, Response of masonry buildings and RC buildings with brick infill, Lateral load resisting systems, guidelines for efficient seismic designs.

Unit 5: Concept of Seismic Design **[7 Hrs]**

Evaluation of seismic forces as per Indian codes, modal analysis techniques, lateral load analysis of building, Torsion provisions.

Unit 6: Codal Provisions for Ductile Detailing of RC Structures subjected to Seismic Forces [7 Hrs]

Design of frame members subjected to flexure, shear and axial load, Design of joints of frame, including reinforcement detailing.

Text Books:

1. Agarwal Pankaj and Shrikhande Manish, Earthquake Resistant Design of Structures, Prentice Hall, India, 2010, 1st Edition.
2. Hosur Vinod, Earthquake Resistant Design of Building Structures, John Wiley, 2012, 1st Edition.
3. S. K. Duggal, Earthquake Resistant Design of Structures, Oxford University Press, 2017, 2nd Edition.

Reference Books:

1. Thomas Paulay and M. J. N. Priestley, Seismic Design of Reinforced Concrete and Masonry Buildings, John Wiley, 1992.
2. IS 456(2000) : Plain and Reinforced Concrete - Code of Practice (Fourth Revision) , Bureau of Indian Standards, New Delhi.
3. IS 1893 (2016) : Criteria For Earthquake Resistant design of buildings (Part I) : General Provisions and Building – Code of Practice (Sixth Revision), Bureau of Indian Standards, New Delhi.
4. IS 13920 (2016) : Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces – Code of Practice (First Revision), Bureau of Indian Standards, New Delhi.

[CE-18003] Waste Water Engineering Laboratory

Teaching Scheme
Practical: 2 hrs/week

Examination Scheme
Term-work: 50 Marks Oral: 50 Marks

Course Outcomes:

Students will be able to:

1. know basic concepts of determination of various waste water parameters.
2. perform various laboratory experiments and decide appropriate technology to treat the waste water.
3. design various waste water treatment units.

I) Laboratory Experiments to be conducted for the Determination of (Any Eight)

1. Dissolved Oxygen
2. Biochemical Oxygen Demand

3. Chemical Oxygen Demand
4. Different Forms of Solids
5. Sludge Volume Index
6. Conductivity and Dissolved Salt Concentration
7. Phosphate
8. Nitrates
9. Heavy Metals
10. Study of Various types of Micro Organisms

II) Site visit to Wastewater Treatment Plant and Visit Report

III) Design of various components of wastewater treatment plant

IV) Study of Software

Note: 1. The term work shall consist of record of above practical in Journal.
2. Oral examinations will be based on above exercises.

Department Elective- I

[CE(DE)-18001] Design of Hydraulic structures

Teaching Scheme

Lectures : 3hrs/week

Examination Scheme

Internal Test 1: 20 marks
Internal Test 2: 20 marks
End Sem. Exam: 60 marks

Course Outcomes:

Students will be able to:

1. demonstrate the knowledge related to hydraulic structures.
2. select and design suitable hydraulic structures.
3. analyze and design the appropriate river training works.
4. assess hydropower potential.

Unit 1 **[7 Hrs]**

Introduction

Types of Dam, Choice of dam, various components of dam, Gravity dam details: joints, water-seals and galleries. Elements of Earth Dam, basic design consideration, design of section, design of filters, rock toe, pitching, causes of failures, piping and its prevention

Unit 2 **[7 Hrs]**

Canal Irrigation

Types of canal, canal alignment, losses in irrigation channel, Irrigation efficiencies , various types of canal lining, economics of lining, determination of Canal capacity, Design of lined channels

Unit 3 **[7 Hrs]**

Spillway and Gates

Spillway capacity, flood absorption and disposal, different types of Spillway, their principles of design and construction, energy dissipation below overflow Spillway, Types and uses, Gates.

Unit 4 **[7 Hrs]**

Diversion Head Works

Selection of sites, layout of the work types of weirs and barrages, design of subsurface flow, safety against piping and uplift, Bligh, Lane, and Khosala's Theories, design of weirs on permeable foundations.

Unit 5 **[7 Hrs]**

Preliminary Sediment Transport Theory

Critical tractive force, regimes of flow, resistance of bed forms, suspended and bed load, its effect on channel design. Design of stable channels in alluvium, the regime method, Semi theoretical approach, cross-section of irrigation channels.

Canal Masonry Works

Cross drainage works, necessity types and selection, comparative merits and demerits, principles of design of various types of cross drainage work, falls and its types.

Unit 6 **(7 hrs)**

River Training Works

Hydraulics of alluvial rivers, meandering, aggradations and degradation, river training, necessity, river training works and bank protection, various measures and their design and construction principles.

Hydro Power

General features of Hydro-power, Principal components of a hydropower station: Intakes and Trash racks, Water conductor system, Tunnels, Surge tanks, Penstocks, Anchor blocks. Types of development, general layouts of different types, Assessment of power potential, Types and selection of turbines, cavitation.

Text Books:

1. Asawa G.L. ,Irrigation and Water Resources Engineering, New Age International (P) Ltd. Publishers, 2006.
2. Garg, S. K., Irrigation Engineering and Hydraulic Structures, Khanna Publishers Delhi, 2007.
3. Modi, P.N.,Irrigation, Water Resource and Water Power Engineering, Standard Book House, Delhi, 2008.

Reference Books:

1. River Behaviour, Management and Training, CBIP Vol-I, 1989.
2. Varshney R. S., Concrete Dams, Oxford and IBH Publishing Co.
3. Goldin, A. L. and Rasskazor, L. N., Design of Earth Dams, CRC Press (1992).
4. Khatsuria, R. M., Hydraulics of Spillways and Energy Dissipators, Marcel Dekker Publishing, New York.

I.S. Codes:

1. I.S. 8605 – 1977 (Reaffirmed 1998), Code of practice for construction of masonry in dams, third reprint, July 1999, B.I.S. New Delhi.
2. I.S. 6512-1984 (Reaffirmed 1998), Criteria for design of solid gravity dams, first revision, first reprint, September, 1998, B.I.S. New Delhi.
3. I.S. 457 – 1957 (Reaffirmed, 2005), Code of practice for general construction of plain and reinforced concrete for dam and other massive structures, sixth reprint, January 1987, B.I.S. New Delhi.
4. I.S. 10135 – 1985, Code of practice for drainage system for gravity dams, their foundations and abutments, first revision, B.I.S. New Delhi.
5. I.S. 14591 – 1999, Temperature control mass concrete for dams – guidelines, B.I.S. New Delhi.
6. I.S. 11223 – 1985 (Reaffirmed 2004), Guidelines for fixing spillway capacity, edition 1.2 (1991-09), B.I.S. New Delhi.
7. I.S. 6934 – 1998 (Reaffirmed 2003), Hydraulic design of high ogee overflow spillways – recommendations, first revision, B.I.S. New Delhi.
8. I.S. 11155- 1994, Construction of spillways and similar overflow structures – Code of practice, B.I.S. New Delhi.
9. I.S. 5186 – 1994, Design of chute and side channel spillway – criteria, first revision, B.I.S. New Delhi.
10. I.S. 10137- 1982 (Reaffirmed 2004), Guidelines for selection of spillways and energy dissipaters, B.I.S. New Delhi.
11. I.S. 4997 – 1968 (Reaffirmed 1995) Criteria for design of hydraulic jump type stilling basins with horizontal and sloping apron, sixth reprint, January, 1998, B.I.S. New Delhi.
12. I.S. 7365-1985, Criteria for hydraulic design of bucket type energy dissipaters, first revision, B.I.S. New Delhi.

[CE(DE)-18005] Design of Hydraulic Structures Laboratory

Teaching Scheme
Practical: 2 hrs./week

Examination Scheme
Continuous Evaluation : 50 Marks
End Sem Oral Examination: 50 Marks

Course Outcomes:
Students will be able to
1. select the appropriate hydraulic structure.
2. design suitable hydraulic structures.
3. carry out benefit cost analysis of water resources project.

Contents:

A) List of Assignments

1. Design of a spillway and stilling Basin.
2. Determination of capacity of canal and its design
3. Design and analysis of a weir on permeable foundation
4. Design of any one type of cross drainage works
5. Design of any one type of canal fall and standing wave flume
6. Benefit cost analysis of water resources project.
7. Design of any one type of river training work

B) Report on Site Visit

A report based on visit to any irrigation project during the academic term.

Note: 1. The term work shall consist of record of the above assignments in Journal.
2. Oral examinations will be based on the above exercises.

[CE(DE)-18009] Matrix Analysis of Structures

Teaching Scheme
Lectures : 3 hrs / week

Examination Scheme
Internal Test 1: 20 marks
Internal Test 2: 20 marks
End Sem. Exam: 60 marks

Course Outcomes:

Students will be able to:

1. Analyse Plane Trusses, and Continuous Beams using Matrix Stiffness Method.
2. Analyse Plane Frames, and Grids .
3. Analyse Space Trusses and Space Frames .
4. Use computer Programs for analysis of Framed Structures.

Unit 1: Introduction **[5 Hrs]**

Matrix methods for skeletal structures, Basic considerations of structural analysis, Boundary conditions, Flexibility Method, Displacement Method, Stiffness relationships.

Unit 2: Matrix Displacement Method **[6 Hrs]**

Bar element with axial force, Member stiffness matrix, Bar element subjected to torsion, Stiffness matrix of a beam element, Assembly of the structure stiffness matrix

Unit 3: Plane Frames **[7 Hrs]**

Pin-jointed frames, Rigid jointed frames, inclined supports, Bandwidth of stiffness matrix, Member Stiffness Relations in the Local Coordinate System, Coordinate Transformations, Stiffness in the Global Coordinate system

Unit 4: Other Kinds of Loading **[5 Hrs]**

Loading between joints, Effects of temperature change and lack of fit

Unit 5: Space Frames **[5 Hrs]**

Grid structures, Ball-jointed space frames, Rigid-jointed space frames, Structure Stiffness Relations [6Hrs]

Unit 6: Programming for Stiffness Method **[7 Hrs]**

Flow Charts, Continuous Beam Program, Plane Truss Program, Plane Frame Program, Space Truss Program

Reference Books:

1. William Weaver and James Gere, " Matrix Analysis of Framed Structures ", Springer Publication, 1990.
2. Damodar Maity , " Computer Analysis of Framed Structures", I. K. International Publication, 2007.
3. Aslam Kassimali, " Matrix Analysis of Structures ", Cengage Learning, 2010.

4. P. N. Godbole, R. S. Sonparote and S. U. Dhote, " Matrix Methods of Structural Analysis", Prentice Hall Publication, 2012.

[CE(DE)-18043] Matrix Analysis of Structures Laboratory

Teaching Scheme
Practical: 2 hrs / week

Examination Scheme
100: Continuous Evaluation: 70 Marks
End Semester oral Examination: 30 Marks

Course Outcomes:
Students will be able to:
1. Analyse Plane Trusses and Beams
2. Analyse Plane Frames.
3. Analyse Grids, Space Trusses, and Space Frames.

Contents:
List of Experiments:
1. Flexibility Analysis of Beams and Plane Trusses.
2. Flexibility Analysis of Plane Frames.
3. Stiffness Analysis of Beams and Plane Trusses.
4. Stiffness Analysis of Plane Frames.
5. Stiffness Analysis of Grids.
6. Analysis of Plane Frames using computer program.
7. Analysis of Space Trusses using computer program.
8. Analysis of Grids using computer program.
9. Analysis of Space Frames using computer program.
10. Analysis for settlement of support, temperature change and Lack of fit for Truss members.

[CE(DE)-18002] Green Building Practices

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
Test 1 and 2 – 20 Marks each
End-Sem Exam- 60 Marks.

Pre-requisite: Building Planning.

Course Outcomes:
After completion of the course Student will able to:
1. Understand the economic benefits of a green building.
2. Classify the terms and the construction methodologies between "traditional building" and "green building".

3. Evaluate the status of building for Indian green building rating system.

Unit 1 **[10 Hrs]**

Concept of green building, environment & Economic issues of conventional building, benefits of green bldg., objectives of GB energy efficiency, water conservation, Low environment impact, building materials, sustainability, waste management Health and wellbeing. Planning of green building

Sustainable site selection orientation, building envelop, building plan layout, design of doors and windows, natural ventilation, solar energy, use of solar energy for water heating, solar concentrators, solar photovoltaic panels, direct and indirect lighting, comparison of various lighting devices-electric tubes, incandescent lamps, CFL and LED lamps, indirect lighting devices-light tubes, fibre optic, Fresnel lens.

Unit 2 **[5 Hrs]**

Passive and active architecture, Natural ventilation and air conditioning, Hybrid system of active and passive refrigeration and air-conditioning. Concept of Embodied energy of various common building materials. Energy and water audit of building.

Unit 3 **[5 Hrs]**

Various rating systems in Green building, LEED criteria, USGBC, IGBC Green rating, GRIHA criteria, Eco housing, Environmental clearance of buildings.

Unit 4 **[6 Hrs]**

Water efficiency, Water Efficient Landscaping- Rain water harvesting, potable water and bore well recharging, minimization of water use, dual flush, Waterless urinals, Smart controlled water tabs, Recycling of treated waste water for different non potable use, Domestic solid waste –segregation, green materials.

Unit 5 **[7 Hrs]**

Indoor environment Quality low-VOC emitting materials. Adhesive and sealants, Paints and coatings, carpet systems, Composite fibre agro fibre products as like jute, bamboo, coconut and their use as interiors.

Unit 6 **[7 Hrs]**

Recycling of building materials, Exiting walls, roofs and floors, Internal non-structural element, Construction waste management, Materials use, Recycled content, Use of fly ash, foundry sand and other inert solid wastes in building, life cycle analysis, Construction phase, Operation phase, demolition and land use.

Reference Books:

1. Michael Bauer, Peter Mösle and Michael Schwarz, “Green Building – Guidebook for Sustainable Architecture” Springer Publication, ISBN 978-3-642-00634-0.
2. Kibert, C. J. “Sustainable construction: Green building design and delivery”, Wiley, Hoboken, NJ. 2013.
3. LEED for homes green building rating system – U.S. green building council, <http://www.usgbc.org/leed/homes>
4. IGBC green building rating system, <http://igbc.in/site/igbc/testigbc.jsp?desc=115708&event=115679>

5. Green Rating for Integrated Habitat Assessment (GRIHA).〈http://www.grihaindia.org〉
6. Building research establishment's environmental assessment method. Design and procurement pre-assessment estimator BREEAM
7. Eco Housing green building rating system. <http://portal.mcgm.gov.in/irj/portalapps/com.mcgm.ecohousing/docs/Eco_housing_Construction.pdf>
8. Comprehensive assessment system for building environmental efficiency. CASBEE for new construction: technical manual 2004 edition. <http://www.ibec.or.jp/CASBEE>
9. ASHRAE Standard 62-1999 Ventilation for Acceptable Indoor Air Quality
10. ASTM E1903-97
11. ASHRAE IESNA Standard: 90.1
12. National Building Code 2017.

