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

Department of Civil Engineering

Curriculum Structure & Detailed Syllabus

(UG Program)

B. Tech.

(Revision: A. Y. 2019-23, Effective from: A. Y. 2022-23)

B. Tech. Civil Engineering Program

Program Educational Objectives (PEOs):

The Graduate students will, after completion of 3 to 5 years of B. Tech. Civil Engineering Program,

PEO1: Have successful career in the diversified sectors of the engineering Industry and/ or higher studies by acquiring knowledge in mathematical, scientific and engineering fundamentals.

PEO2: Analyze and design Civil engineering systems with social awareness and responsibility.

PEO3: Exhibit professionalism, ethical approach, communication skills, teamwork in their profession and adapt to modern trends by engaging in lifelong learning.

Program Outcomes:

At the time of graduation, student will be able to:

PO1: Apply knowledge of mathematics, science and engineering to Civil engineering problems.

PO2: Identify, formulate, research literature and solve complex Civil engineering problems.

PO3: Design various structures or particular system that meets desired specifications and requirements.

PO4: Design and conduct experiments, interpret and analyze data, synthesize the information to provide conclusion.

PO5: Select and use appropriate engineering techniques and software tools to analyze Civil engineering problems with understanding of limitations.

PO6: Assess local and global impact of societal issues on Civil engineering profession.

PO7: Able to understand the impact of engineering solutions on society and demonstrate the knowledge of, and need for sustainable development.

PO8: Demonstrate their professional and ethical responsibilities.

PO9: Able to function as a member or a leader on engineering and science laboratory teams, as well as on multidisciplinary teams.

PO10: Communicate effectively in both verbal and written forms.

PO11: Understand engineering and management principles and apply to their work as a member and/ or leader in a team to manage projects.

PO12: 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**											
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
PEO1	✓	✓	✓		✓						✓	
PEO2		✓	✓	✓	✓		✓					
PEO3						✓	✓	✓	✓	✓	✓	✓

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

Program Specific Outcomes (PSOs):

At the time of graduation, student will be able to:

PSO1: Survey, map, plan and mark layouts for buildings and other structures.

PSO2: Specify, analyze, design, test and assess different structures with quality and safety aspect.

PSO3: Plan, analyze, and design water resources systems with effectiveness and sustainable environmental considerations.

PSO→ PEO↓	PSO1	PSO2	PSO3
PEO1	✓	✓	✓
PEO2		✓	✓
PEO3	✓	✓	✓

List of Abbreviations

Abbreviation	Title
A.Y.	Academic Year
DE	Department Elective Course
HSMC	Humanity Science Course
IFC	Interdepartmental Foundation Course
IOC	Interdepartmental Open Course
LC	Laboratory Course
LLC	Liberal Learning Course
MLC	Mandatory Learning Course
PCC	Program Core Course
SBC	Skill Based Course

B. Tech. Civil Syllabus w. e. f. 2022-2023

Semester VII [Civil Engineering]: Scheme A

Sr. No.	Course Type	Course Code	Course Name	Teaching Scheme			Credits
				L	T	P	
1	LLC		Liberal Learning Course	1	0	0	1
2	IOC		Interdisciplinary Open Course-III [To be offered to other department students]	2	0	0	2
3	MLC		Intellectual Property Rights	1	0	0	0
4	DEC		Department Elective-II	3	0	0	3
5	PCC		Introduction to Earthquake Engineering	3	0	0	3
6	PCC		Quantity Surveying and Valuation	3	0	0	3
7	PCC		Quantity Surveying and Valuation Lab	0	0	2	1
8	PCC		Wastewater Engineering Lab	0	0	2	1
9	SLC		Massive Open Online Course -I	2	0	0	2
			Total Credits				**16**

Semester VIII [Civil Engineering]: Scheme A

Sr. No.	Course Type	Course Code	Course Name	Teaching Scheme			Credits
				L	T	P	
1	DEC		Department Elective-III	3	0	0	3
2	DEC		Department Elective-IV	3	0	0	3
3	SBC		Major Project	0	0	12	8
			Total Credits				**14**

List of Department Electives

DEC	Department Elective-II	1. Advanced Environmental Engineering 2. Appropriate Technology in Construction 3. Building Information Modelling 4. Introduction to Finite Element Analysis 5. Special Concretes 6. Watershed Management

DEC	Department Elective-III	1. Advanced Fluid Mechanics 2. Advanced Foundation Engineering 3. Advanced Plumbing Services 4. Industrial Wastewater Treatment 5. Prestressed Concrete Structures
DEC	Department Elective-IV	1. Geospatial Technologies for Water Resources Engineering 2. Human Resource Management in Construction 3. Tunnels, Docks, harbour & Railway Engineering 4. Water Resources Planning and Management 5. Structural Health Monitoring and Retrofitting

Semester VII [Civil Engineering]: Scheme B

Sr. No.	Course Type	Course Code	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	IOC		Interdisciplinary Open Course-II [From Civil Department]	2	0	0	2
4	DEC		Department Elective-II	3	0	0	3
5	PCC		Introduction to Earthquake Engineering	3	0	0	3
6	PCC		Quantity Surveying and Valuation	3	0	0	3
7	PCC		Quantity Surveying and Valuation Lab	0	0	2	1
8	PCC		Wastewater Engineering Lab	0	0	2	1
9	SLC		Massive Open Online Course -I	2	0	0	2
			Total Credits				**18**

Semester VIII [Civil Engineering]: Scheme B

Sr. No.	Course Type	Course Code	Course Name	Teaching Scheme			Credits
				L	T	P	
1	SBC		Internship and Major Project with Industry/Corporate/Academia	0	0	20	8
2	SLC		Massive Open Online Course –II	3	0	0	3
3	SLC		Massive Open Online Course –III	3	0	0	3
			Total Credits				**14**

Honors and Minor courses of Civil Engineering Department

Sem.	Honors		Minor in Civil Engineering
	Structural Engineering	**Civil Engineering (Any one course in each semester)**	
VII	Advanced Structural Design	1. Project Management 2. Ground Water Engineering 3. Any M. Tech Elective Course	Structural Analysis
VIII	Structural Design of Foundations	1. Advanced Transportation Engineering 2. Infrastructure Management 3. Advanced Irrigation Engineering 4. Any M. Tech Elective Course	Basics of Transportation Engineering

ADVANCED ENVIRONMENTAL ENGINEERING

Teaching Scheme
Lectures: 3 Hrs/ week

Examination Scheme:
T1 and T2 - 20 marks each
End Sem. Exam. - 60 marks

Course Outcomes: At the end of the course, the students are able to

CO 1: Identify local and global effects of pollution and suggest control measures.

CO 2: Identify atmospheric stability conditions and relate them to transport of air pollutants and design of stack under given conditions.