[CE(DE)-18006] Green Building Practices Laboratory

Teaching Scheme	**Examination Scheme**
Practical: 2hrs/week	Test 1: Oral 20 Marks Test 2: MCQ: 20 Marks ESE: Submission and oral 60 Marks

Pre-requisite: Building Planning and Drawing Theory and Laboratory.

Course Outcomes:

After completion of the course Student will able to:

1. Evaluate the economic benefits of a green building.
2. Evaluate the status of building for Indian green building rating system.
3. Evaluate building for energy and water audit.

Contents:

Term work shall be based on the following:

a) Term Work Based on Course Work

1. Assignments based on advanced green building materials.
2. Energy audit of one building.
3. Water audit of one building.
4. Suggested modifications for improving green rating and and energy conservation in building studied.
5. Life cycle analysis of green buildings.
6. Case study of GB – Residential /Commercial / institutional/ industrial with salient features in terms of planning, material, water management, construction techniques, waste management etc.

b) Site Visit to Project Site

7. A report would be presented as a part of course work and shall form the part of term work. Course Teacher will arrange all the visits to suit the course work.
8. A Laboratory Journal based on the practical work would be prepared for the term-work.
9. Oral Examination would be based on the term work. Course Teacher for the Laboratory would decide the breakup of marks for the Oral Examination. An Objective Multiple Choice Test based on the theory for the Course Work can be conducted as a part of the oral examination.

[CE(DE)-18003] Advanced Surveying

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
100 marks: Continuou Evaluation- Assignments /Quiz- 40 Marks, End - Sem Exam – 60 Marks

Course Outcomes:

Students will be able to:

1. use advanced instruments for surveying.
2. make survey for large area.
3. apply corrections to field data.

Unit 1 **[7 Hrs]**

Triangulation Adjustment :

Kinds of errors, Laws of weights, Determination of Most probable values [MPV] of conditioned and independent quantities, Method of least squares, probable error and its determination, Distribution of error to the field measurement. Normal equation, Method of correlates, station adjustment and figure adjustment of Geodetic triangle [without central station] and Geodetic Quadrilateral [without central station], Spherical triangle, calculations of spherical excess and sides of spherical triangle.

Unit 2 **[7 Hrs]**

Hydrographic Surveying:

Objects, Establishing controls, Shoreline survey, soundings, Equipments for measuring soundings and method of locating soundings, Reduction of soundings, Plotting of soundings, Three point problem and its solution by Analytical and Graphical methods. Tides and tide gauges, Nautical sextant and its use.

Unit 3 **[7 Hrs]**

Remote Sensing:

Basic principles, Electromagnetic spectrum, Interaction mechanism and image formation, Classification of remote sensing systems, platforms for sensing different types of data products, Applications to Civil Engineering, concept of global positioning systems [GPS] and differential GPS.

Unit 4 **[7 Hrs]**

GIS:

Components of GIS- data acquisition, spatial and attribute data, pre-processing, storage and management; Data structures- raster and vector data; GIS analysis functions; Errors and corrections; Data presentation and generation of thematic maps; Applications.

Unit 5 **[6 Hrs]**

GPS:

Detailed discussion on various generations of GPS satellites, trilateration techniques, GPS signals, anti-spoofing, concept of standalone positioning and GNSS receivers.

Unit 6 **[6 Hrs]**

Modern Surveying Instruments:

Electromagnetic waves and their properties, phase, phase comparison, Modulation, Types of Electromagnetic Distance Meters [E.D.M.]–Geodimeter, Tellurometer, Distomat. Total Station and its uses.

Text Books:

1. T.P.Kanetkar & S.V.Kulkarni, “Surveying and Levelling Vol. II”, Pune Vidhyarthi Gruh
2. Dr. B.C.Punmia ,”Surveying Vol. II & III”, Laxmi Publications (P) Ltd., New Delhi.
3. Dr. K.R.Arora ,”Text book in Surveying Vol. II & II”, McMillan Publication..

Reference Books:

1. J. Uren and W.F.Price, “Surveying for Engineer”, McMillan Publication.
2. Anderson, ”Introduction to Surveying”, McGraw Hill Publication.
3. Paul R Wolf,”Elements of Photogrammetry”, McGraw Hill Publication.
4. J.M.Kennie and M.C.Matthews ,”Remote Sensing in Civil Engineering”, McGraw Hill Publications.

[CE(DE)-18007] Advanced Surveying Laboratory

Teaching Scheme	**Examination Scheme**
Practical: 2 hrs./week	Term-work: 50 Marks
	Oral & Practical: 50 Marks

Course outcomes:

Students will be able to:

1. use advanced instruments for surveying.
2. make survey for large area.
3. apply corrections to field data.

List of practicals:

1) Traversing by 1" Theodolite.
2) Triangulation adjustment.
3) Measurement of horizontal angle by Nautical sextant.
4) Total station applications.
5) Differential global positioning system.
6) Assignments on GIS and remote sensing.

[CE(DE)-18004] – Foundation Engineering

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
100 marks: Continuous evaluation-
Assignments /Quiz- 40 Marks
End - Sem Exam – 60 Marks

Course outcomes:

1. Students will be able to plan and execute soil exploration activity.
2. Student will be able to decide soil parameters for foundation design.
3. Student will be able to design foundation for expansive soil.
4. Student will be able to determine bearing capacity of rock.

Unit 1:Soil Exploration: [6 Hrs]

Purpose, importance, methods of soil exploration, subsurface exploration, trial pits, boring: method of borings. Number of boreholes, depth and spacing of boreholes, types of test to suit the soil conditions, Location of water table, Sampling: Disturbed And Undisturbed Samples, Area ratio, Field tests: SPT, DCPT, SCPT, pressure-meter test, plate load test, field vane shear test

Unit 2: Bearing Capacity: [7 Hrs]

Terzaghi's bearing capacity analysis, Meyerhoff, Hansen's and Vasic equations for strip, rectangular and round footing, effect of various water table on bearing capacity, method of determination of bearing capacity using field test (SPT and Plate Load)**(IS:SP 36 (Part-II): 1987)**, Housel's method for bearing capacity from plate load test, bearing capacity of rocks, RQD and RMR concepts

Unit 3: Settlement of Shallow Foundation: [7 Hrs]

Stresses in soil due to footing pressure, Westergaard's method for computing soil pressures, Immediate settlement computations, Settlement of foundation due to consolidation, correction factor for consolidation settlement.

Unit 4: Design of Shallow Foundation: [7 Hrs]

Geotechnical design of isolated and raft foundation, shear failure and settlement criteria.

Unit 5: Pile and deep Foundation: **[7 Hrs]**

Pile classification, Carrying capacity of pile, static and dynamic methods, pile load test, group action, Rigid block method, Negative skin friction, Settlement of single and group of piles, introduction to well foundation.

Unit 6: Foundation on Expansive soil: **[6 Hrs]**

Identification of expansive soil, field condition that favour swelling, design of foundation for expansive soils.

Text Books:

1) Dr. B. J. Kasmalkar, "Foundation Engineering", Pune Vidyarthi Griha Prakashan, Pune.
2) Gopal Ranjan and A S Rao, "Basic and Applied Soil Mechanics", New Age International Publishers, (2010).
3) B.C. Punmia, "Soil Mechanics and Foundation Engineering", Laxmi Publication.
4) A.K.Arora, "Soil Mechanics and Foundation Engineering", Standard Publishers, 2009.
5) P.C. Varghese," Foundation Engineering", PHI learning private limited, 2014.

Reference Books:

1) J. E. Bowles, "Foundation Analysis and Design", McGraw-Hill International.
2) B. M. Dass, "Foundation Engineering", Cengage Learning; 7 edition.
3) N.V. Nayak, "Foundation Design Manual", Dhanpat Rai and Sons, First Edition.
4) IS Codes such as, IS:1904 (1986), IS: 6403 (1981), IS: 8009Part I (1986), IS: 12070 (1987).

[CE(DE)-18008] Foundation Engineering Lab

Teaching Scheme
Practical: 2 Hrs/week

Examination Scheme
Term-work: 50 Marks
Oral: 50 Marks

Course Outcomes:

1. Students will be able to carry out and interpret field tests.
2. Student will be able to understand real life geotechnical problems with the help of site visits
3. Student will be able to design shallow and deep foundation using suitable softwares.

A) The following Laboratory experiments shall be carried out

1. Electrical resistivity test.
2. Standard penetration test (SPT).
3. Static cone penetration test (SCPT) / Dynamic cone penetration test (DCPT).
4. Plate bearing test /Pressure meter test.

B) Use of suitable computer software (Geoslope or plaxis) for analysis and design of shallow and pile foundation.

1. Report on the basis of the field visit.

Reference Books:

1. SP 36 (Part-II): 1987 Compendium of Indian Standard on soil Engineering: Part-I &II (Laboratory & Field) testing of soils Civil Engineering purposes.

[CE(DE)-18011] Structural Health Monitoring and Retrofitting

Teaching Scheme
Lectures : 3 hrs / week

Examination Scheme
Internal Test 1: 20 marks
Internal Test 2: 20 marks
End Sem. Exam: 60 marks

Course Outcomes:

Students will be able to:

1. Observe the status of structure from Visual observation and NDT Test.
2. conduct structural audit.
3. Suggest repairing methods and or retrofitting technique for strengthening of structural member and or structure.

Unit 1: **[7 Hrs]**

Introduction, need of structural Health Monitoring (SHM), factors affecting health of structures**,** causes of distress, load variation, material variations, Structural health monitoring. Various measures, regular maintenance, Advantages of SHM.

Unit 2: **[7 Hrs]**

Visual Inspection of structure, techniques, different types of NDT tests.

Unit 3: **[7 Hrs]**

Structural audit, Role of Engineer, Purpose, survey of structural defects, Guidelines for structural audit, case studies.

Unit 4: **[7 Hrs]**

Cracks in structural members, types, measurements of cracks, performance of structure for different loading, failure of structures, different techniques for repairs of cracks.

Unit 5: **[7 Hrs]**

Carbonation of concrete, concept, deterioration of concrete, corrosion of reinforcement, settlement of structures.

Unit 6: **[7 Hrs]**

Structural repairs and retrofitting, different techniques, case studies, safety of structures.

Reference Books and Journals:

1. Daniel Balageas, Claus-Peter Fritzen, Alfredo Güemes, Structural Health Monitoring, John Wiley and Sons, 2006.
2. Douglas E Adams, Health Monitoring of Structural Materials and Components-Methods with Applications, John Wiley and Sons, 2007.
3. J.P. Ou, H.Li and Z.D. Duan, Structural Health Monitoring and Intelligent Infrastructure, Vol-1, Taylor and Francis Group, London, U.K, 2006.
4. Victor Giurglutiu, Structural Health Monitoring with Wafer Active Sensors, Academic Press Inc, 2007.

[CE(DE)-18042] Structural Health Monitoring and Retrofitting Lab

Teaching Scheme

Practical: 2 hrs / week

Examination Scheme

Continuous Evaluation : 50 Marks

End Sem oral Examination: 50 Marks

Total: 100 Marks

Course Outcomes:

Students will be able to:

1. Interpret types of defects in structures from visual observations and reasons behind them.
2. Conduct structural audit of a structure.
3. Suggest remedial measures for strengthening of a structure.

LIST OF EXPERIMENTS:

1. Site visit to old structures or structures under repair.
2. Assignments based on various defects in a structure.
3. Structural audit of existing small structure.
4. Experiments on concrete and RCC specimens to verify their load carrying capacities.
5. Assignment on different repairs and retrofitting techniques.
6. Site visit to observe and study a retrofitted /repaired structure.

[CE-18005] Project -I

Teaching Scheme

Practical: 2hrs./week

Examination Scheme

100 marks: Continuous evaluation-
Mid-sem presentation- 40 Marks,
End - Sem Exam – 60 Marks

Course Outcomes:

1. Students will be able to formulate problem based on literature survey.
2. Students will be able to present their ideas effectively.
3. Students will be able to communicate the importance of the selected topic effectively.

Project Topics:

Project Topics should preferably be design, development, design aid type and interdisciplinary socially relevant and application oriented. The project should aim at training the students in going through all important phases of project studies starting from establishing the need through collection of data, analysis, design, development, drawing, cost estimates and project reports, where appropriate some alternatives which meet the same needs should also be considered and evaluated using appropriate evaluation criteria

Methodology For Project Evaluation

During the First Stage of the Project Students would identify a project in a area related with engineering and carryout the necessary literature review. Based on the literature review during first stage of the project student would write a report which would give a review of literature, problem formulation and methodology to be adopted. The report would be presented through a seminar which would be evaluated at the end of the term by the committee.

The Work may consist of the following points:

1. Problem Formulation
2. Survey of Literature
3. Experimental investigation/ Data collection
4. Design and Fabrication of Model
5. Industrial Assignment

Note:

Seminar Report for Project-I would cover Literature Review, Project Formulation and Time Scaled Schedule for Project-II. Seminar would be evaluated by the panel of examiners. Preferably same panel of examiners will be maintained during second stage evaluation. Project group will consist of **maximum three** students in a group.

Minor

[CE(MI)18001] Structural Analysis

Teaching Scheme
Lectures : 3 hrs / week

Examination Scheme
Internal Test 1: 20 marks
Internal Test 2: 20 marks
End Sem. Exam: 60 marks

Course Outcomes:

Students will be able to:

1. Convert given practical problem into structural model by applying knowledge of various types of structures and supports.
2. Analyse isotropic structural skeletal members subjected to loading.
3. Analyse statically determinate beams, frames and trusses for deflection.
4. Analyse statically indeterminate structures using computer programs.

Unit 1: Introduction **[6 Hrs]**

(a) Basic concepts of Structural Analysis: Types and classification of structures based on Structural forms. Skeleton structures, Surface Structures, 3D Structures

(b) Simple Stresses and Strains: Different types of stresses and strains, Generalised Hooke's law, Elastic constants and their relationships for isotropic materials

Unit 2: Stresses in beams due to bending and shear: **[6 Hrs]**

(a) Shear force and bending moments for determinate beams

(b) Theory of pure bending, flexure formula, maximum and average shear stress

Unit 3: Energy methods for Analysis of determinate structures **[7 Hrs]**

(a) Strain energy: Concept, Strain energy due to axial force, shear force, bending moment and torsional moment

(b) Unit load method for deflection of beams, rectangular portals and trusses

Unit 4: Analysis of indeterminate structures **[7 Hrs]**

(a) Concept of indeterminacy and degrees of freedom: Static and kinematic indeterminacy

(b) Analysis of indeterminate structures: Castigliano's least work method for analysis of beams, rectangular portals and trusses

Unit 5: Stiffness Method **[7 Hrs]**

Stiffness method of analysis of indeterminate beams, frames and trusses

Unit 6: Computer Applications **[7 Hrs]**

Computer Applications of stiffness method for analysis of beams, frames and trusses

Reference Books:

1. Hibbeler R.C., "Mechanics of Materials", Pearson Education Asia Publication, 8/e, Pearson Publication, 2012.
2. Hibbeler R.C., "Structural Analysis", Pearson Education Asia Publication, 10/e, Pearson Publication, 2017.
3. Reddy, C. S., "Basic Structural Analysis", Tata McGraw Hill Publishing Company Limited.
4. Hearn E. J., "Mechanics of Materials", Butterworth Heinemann, Publications (Third Edition), 1997.
5. Devdas Menon, "Structural Analysis", Alpha Science, 2008.

Honors

[CE(HO)18001] Project Management

Teaching Scheme	**Examination Scheme**
Lectures : 3 hrs/week	Test 1 and 2 – 20 Marks each End-Sem Exam- 60 Marks.

Pre-requisite: Construction Management.

Course Outcomes:

Students will be able to:

1. Understand the importance of Project Management tools.
2. Plan and Schedule the Project by using CPM, PERT, precedence and MSP.
3. To understand financial analysis using ratios, cash flow, funds flow.
4. Know the importance of Safety and Risk Management in Construction.

Unit 1 **[7 Hrs]**

Network analysis: Critical Path method, Programme evaluation and review technique, Ladder Network, Line of Balance, Activity-on-Node and with Leads, Lags, and Windows – Scheduling with Resource Constraints and Precedence – Use of Advanced Scheduling Techniques – Scheduling with Uncertain Durations – Calculations for Monte Carlo Schedule Simulation – Crashing and Time/Cost Tradeoffs – Improving the Scheduling Process.

Unit 2 **[7 Hrs]**

The Cost Control Problem – The Project Budget – Forecasting for Activity Cost Control – Financial Accounting Systems and Cost Accounts – Control of Project Cash Flows –Schedule Control – Schedule and Budget Updates – Relating Cost and Schedule Information.

Unit 3 **[7 Hrs]**

Quality and Safety Concerns in Construction – Organizing for Quality and Safety – Work and Material Specifications – Total Quality Control – Quality Control by Statistical Methods – Statistical Quality Control with Sampling by Attributes – Statistical Quality Control with Sampling by Variables – Safety.

Unit 4 **[7 Hrs]**

Profit and loss, balance sheet, income statement, ratio analysis, depreciation and amortization, preparation of financial statements, inflation accounting and corporate practices in India.

Unit 5 **[7 Hrs]**

Time value of money, discounted cash-flow, NPV, ROR, benefit cost ratio, incremental rate of return, benefit cost analysis, replacement analysis, break even analysis.

Unit 6 **[7 Hrs]**

Computer Application in Project Management: Microsoft project and Primavera Project Planner (P6) and its application, Case studies

Risk Management –Definition, Types, Risk Identification Process, Sources of Risk, Risk Classification, Risk Mitigation- Risk Reduction, Risk Acceptance, Risk Avoidance.

Reference Books:

1. Calin M. Popescu, Chotchai Charoenngam (1995.) "Project Planning, Scheduling and Control in Construction: An Encyclopedia of Terms and Applications". 1st Edition. Wiley, New York.
2. Chitkara. K. K (1998) "Construction Project Management Planning - Scheduling and Control". 3rd Edition. Tata McGraw Hill Publishing Co., New Delhi.
3. Cleland, D. I. and Ireland. L. R. (2002). "Project Management: Strategic Design and Implementation". 4th Edition, McGraw-Hill, New York.
4. Kumar Neeraj Jha (2016) "Construction Project Management: Theory and Practices" 2nd Edition, Pearson Education Publishers.
5. Willis. E.M.(1986). "Scheduling Construction Projects". Wiley New York.
6. Danny Myers (2004). "Construction Economics: A New Approach". 2nd Edition. Routledge (Taylor and Francis) Publisher.
7. Halpin, D.W. (1985). "Financial and cost concepts for construction Management". 1st Edition. Wiley, New York.
8. James C Van Horne (2001). "Financial Management and Policy". 12th Edition. Prentice Hall, New Delhi.
9. Ofori. G (1991). "The Construction Industry: Aspects of its Economics and Management". Singapore.
10. Prasanna Chandra (2007) "Finance Management", 7th Edition. Tata McGraw Hill Publishing Co. Ltd. New Delhi.
11. Riggs, J.L., Bedworth, D.D., and Randhawa, S.U. (2005). Engineering Economics Tata- McGraw Hill Publishing Co Ltd.
12. Tarquin, A.J. and Blank, L.T. (1976) Engineering Economy, A Behavioural Approach McGraw Hill Book Company.

[CE(HO)-18002] Advanced Structural Design

Teaching Scheme
Lectures : 3hrs/week

Examination Scheme
Internal Test 1 : 20 marks
Internal Test 2 : 20 marks
End Sem. Exam: 60 marks

Course Outcomes:
Students will be able to:

1. interpret the behaviour and analyse special structures and their components. [PO a, b]
2. design and prepare detailed structural drawings for field execution according to relevant IS codes. [PO c]

Unit 1: 3D Analysis and Design of RC Building up to G+10 **[8 Hrs]**
3D modeling and analysis of RC Framed Building Structure under design load combinations including wind, earthquake and blast loads. Use of commercial software. Analysis of results for design of structural Elements, including flat slabs.

Unit 2: Shear Walls **[6 Hrs]**
Design of RC and Steel plate Shear Walls in multi-storey building.

Unit 3: Liquid Retaining Structures **[7 Hrs]**
Basic design philosophy, Analysis and design of water tank (GSR and ESR) subjected to hydrostatic, wind and earthquake loading. Professional design and detailing.

Unit 4: Earth Retaining Structures **[7 Hrs]**
Basic design philosophy, Calculation of lateral earth pressure based on Rankine's theory and Coulomb's theory. Analysis and design of Cantilever retaining walls, Counterfort retaining walls and box type retaining walls. Introduction to soil-structure interaction.

Unit 5: Design of Foundations **[7 Hrs]**
Design of combined footing, trapezoidal footing, raft foundation, pile foundation and; combined raft & pile foundation.

Unit 6: Structural Vibration Control **[7 Hrs]**
Design of elastomeric base isolators for multi-storey RC building.

Text Books:

1. P.C. Varghese, Design of Reinforced Concrete Foundations, Prentice Hall of India Private Limited, 2009.

2. S.U. Pillai and D. Menon, Reinforced Concrete Design, Tata McGraw Hill, 3rd Edition.
3. P. Agarwal and M. Shrikhande, Earthquake Resistant Design of Structures, Prentice-Hall of India Private Limited, 2006.

Reference Books:

1. T. Paulay and M.J.N. Priestley, Seismic Design of Reinforced Concrete and Masonry Buildings, John Wiley and Sons Inc., 1992.
2. S.K. Duggal, Earthquake Resistant Design of Structures, Oxford University Press, 2007.
3. IS 456 (2000), Plain and Reinforced Concrete - Code of Practice, Bureau of Indian Standards, New Delhi.
4. IS 1893 (Part 1): 2016 and IS 1893(Part 3): 2014, Criteria for Earthquake Resistant Design of Structures, Bureau of Indian Standards, New Delhi.
5. IS 13920 (2016), Code of Practice for Ductile Detailing of Reinforced Concrete Structures subjected to Seismic Forces, Bureau of Indian Standards, New Delhi.
6. IS 3370 (Part I): 2009, Code of Practice for Concrete Structures for Storage of Liquids Part I General Requirements. Bureau of Indian Standards, New Delhi.
7. IS 3370 (Part II): 2009, Code of Practice for Concrete Structures for the Storage of Liquids Part II Reinforced Concrete Structures. Bureau of Indian Standards, New Delhi.
8. IS 3370 (Part IV): 1997, Code of Practice for Concrete Structures for the Storage of Liquids, Design Tables. Bureau of Indian Standards, New Delhi.
9. IS 11682 (1985) : Criteria for Design of RCC Staging for Overhead Water Tanks.

[CE(HO)18004] Ground Water Engineering

Teaching Scheme	**Examination Scheme**
Lectures : 3 hrs/week	Test 1 and 2 – 20 Marks each
	End-Sem Exam- 60 Marks.

Course Outcomes:

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

1. Demonstrate the different terminologies related with groundwater hydrology.
2. Identify suitable method of determination of aquifer parameters.
3. Choose suitable ground water exploration techniques and assess ground water potential
4. Compare and contrast suitable ground water development and management methods.

Unit 1: Ground Water **[7 Hrs]**

zone of aeration, saturation, soil water, adsorbed water, capillary water, capillary potential, storage coefficients of aquifers, porosity, specific yield, specific retention, unconfined and confined aquifer, fluctuation of water table, fluctuation of the piezometric surfaces, ground water potential in India, geophysical methods for groundwater explorations.

Unit 2: Well Hydraulics **[7 Hrs]**

Darcy's law, permeability and transmissibility, Theim and Dupuit's theory for unconfined and confined aquifers. Groundwater flow potential, Ground water theory for one, two and three dimensional problem, Differential equations governing groundwater flow for steady and unsteady state problems, use of finite difference method to solve simple ground water flow problem. zone of aeration, saturation

Unit 3: Evaluation of Aquifer Properties **[7 Hrs]**

Aquifer tests control well, observation well, measurement during test, Theis method, Jacob and Chow's method of determination of aquifer parameters, Theis' recovery method, bounded aquifer, interference among wells, Image well theory and its application in groundwater flow.

Unit 4: Drilling of Wells **[6 Hrs]**

Groundwater well losses, water well design and well drilling: well screen, development and completion of wells, Rotary drilling and Rotary percussion drilling, maintenance of wells.

Unit 5: Groundwater Development and Management **[7 Hrs]**

Conjunctive use, artificial recharge of groundwater- different methods, subsurface dam, waste water recharge, recharge by urban storm runoff, ground water storage changes, percolation from tanks, recharge from irrigated fields, dating of ground water, estimation of ground water discharge, ground water resource evaluation in India.

Unit 6: Ground Water Modelling **[6 Hrs]**

Groundwater Modeling: Groundwater flow, sand models, membrane model, thermal model, electric analog model and mathematical models.

Textbooks:

1. Raghunath, H.M. (2017) "Ground Water" New Age International (P) Limited, New Delhi.
2. Bhagu R Chahar (2015) "Ground Water Hydrology", McGraw Hill Education India Pvt Ltd, New Delhi

Reference Books:

1. Todd, D.K. "Ground Water Hydrology", John Wiley & Sons, Singapore.
2. Karanth, K. R. "Ground Water Assessment Development and Management", Tata McGraw Hill Publishing Company Limited, New Delhi
3. Domenico "Concepts and Models in Groundwater Hydrology", McGraw Hill Inc., NewYork
4. L. Harvil and F. G. Bell, *Ground Water Resources and Development*, Butterworth's, London.
5. Herbert F Wang and Mary P. Anderson "Introduction to Ground Water Modeling", W.H. Freeman and Company, NewYork

Semester VIII

[CE-18006] Quantity Surveying and Valuation

Teaching Scheme
Lectures : 3hrs/week

Examination Scheme
100 marks: Continuous evaluation- Assignments /Quiz- 40 Marks,
End - Sem Exam – 60 Marks

Course Outcomes:
Students will be able to:

1. Take out of quantities for various construction projects.
2. Prepare estimates for various civil engineering works.
3. Calculate rates for various items of construction.
4. Draft specifications and tender notice.
5. Prepare valuation report for residential building.

Unit 1 **[7 Hrs]**

Estimating:
Definition, importance of quantity surveying for civil engineer, purpose, types of estimates, data required for estimates. Item of work, Description of an item work, units of measurement and principles deciding the units, I.S. & PWD mode of measurements of building. Definition and purpose of approximate estimate, methods of approximate estimating of building and other civil engineering projects like roads, irrigation & water supply and sanitary engineering.

Unit 2 **[7 Hrs]**

Taking out Quantities:
Principles, methods of taking out quantities for different assignments mentioned in term work, use of software for taking out quantities. Abstracting bill of quantities, provisional and prime cost items, contingencies, establishment charges, Centage charges.

Unit 3 **[7 Hrs]**

Analysis of Rates:
Factors affecting cost an item of work materials, labour, tools, and plant, overheads and profit.
Task work-definition and factors affecting task work, Transportation of material and cost Schedule of materials and labour, schedule of rates (D.S.R).Analysis of rates of different items mentioned in T.W.

Unit 4 **[7 Hrs]**

Specifications:
Definition and purpose, types, drafting specifications, legal aspect, specifications of stone masonry, wood work, earth work, reinforcing brick work of R.C.C. work.

Unit 5 **[7 Hrs]**

Valuation of Property:

Purpose, nature of value, price, constant value, factors affecting value of a property. Free hold and leasehold property. Depreciation and methods of working out depreciation, sinking fund, years purchase, out goings.

Methods of valuation

i) Land and building basis ii) Rental basis iii) Reproduction and replacement cost basis
iv) Profit basis, fixation of rent.

Unit 6 **[7 Hrs]**

Contracts and Tenders:

General idea, Types of contracts. Law of contract, definition, objects and essentials of contract conditions specific condition, condition regarding EM, SD, Time limits (its importance). Liquidated damages and other more important condition regarding addition, alteration , extra items, testing and materials, defective work, subletting powers delegated to engineer in charge, regarding the above aspect, defect liability period, retention money, termination of contract, condition regarding payment to contractors , interim payment or running amount bills, advance payment, secure advance ,final bill Tenders and tender Notice Tender, Types of tenders, invitation of tender notice, documents, methods of preparation and submission of tenders, scrutiny of tenders, acceptance of tenders, general idea of global tenders. Methods of Extending Work PWD procedure of execution of work, Administrative approval, budget provision technical 37 sanction, Different methods of execution of work in PWD, like piecework, rate list, day work, daily labour, DPR.BOT for large project.

Text Books:

1. B.N.Dutta, “Estimating and costing”, 28th Edition, UBH Publishing.
2. B.S.Patil, “Civil Engineering Contracts and Estimates”, 4th Edition, Universities press.
3. Bhasin P.L., “Quantity Surveying: For Building and Civil Engineering Works”, S. Chand, Limited, 3rd Edition 1987.
4. Chakraborti M.”Estimating, Costing and Specification in Civil Engineering”, 24th Edition.
5. G.H.Birdie, “Estimating and Costing (Civil Engineering)”, 7th Edition 2015, Dhanpat Rai
6. Publishing.
7. Rangwala, “Elements of Estimating and Costing”, 8th Edition, Charotar Publishing House.

Reference Books:

1. PWD Hand Book and Red Book.
2. PWD District Schedule of Rates (DSR) – Latest.
3. IS 1200 (Part1-Part 28) Method of measurement of building and civil engineering works.

[CE-18010] Quantity Surveying and Valuation Laboratory

Teaching Scheme
Practical: 2 hrs / week

Examination Scheme:
100: Continuous Evaluation: 50 Marks
End Semester oral Exam: 50 Marks

Course Outcomes:
Students will be able to:

1. take out of quantities for various construction projects. (PO-a,j)
2. prepare estimates for various civil engineering works. (PO- a, d,i, j, k)
3. calculate rates for various items of construction. (PO-a, d, e, h,l)
4. draft specifications and tender notice. (PO- a, f, g, h, j, k)
5. prepare valuation report for residential building. (PO- a, d, e,f, g, h, i, l)

Contents:

A) Working out Detailed Quantities for

i) A Two storied R.C.C. framed building based on prevailing DSR rates for Pune District.
ii) Estimation of quantities of steel reinforcement for an R.C.C. frame structure in (i) above.
iii) Detailed Estimate of Residential Drainage and Water Supply Project.