CO3: Analyze data and problem of noise, odour pollution & solid waste management

CO 4: Prepare stages of environmental impact assessment

CO 5: Design the flow diagram for water and wastewater treatment process.

Unit 1: Environment and its interaction with human activities [5 Hrs]

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 equipment, For particulate pollutants, Air Pollution control by using Equipment

Land use planning: As a method of air pollution control

Unit 2: Air pollution [5 Hrs]

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

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: Meteorological Aspects [7 Hrs]

Parameters influencing air pollution, measurement of parameters plume behavior, 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]

Solid waste Management

Sources, classification issues related to SWM, treatment techniques.

Odors:
Sources, measurement and control

Unit 5: **[7 Hrs]**

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

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: Water and Wastewater treatment **[9 Hrs]**

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

Text 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. G. J. Gau, C. D. Wooten, Environment Impact Assessment - Analysis Handbook, McGraw Hill.

Reference Books:

1. Manual on sewerage & sewage Treatment published by Ministry of Urban Development Govt. of India Msy-2000.
2. Metcalf and Eddy, Wastewater Engineering, Tata McGraw Hill, 1996.

- Give the mapping of COs with POs and PSOs - indicating dash- no mapping, 1- Low, 2 - Med, 3 - High.

POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
COs															

CO 1	1			2		2	2								2
CO 2	1	2	2	2	2									1	2
CO 3	1	2	2	2	2	2	2								2
CO 4	1			2		2	2	1							2
CO 5	1	2	2		3	1									2

APPROPRIATE TECHNOLOGY IN CIVIL ENGINEERING

Teaching Scheme:
Lectures: 3 Hrs/ week

Examination Scheme:
T1 and T2 - 20 marks each
End Sem. Exam. - 60 marks

Course Outcomes: At the end of the course, the students are able to

CO 1: Justify need of appropriate Technology using locally available materials as well as modern construction materials.

CO 2: Identify the areas in Civil Engineering in which appropriate technology is possible.

CO3: Suggest / Develop an appropriate technology for the problems identified in construction and various areas in Civil Engineering.

CO 4: Analyse / test and design selected materials / process to be used in appropriate technology.

CO 5: Transfer the knowledge of Appropriate Technology developed through Interaction.

Unit 1: Need of Appropriate Technology [6 Hrs]

Introduction, Overview of traditional construction methods and processes in various areas of Civil Engineering.

Need of low cost construction and appropriate use of materials.

Need for improving processes in various areas of Civil Engineering

Unit 2: Appropriate Technology Concept, Guidelines [6Hrs]

Appropriate technology, concept, Guidelines for appropriate technology, Advantages of appropriate technology, sustainable development through appropriate technology.

Appropriate Technology in different areas of Engineering

Unit 3: Resources for Appropriate Technology and agencies involved [7 Hrs]

Identification of problems in Civil Engineering areas where appropriate technology is possible,

Defining the problems through discussion, site visits, literature reviews, Interaction with outside agencies, NGO, contractors, institutes and other organizations.

Role of locally available materials and modern materials and processes in the development of Appropriate Technology

Unit 4: Economics of Appropriate Technology and cost reduction techniques [7 Hrs]

Factors affecting the quality, cost of materials for construction and processes selected in appropriate technology.

Procedure for the development of materials/ process technology.

Various techniques for reducing cost of construction / process. Job opportunities in appropriate technology

Unit 5: Current status of research on low cost technology. [7 Hrs]

Current status of research on the materials and process selected through literature review.

Selection of appropriate procedure for testing of materials/ process , Conducting necessary tests /developing models/ processes depending upon the appropriate technology suggested.

Unit 6: Applications of Appropriate Technology / case studies [7 Hrs]

Transfer of knowledge of appropriate technology on suitable platform through interaction/ case studies.

Identifying the scope for self-employment, entrepreneurship development, social development, research in the appropriate technology suggested/ developed

Text Books:

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.

Reference Books:

1. Sergio Meriani (2008), "Available technologies for local building materials" International Centre for Science and High Technology, ICS-UNIDO, AREA Science Park Padriciano Trieste, Italy.
2. Camila Cortés Ballerino – Chile (2002) "Building Materials & Engineering Design Low-Income Housing Projects" The Royal Institute of Technology, Stockholm, Sweden.
3. Research papers related to materials and processes in civil Engineering.

- Mapping of COs with POs and PSOs-
  [dash- no mapping, 1-Low, 2 -Med, 3 -High].

POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
COs															
CO 1		3	3	1			2								
CO 2			3		2	1									
CO 3					3	1	2							3	
CO 4				3	2			1						3	
CO 5								3		2		1			3

BUILDING INFORMATION MODELLING

Teaching Scheme
Lectures: 3 Hrs/ week

Examination Scheme
T1 and T2 - 20 marks each
End Sem. Exam. - 60 marks

Course Outcomes: At the end of the course, the students are able to
CO 1: Understand BIM concept and process.
CO 2: Implement 4D, 5D, 6D in BIM.
CO 3: Extract information from BIM model.
CO 4: Interpret BIM families and components.
CO 5: Design architectural, structural and MEP models.

Unit 1: BIM Concept [7 Hrs]
What is BIM, BIM development & History, Difference between BIM model and CAD model, BIM maturity levels, Terms used in BIM, BIM standards, BIM Benefits, Risks and challenges, Present State of BIM Adoption and Road ahead.

Unit 2: Architectural BIM modeling [7 Hrs]
Architectural BIM modelling Building element and Revit element, Revit interface, Basic operation, Architectural element modelling, Views and sheet composition, Design and documentation.

Unit 3: Structural BIM modelling [7 Hrs]
Modelling structural element, Structural detailing, Create analytical model, Structural analysis, Documentation.

Unit 4: MEP BIM modelling [7 Hrs]
Modelling for HVAC system, Air terminals, Mechanical equipment, Piping system & plumbing fixture, Linking with cross discipline model, Clash detection, Energy

analysis, Create customize families-System families, Component families, In place families.

Unit 5: Project management 4D- BIM [6 Hrs]

Project phasing, 4D simulation, Project WBS planning, Visual validation for construction processes, Real time project monitoring. Project Management 5D- BIM, 6D-BIM

Unit 6: Project Management 5D- BIM, 6D-BIM [6 Hrs]

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

Text Books:

1. Brad Hardin and Dave McCool, BIM and Construction Management: Proven Tools, Methods, and Workflows, Wiley publication, Second edition.

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. Brad Hardin , Dave Mccool, BIM and Construction Management: Proven Tools, Methods and Workflows, 2ed , 2015.