B) Preparation of Estimate using Computer Software

Detailed estimate of any two of the following

i) One column, column footing, beam and slab panel.
ii) Quantities of form work.
iii) Pipe culvert and slab culvert.
iv) Earthwork (for a road, Railway, Canal or a small dam).

C) Writing Detail specifications of any two items Work

Form the items of works in (A) above

D) Analysis of Rates

For the two Items of Works in (A) above based on the prevailing market rates of various items and labour involved.

E) Valuation reports

Of a residential buildings using the format given in the O-1 form

F) Preparation of draft of tender notice

For the Work for which Detailed Estimate is Prepared.

G)Report on large project management a) PMC b)BOT

Note:

A Laboratory Record based on the laboratory work would be submitted for the term-work. Oral Examination would be based on the term work and theory covered in the class under the course Quantity Surveying and Valuation. Course Teacher for the Laboratory would decide the breakup of Oral Examination. An Objective Multiple Choice Test may be conducted as a part of the Oral.

Department Elective- II

[CE(DE)-18019] Water Resources Planning and Management

Teaching Scheme

Lectures : 3hrs/week

Examination Scheme

Internal Test 1: 20 marks
Internal Test 2: 20 marks
End Sem. Exam: 60 marks

Course Outcome:

Students will be able to:

1. analyze data like inflow, crop data, evaporation, sediments, etc. (PO-a, d)
2. plan and design reservoir for irrigation and hydropower. (PO-c)
3. evaluate the most economic project from the available options. (PO-b, c, e)
4. formulate a mathematical model for irrigation project and obtain optimal solution (PO-a, b, e)

Unit 1 **[7 Hrs]**

Introduction:

Introduction, National water policy, Development stages for conservation and flood protection purpose, reservoir yield and capacity, mass curve, sequent peak method, reservoir sediment distribution by various methods, flood routing and various methods.

Unit 2 **[7 Hrs]**

Reservoir Planning (Irrigation):

Planning for irrigation, evapotranspiration, methods of evapotranspiration, crop irrigation requirement, reservoir regulation, Reservoir operation- standard operating policy, Hedging rules and rule curves.

Unit 3 **[7 Hrs]**

Reservoir Planning (Hydropower):

Planning for hydropower, flow duration curve and load duration curve, Planning for run-of-river plant, planning of storage plant, base load plant, peak load plant and its planning, reservoir regulation.

[7 Hrs]

Unit 4

Systems Analysis in water resources planning:

Concepts, optimizing techniques, conventional and evolutionary, simulation, applications of soft computing techniques for water resources planning and management. Linear programming, Formulation of model, solution by Graphical method and software

Unit 5 **[7 Hrs]**

Water resources economics:

Water resources economics- cash flow diagram, discounting Factors, discounting techniques-benefit-cost ratio, internal rate of return, Annual cost and Present worth method, Evaluation of discounting techniques

Unit 6 **[7 Hrs]**

Watershed management and Basin Planning:

concept and principles of watershed management, Water balance of a basin, integrated river basin development, River water disputes, Inter-basin river water transfers, Environmental considerations in water resources planning.

Reference Books:

1. Goodman, A.S., Principles of Water Resources Planning, Prentice Hall Inc., New Jercy, 1984.
2. James, L.D. and Lee, R.R., Economics of Water Resources Planning, McGraw Hill, 1971.
3. Warnic, C.C., Hydropower Engineering, Prentice Hall Inc., New Jercy, 1984.
4. Vedula, S. and Majumdar, P. P., Water Resources Systems. Modeling Techniques and Analysis, TATA Mc Graw Hill, 2005
5. Linsley, R.K. and Franzini, J.B., Water Resources Engineering, Third Edition, Mc Graw Hill,Inc.
6. Kuiper, E., Water resources development: planning, engineering and economics, Butterworths, 1965.

[CE(DE)-18019] Water Resources Planning and Management Lab

Teaching Scheme

Practical: 2 hrs / week

Examination Scheme:

100:Continuous Evaluation: 50 Marks

End Semester oral Exam: 50 Marks

Course Outcome:

Students will be able to:

1. calculate reservoir capacity, yield, crop water requirement, revised reservoir capacity and area after sediment distribution, etc. (PO-a, d)
2. regulate reservoir for irrigation and hydropower. (PO-c)

3. evaluate the most economic project from the available options. (PO-b, c, e)
4. formulate a mathematical model for irrigation project and obtain optimal solution using software and optimization technique. (PO-a, b, e)

The term work shall consist of the assignments based on the following topics:

1. Estimation of reservoir capacity and yield by mass curve and sequent peak method
2. Estimation of crop water requirements
3. Preparation of working table for reservoirs
4. Flood routing methods
5. Reservoir sediment distribution by Empirical area reduction and Area increment methods
6. Flow duration curve, Load duration curve and Energy calculations
7. Regulation of reservoir for hydropower generation
8. Select the most economic project using various discounting Techniques
9. Formulation of mathematical model and solution using optimization technique and software.

Note:

A Laboratory Record based on the assignments would be submitted for the term-work. Oral Examination would be based on the term work and theory covered in the class under the subject - Water Resources Planning and Management. Course Teacher for the Laboratory would decide the breakup of Oral Examination.

[CE(DE)-18013] Special Concretes

Teaching Scheme

Lectures : 3 hrs / week

Examination Scheme

Internal Test 1: 20 marks
Internal Test 2: 20 marks
End Sem. Exam: 60 marks

Course Outcomes:

Students will be able to:

1. Design a Concrete Mix as per requirement and of desired quality.
2. Select suitable type of concrete for the specific application
3. To study the properties of concrete making materials, tests, mix design, special concretes and various methods for making concrete.

Unit 1: Ingredients of Concrete and Concrete Mix Design: [7 Hrs]

Importance of concrete, Ingredients of concrete and their properties, Different tests on cement, aggregates, Properties of fresh concrete, Principles of concrete mix design, Different methods of concrete mix design like IS Method, ACI method, DOE method, statistical quality control, sampling and acceptance criteria. Requirements of special concrete, admixtures and their types.

Unit 2: Properties of Hardened concrete: [6 Hrs]

Properties of hardened concrete, strength, elastic properties, creep and shrinkage, durability of concrete in different environment, Limitations of concrete,

Unit 3: **Types of concrete and their applications:** **[7 Hrs]**

Different classifications of concretes, Fly ash concrete, Sulphur impregnated concrete, Geo Polymer Concrete, Properties of Self compacting concrete and High performance Concrete, Design and procedure for making SCC and HPC

Unit 4: Fibre Reinforced Concrete: **[7 Hrs]**

Role of fibre and Types of fibres, Fibre reinforced cement Composite , continuous and short fibres, Applications of Fibre Reinforced cement Concrete in civil Engineering, different types of fibres, Comparative Study of the Mechanical Behavior of FRC, Ferro-cement technology, Glass fibre reinforced cement concrete.

Unit 5: Light weight concrete: **[7 Hrs]**

Advantages of light weight concrete, different materials used for LWC, Design of LWC, strength and durability of Light weight concrete, Current research in Light weight concrete .

Unit 6: Natural and synthetic Fibre Reinforced concrete: **[6 Hrs]**

Natural fibre reinforced concrete, synthetic fibre reinforced concrete, Durability aspects of different FRC Experimental Evaluation of Fibre reinforced cement and concrete composites , Case studies on FRC , Current Research and applications in FRC

Reference Books and Journals:

1. Gambhir.M.L., Concrete Technology, McGraw Hill Education, 2006.
2. Gupta.B.L., Amit Gupta, "Concrete Technology, Jain Book Agency, 2010.
3. Neville, A.M., Properties of Concrete, Prentice Hall, 1995, London.
4. Santhakumar.A.R. ;"Concrete Technology",Oxford University Press,2007.
5. Shetty M.S., Concrete Technology, S.Chand and Company Ltd. Delhi, 2003.
6. ACI Concrete Journals.
7. Indian Concrete Journal.

[CE(DE)-18023] Special Concretes Laboratory

Teaching Scheme

Practical: 2 hrs / week

Examination Scheme:

Continuous Evaluation: 50 Marks

End Semester oral Examination: 50 Marks

Total: 100 Marks

Course Outcomes:

Students will be able to:

1. Demonstrate their practical understanding on special concretes.
2. Design special concrete as per the requirements.
3. Conduct required tests on special concrete.

LIST OF EXPERIMENTS:

1. Design of concrete mix for ordinary concrete with and without admixture.
2. Tests on fresh and hardened concrete .
3. Design of self compacting concrete and High Performance concrete.
4. Case studies on special concretes.
5. Experimental work on Lightweight concrete
6. Experimental work on any one type of fibre reinforced concrete given below:
   a. Natural fibre reinforced concrete.
   b. Synthetic fibre reinforced concrete
   c. Steel fibre reinforced concrete.

[CE(DE)-18014] Appropriate Technology in Construction

Teaching Scheme
Lectures : 3 hrs / week

Examination Scheme
Internal Test 1: 20 marks
Internal Test 2: 20 marks
End Sem. Exam: 60 marks

Course Outcomes:

Students will be able to:

1. Justify need of appropriate Technology.
2. develop appropriate cost effective technology for the construction using locally available materials.
3. Apply and transfer knowledge of Appropriate Technology for development of traditional construction methodology in rural areas.

Unit 1: **[6 Hrs]**

Introduction, need of low cost construction, demands for housing, present status of housing in rural and urban areas in India, Traditional housing in rural areas.

Unit 2: **[6 hrs]**

Appropriate technology , concept, Advantages of appropriate technology, sustainable development, Appropriate Technology in different areas of Engineering.

Unit 3: **[7 Hrs]**

Development of Appropriate Technology, concept, quality of construction, Factors affecting cost of construction, Use of local materials for construction.

Unit 4: **[7 Hrs]**

Various techniques for reducing cost of construction of houses, Low cost rural roads, job opportunities in appropriate technology for construction.

Unit 5: **[7 Hrs]**

Current status and applications of low cost construction technology, Government policy in affordable housing, Role of NGO, Role of Institute in Unnat Bharat Abhiyaan.

Unit 6: **[7 Hrs]**

Durability aspects of low cost construction materials, Challenges in improving quality of construction in appropriate technology, case studies, site visit.

Reference Books and Journals:

1. R.J.Congdon. Introduction to Appropriate Technology. Rodale Press,1977.
2. L.G. Goodman ," Low cost Housing Technology : An East and West perspective , New York Pergamon press 1979.
3. Betz, M. J., McGowan, P., & Wigand, R. T. (Eds.). (1984). Appropriate Technology: Choices and development. Durham, NC: Duke University Press.
4. Journal papers related to use of natural fibres in construction.

[CE(DE)-18024] Appropriate Technology in Construction Laboratory

Teaching Scheme
Practical: 2 hrs / week

Examination Scheme
CE: 50 Marks, ESE: 50 Marks

Course Outcomes:

Students will be able to:

1. Address importance of appropriate technology to solve problems related to construction.
2. Identify and evaluate properties of available cost effective construction materials for their appropriate use in construction.
3. Under take small experimental works related to appropriate technology.

LIST OF EXPERIMENTS:

1. Site visit to rural and slum areas to observe traditional housing and identify problems related to housing.
2. Review of research works done by researchers on available local materials other than conventional materials like cement, concrete or steel.
3. Experimental works to observe performance of cost effective technology based construction materials.
4. Demonstration of a small project work based on appropriate technology.

[CE(DE)-18015] Introduction to Finite Element Analysis

Teaching Scheme
Lectures : 3 hrs / week

Examination Scheme
Internal Test 1: 20 marks
Internal Test 2: 20 marks
End Sem. Exam: 60 marks

Course Outcomes:
Students will be able to:

1. Solve Truss problems.
2. Solve beam problems.
3. Solve plane stress and plane stress problems.
4. Solve three dimensional and axi-symmetric problems.

Unit 1: Introduction [7 Hrs]
Introduction to Finite Element Method, General Procedure of Finite Element Analysis, History of the Finite element Method, Examples of Finite Element Analysis

Unit II: One dimensional Elements (Axial Force) [7 Hrs]
Bar Element, Nodal Equilibrium Equations, Element Stiffness matrix, Element Load Vector, Element Strain and Stress, Element Transformation, Assembly of Global Stiffness Matrix, Boundary conditions, Application to Trusses.

Unit III: One Dimensional Elements (Beam Element) [7 Hrs]
Elementary Beam Theory, Beam Element, Beam Element Stiffness Matrix, Element Load Vector, Flexure Element with Axial Loading.

Unit IV: Two Dimensional Elements (Plane Stress & Plane Strain) [7 Hrs]
Triangular Elements, Rectangular Elements, Quadrilateral elements, Isoparametric Formulation, Numerical Integration.

Unit V: Three Dimensional Elements [5 Hrs]
Three-Dimensional Elements- Tetrahedron and Brick elements.

Unit VI: Applications in Solid Mechanics [9 Hrs]
Plane Stress, Plane Strain, Axi-symmetric Stress analysis, General Three-dimensional Stress Elements, Strain and Stress Computation.

Reference Books:

1. T.R. Chandrupatla and A. D. Belegundu, “Introduction to Finite Elements in Engineering”, Prentice Hall Publication, 4/e, 2011.
2. D. V. Hutton, “Fundamentals of Finite Element Analysis”, McGraw Hill Publication, 10/e,

Pearson Publication, 2017.
3. P. Seshu, “Textbook of Finite Element Analysis”, Tata McGraw Hill Publishing Company Limited.
4. D.L. Logan, “A First Course in the Finite Element Method”, Cengage Publications, 2012.

[CE(DE)-18025] Introduction to Finite Element Analysis Lab

Teaching Scheme
Practical: 2 hrs / week

Examination Scheme
Continuous Evaluation: 50 marks
End Sem. Exam: 50 marks

Course Outcomes:
Students will be able to:
1. Write program for Plane Stress and Plane strain Problems using triangular elements.
2. Write program for plane Stress and Plane strain Problems using quadrilateral elements.
3. Use commercial software for three dimensional and axi-symmetric problems.

Contents:

Introduction to MATLAB Programming
Basics of MATLAB Programming, arrays and matrices, inverse of a matrix, File I/ O operations

Computer Programs for Plane Stress & Plane Strain Problems
Development of Computer Programs using Triangular Elements, Rectangular Elements, Quadrilateral elements,

Study of Commercial Software and its applications
Use of commercial software for three dimensional and axi-symmetric problems.

Reference Books:
1. T.R. Chandrupatla and A. D. Belegundu, “Introduction to Finite Elements in Engineering”, Prentice Hall Publication, 4/e, 2011.