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POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 11	PS O1	PS O2	PS O3
COs															

CO 1	-	2	-	-	2	-	-	-	-	-	-	-	-	-	-
CO 2	-	1	1	-	1	-	-	-	-	-	-	-	-	1	-
CO 3	-	-	-	3	3	-	-	-	-	-	-	-	-	2	-
CO 4	-	-	-	3	3	-	-	-	-	-	-	-	-	2	-
CO 5	-	-	2	2	2	-	-	-	-	-	-	-	-	-	2

INTRODUCTION TO FINITE ELEMENT ANALYSIS

Teaching Scheme:
Lectures: 3 Hrs/ week

Examination Scheme:
T1 and T2 - 20 marks each
End Sem. Exam. - 60 marks

Course Outcomes: At the end of the course, the students will be able to
CO 1: Solve simple engineering problems using finite element analysis.
CO 2: Work out truss and beam problems using the concepts of finite element analysis.
CO 3: Evaluate plane stress and plane strain problems using the concepts of finite element analysis.
CO 4: Solve three dimensional and axi-symmetric problems using the concepts of finite element analysis.
CO 5: Analyze and design simple problems with the help of a computer software.

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 2: 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 Truss Problems.

Unit 3: One Dimensional Elements (Beam Element) [7 Hrs]
Elementary Beam Theory, Beam Element, Beam Element Stiffness Matrix, Element Load Vector, Flexure Element with Axial Loading. Application to Beam Problems.

Unit 4: Two Dimensional Elements (Plane Stress & Plane Strain) [7 Hrs]
Triangular Elements, Rectangular Elements, Quadrilateral elements, Isoparametric Formulation, Numerical Integration.

Unit 5: Three Dimensional Elements [6 Hrs]

Three-Dimensional Elements - Tetrahedron and Brick elements.

Unit 6: Applications in Solid Mechanics [6 Hrs]

Plane Stress, Plane Strain, Axi-symmetric Stress analysis, General Three-dimensional Stress Elements, Strain and Stress Computation. Use of a computer software to solve simple problems (analysis and design, Introduction to solver). Software's result interpretation.

Text Books:

1. D. V. Hutton, "Fundamentals of Finite Element Analysis", McGraw Hill Publication, 10/e, Pearson Publication, 2017.
2. P. Seshu, "Textbook of Finite Element Analysis", Tata McGraw Hill Publishing Company Limited, 2012.
3. T.R. Chandrupatla and A. D. Belegundu, "Introduction to Finite Elements in Engineering", Prentice Hall Publication, 4/e, 2011.
4. D.L. Logan, "A First Course in the Finite Element Method", Cengage Publications, 2012.

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  [dash- no mapping, 1-Low, 2 -Med, 3 -High].

POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
COs															
CO 1	2	2	3	3	-	-	-	-	-	-	-	-	2	2	-
CO 2	2	2	3	3	-	-	-	-	-	-	-	-	2	2	-
CO 3	2	2	3	3	-	-	-	-	-	-	-	-	2	2	-
CO 4	2	2	3	3	-	-	-	-	-	-	-	-	2	2	-
CO 5	2	2	3	3	-	-	-	-	-	-	-	-	2	2	3

[CE(DE)-18013] SPECIAL CONCRETES

Teaching Scheme:
Lectures: 3 Hrs/ week

Examination Scheme:
T1 and T2 - 20 marks each
End Sem. Exam. - 60 marks

Course Outcomes: At the end of the course, the students are able to

CO 1 : Select proper ingredients of concrete for producing environmental friendly concrete/green concrete.

CO 2 : Design a concrete mix proportion as per the requirement and of desired quality using different codes.

CO 3 : Enhance his/her knowledge regarding durability of concrete subjected to harsh environments.

CO 4 : Relate and compare special concretes such as self-compacting concrete, ultra-high performance concrete, geopolymer concrete, fibre reinforced concrete, no curing concrete, porous concrete.

CO 5 : Assess the importance of microstructure characterization techniques of concrete.

Unit 1: Ingredients of Concrete and Concrete Mix Design [8 Hrs]

Importance of concrete ingredients and their properties, admixtures and their types, 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. Requirements of special concrete.

Unit 2: Properties of Hardened concrete [5 Hrs]

Mechanical properties of hardened concrete, elastic properties, creep and shrinkage, durability of concrete in different environment, limitations of concrete.

Unit 3: Types of special concretes and their applications [8 Hrs]

Different classifications of concretes, binary and ternary mixes. Introduction, importance and applications of special concretes such as Geo Polymer Concrete, Self-Compacting Concrete (SCC), High Performance Concrete (HPC), No Curing Concrete, and Porous Concrete.

Mix Design, Fresh and Hardened Properties of SCC and HPC.

Unit 4: Fibre Reinforced Concrete (FRC) [6 Hrs]

Importance of FRC, different types of fibres, fibre reinforced cement composites, applications of FRC in Civil Engineering. Mechanical properties of FRC and Ferro-cement technology. Current research and advanced applications of FRC in current scenario.

Unit 5: Light weight concrete (LWC) [6 Hrs]

Importance of LWC, different materials used for LWC, advantages of light weight concrete, strength and durability of LWC. Mix design of LWC. Current research in LWC.

Unit 6: Microstructure characterization of concrete [7 Hrs]

Importance of microstructure characterization of concrete, methods/techniques available for microstructure characterization of concrete (Optical, Scanning Electron Microscope and Micro Tomography and etc.), importance of sample preparation techniques for microstructure study of concrete, current research and applications of different microstructure characterization techniques of concrete.

Text Books:

1. Mehta, P. K. A. M., and Paulo Monteiro. Concrete: microstructure, properties, and materials. McGraw-Hill Education, 2014.
2. Neville, Adam M. Concrete: Neville's insights and issues. Thomas Telford, 2006.
3. Gambhir.M.L., Concrete Technology, McGraw Hill Education, 2006.
4. Gupta.B.L., Amit Gupta, "Concrete Technology, Jain Book Agency, 2010.
5. Neville, A.M., Properties of Concrete, Prentice Hall, London, 1995.
6. Santhakumar.A.R.;" Concrete Technology", Oxford University Press, 2007.
7. Shetty M.S., Concrete Technology, S. Chand and Company Ltd. Delhi, 2003.
8. ACI Concrete Journals.
9. Relevant IS Codes.
10. Indian Concrete Journal.

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POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 11	PS O1	PS O2	PS O3
COs															
CO 1	3	2	-	-	-	-	-	-	-	-	-	-	-	3	
CO 2	3	-	-	-	-	-	-	-	-	-	-	-	-	3	
CO 3	3	-	-	-	-	-	-	-	-	-	-	-	-	3	
CO 4	-	-	3	-	-	-	-	-	-	-	-	-	-	3	
CO 5	3	-	-	-	-	-	-	-	-	-	-	-	-	3	

WATERSHED MANAGEMENT

Teaching Scheme
Lectures: 3 Hrs/ week

Examination Scheme:
T1 and T2 - 20 marks each
End Sem. Exam. - 60 marks

Course Outcomes: At the end of the course, the students are able to

CO 1 : Demonstrate different terminologies related to watershed management.
CO 2 : Select suitable structure in a particular situation for water conservation.
CO 3 : Apply the various concepts of watershed planning, modeling, monitoring and

evaluation.

CO 4 : Assess land erosion, sedimentation.

CO 5 : Estimate surface water, ground water and various water demands.

Unit 1: Introduction and Basic Concepts of Watershed [6 Hrs]

Watershed, need of watershed concept, Introduction to watershed management, Characteristics: size, shape, physiography, slope, climate and drainage, Different stakeholders and their relative importance, Integrated multidisciplinary approach, Watershed management policies and decision making.

Unit 2: Watershed Modelling [7 Hrs]

Standard modeling approaches and classification, system concept for watershed modeling, structure of watershed model, modeling of rainfall runoff process, subsurface flows and groundwater flow.

Unit 3: Soil Erosion Modeling and Sedimentation [6 Hrs]

Soil Erosion, estimation of soil erosion, sources of sediments, sedimentation in streams and reservoirs.

Unit 4: Storm Water and Flood Management [6 Hrs]

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: Water Harvesting and Storage Structures [7 Hrs]

Water harvesting, techniques for preparing water harvesting catchments, storage of harvested water, traditional methods of water harvesting, objectives and functions of water storage structures, different structures and their suitability, losses of stored water, control of losses of stored water, conjunctive use of water

Unit 6: Monitoring and Evaluation of Watershed Projects [7 Hrs]

Need of monitoring, types of monitoring, monitoring systems, phases, selection of indicators, criteria for performance evaluation, outcomes and lessons learnt from monitoring and evaluation of watershed projects.

Text Books:

1. Rajvir Singh, "Watershed Planning and Management", Yash Pulishing House, Jaipur, India 3rd Edition 2016
2. J V S Murty, “Watershed Management”, New Age International Publisher, Daryaganj New Delhi, Second Edition 2013

3. Madan Mohan Das and Mimi Das Saikia, “Watershed Management”, PHI Learning Private Limited New Delhi, Edition 2013

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. V. P. Singh and Donald K. Frevert, “Watershed Models", Taylor & Francis

- Mapping of COs with POs and PSOs - indicating dash- no mapping,

1- Low, 2 - Med, 3 - High

POs & PSOs COs	PO 1	2	3	4	5	6	7	8	9	10	11	12	PS O1	PS O2	PSO 3	PEO 1	PEO 2	PE O3
CO1	2	-	-	-	-	-	-	-	-	-	-	-	2	-	2	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-		1	-	-	-	-
CO3	-	2	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
CO4	-	2	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-
CO5	-	-	2	-	-	-	-	-	-	-	-		2	3	-	-	2	-

INTRODUCTION TO EARTHQUAKE ENGINEERING

Teaching Scheme
Lectures: 3 Hrs/ week

Examination Scheme:
T1 and T2 - 20 marks each
End Sem. Exam. - 60 marks

Course Outcomes: At the end of the course, the students are able to

CO 1: Explain basic terminology in seismology, seismicity and will be able to perform simple calculations on recorded earthquake ground motions.

CO 2: Apply basics of structural dynamics in the analysis of structures subjected to earthquake induced vibrations (up to 2 Degrees of freedom).

CO 3: Analyse different structural members of RC building considering Earthquake induced forces as per relevant IS codal provisions.

CO 4: Design different structural members of RC building considering Earthquake induced forces as per relevant IS codal provisions.

CO 5: Explain Earthquake resistant features of masonry**.**

Unit 1: Seismology [7 Hrs]

Introduction: Theory of plate tectonics, seismic waves, earthquake size: magnitude and intensity, local site effects, Indian seismicity, seismic zoning map of India, history of past earthquakes in world and India

Unit 2: Vibration Theory: Single and Two Degrees of Freedom Systems [7 Hrs]

Dynamic Equation of equilibrium, Concept of shear building
Free and Forced Vibrations with and without damping, earthquake ground motion, Concept of response spectra and design spectra

Unit 3: Structural Form and Response [7 Hrs]

Effect of Structural Irregularities on seismic performance of RC buildings, Vertical irregularity and plan configuration problems, Seismo-resistant building architecture – lateral load resistant systems, building configuration, building characteristics

Unit 4: Determination of design lateral loads Seismic design philosophy [7 Hrs]

Determination of design lateral loads Seismic design philosophy, Evaluation of seismic forces as per IS 1893:2016, Equivalent static lateral force method, response spectrum methods, lateral load analysis of building, Torsion provisions

Unit 5: Ductility Considerations in Earthquake Resistant Design of RC Buildings[6 Hrs]

Introduction- Impact of Ductility- Requirements for Ductility- Assessment of Ductility- Factors affecting Ductility- Ductile detailing considerations as per IS 13920:2016. Behaviour of beams, columns, and joints in RC buildings during earthquakes

Unit 6: Features of Earthquake Resistant Masonry Structure [6 Hrs]

Un-reinforced Masonry, Earthquake resistant features of masonry: bands and vertical reinforcement (IS 4326, IS13827, IS 13828)

Text Books:

1. Pankaj Agarwal and Manish Shrikhande, "Earthquake Resistant Design of structures", Prentice Hall of India Pvt. Ltd. 2006.
2. S. K. Duggal, "Earthquake Resistant Design of structures", Oxford University Press, 2013.

Reference Books:

1. T. Paulay and M.J.N. Priestly, "Seismic Design of Reinforced Concrete and Masonry Building", John Wiley & Sons, 1992.
2. IS: 1893 (Part-1) -2016. "Criteria for Earthquake Resistant – Design of structures." B.I.S., New Delhi.

3. IS: 13920- 2016, "Ductile detailing of concrete structures subjected to seismic force" – Guidelines, B.I.S., New Delhi.

- Mapping of COs with POs and PSOs- [dash- no mapping, 1-Low, 2 -Med, 3 - High].

POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PS O2	PS O3
COs															
CO 1	1	-	2	2	-	-	3	1	1	-			1	2	-
CO 2	1	-	2	1	-	1	3	1	1	-			1	2	1
CO 3	-	1	3	2	2	1	2	-	-	-			1	2	3
CO 4	-	1	3	2	2	1	2	-	-	-			-	2	3
CO 5	-	2	2	2	2	2	1	1	1	-			-	2	1

QUANTITY SURVEYING AND VALUATION

Teaching Scheme:
Lectures: 3 Hrs/ week

Examination Scheme:
T1 and T2 - 20 marks each
End Sem. Exam. - 60 marks

Course Outcomes: At the end of the course, the students are able

CO 1: To take out quantities for various construction projects and prepare a estimate
CO 2: To make rate analysis for various items of construction.
CO 3: To draft specifications for any item of work in the construction.
CO 4: To draft tender notice for any type of construction work
CO 5: To prepare valuation report for residential building.