[CE(DE)-18016] Advanced Environmental Engineering

Teaching Scheme
Lectures : 3 hrs/week

Examination Scheme
Test 1 and 2 – 20 Marks each
End-Sem Exam- 60 Marks.

Pre-requisite: Environmental Engineering, and Wastewater Engineering

Course Outcomes:
After completion of the course, Student will be able to:

1. Analyze data of meteorological parameters and design stack for industries.
2. Decide sampling process and interpretation of test results.
3. Collect data and analyze the problem of noise, odour, pollution & solid waste management.
4. Understand importance & preparation stages of Environmental Impact Assessment.
5. Decide advanced water and waste water treatment process.

Unit 1 **[7 Hrs]**

Meteorological Aspects:
Parameters influencing air pollution, measurement of parameters plume behaviour, transport, and diffusion. Formulae for stack heights, Gaussian diffusion models for finding ground level concentration. Design problems of height of chimney and ground level concentration.

Unit 2 **[7 Hrs]**

Sampling and Analysis:
Air Pollution survey, Basic and statistical considerations of sampling sites, Devices and methods used for sampling gases and particulars, Stack sampling, Iso-kinetic sampling Analysis of air samples, Chemical and instrumental methods, Ambient air quality standards and emission standards.

Unit 3 **[7 Hrs]**

A) Chemistry of air pollution: Photochemistry of air pollution, Photochemical smog reactions involved in its formation, Factors influencing its reactions.
B) Effects of Air Pollution: Effects on man, animals, vegetation and property, Economics of loss due to pollution, Episodes, Air Pollution index. Cost / benefit ratio, optimization.
C) Odors: Sources, measurement and control.

Unit 4 **[7 Hrs]**

Control of Pollution: By process modification, Change of raw materials, Fuels, process equipment and process operation by use of air pollution control equipments, For particulate pollutants, Air Pollution control by using Equipments, Design of control equipments as ESP, Scrubber, Bag filter, Cyclones etc Control of gaseous pollutants Absorption devices, Adsorption Devices, Combustion devices, Condensation devices **Land use planning:** As a method of air pollution control.

Unit 5 **[7 Hrs]**

A) Noise Pollution:

Sources, Noise characteristics, measurement of noise, Effects of noise, Control of noise.

B) Environmental Impact Assessment:

Definition, Broad Goals, Objectives, Phases in EIA, Contents of Application form, Advantages & Disadvantages of EIA, Environmental management plan, Environmental Impact of Industries, Urbanization and Agricultural activities.

Unit 6 **[7 Hrs]**

Advanced Water Treatment:

De fluoridation- Causes of fluorides in water, significance of high and low fluorides in water, methods of de fluoridation.

Modification of Rapid Sand Filter- Up flow Filters. Dual Media, Multimedia and mixed bed filters. Diatomaceous filters. Application Membrane Processes,

Emerging technologies in wastewater treatment like MBR, MBBR, SBR, Modifications in Septic tanks.

Text Books:

1. M.N. Rao ,Air Pollution, Tata Macgrahill 1989 edition
2. G. J. Gau and C. D. Wooten ,Environment Impact Assessment - Analysis Handbook, McGraw Hill.

Reference books

1. Martin Crawford, *Air Pollution Control Theory,* T M H Edition 1980.
2. Perkins , Air Pollution, McGraw-Hill Edition 2000.
3. KVSG Muralikrishnan, Air Pollution, Kaushal & Company Kakinada A.P.
4. Canter, Environment Impact Assessment, Mc Graw Hill.
5. Metcalf and Eddy, Wastewater Engineering, Tata McGraw Hill, 1996.

[CE(DE)-18026] Advanced Environmental Engineering Laboratory

Teaching Scheme	**Examination Scheme**
Practical: 2hrs/week	Continuous Evaluation: 50 marks End Sem. Exam: 50 marks

Course Outcomes:

Students will be able to:

1. determine pollution levels in atmospheric air.
2. design sampling system & determine pollution levels in stack.
3. design various air pollution control equipments in an industry.
4. suggest water treatment processes.

Course Contents in brief:

The term work shall consist of following

A) Following Assignments/ Seminar presentation / Literature review based on

1. Meteorological Aspect
2. Sampling and Analysis
3. Chemistry of air pollution
4. Control of Pollution
5. Noise Pollution / Environmental Impact Assessment
6. Advanced Water Treatment

B) A visit to an Industry to study Air pollution monitoring, control Equipments etc./ water treatment plant

Text Books:

1. Air Pollution By M.N. Rao Tata Macgrahill 1989 edition.
2. Environment Impact Assessment - Analysis Handbook - G. J. Gau, C. D. Wooten (McGraw Hill).

Reference Books:

1. Martin Crawford, Air Pollution Control Theory, T M H Edition 1980.
2. Air Pollution By Perkins McGraw-Hill Edition 2000.
3. Air Pollution By KVSG Muralikrishnan Kaushal & Company Kakinada A.P.
4. Environment Impact Assessment - Canter (Mc Graw Hill).
5. Metcalf and Eddy, Wastewater Engineering, Tata McGraw Hill, 1996.

[CE(DE)-18017] Computer Aided Structural Design

Teaching Scheme	**Examination Scheme**
Lectures: 3hrs/week	Internal Test 1 : 20 Marks
	Internal Test 2 : 20 Marks
	End Sem Exam : 60 Marks

Course Outcomes:

Students will be able to:

1. interpret the behaviour and analyse structures and their components. [PO a, b]
2. design structures according to relevant IS codes, using software and prepare detailed structural drawings for field execution. [PO c]

Unit 1: Introduction to commercial software: **[7 Hrs]**

Introduction to commercial software such as STAAD Pro, SAP 2000, ETABS and CSI Bridge

Unit 2: Design of RC Buildings: **[7 Hrs]**

Selection of dimensions of structural members from practical point of view, Analysis and design of: (i) Buildings with moment resisting frames (ii) Buildings with bracings (iii) Buildings with shear walls.

Unit 3: Use of CSI Bridge: **[7 Hrs]**

Analysis and design of RCC Bridge, Steel Bridge and Prestressed Concrete Bridge.

Unit 4: **[7 Hrs]**

Analysis and design of foundations like isolated footings, combined footing, raft etc.

Unit 5: **[7 Hrs]**

Analysis and design of Industrial building, Concept of pre-engineered building.

Unit 6: **[7 Hrs]**

Design of transmission and mobile towers.

Text Books:

1. Varghese P. C., "Design of Reinforced Concrete Foundations", PHI Learning Pvt. Ltd., 2009.
2. S. Ponnuswamy, "Bridge Engineering", Tata Mc Graw Hill, 2nd Edition.
3. Reference Manuals for all software.

Reference Books:

1. Bungale S. Taranath, "Structural Analysis and Design of Tall Buildings: Steel and Composite Construction", CRC Press, 1st Edition.
2. Bungale S. Taranath, "Reinforced Concrete Design of Tall Buildings", CRC Press, 1st Edition.
3. IS 800, IS 456, IS 1343, IS 1893, IS 13920, IS 875, IS 4091.
4. IRC 6, IRC 21, IRC 112.

[CE(DE)-18027] Computer Aided Structural Design: Lab

Teaching Scheme	**Examination Scheme**
Practical: 2hrs/week	Continuous Evaluation: 50 marks End Sem. Exam: 50 marks

The lab work shall consist of following assignments:

1. Solution of tutorial problems on commercial software STAAD Pro.
2. Solution of tutorial problems on commercial software SAP 2000.
3. Solution of tutorial problems on commercial software ETABS.
4. Solution of tutorial problems on commercial software CSI Bridge.
5. Analysis and design of Buildings with moment resisting frames, with bracings and with shear walls.

6. Analysis and design of RC and PSC bridges.
7. Analysis and design of industrial buildings.
8. Design of transmission towers.

Reference:

1. STADD-Pro and ETABS Software.

[CE(DE)-18018] Advanced Fluid Mechanics

Teaching Scheme
Lectures : 3 hrs / week

Examination Scheme
Internal Test 1: 20 marks
Internal Test 2: 20 marks
End Sem. Exam: 60 marks

Course Outcomes:

Students will be able to:

1. Demonstrate the concept of pipe flow and various conditions of pipe flow.
2. Demonstrate the concept of Boundary Layer Theory and to have the concept of different thickness related to boundary layer.
3. Demonstrate the concept of Laminar Flow, losses in laminar flow through pipes and plates.
4. Details of Turbulent flow and concept of Moody's diagram.
5. Demonstrate the concept of Drag and Lift and related equations.
6. Demonstrate the Concept of unsteady flow and Water Hammer Phenomenon.

Unit 1 **[7 Hrs]**

Pipe Flow Problems: Losses in pipe flow, pipes in series, pipes in parallel, branching pipes, siphons, multi-reservoir problems, pipe net works. Major and minor losses in pipes. Derivation of Darcy Weisback Equation. Different types of minor loses viz: loss due to entry, loss due to exit, loss due to sudden and gradual enlargement, loss due to sudden contraction, loss due to bend, loss due to elbow bend, loss due to valve fitting, loss due to junction and fittings. The concept of unsteady flow. The concept of water hammer phenomenon. Water hammer action for gradual and sudden closure. Two conditions for sudden closure for rigid and flexible pipes. Concept of Surge and design of surge tank.

Unit 2 **[6 Hrs]**

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.

Unit 3 **[7 Hrs]**

Laminar flow, relation between pressure gradient and shear stress gradient for laminar flow. Laminar flow between two parallel plates, laminar flow through pipes, Derivation of Hagen Poiseuillie Equation.

The relation between mean and maximum velocity for laminar flow through pipes and parallel plates. Flow between two fixed parallel plates, flow between two parallel plates (one fixed and one moving), flow between two parallel plates (both moving in different directions). Derivation of Navier's-Stokes equation of for laminar Flow. Dimensional Analysis and Model Studies.

Unit 4 **[8 Hrs]**

Characteristics of Turbulent Flow, instantaneous velocity, temporal velocity, scale of turbulence and intensity of turbulence, semi empirical theories to estimate shear stress in turbulent flow using Boussinesq's theory, Prandtl's mixing length theory, velocity distribution in Turbulent flow, Prandtl's velocity distribution equation, Karman Prandtl velocity distribution equations for smooth and rough boundaries, Equation for mean velocity for pipes, Nikuradse's experiments on artificially roughened pipe, Friction factor for commercial pipes, Moody's diagram, explicit equations for friction factor.

Unit 5 **[7 Hrs]**

Practical Problems involving fluid flow around submerged objects; Definitions and expression for drag, lift drag coefficient, lift coefficients. Type of drag, Dimensional Analysis of Drag and Lift. Drag on sphere, cylinder, flat plate and aerofoil, Karmann's Vortex Street, Effects of free surface and compressibility on drag, Development of lift on cylinder and aerofoil, Magnus effect, Polar Diagram. Derivation of Kutta Joukowski Equation.

Unit 6 **[5 Hrs]**

Steady gradually varied flow, Dynamic equation, Characteristics of flow profile and methods of computation, Practical problems, gradually varied flow classification, analysis and computations. Steady rapid varied flow, Hydraulic jump analysis and location, introduction to surges in channel, Design of spillways, Energy dissipaters, Channel transitions.

Text Books :

1. Modi, P. N. and S. N. Seth "Hydraulics and Fluid Mechanics", Standard book house, New Delhi.
2. A.K. Jain "Mechanics of fluids", Khanna Publisher., Delhi.

[CE(DE)-18028] Advanced Fluid Mechanics Laboratory– I

Teaching Scheme
Lectures: 2/ week

Examination Scheme
Term Work: 50
Oral : 50 Marks

Course Outcomes:

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

1. Identify, name and characterize flow pattern in flat plate.
2. Demonstrate practical understanding of friction losses in pipes.

3. Demonstrate practical understanding of boundary layers, separation, drag, and lift.
4. Understand the open-channel flow phenomena.
5. Analyze hydraulic jump as a energy dissipater.

List of Experiments:

1. Study of major losses in pipe.
2. Study of minor losses in pipe.
3. Velocity distribution within laminar and turbulent boundary layer on a flat plate.
4. Pipe flow to determine the transition from laminar to turbulent flow.
5. Calibration of standing wave flume.
6. Study of hydraulic jump as energy dissipater.
7. Development of polar diagram for aerofoil.
8. Study of water hammer.

[CE(DE)-18037] Building Information Modelling

Teaching Scheme

Lectures : 3hrs/week

Examination Scheme

Internal Test 1: 20 marks
Internal Test 2: 20 marks
End Sem. Exam: 60 marks

Course Outcome:

Students will be able to:

1. Understand BIM concept and process.
2. Create architectural, structural & MEP models.
3. Extract information from BIM model.
4. Creation of families and components.
5. Understanding and implementation of 4D, 5D, 6D BIM.

Unit 1 **[5 Hrs]**

BIM Concept

What is BIM, BIM development & History, Difference between BIM and Cad, Terms used in BIM, BIM Benefits, Risks and challenges, Present State of BIM Adoption and Road ahead.

Unit 2 **[7 Hrs]**

Architectural BIM modelling

Building element and Revit element, Revit interface, basic operation, architectural element modelling, views and sheet documentation

Unit 3 **[7 Hrs]**

Structural BIM modelling

Modelling structural element, create analytical model, structural analysis, documentation

Unit 4 **[7 Hrs]**

MEP BIM modelling

Modelling for HVAC system, air terminals, mechanical equipment, piping system & plumbing fixture, linking with cross discipline model, create customize families-System families, component families, in place families.

Unit 5 **[7 Hrs]**

Project management 4D- BIM

Project phasing simulation, Project WBS planning, Visual validation for construction processes, Real time project monitoring.

Unit 6 **[7 Hrs]**

Project Management 5D- BIM, 6D-BIM

Quantity extraction, Estimates and cost analysis, Cost audits, RA Bill Validation. Facility Management. Importance of FM in life cycle of a project. FM Implementation strategies.

Reference Books:

1. Willem Kymmell , Building Information Modelling , McGraw-Hill Construction ,New York, 2008.
2. BS 1192:2007 , A2:2016 Collaborative production of architectural, engineering and construction information. Code of practice.
3. PAS 1192-2 Specification for information management for the capital/delivery phase of construction projects using Building Information Modelling.
4. AEC (UK) BIM Technology Protocol Practical implementation of BIM for the UK Architectural, Engineering and Construction (AEC) industry. Version 2.1.1 June 2015 Updated to align with current industry protocols, specification and documents.
5. AEC(UK) BIM Protocol for Autodesk Revit, version 2.0 ,2012.
6. Official Autodesk Revit knowledge network guide 2019. https://knowledge.autodesk.com/.
7. Marcus Kim , Lance Kirby , Eddy Krygiel, Mastering Autodesk Revit 2017 for Architecture 2016.
8. Sham Tickoo , Exploring Autodesk Revit 2017 For Structure 2017.
9. Sham Tickoo , Exploring Autodesk Revit 2017 for MEP 2017.
10. Brad Hardin , Dave Mccool, BIM and Construction Management: Proven Tools, Methods and Workflows, 2ed , 2015.