Unit 1: Estimating [7 Hrs]

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: Taking out Quantities [7 Hrs]

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: Analysis of Rates [7 Hrs]

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: Specifications [7 Hrs]

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: Valuation of Property [7 Hrs]

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: Contracts and Tenders [7 Hrs]

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.

Textbooks:

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", S. Chand, Limited, 3rd Edition 1987.
4. Chakraborti M. "Estimating,Costing and Specification in Civil Engineering",24th Edition,Chakraborti M
5. G.H.Birdie, "Estimating and Costing (Civil Engineering)", 7th Edition 2015, Dhanpatrai Publishing
6. 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.

- Mapping of COs with POs and PSOs- [dash- no mapping, 1-Low, 2 -Med, 3 -High].

POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 11	PS O1	PS O2	PS O3
COs															
CO 1	1														
CO 2				2										1	
CO 3			2												
CO 4										2					
CO 5															

QUANTITY SURVEYING AND VALUATION LAB

Teaching Scheme:
Practical: 2 hrs/week

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

Course Outcomes: At the end of the course, the students are able
CO 1: To take out of quantities for various construction projects.
CO 2: To prepare estimates for various civil engineering works.
CO 3: To calculate rates for various items of construction.
CO 4: To draft specifications and tender notice.
CO 5: To prepare valuation report for residential building.

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 of work

For 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

For the residential buildings

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.

- Mapping of COs with POs and PSOs- [dash- no mapping, 1-Low, 2 -Med, 3 -High].

POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 11	PS O1	PS O2	PS O3
COs															
CO 1	1														
CO 2														1	
CO 3				1											

CO 4			2							2					
CO 5															

WASTEWATER ENGINEERING LAB

Teaching Scheme:
Practical: 2 hrs/week

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

Course Outcomes: At the end of the course, the students are 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

PART 1 **Laboratory Experiments to be conducted for the Determination (Any Eight)**

1 Determination of dissolved oxygen (DO)
2 Determination of biochemical oxygen demand
3 Determination of chemical oxygen demand
4 Determination of different forms of solids (TS, TS5. TDS, VSS and FS)
5 Determination of sludge volume index
6 Determination of electrical conductivity and dissolved salt concentration
7 Determination of sodium dodecyl sulphate
8 Determination of phosphate
9 Determination of oil and grease
10 Study of various types of micro-organisms

PART 2 II) Site visit to Wastewater Treatment Plant and Visit Report
III) Design of various components of wastewater treatment plant

Note: Term work shall consist of record of above practicals. Oral examinations will be based on above exercises.

- Mapping of COs with POs and PSOs- [dash- no mapping, 1-Low, 2 -Med, 3 -High].

POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 11	PS O1	PS O2	PS O3
COs															
CO 1															
CO 2															

CO 3															
CO 4															
CO 5															

ADVANCED FLUID MECHANICS

Teaching Scheme:
Lectures: 3 Hrs/ week

Examination Scheme:
T1 and T2 - 20 marks each
End Sem. Exam. - 60 marks

Course Outcomes: At the end of the course, the students will be able to

CO 1: Analyze the various losses in pipe, water hammer due to gradual and sudden closer of valve.

CO 2: To analyze surge phenomenon and design surge tank.

CO 3: To interpret boundary layer thickness, displacement, momentum, and energy thickness.

CO 4: To analyze laminar flow between two parallel plates and turbulent flow in pipes

CO 5: To interpret drag and lift effects and design of spillway and energy dissipaters

Unit 1: Pipe Flow Problems: [7 Hrs]

Losses in pipe flow, pipes in series, pipes in parallel, branching pipes, siphons, multi-reservoir problems, pipe networks. 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: Boundary Layer Theory: [6 Hrs]

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: Laminar flow: [7 Hrs]

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: Turbulent Flow [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: [6 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.

Textbooks:

1. Modi, P. N. and S. N. Seth " Hydraulics and Fluid Mechanics", Standard book house, New Delhi.

Reference Books:

1. A.K. Jain "Mechanics of fluids", Khanna Publisher., Delhi.

- Mapping of COs with POs and PSOs-
  [dash- no mapping, 1-Low, 2 -Med, 3 -High].

POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 11	PS O1	PS O2	PS O3
COs															
CO 1	1	3	2	3	2		2							2	
CO 2	1	3	2	3	2		2							2	
CO 3	1	3	2	3	2		2							2	
CO 4	1	3	2	3	2		2							2	
CO 5	1	3	2	3	2		2							2	

ADVANCED FOUNDATION ENGINEERING

Teaching Scheme:
Lectures: 3 Hrs/ week

Examination Scheme:
T1 and T2 - 20 marks each
End Sem. Exam. - 60 marks

Course Outcomes: At the end of the course, the students are able to

CO 1 : Assess bearing capacity of the shallow foundations according to various types of loading conditions, such as inclined, and moment conditions.

CO 2 : Evaluate settlement of the shallow foundations according to various types of loading conditions, such as inclined, and moment conditions.

CO 3 : Design raft foundation, well foundation and machine foundation

CO 4 : Design ground improvement technique, reinforced earth wall, foundations on expansive soil and on rock.

CO 5 : Select type of foundations on various soil type.

Unit 1: Raft Foundation [06 hrs]

Geotechnical design of raft foundation shear failure and settlement criteria, Modulus of subgrade reaction.

Unit 2: Foundations for retaining wall [07 hrs]

Allowable bearing pressure below base slab of retaining wall subjected to gravity and seismic loads, global stability analysis.

Unit 3: Machine Foundation [07 hrs]

Machine vibration, free vibration and force vibration, determination of soil properties for dynamic analysis, Bearing capacity determination for various machine foundation.

Unit 4: Ground Improvement [07 hrs]

Design of prefabricated Vertical Drains (PVD) and Stone columns, remedial measures of soil liquefaction.

Unit 5: Design of foundations on rock [07 hrs]

Identification of types of rock, bearing capacity of shallow foundation on rock, RQD concept.Rock anchored.

Unit 6: Foundations on expansive soil [07 hrs]

Identification of expansive soil, design of foundations on expansive soil

Text Books:

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

Reference Books:

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

- Give the mapping of COs with POs and PSOs - indicating dash- no mapping, 1- Low, 2 - Med, 3 - High.

POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
COs															
CO 1	2	1	1	3	1	1	1	1	1	2	1	1	1	2	1
CO 2	2	1	1	3	1	1	1	1	1	2	1	1	1	2	1
CO 3	2	1	1	3	1	1	1	1	1	2	2	1	1	2	1
CO 4	2	1	1	3	2	2	2	1	1	2	2	1	1	2	1
CO 5	2	2	1	3	2	1	1	1	1	2	1	1	1	2	1

[CE 22001] ADVANCED PLUMBING SERVICES

Teaching Scheme:
Lectures: 3 Hrs/ week

Examination Scheme:
T1 and T2 - 20 marks each
End Sem. Exam. - 60 marks

Course Outcomes: At the end of the course, the students are able to

CO 1 : Interpret and analyze the data required for planning of water supply, drainage schemes for residential, commercial, and public uses.

CO 2 : To design water supply, for residential commercial and public building.

CO 3 : To design Hot water supply system for residential, commercial, and public buildings

CO 4 : To design Drainage system for residential, commercial, and public buildings

CO 5 : 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, 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: **[7 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: **[7 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, color 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: **[7 Hrs]**

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: **[7 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: **[6 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.

Textbooks:

1. Deolalikar S.G. " Plumbing Design and Practice", Tata McGraw Hill Publishing company Ltd., New Delhi, ISBN, 933922132X, 9789339221324

Reference Books:

2. National Building Code (NBC) 2017
3. Uniform Illustrated Plumbing Code- India (UIPCI 2017)

- Mapping of COs with POs and PSOs- [dash- no mapping, 1-Low, 2 -Med, 3 -High].

POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 11	PS O1	PS O2	PS O3
COs															
CO 1	1	2	3	3		2								2	
CO 2	1	2	3	3		2								2	
CO 3	1	2	3	3		2								2	
CO 4	1	2	3	3		2								2	
CO 5	1	2	3	3		2								2	

INDUSTRIAL WASTEWATER TREATMENT

Teaching Scheme:
Lectures: 3 Hrs/ week

Examination Scheme:
T1 and T2 - 20 marks each
End Sem. Exam. - 60 marks

Course Outcomes: At the end of the course, the students are able to

CO 1 : Define and understand significance of Wastewater characteristics and pollution effects of industrial waste on environment.

CO 2 : Analyse unit operations and unit processes for treatment of wastewater and carry out treatability studies

CO 3 : Formulate problems, gathering data related to the problem, generating and prioritizing a set of alternative solutions, and selecting the best alternative to reduce, recycle and treat industrial wastewater.

CO 4 : Plan location of industries, industrial estates and common effluent treatment plants.

CO 5 : Demonstrate industrial water budgeting and performance studies for treatment plant.

Unit 1 **[7 Hrs]**

Industrial waste waters, flow measurements, Characteristics and Treatability studies

of industrial waste waters. Stream sanitation. Different equations of self-purification, River standards, Effluent standards, Minimal national standards (MINAS). Sources and effects of various pollutants, Disposal of industrial wastes-on land, in creeks, in sea, in inland streams, into impoundments.

Unit 2 **[7 Hrs]**

Unit operation and unit processes, Generation of influent, Importance of planning location of industries and industrial estates, Common effluent treatment plants, their economics and management.

Unit 3 **[7 Hrs]**

Pre-treatment of industrial wastes, Characteristics, collection treatment and disposal of Textile Wastes, Dairy wastes. Treatability Studies: - Bench Scale & Pilot scale, Preparation of Feasibility Reports.

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. Industrial water budgeting from Environmental angle, Performance study of Wastewater 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.

- Mapping of COs with POs and PSOs- [dash- no mapping, 1-Low, 2 -Med, 3 -High].

POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 11	PS O1	PS O2	PS O3
COs															
CO 1	1			2		2	2								
CO 2	1	2	2	2	2										
CO 3	1	2	2		2	2	2								
CO 4	1		1	2		2		2							
CO 5	1	2	2		3	1									

PRESTRESSED CONCRETE STRUCTURES

Teaching Scheme:
Lectures: 3 Hrs/ week

Examination Scheme:
T1 and T2 - 20 marks each
End Sem. Exam. - 60 marks

Course Outcomes: At the end of the course, the students are able to

CO 1 : Apply the basic concepts of prestressed concrete fundamentals, including pre- and post- tensioning processes, losses and deflections in PSC sections
CO 2 : Analyse prestressed concrete flexural members
CO 3 : Design prestressed concrete beams / girders.
CO 4 : Design of end blocks for prestressed concrete members.
CO 5 : Analyse statically indeterminate beams
CO 6: Analyse prestressed composite sections.

Unit 1: Introduction to Prestressed Concrete [7 Hrs]

Types of prestressing, systems and devices, materials, losses in prestress, Applications of relevant IS codes and standards

Unit 2: Analysis of Flexural Members [7 Hrs]

Analysis of PSC flexural members: basic concepts, stresses at transfer and service loads, ultimate strength in flexure, calculations for deflections of PSC sections, code provisions.

Unit 3: Anchorage Zones [7Hrs]

Transmission of prestress in pretensioned members; Anchorage zone stresses for post-tensioned members, End Block design as per IS: 1343.

Unit 4: Statically Determinate Beams [7 Hrs]

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

Unit 5: Statically Indeterminate Beams [6 Hrs]

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

Unit 6: Composite Sections [6 Hrs]

Analysis of Composite construction with precast PSC beams and cast in-situ RC slab, Use of any commercial software for analysis and design of PSC beams / girders.

Text Books:

1. Prestressed Concrete, Krishnaraju N., Tata McGraw Hill, New Delhi, 6th edition 2018.
2. Prestressed concrete, Pandit and Gupta, CBS publishers, January 2019.

Reference Books:

2. Design of Prestressed Concrete Structures, Lin T.Y., Asia Publishing House, 6th edition 2018.
3. Limit State Design of Prestressed Concrete, Guyan Y., Applied Science Publishers, 1974.
4. Prestressed Concrete, Dayaratnam, Medtech Publishers, 7th edition, 2017
5. Fundamentals of Prestressed Concrete Sinha N.C. & Roy, S. Chand & Company, 3rd edition, 2011.
6. Prestressed Concrete, Rajagopalan N, Narosa Publishing house, 2nd edition, 2010.
7. IS 1343: 2012, Code of Practice for Prestressed Concrete, BIS, 2012.
8. All latest relevant Indian Standards published by BIS, India and Indian Road Congress, India.

- Give the mapping of COs with POs and PSOs - indicating dash- no mapping, 1- Low, 2 - Med, 3 - High.

POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 11	PS O1	PS O2	PS O3

COs															
CO 1	3		1									1		2	
CO 2	3		1									1		3	
CO 3	3		3	2								1		3	
CO 4	3		3	2								1		3	
CO 5	3		1		2							1		2	
CO6	3	3	1		2							2		2	

GEOSPATIAL TECHNOLOGIES FOR WATER RESOURCES MANAGEMENT

Teaching Scheme:
Lectures: 3 Hrs/ week

Examination Scheme:
T1 and T2 - 20 marks each
End Sem. Exam. - 60 marks

Course Outcomes: At the end of the course, the students are able to

CO 1 : Demonstrate fundamental concepts of the remote sensing, GIS and GPS technologies.