[CE(DE)-18038] Building Information Modelling Lab

Teaching Scheme
Practical: 2 hrs / week

Examination Scheme:
Continuous Evaluation: 50 Marks
End Sem oral Exam: 50 Marks

The term work shall consist of the assignments based on the following topics:

1. BIM process.
2. Architectural BIM model creation.
3. View & sheet documentation.
4. Structural model Creation.
5. Mechanical, Electrical and Plumbing Elements modelling.
6. Creations of component family.
7. 4D, 5D, 6d assignments for real life BIM project.

Note:
A Laboratory Record based on the assignments would be submitted for the term-work. Oral Examination would be based on the term work and theory covered in the class under the subject – Building Information Modelling. Course Teacher for the Laboratory would decide the breakup of Oral Examination.

Department Elective- III

[CE(DE)-18029] Industrial Waste Water Treatment

Teaching Scheme
Lectures : 3 hrs/week
Practical: 2hrs/week

Examination Scheme
Test 1 and 2 – 20 Marks each
End-Sem Exam- 60 Marks.

Pre-requisite: Environmental Engineering, and Wastewater Engineering.

Course Outcomes:
Student will be able to:

1. A Define and understand significance of Wastewater characteristics.
2. B Decide treatment process based on industrial operations.
3. C Collect data and Design waste treatment plant.

Unit 1 **[7 Hrs]**
Domestic waste water and industrial waste waters, Flow measurements, Characteristics and Treatability studies of industrial waste waters.

Unit 2 **[7 Hrs]**

Unit operation and unit processes, Generation of influent, Segregation, Stream pollution and self-purification.

Unit 3 **[7 Hrs]**

Pre-treatment of industrial wastes, Characteristics, collection treatment and disposal of Textile Wastes, Dairy wastes.

Unit 4 **[7 Hrs]**

Pre-treatment of industrial wastes, Characteristics, collection treatment and disposal of Tannery wastes, Sugar mill wastes, Pulp and paper mill wastes.

Unit 5 **[7 Hrs]**

Pre-treatment of industrial wastes, Characteristics, collection treatment and disposal of Fermentation industry wastes, The engineering industry, Petroleum refining industry.

Unit 6 **[7 Hrs]**

Pre-treatment of industrial wastes, Characteristics , collection treatment and disposal of Petrochemicals industry, Fertilizers and pesticides industries, Vegetable oil, food and allied industries, Dyestuff and dye manufacturing industries, Rubber wastes, Radioactive wastes, Organic and inorganic chemicals, Common effluent treatment plants.

Text Book:

1. A.D. Patwardhan “Industrial Waste Water Treatment” PHI Learning Pvt. Ltd.

Reference Books:

1. Fair, G.M. and G.C. Geyer (1954): Water supply and Wastewater Disposal. New York: Wiley.
2. Mahajan, S.P.(1998): Pollution Control in Process Industries, New Delhi :Tata McGraw-Hill.

[CE(DE)-18030] Prestressed Concrete Structures

Teaching Scheme

Lectures : 3 hrs / week

Examination Scheme

Internal Test 1 : 20 marks
Internal Test 2 : 20 marks
End Sem. Exam: 60 marks

Course outcomes:

Students w i l l b e able to:

1. Analyse section using the basic aspects/ fundamentals of prestressed concrete, including pre- and post-tensioning processes.

2. Determine different types of losses in prestressed concrete.
3. Analysis and design fully prestressed concrete flexural members, compression members and tension members.
4. Design end blocks with prestressing anchorages.

Unit 1: Introduction to prestressed concrete: **[6 Hrs]**

Applications, Types of prestressing, prestressing systems and devices, materials, losses in prestress, Introduction to IS 1343

Unit 2: Analysis of Flexural Members: **[6 Hrs]**

Basic concepts, stresses at transfer and service loads, ultimate strength in flexure, Design of PT slabs, voided slabs for bridges, code provisions.

Unit 3: Statically determinate PSC beams: **[8 Hrs]**

Design for ultimate and serviceability limit states for flexure, analysis and design for shear and torsion, code provisions. Composite construction.

Unit 4: Statically indeterminate PSC beams: **[7 Hrs]**

Analysis and design of two span continuous beams, choice of cable profile, linear transformation and concordancy.

Unit 5: Use of commercial software: **[6 Hrs]**

Analysis and design of simply supported PSC box girder for case study bridge using commercial software.

Unit 6: End Block design: **[6 Hrs]**

Design of end block. Transmission of prestress in pre-tensioned members; Anchorage zone stresses for post-tensioned members.

Text Books:

1. Krishna Raju N, "Prestressed Concrete" , 4th Edition Tata Mc Graw Hill, New Delhi, 2000.
2. Pandit and Gupta, "Prestressed concrete", CBS, 2002.

Reference Books:

1. Sinha N.C. & Roy, "Fundamentals of Prestressed Concrete", S. Chand & Company, 1985.
2. Rajagopalan N, "Prestressed Concrete", Narosa Publishing house, 2002.
3. Lin T.Y, "Design of Prestressed Concrete Structures", John Wiley & Sons.

[CE(DE)-18031] Advanced Foundation Engineering

Teaching Scheme
Lectures : 3 hrs / week

Examination Scheme
100 marks: Continuous evaluation-
Assignments /Quiz- 40 Marks
End - Sem Exam – 60 Marks

Course Outcomes:
Students will be able to:

1. Assess bearing capacity and settlement of the shallow foundations according to various types of loading conditions, such as inclined, and moment conditions.(PO- a, b, c, e, h, j)
2. Design raft foundation, well foundation and machine foundation (PO- a, b, c, e, j)
3. Design ground improvement technique, reinforced earth wall, foundations on expansive soil and on rock (PO- a, b, c, e, j)

Unit 1: Raft Foundation **[6 Hrs]**
Allowable pressure in raft, Modulus of subgrade reaction, rigid beam analysis, piled raft design.

Unit 2: Foundations for retaining wall **[7 Hrs]**
Allowable Bearing pressure below base slab of retaining wall subjected to gravity, seismic and traffic loads, global stability analysis.

Unit 3: Machine Foundation **[7 Hrs]**
Machine vibration, free vibration and force vibration, determination of soil properties for dynamic analysis, design of machine foundation.

Unit 4: Ground Improvement **[7 Hrs]**
Design of prefabricated Vertical Drains (PVD), and Stone columns, remedial measures for liquefaction.

Unit 5: Design of foundations on rock **[7 Hrs]**
Identification of types of rock, bearing capacity of shallow foundation on rock, pile foundation on rock.

Unit 6: Foundations on expansive **[6 Hrs]**
Identification of expansive soil, design of foundations on expansive soil.

Text Books:

1. Basic and Applied Soil Mechanics by GopalRanjan and Rao, New Age International Publishers
2. Principles of foundation engineering by B. M. Das, Cengage Learning (Thompson)
3. Soil Mechanics and foundation Engineering, Dr.K.R.Arora, Standard Publishers Distributors.

Reference Books

1. Soil Mechanics and Foundations, Muni Budhu, John Wiley and Sons Inc
2. Foundation Analysis and Design, J.E.Bowles, McGraw Hill International
3. Foundation Design Manual, DhanpatRai Publication, N. V. Nayak
4. Design aids in soil mechanics and foundation engineering, Kaniraj S.R., Tata McGraw Hill Publishing Company Ltd.
5. Foundation Design and Construction, M.J.Tomlinson, ELBS Publication.

[CE(DE)-18033] Advanced Plumbing Services

Teaching Scheme
Lectures : 3 hrs / week

Examination Scheme
Internal Test 1: 20 marks
Internal Test 2: 20 marks
End Sem. Exam: 60 marks

Course Outcomes:

Students will be able to:

1. Interpret and analyze the data required for planning of water supply, drainage schemes for residential, commercial and public uses.
2. To design water supply, Drainage and Hot water supply system for residential, commercial and public building.
3. To prepare an estimate and BOQ for high rise building.

Unit 1 **[6 Hrs]**

Introduction to plumbing engineering:

Definition- plumbing engineering, plumber, role of architect, structural consultant, plumbing consultant, plumbing contractor, and plumber. Alternate source of water, water quality norms as per CPCB, IS standards, acceptable limits, impurities of water and their impacts on various applications.

Introduction to codes and standards: Introduction to NBC, UIPCI. Approvals, AHJ, local municipal laws relating to plumbing, generals regulations. Testing and labelling, alternate material, workmanship and minimum standards, space required for various sanitary facilities, plumbing shaft, water tanks and pump rooms. Architectural and Structural coordination, structural parameters such as sunken toilets, location of columns and beam, importance of ledge walls.

Unit 2 **[6 Hrs]**

Plumbing Terminology: Definitions for most words can be found in a dictionary, but there are technical or trade terms which take on a special meaning when used in relation to plumbing.

Plumbing Fixtures and Fixture Fittings: types of various plumbing fixtures and fittings, water conserving fixtures, rating system for water efficient products (WEP water closets, bidets, urinals, flushing devices, lavatories, bath/shower, kitchen sinks, water coolers, drinking fountain, clothes washer, mop sink,

overflows, strainers, prohibited fixtures, installation standards, strainers, floor drains, floor slopes, location of valves, hot water temperature, and table of minimum plumbing facilities.

Unit 3 **[8 Hrs]**

Water Supply: Type of water supply pipes fittings and joints, GI, SS, Copper, HDPE, MDPE, PVC, cPVC, uPVC, Pex, Multilayer, composite pipe, PEX, jointing methods, tools etc, type of valves (isolation valves, PRV, NRV, ARV, purge valves etc), backflow prevention, air gap, cross connection, installation and disinfections, protection of pipe, colour codes and arrow marking. Introduction to WSFU, minimum and maximum velocity, pressure, temperature in water supply pipe, sizing calculations.

Solar Hot Water: Introduction to solar water systems. System components, panels, hot water tanks, electrical backup, safety measures, auto controls, hot water supply and return systems, various insulating materials, control valves, introduction to other methods of hot water generation

Unit 4 **[6 Hrs]**

Traps and Interceptors: Traps- purpose, function and requirement, trap arms, developed length, trap seals, venting to traps, trap primers, prohibited traps, building traps, clarifiers, grease interceptors, sizing, FOG disposal, oil and sand interceptors, Trap Malfunction.

Indirect Waste: Air-gap, food establishments, sink traps, dish washers, drinking fountains, waste receptors, sterile equipment, appliances, condensers, chemical wastes, point of discharge, venting. Introduction to pipe sizing.

Vents: Vent requirement, concept of venting, materials, vent connections, trap seal protection, flood rim level, termination, vent stacks, water curtain and hydraulic jump, horizontal and vertical wet venting, combination waste and vent system, cleanouts, venting of interceptors. Introduction to vent sizing, sizing of combination vents etc.

Unit 5 **[8 Hrs]**

Sanitary Drainage: Types of drainage system i.e. one pipe system, two pipe system, single stack and double stack system, pipe materials and jointing methods, special joints, fixture connections (drainage), hydraulic jump, change in direction of flow, T and Y fittings, cleanouts, pipe grading, fixtures below invert level, suds relief, testing, building sewers, testing, sumps and pumps, public sewers, sewage disposal. Introduce DFU, sizing of horizontal and vertical pipes.

Storm Drainage: Storm drain required, prohibited connections, subsoil drains, sub-drains, gutters/channels/scuppers, window areaway drains, roof drains, strainers, leaders, conductors and connections, siphonic drains, underground drains, materials, traps required, prohibited installations, testing. Introduction to sizing of channels, rainwater down takes, underground drains. Introduction to rain water harvesting.

Gray-water Systems: Definition of gray water, specifications and drawings, total gray water discharge, soil absorption, holding tanks, valves and piping. Reclaimed water systems, definition of reclaimed water, pipe identification, installation, signs, valves, cross connection, inspection and testing, approved uses.

Unit 6 **[7 Hrs]**

Pumps and HPS: Types of pumps for water supply, heat exchangers, wastewater dewatering and sewage. Pressure boosting and hydro-pneumatic systems shall be elaborated along with the accessories and controls.

Construction Management: Organization charts, inter-organization relations, coordination of other agencies, role of Engineer-in-charge, safety and security, working at heights and confined spaces, accidents reporting. Inventory, material ordering and stacking, testing, record keeping, measurements, and billing. Time and cost analysis, specifications writing, resources planning, takeoff quantities (BOQ), and cost estimates of few plumbing items. Break down activities, activity sequence and activity period for few selected cases.

Reference Books:

1. National Building Code (NBC) 2017.
2. Uniform Illustrated Plumbing Code- India (UIPCI 2017).
3. Deolalikar S.G. " Plumbing Design and Practice", Tata McGraw Hill Publishing company Ltd., New Delhi, ISBN, 933922132X, 9789339221324.

[CE(DE)-18034] Watershed Management

Teaching Scheme

Lectures : 3 hrs / week

Examination Scheme

Internal Test 1: 20 marks
Internal Test 2: 20 marks
End Sem. Exam: 60 marks

Course Outcomes:

Students will be able to:

1. Apply the various concepts of watershed planning, development and management.
2. Access land erosion, sedimentation.
3. Estimate surface water and ground and various water demands.
4. Develop integrated watershed plan for implementation.

Unit 1: **[6 Hrs]**

Introduction and basic concepts:

Concept of watershed, Introduction to watershed management, different stakeholders and their relative importance, Watershed management policies and decision making.

Unit 2: **[8 Hrs]**

Watershed Modelling:

Standard modelling approaches and classification, system concept for watershed modelling, overall description of different hydrologic processes, modelling of rainfall runoff process, subsurface flows and groundwater flow.

Unit 3: **[6 Hrs]**

Soil Erosion Modeling:

Soil Erosion, Estimation of soil erosion.

Unit 4: **[8 Hrs]**

Storm Water and Flood Management:

Storm water management, design of drainage system, flood routing through channels and reservoir, flood control and reservoir operation, case studies of flood damage.

Unit 5: **[6 Hrs]**

Drought Management:

Drought assessment and classification, drought analysis techniques, drought mitigation planning.

Unit 6: **[6 Hrs]**

Integrated Watershed Management:

Introduction to integrated approach, conjunctive use of water resources, rainwater harvesting.

Reference Books:

1. E.M. Tideman,"Watershed Management: Guidelines for Indian Conditions", Omega Scientific Publishers.
2. Ghanshyam Das, "Hydrology and Soil Conservation Engineering", Prentice Hall India.
3. Dr. Rajvir Singh, "Watershed Planning & Management", Yash Pulishing House.
4. Paul A. DeBarry, "Watersheds - Processes, Assessment and Management", John Wiley & Sons.
5. V.P.Singh and Donald K. Frevert, "Watershed Models", Taylor & Francis.

[CE(DE)-18035] Human Resource Management in Construction

Teaching Scheme

Lectures : 3 hrs / week

Examination Scheme

Internal Test 1: 20 marks
Internal Test 2: 20 marks
End Sem. Exam: 60 marks

Course Outcomes:

Students will be able to:

1. To have the basic concept of Human Resource Management.
2. To have the clear concept about planning, Manpower Calculations, Supervisory skills etc.
3. To have the clarity about the meaning of Decision making, Leadership and Time Management- the three most important aspects of HRM.
4. To have the proper idea about the recruitment process, orientation programme and team work.
5. To have the idea about importance of Training and the matters viz: Job rotation, Job evaluation and Job enrichment.