CO 2 : Formulate GIS-based models and solve the related problems.

CO 3 : Demonstrate the basic principles underlying the RS-GIS based modeling of the hydrological systems.

CO 4 : Apply the geospatial tools for sustainable management of water resources and related issues.

CO 5 : Demonstrate fundamental concepts of the remote sensing, GIS and GPS technologies.

Unit 1: Remote Sensing **[8 Hrs]**

Fundamental of Remote Sensing, History , Components of RS data acquisition system, Electromagnetic spectrum, Atmospheric windows, Remote Sensing platforms and sensors, Data acquisition through various platforms, Cameras and sensor parameters, Elements of satellite images, spectral signature, Concept of bands, pixel, digital number, metadata, Spatial, spectral, radiometric and temporal resolutions, 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, Supervised and unsupervised classification, Ground truths verification, omission and commission errors. RS applications in WRE.

Unit 2: GIS **[6 Hrs]**

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

Unit 3: GPS **[6 Hrs]**

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: Hydrological modelling **[6 Hrs]**

Introduction to modelling, Modelling parameters, Concepts of systems engineering, MIS- DSS in water resources engineering, Hydro meteorological data collection systems, Watersheds, streams /drainage parameters, morphological parameters, Spatial-temporal rainfall runoff analysis, Soil and land use mapping, , Flood estimation-SCS, Presentation of modelling results.

Unit 5: Geoinformatics applications **[6 Hrs]**

Applications in water and environment, agriculture, irrigation, drainage, water logging, salinity affected areas, reservoir sedimentation, floods mitigation, Water quality monitoring for water bodies/rivers, Stream rejuvenation, Flood forecasting, Flood inundation studies.

Unit 6: Arc-GIS Software (hands on) **[8 Hrs]**

Familiarize GIS software, Data pre-processing, Geo-referencing, Data sources, input-output file systems, ,Layers and Attribute tables, Data editing, errors and quality control, Raster and Vector, Data transformation, Proximity analysis, Overlay analysis, Watershed delineation, Estimation of morphological parameters, Spatial Rainfall analysis, GIS application based mini project.

Text Books:

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

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 Publisher: ITC, nschede Editors: N. Kerle, L.L.F. Janssen, G.C. Huurneman.

- Give the mapping of COs with POs and PSOs - indicating dash- no mapping, 1- Low, 2 - Med, 3 - High.

POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 11	PS O1	PS O2	PS O3
COs															
CO 1	3				2		1								2
CO 2		3			3	1	1								
CO 3				3		1		1							2
CO 4					3	1	2								3

HUMAN RESOURCE MANAGEMENT IN CONSTRUCTION

Teaching Scheme:
Lectures: 3 Hrs/ week

Examination Scheme:
T1 and T2 - 20 marks each
End Sem. Exam. - 60 marks

Course Outcomes: At the end of the course, the students are able to

CO 1 : Understand the basic concept of Human Resource Management**.**
CO 2 : Interpret human resource planning, manpower calculations, supervisory skills etc.
CO 3 : Develop decision making, leadership and time management capabilities.
CO 4 : Analyze recruitment process, orientation programme and team work.
CO 5 : Formulate the training activity for different human resource hierarchy**.**

Unit 1: Introduction to HRM [07 Hrs]

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: Human Resource Planning [07 Hrs]

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: Personnel Management [07 Hrs]

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: Recruiting Human Resources [07 Hrs]

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: Training [07 Hrs]

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: Motivation and Perspective: [07 Hrs]

Motivation, importance of motivation, theories of motivation, Theories of Motivation and their comparison, Motivation as an incentive. 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. Dainty, Andrew, and Martin Loosemore, eds. Human resource management in construction projects. Routledge, 2013.

Reference Books:

1. Loosemore, M., Dainty, A., & Lingard, H. (2003). Human resource management in construction projects: strategic and operational approaches. Routledge.
2. Monappa A, Personnel Management , Tata McGraw Hill, New Delhi, 1997
3. Rao T , HRD in the New Economic Environment , Tata McGraw Hill
4. William J Bruns Jr. Performance Measurement, Evaluation and Incentives , Tata McGraw Hill.
5. NICMAR Publication on - HRD in the Construction Industry - papers and proceedings of the 5th National HRD round table in the Construction Industry - Pune - March – 2000
6. Shawn Smith and Rebecca Mazin, The HR Answer Book: An Indispensable Guide for Managers and Human Resources Professionals.

- Mapping of COs with POs & PSOs - indicating dash- no mapping, 1- Low, 2 - Med, 3 - High

POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 11	PS O1	PS O2	PS O3
COs															
CO 1		2			2						2				1
CO 2		1	1		1						2			1	
CO 3				3	3						2			2	
CO 4				3	3						2			2	
CO 5			2	2	2						2				2

Tunnels, Docks, Harbour and Railway Engineering

Teaching Scheme:

Lectures: 3 Hrs/ week

Examination Scheme:

T1 and T2 - 20 marks each

End Sem Exam. - 60 marks

Course Outcomes: At the end of the course, the students are able to

CO 1 : Relate various component parts & processes to run tunnel engineering system.

CO 2 : Define fundamentals of tunnel, its excavation methods, support systems, and executional aspects.

CO 3 : Classify 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.

CO 4 : Elaborate and apply the tunneling technique.

CO 5 : Recommend type of structure in a given situation.

Unit 1: General Introduction about Tunnels: [06 Hrs]

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: Driving Tunnels in Soft ground: [06 Hrs]

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: Driving tunnels in hard ground: [06 Hrs]

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: Blasting, explosives and Support Systems: [06 Hrs]

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: Docks and Harbour: [08 Hrs]

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: Breakwater, Jetty and Types of Docs: [08 Hrs]

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.

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POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
CO1	2												2		
CO2		1												2	
CO3			2											1	
CO4				2	2										3
CO5					3										3

WATER RESOURCES PLANNING AND MANAGEMENT

Teaching Scheme:
Lectures: 3 Hrs/ week

Examination Scheme:
T1 and T2 - 20 marks each
End Sem. Exam. - 60 marks

Course Outcomes: At the end of the course, the students are able to

CO 1 : Demonstrate the knowledge of basic concepts in water resources planning and management.

CO 2 : Analyze data like inflow, crop data, evaporation, sediments, etc.
CO 3 : Plan and design reservoir for irrigation and hydropower.
CO 4 : **S**elect and apply appropriate discounting techniques and evaluate the most economic project from the available options.
CO 5 : Formulate a mathematical model for irrigation project and obtain optimal solution using graphical approach and software.