6. To have the idea about role of motivation, labour laws and labour legislation.

Unit 1 **[8 Hrs]**

Introduction to HRM. Scope of HRM. Functions and objectives of HRM.HRM Model. Evaluation of HRM. Need of HRD in the context of globalization. Man Management.

Unit 2 **[6 Hrs]**

Human Resource Planning. Nature and Importance of HRP, Factors affecting HRP, Planning Process, Manpower Calculations. Techniques of manpower planning for company projects. Various HRD parameters, functional skills, supervisory skills, Entrepreneurship. Industrial Psychology. Personality Development.

Unit 3 **[7 Hrs]**

Personnel Management: Concept of Personnel Management, Role and Function of a Personnel Manager. Necessity of Personnel Management. Time Management, leadership. Qualities of a leader. Directing, Decentralizing, Delegation, Departmentalization and Division of Labour. Decision making. Communication skills. Coordinating and Controlling. Quality Control.

Unit 4 **[7 Hrs]**

Recruiting Human Resources: Nature, purpose and importance of recruitment, factors governing recruitment, Recruitment process, Selecting Human Resources: Organization for selection, selection process, barriers to effective selection, selection in India. Right Man for the Right Job. Inducting and placing: Evaluation of Orientation programmes, Problems of orientation, typical orientation programme. Team Work and its importance. Corporate expectations from its employees.

Unit 5 **[7 Hrs]**

Training: Nature of training and development, Inputs in training and development, gaps in training, the training process in various construction companies. Impact of practical Training. Human Relations. Remuneration: Remuneration of Personnel. Factors influencing employees' remuneration, various methods of deciding the remuneration wage policy in India. Job evaluation, Job Satisfaction, Job Rotation, Job Enrichment. Performance appraisal and Merit rating. Success of a corporate leader. Success of an Organization.

Unit 6 **[7 Hrs]**

Motivation and Perspective: Motivation, importance of motivation, theories of motivation, Theories of Motivation and their comparison, Motivation as an incentive. Strong point of a person. SWOT Analysis. Promotion. HRM and IHRM. Managing international HR activities, Labour laws, Labour Legislation. Employees' health.

Text Books :

1. Josephat Stephen Itika, Fundamentals of Human Resource Management, African Studies Centre.
2. Verne Harnish, Mastering The Rockefeller Habits.
3. Steve Chandler**,** 100 Ways to Motivate Others: How Great Leaders Can Produce Insane Results

Without Driving People Crazy.

Reference Books :

1. Jim Collins, Good to Great.
2. Simon Sinek, Start With Why.
3. Shiv Khera, You Can Win.
4. Prof. Suvasish Mukhopadhyay, Management in Corporate (e-book).
5. Shawn Smith and Rebecca Mazin, The HR Answer Book: An Indispensable Guide for Managers and Human Resources Professionals.

[CE(DE)-18036] Tunnels, Docks and Harbour Engineering

Teaching Scheme
Lectures : 3 hrs /week

Examination Scheme
Internal Test 1: 20 marks
Internal Test 2: 20 marks
End Sem. Exam: 60 marks

Course Outcomes:

Students will be able to:

1. Study various component parts & processes to run tunnel engineering system.
2. Learn about fundamentals of tunnel its excavation methods, support systems, and executional aspects.
3. Learn the navigational mode of transportation in which he gets basic information of harbour, port, dock and design of various component parts of docks & harbor and their functioning.

Unit 1 **[6 Hrs]**

General Introduction about Tunnels:

Advantages and disadvantages of tunnel with respect to open cuts. Geotechnical and Geological Exploration for tunnels and its importance, Tunnel surveying, surface and subsurface surveys, Transferring centerline, Setting out and Transfer of Levels, Criteria for Selection of size and shape of tunnels, Factors affecting the methods of Tunneling, Application of tunnels in sewer line construction, water supply, irrigation, roads, railways, metro construction, etc.

Unit 2 **[6 Hrs]**

Driving Tunnels in Soft ground:

General, Characteristics of soft ground, Needle beam method, Use of Shield, Soil freezing method, NATM method of Tunneling, excavation sequence history, Stand up time, Safety measures and health protection in tunnels, .

Unit 3 **[6 Hrs]**

Driving tunnels in hard ground:

Sequence of operation and typical distribution of time for each operation, Meaning of the term

'Faces of Attack', Determination of Rock pressure, Drill blast method of tunneling for hard strata, Different patterns of drilling, Full face tunneling with and without supports.

Unit 4 **[6 Hrs]**

Blasting, explosives and Support Systems:

Meaning of the terms, types of explosives, method of blasting in brief. Ventilation, Meaning of the term, requirements a ventilating system, Methods of ventilation with advantages and disadvantages. Lighting and aspects of drainage in brief. Methods of supporting roof consisting of shotcrete, Cement grouting, rock bolting, CI and MS Plates, Ribs, Cast in-situ, precast lining, etc., Service, operation and maintenance of tunnels, Problems associated with tunneling and the remedial measures.

Unit 5 **[8 Hrs]**

Docks and Harbour:

Introduction, Definition of the terms associated with docks and harbour, Requirements of harbour and port, classification of harbours with examples. Factors affecting Factors affecting growth of port, Major Ports in India and abroad, Planning a Port, Selection of ideal location of harbour, Introduction and need of dredging.

Unit 6 **[8 Hrs]**

Breakwater, Jetty and Types of Docs:

Breakwater and materials of construction for breakwater, Introduction to design of break waters, Dock, Bulkhead and Sea Walls, Design Considerations and Construction Materials, Revetments, Water front structures, Wharves, Jetty, Dolphins, Different types of dock fenders, Under water construction, Uses of wet docks and Dry/ Repair docks. Port facilities, Transit sheds and warehouses, Under water concreting.

Text-books:

1. S.K. Sharma, “Docs and Harbour”, McGraw Hill.
2. S.C. Saxena, “Tunnel Engineering”, Dhanpat Rai Publications.

Reference Books:

1. Vicksburg, “Coastal Engineering Manuals Volume I and II”, US Army Corps of Engineers.
2. The Art of Tunnelling by Szechy, K, Akademiai Kiado.

[CE(DE)-18039] Operations Research

Teaching Scheme
Lectures : 3hrs/week

Examination Scheme
100 marks: Continuous evaluation
Assignments / Quiz- 40 Marks
End Sem Exam – 60 Marks

Course Outcomes:
Students will be able to:

1. understand different optimisation methods.
2. apply operations research technique in civil engineering.
3. solve engineering problems with the use of software.

Unit 1: Introduction and Basic Concepts **[7 Hrs]**

Historical Development; Engineering applications of Optimization; Art of Modeling, Objective function; Constraints and Constraint surface; Formulation of design problems as mathematical programming problems, Classification of optimization problems, Optimization techniques – classical and advanced techniques

Optimization using Calculus: Stationary points; Functions of single and two variables; Global Optimum, Convexity and concavity of functions of one and two variables, Optimization of function of one variable and multiple variables; Gradient vectors; Examples, Optimization of function of multiple variables subject to equality constraints; Lagrangian function, Optimization of function of 1 multiple variables subject to equality constraints; Hessian matrix formulation; Eigen values, Kuhn-Tucker Conditions; Examples.

Unit 2: Linear Programming **[7 Hrs]**

Standard form of linear programming (LP) problem; Canonical form of LP problem; Assumptions in LP Models; Elementary operations, Graphical method for two variable optimization problem; Examples, Motivation of simplex method, Simplex algorithm and construction of simplex tableau; Simplex criterion; Minimization versus maximization problems, Revised simplex method; Duality in LP; Primaldual relations; Dual Simplex 1 method; Sensitivity or post optimality analysis, Other algorithms for solving LP problems – Karmarkar's projective scaling method

Use of software for solving linear optimization problems using graphical and simplex methods, Examples for transportation, assignment, water resources, structural and other optimization problems

Unit 3: Integer Programming **[7 Hrs]**

Formulations, Zero-One Problem- additive algorithm, Gomory's cutting plane algorithm, Branch and bound algorithm, All integer primal-duel algorithms

Unit 4: Transportation and Assignment **[7 Hrs]**

Formulation of Transportation Problem, Initial Feasible Solution Methods, Optimality Test, Degeneracy in TP; Assignment Problem, Hungerian Method, Traveling Salesman Problem

Unit 5: Game Theory and Sequencing **[7 Hrs]**

Two Person Zero Sum Game, Pure and Mixed Strategies, Algebraic Solution Procedure, Graphical Solution, Solving by Linear Programming; Sequencing Problem, Processing of n Jobs Through Two Machines and m Machines, Graphical Method of Two Jobs m Machines Problem.

Unit 6: Inventory and Queuing Models **[6 Hrs]**

Classical EOQ Models, EOQ Model with Price Breaks, EOQ with Shortage, Probabilistic EOQ Model, Newsboy Problem. Elements of Queuing Model, Pure Birth Death Model, Single Server and Multi-server Markovian Models with Infinite and Finite Capacity, Machine Repair Model, Networks of Queues.

Reference Books:

1. Chandra, Suresh, Jayadeva and Mehra, Aparna, Numerical Optimization with Applications, Narosa, 2009.
2. Hiller, F. S. and Liebermann, G. J., Introduction to Operations Research, Tata McGraw Hill, 2002.
3. Mittal, K. V. and Mohan, C., Optimization Methods in Operations Research and Systems Analysis, New Age, 2003.
4. Mohan, C. and Deep, Kusum, Optimization Techniques, New Age, 2009.
5. Ravindran, A., Phillips, D. T and Solberg, J. J., Operations Research: Principles and Practice, John Willey and Sons, 2nd Edition, 2009.
6. Rao S. S. Engineering optimization: Theory and Practice, 4th Edition, ISBN: 978-0-470-18352-6, 2009.
7. Taha, H.A., Operations Research - An Introduction, Prentice Hall, (7th Edition), 2002.

[CE(DE)-18040] Geospatial Technologies for Water Resources Engineering

Teaching Scheme

Lectures : 3hrs/week

Examination Scheme

100 marks: Continuous evaluation
Assignments / Quiz- 40 Marks
End Sem Exam – 60 Marks

Course Outcomes (CO's):

Students will be able to:

1. demonstrate fundamental concepts of the remote sensing, GIS and GPS technologies.
2. formulate GIS-based models and solve the related problems.
3. demonstrate the basic principles underlying the RS-GIS based modeling of the hydrological systems.
4. apply the geospatial tools for sustainable management of water resources and environmental issues.

Unit 1 **[6 Hrs]**

Remote Sensing

Fundamental of Remote Sensing, History , Type of Remote Sensing,Remote Sensing platforms and sensors, Data acquisition through various platforms, Cameras and sensor parameters, Elements of satellite images, Concept of bands, pixel, digital number, metadata, Multispectral Remote Sensing, Multispectral image, False color composite, Interpretation of multispectral image, Combination of sensors, Image interpretation parameters, Examples of interpretation key such as color, texture, pattern etc., Digital image processing ,Atmospheric, radiometric, geometric corrections, Histograms, Density slicing, Contrast stretching, Filtering, Principle component analysis, Ground truths.

Unit 2 **[6 Hrs]**

GIS

Introduction to GIS , Components of GIS, Hardware and software, GIS functionality, Data capture, management, analysis and visualization, Projections and georeferencing, Concepts of projections, Types of projections and their applications, Topological data model, TIN, spaghetti, polygon structure data models, Digitization, Applications of GIS.

Unit 3 **[7 Hrs]**

GPS

Introduction and overview of GPS , Fundamental concepts, Coordinates and reference systems, Components of GPS system, GPS for land navigation and survey reconnaissance , Static / Differential Positioning, Dynamic / Kinematic Positioning, GPS equipment, National GPS applications.

Unit 4 **[7 Hrs]**

Hydrological modelling

Introduction to modelling, Modelling parameters, Mapping of water and environmental features, Watersheds, streams /drainage parameters, Estimation of morphological parameters, Spatio-temporal rainfall runoff analysis, Soil and land use mapping, Terrain analysis for hydrological modelling, Flood estimation-SCS, Presentation of modelling results.

Unit 5 **[7 Hrs]**

Geoinformatics applications

Applications in water and environment, Agriculture, irrigation, drainage, water logging, salinity affected areas, Drought mitigation, reservoir sedimentation, Ground water, Disaster management-landslides, floods mitigation, Water quality monitoring for water bodies/rivers. Afforestation- deforestation trends detection, Forest fires.

Unit 6 (Group Case study) **[7 Hrs]**

GIS Software (ARC-GIS- hands on)

Familiarize ARC GIS software, Data pre-processing, Georeferencing, Data sources, input, scanning systems, On-screen digitization, Data editing, errors and quality control, Raster and vector, Data

transformation, overlay analysis, Watershed delineation, Estimation of morphological parameters, Rainfall –Runoff analysis,0 GIS Project

Text Book:

1. "Remote Sensing and Image Interpretation" Thomas Lillesand , Ralph W. Kiefer , Jonathan Chipman.

Reference Books:

1. "Geographic Information Systems and Environmental Modeling" by Clarke, Keith C., Bradley O. Parks, and Michael P. Crane. Upper Saddle River, NJ: Prentice Hall, 2002.
2. "Principles of Remote Sensing" Edition: ITC Educational Textbook Series 2,Publisher: ITC, nschede Editors: N. Kerle, L.L.F. Janssen, G.C. Huurneman.

[CE(DE)-18041] Applied Hydrology

Teaching Scheme
Lectures : 3hrs/week

Examination Scheme
100 marks: Continuous evaluation
Assignments / Quiz- 40 Marks
End Sem Exam – 60 Marks

Course Outcomes:
Students will be able to:

1. demonstrate a sound fundamental understanding preparation of Hydrology Chapter for DPR of Water resources project.
2. illustrate various tools for collection and analysis of hydro-met data for water projects.
3. demonstrate the basic principles for estimation of various hydrological parameters for water projects modeling of the hydrological systems.
4. apply the modern hydrological tools for preparation of DPRs for water resources projects.

Unit 1 **[6 Hrs]**

Hydo-met data

Hydrometry, Hydro-met instrumentation, Modern tools for measurement of hydro-met parameters (precipitation, runoff, evaporation, infiltration), Discharge measurement techniques, Hydrological design of water projects.

Unit 2 **[7 Hrs]**

Hydrology component of DPR: Water availability analysis

Rainfall run-off data processing, spatial –temporal distribution, interpolation, extrapolation, ungauged catchments, Dependability, Water availability analysis, FRL for reservoirs.

Unit 3 **[7 Hrs]**

Hydrology component of DPR: Design flood analysis

Short duration rainfall runoff data processing, peak flood events, spatial –temporal distribution, conventional methods of design flood estimation, Deterministic and stochastic models, Distributed Rainfall-Runoff modelling,(GIS based models) MWL, spillways for reservoirs. Flood management Flood forecasting / flood mitigation, Flood impact assessment, Floodplain zoning.

Unit 4 **[7 Hrs]**

Hydrology component of DPR: Sedimentation analysis

Collection compilation of sediment data, estimation of sediment load, methods of sediment distribution, dead storage level.

Unit 5 **[7 Hrs]**

Hydrology component of DPR: Water quality

Water quality data collection, sampling and testing, physical, chemical, and biological parameters, water quality standards for various uses, water quality management.

Unit 6 **[6 Hrs]**

River Morphology

Use of ARC GIS, hands on practice, remote Sensing and GIS applications in hydrology, basin delineation, contours, relief, drainage, slope, aspect for the basin, Estimation of morphological parameters, (LAB: ARC–GIS).

Text Book:

1. Engineering Hydrology, K. Subramanya, Tata McGraw-Hill Education, 01-Jan-1994 - Hydrology - 392 pages.

Reference Book:

1. Handbook of Applied Hydrology**,** Ven Te Chow, Ed. McGraw-Hill, New York, 1964. 1418 pp.

[CE-18011] Project -II

Teaching Scheme
Practical: 12hrs./week

Examination Scheme
100 marks: Continuous evaluation-
Mid-sem presentation- 40 Marks,
End - Sem Exam – 60 Marks

Course Outcomes:

1. Students will be able to design, develop and analyze civil engineering structures and schedule activities. (PO- b, c ,d, e, f, g, h, i, j, k)
2. Students will be familiar with modern analytical tools. (PO-a, e, j)
3. Students will be able to communicate effectively. (PO- j)
4. D. Students will identify social problems and provide viable engineering solutions. (PO-f, g, h)

Methodology of Evaluation

During the Second Stage of the Project, students would present their project work completed on the basis of the formulation they have presented during first stage. Based on the literature review and project work carried out during second stage of the project student would write a report which would give a review of literature, problem formulation, methodology adopted and the findings of the project work. The project report would be presented through a seminar which would be evaluated by a panel of examiners.

During evaluation of the project specific attention would be given to find out the contribution of each team member of the project team. Publication of work is desirable.
Soft copy of project report, power point presentation of all 4 stages (Project I and II) should be included in CD and submitted along with project report.

Text Books:

1. Basic and Applied Soil Mechanics by Gopal Ranjan and Rao, New Age International Publishers.
2. Foundation Engineering by P.C. Varghese, PHI Learning Publication.

Reference Books

1. Foundation Analysis and Design, J.E.Bowles, McGraw Hill International.
2. Foundation Design and Construction, M.J.Tomlinson, ELBS Publication.

Minor

[CE(MI)18002] Basics of Transportation Engineering

Teaching Scheme
Lectures : 3 hrs /week

Examination Scheme
Internal Test 1: 20 marks
Internal Test 2: 20 marks
End Sem. Exam: 60 marks

Course Outcomes:

Students will be able to:

1. select different modes of transportation under given situations.
2. Identify different types of construction materials based on ground conditions.
3. Study principles of planning for different modes of transportation.

Unit 1 **[6 Hrs]**

Introduction to Transportation Engineering

Importance of Transportation, different modes of transportation, importance of roads in India, highway and railway development in India.

Unit 2 **[7 Hrs]**

Highway Planning

Necessity of highway planning, classification of roads, road pattern, planning surveys, preparation of plans, interpretation of planning surveys, preparation of master plans, highway cross section elements, sight distance.

Unit 3 **[7 Hrs]**

Traffic Engineering

Traffic characteristics, Traffic Operation, intersections, parking facility, traffic planning, traffic signs, introduction to signal system.

Unit 4 **[7 Hrs]**

Highway Materials

Aggregates, tests on aggregates, bituminous materials: tar, cutback, bitumen, emulsion, tests on different bituminous materials, bituminous paving mixes, cement, cement concrete.

Unit 5 **[6 Hrs]**

A) Railway Engineering

Location survey, types of gauges, railway stations and yards, signaling and interlocking, track junction-points and crossings

B) Airport Engineering

Aircraft characteristics, airport obstructions, runway, taxiways, aprons, terminal area planning

Unit 6 **[7 Hrs]**

A) Docs and Harbours

Types, layout and planning principles, breakwaters, transit sheds, navigations aids

B) Urban Transportation Units

Bus transit, metro, mono rail, sky bus, flyovers, underpasses

Text-books:

1. S.K. Khanna, C.E.G. Justo, "Highway Engineering", 10th Edition, Nem Chand and Bro.
2. S.K. Khanna, M.G. Arora, S.S. Jain,"Airport Planning and Design", Nem Chand and Bros.
3. S.C. Saxena, S.P. Arora , "A Text Book of Railway Engineering", Dhanpat Rai Publications.
4. S.P. Bindra' "A Course in Docks and Harbour Engineering", Dhanpat Rai Publications.

Reference Books:

1. C.J.Khisty and Lall B.K, "Transportation Engineering: An Introduction", 3rd Edition, Pearson Publication.
2. J.S. Mundrey, "Railway Track Engineering", Tata McGraw Hill, New Delhi
3. Vicksburg, "Coastal Engineering Manuals Volume I and II", US Army Corps of Engineers.

Honors

[CE(HO)18005] Advanced Transportation Engineering

Teaching Scheme

Lectures : 3 hrs /week

Examination Scheme

Internal Test 1: 20 marks
Internal Test 2: 20 marks
End Sem. Exam: 60 marks

Course Outcomes:

Students will be able to:

1. Select different modes of transportation under given situation.
2. Analyse and design different types of pavements.
3. Estimate traffic and cost of transport.

Unit 1 **[6 Hrs]**

Transportation System Planning :

Transport Policy, process, and types of surveys, OD matrix, Travel demand forecasting, trip generation, modal split analysis, trip distribution, route assignment analysis, transport networks, network flow analysis

Unit 2 **[6 Hrs]**

Urban Transport Technologies:

Classification, mass and rapid transit system, Intelligent transport system, Introduction to BRT, Mono rail, Sky bus, Metro projects, grade separated interchanges such as flyovers, underpasses, overpasses, concept of Integrated Inter Model transit system.

Unit 3 **[6 Hrs]**

A) Cost of Transport:

Vehicle ownership and operating cost, congestion cost, concept of generalized cost, joint and common cost of infrastructure,

B) Transport Financing:

Pay as you go method, credit financing, private financing, BOT, BOOT, dedicated road funds, road pricing, tolls, private provisions, advantages& limitations.

Unit 4 **[7 Hrs]**

Traffic Systems:

Traffic impacts, traffic studies, level of service, traffic analysis process, basic traffic theory, intersection studies, turning movements, flow, delays, and queuing, signal design, grade separated intersection, parking studies, Traffic generation and parking, parking demand surveys and requirements, parking facilities, instrumentation of traffic monitoring.

Unit 5 **[8 Hrs]**

Analysis and Design of Flexible Pavement:

Details of highway and airport pavements, Flexible pavements studies, performance studies, surface, surface characteristics of pavements, profile measurements, pavement unevenness, skid resistance, its measurements, IRC, AASHTO guide to design of pavement, Overlay Design, pavements failure, maintenance strategy, Strengthening of pavement – Benkelmen beam method, Falling weight deflectometer. Distresses in Pavements.

Unit 6 **[7 Hrs]**

Design of Rigid Pavement:

Concept of rigid pavement, comparison of rigid pavement over flexible pavement , Stress distribution in layered media, joints in rigid pavement, design as per IRC guidelines, design of joints, dowel bars, temperature reinforcement, pavement failure, maintenance strategy strengthening of rigid pavement, mechanization in pavement construction.

Text-books:

1. S.K. Khanna, C.E.G. Justo, “Highway Engineering”, 10th Edition, Nem Chand and Bro.
2. S.K. Khanna, M.G. Arora, S.S. Jain,”Airport Planning and Design”, Nem Chand and Bros.

Reference Books:

1. Y.H. Huang, “Pavement Analysis and Design”, 2nd edition, Pearson Publication

2. E.J.Yoder, "Principals of Pavement Design",2nd Edition, Wiley Publication.
3. C.J.Khisty and Lall B.K, "Transportation Engineering: An Introduction", 3rd Edition, Pearson Publication.

CE(HO)18006 - Geotechnical and Structural Design of Foundations

Teaching Scheme
Lectures : 3 hrs / week

Examination Scheme
100 marks: Continuous evaluation-
Assignments /Quiz- 40 Marks
End - Sem Exam – 60 Marks

Course Outcomes:
Students will be able to:

1. Students will be able to assess various kinds of loads on wall Foundations, raft foundation, retaining walls foundations and pile foundations (PO- a, b, c, e, h, j)
2. Student will be able to design wall Foundations, raft foundation, retaining walls foundations and pile foundations from geotechnical and structural points of view (PO- a, b, c, e, h, j)

Unit 1: Design of wall Foundations [7 Hrs]
Assessment of loads coming on wall foundations, Design of masonry and RCC walls from Geotechnical and structural points of view.

Unit 2: Design of raft foundations [7 Hrs]
Assessment of loads coming on raft foundations, Design of Raft foundations for buildings and other structures from geotechnical and structural points of view.

Unit 3: Design of retaining wall foundations [7 Hrs]
Loads on retaining wall foundations, Design of retaining wall foundations for roads, and basement (geotechnical and structural aspects).

Unit 4: Design of pile foundations [7 Hrs]
Assessment of loads on pile foundations, Design of pile foundations for buildings and other structures In view of geotechnical and structural considerations.

Unit 5: Design of foundations on difficult soil conditions [7 Hrs]
Design of foundations on difficult soil conditions such as on slopes, and on near adjacent structures, (geotechnical and structural considerations).

Unit 6: Design of foundations for bridges [5 Hrs]
Assessment of loads on foundations of bridges as per IRC provisions, Design of foundations for bridges subjected to gravity and earthquake forces, concepts from geotechnical and structural aspects.

Text Books:

1. Basic and Applied Soil Mechanics by Gopal Ranjan and Rao, New Age International Publishers.

2. Foundation Engineering by P.C. Varghese, PHI Learning Publication.

Reference Books

3. Foundation Analysis and Design, J.E.Bowles, McGraw Hill International.
4. Foundation Design and Construction, M.J.Tomlinson, ELBS Publication.

[CE(HO)18007] Infrastructure Management

Teaching Scheme
Lectures : 3 hrs /week

Examination Scheme
Internal Test 1: 20 marks
Internal Test 2: 20 marks
End Sem. Exam: 60 marks

Course Outcomes:

Students will be able to:

1. Have a technical knowledge of deterioration, maintenance, and repair techniques.
2. Function as a professional engineer within the context of the lifecycle management of infrastructure assets.
3. Have the understanding of economic constraints to develop a management plan for critical infrastructure structures and systems for the needs of society.

Unit 1 **[6 Hrs]**

Basic Concepts Related to Infrastructure

Infrastructure scenario in India, transportation infrastructure, Urban infrastructure in India, rural infrastructure in India, introduction to special economic zone, infrastructure finance .

Unit 2 **[7 Hrs]**

Construction Management

Scheduling, contract management, quality and safety management, economics of construction, financing of infrastructure projects.

Maintenance of Infrastructure Assets

Impact of failure, risk analysis, monitoring, performance, resilience, service life, repair, condition assessment, no-destructive testing and evaluation.

Unit 3 **[7 Hrs]**

Planning and Creation of Infrastructure Assets

Environment impact assessment, life cycle cost and analysis, sustainable design and construction, service life of structure, quality control and assurance.

Unit 4 **[6 Hrs]**

Private Involvement in Infrastructure

Overview of infrastructure privatization, benefits of infrastructure privatization, problems of infrastructure privatization, case studies on privatization of infrastructure projects in India.

Unit 5 **[6 Hrs]**

Risks in Infrastructure Planning and Implementation

Economic and demand risks, political risks, socio-environmental risks, legal and contractual issues in infrastructure, challenges in construction and maintenance of infrastructure.

Unit 6 **[6 Hrs]**

Strategies for Successful Infrastructure Project Implementation

Sustainable contracts, introduction to fair process and negotiation, negotiation with multiple stakeholders on infrastructure projects, sustainable development of infrastructure, innovative design and maintenance of infrastructure facilities.

Text-books:

1. B. Sengupta, "Construction Management and Planning", Tata McGraw Hill Publication.
2. Srinath L.S., " PERT and CPM: Principles and Applications ", 3rd Edition, Affiliated East West Press, Delhi.

Reference Books:

1. N.S.Grigg, "Infrastructure Engineering and Management", John Wiley and Sons.
2. W.R. Hudson, R. Hass, W. Uddin, "Infrastructure Management", McGraw-Hill Inc.

[CE(HO)18008] Advanced Irrigation Engineering

Teaching Scheme:
Lecture: 3 hours/Week

Examination Scheme:
Test 1 : 20 Marks
Test 2 :20 Marks
End-Semester Examinat : 60 Marks

Course Outcomes:

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

1. Demonstrate the different terminologies related with irrigation techniques
2. Design micro irrigation system.
3. Compare different irrigation system.

Unit 1 **[7 Hrs]**

Irrigation Water Quality: Water quality for irrigation, salinity and permeability problem, root zone salinity, irrigation practices for poor quality water, saline water irrigation – future strategies.

Unit 2 **[7 Hrs]**

Water Conveyance System: Canals, open channel, lined and unlined channels, canal losses, types of lining, and economics of lined channels. Cross drainage works, Regulating structures, Types of cross drainage works, aqueduct, super passage, siphon, culverts etc. Layout and design concepts.

Unit 3 **[7 Hrs]**

Head Regulator, Cross regulator, their layout, and hydraulic design, Conveyance through closed conduit system, elements, Controlling devices, general design concepts.

Unit 4 **[7 Hrs]**

Lift Irrigation: General concepts, Elements of lift irrigation system, Design considerations involved in Intake well, Jack well, rising main, and distribution system, Concepts and economics.

Unit 5 **[6 Hrs]**

Drip irrigation, General concept, Advantages, limitations, elements of drip irrigation system, design.

Unit 6 **[6 Hrs]**

Sprinkler irrigation, General concept, advantages and limitations, Components of the system, types of sprinklers, design concept.

Textbooks:

1. Majumdar D.P. (2004) "Irrigation Water Management Principles and Practices", Prentice Hall of India, New Delhi,
2. Asawa, G.L. (2015) "Irrigation Engineering", New Age International Pub. Co. N Delhi.
3. Michael A M (2009)“Irrigation -Theory and Practice” Vikas Publishing House Pvt. Ltd. New Delhi
4. Sharma R.K. and Sharma T.K. (2008) “Irrigation Engineering”, S.Chand, New Delhi.

References:

1. Vladmir Novonty(2003) “Water quality: Diffuse pollution and watershed management”, 2nd Edition, John Wiley & Sons
2. Dilipkumar Mujumdar (2004) “Irrigation Water Management”, Prentice Hall Inc.
3. R.Suresh (2010) “Principles of Micro Irrigation Engineering”, Standard Publishers Distributors, New Delhi.