Unit 1: Introduction [7 Hrs]

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: Reservoir Planning (Irrigation) [7 Hrs]

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

Unit 3: Reservoir Planning (Hydropower) [7 Hrs]

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

Unit 4: Systems Analysis in Water Resources Planning [7 Hrs]

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: Water Resources Economics [7 Hrs]

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: Watershed Management and Basin Planning [7 Hrs]

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.

Text Books:

1. S. K. Jain and V. P. Singh, "Water Resources Systems Planning and Management," Elsevier Science B.V, Amsterdam, 2003.
2. Bhave, P. R., Water Resources Systems, Narosa Pub. House Pvt. Ltd., India, 2011.

Reference Books:

1. Daniel P. Loucks and Eelco van Beek, "Water Resource Systems Planning and Management" Springer Cham, 2017.
2. Vedula, S. and Majumdar, P. P., Water Resources Systems. Modelling Techniques and Analysis, TATA Mc Graw Hill, 2005
3. Kuiper, E., Water Resources Development: Planning, Engineering and Economics, Springer, 2013.
4. Linsley, R.K. and Franzini, J.B., Freyberg D. L. and Tchobanoglous D. Water Resources Engineering, Fourth Edition, Mc Graw Hill,Inc. 1992.
5. James, L.D. and Lee, R.R., Economics of Water Resources Planning, McGraw Hill, 1971.

- Give the mapping of COs with POs and PSOs - indicating dash- no mapping, 1- Low, 2 - Med, 3 - High.

POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PS O1	PS O2	PS O3
COs														
CO 1	3	-		-	-	-	-	-	-	-	-	-	-	-
CO 2	1	-	-	3	-	-	-	-	-	-	-	-	-	-
CO 3	-	-	3	-	-	-	-	-	-	-	-	-	-	3
CO 4	-	2	2	-	3	-	-	-	-	-	-	-	-	-
CO 5	1	3	-	-	3	-	-	-	-	-	-	-	-	-

STRUCTURAL HEALTH MONITORING AND RETROFITTING

Teaching Scheme: 3 hrs / week
Lectures: 3 Hrs/ week

Examination Scheme:
T1 and T2 - 20 marks each
End Sem. Exam. - 60 marks

Course Outcomes: At the end of the course, the students are able to

CO 1 : Observe the status of structure from Visual observation and NDT Test.

CO 2 : Conduct structural audit.

CO 3 : Suggest repairing methods and or retrofitting technique for strengthening of structural member and or structure.

CO 4 : Find out reasons for cracks in concrete structures

CO 5 : Study and present conclusions for case studies related to failure of structures

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: **[7Hrs]**

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:

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.

- Give the mapping of COs with POs and PSOs - indicating dash- no mapping, 1- Low, 2 - Med, 3 - High.

POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 11	PS O1	PS O2	PS O3
COs															
CO 1	3	2				1							3	2	2
CO 2	2			3	1								2		
CO 3				2	3	1								2	3
CO 4		3			2	1								3	2
CO 5			1			3	2						3		

Honors

[VII Semester] [CE 2200] ADVANCED STRUCTURAL DESIGN

Teaching Scheme:
Lectures: 3 Hrs/ week

Examination Scheme:
T1 and T2 - 20 marks each
End Sem. Exam. - 60 marks

Course Outcomes: At the end of the course, the students are able to

CO 1 : Understand the behaviour of structural components of multi-storey building frames.

CO 2 : Identify suitable locations for shear walls

CO 3 : Evaluate lateral forces on multi-Storey Building frames, water tanks and retaining walls.

CO 4 : Analyse multi-storey buildings, water tanks, retaining walls for service load conditions and forces on base-isolators.

CO 5 : Design and prepare structural drawings for the Building Frames, Water Tanks, Retaining Walls, Footings and Base-Isolators.

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. [8 hours]

Unit 2: Shear Walls [6 Hrs]

Design of RC and Steel plate Shear Walls in multi-storey building [6 hours]

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. Varghese P. C., "Design of Reinforced Concrete Foundations", Prentice Hall of India Private Limited, 2009.
2. Pillai S. U. and Menon D.," Reinforced Concrete Design", Tata McGraw Hill, 3rd Edition.
3. Agarwal P. and Shrikhande M., "Earthquake Resistant Design of Structures", Prentice-Hall of India Private Limited, 2006.

Reference Books:

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

- Mapping of COs with POs and PSOs-
  [dash- no mapping, 1-Low, 2 -Med, 3 -High].

POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 11	PS O1	PS O2	PS O3
COs															
CO 1	3	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO 2	3	-	2	2	-	-	-	-	-	-	-	-	-	3	-
CO 3	3	2	2	-	-	-	-	-	-	-	-	-	-	3	-
CO 4	3	-	3	1	-	-	-	-	-	-	-	-	-	3	-
CO 5	-	-	3	-	3	-	-	-	-	-	-	-	3	-	-

Honors

[VII Semester] [CE(HO)18001] PROJECT MANAGEMENT

Teaching Scheme:
Lectures: 3 Hrs/ week

Examination Scheme:
T1 and T2 - 20 marks each
End Sem. Exam. - 60 marks

Course Outcomes: At the end of the course, the students are able to

CO 1 : Identify the importance of project management in the construction industry.
CO 2 : Recognize the feasibility and leadership aspect of project management
CO 3 : Analyze quality control aspects in project management using statistical methods.
CO 4 : Explain the importance of monitoring, cost management, and risk management in construction
CO 5 : Apply the knowledge of computer applications in advance project planning and management practices.

Unit 1: Introduction to Project Management [8 Hrs]

Importance, Objectives & Functions of Management, Principles of Management, Categories of Project, Project Failure, Project-Life Cycle Concept and Cost Components, Project Management Book of Knowledge {PMBOK} – Different Domain Areas, Project management Institute and Certified Project Management Professionals (PMP). Importance of organizational Structure in Management-Authority / Responsibility Relation, Management by objectives (MBO)

Unit 2: Project Feasibility, Selection and Leadership Aspect of Project Managemen [7 Hrs]

Project Selection, Types of Project Selection Models, Project Feasibility Studies and

Appraisal, Project Portfolio Management (PPM), Project Manager Responsibilities, Dealing with Conflict, Special Demands and Attributes of Effective Project Managers, Problem of Cultural Differences.

Unit 3: Project Quality Management [7 Hrs]

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: Project Monitoring and Cost Management [7 Hrs]

Performance Monitoring Technique, Cost Variance Analysis, Project Cost Control, Cost Control & Monitoring Mechanism, Earned Value Management, Sources of Project Finances – Concepts of Debt Capital and Equity Capital. Types of Capital – Fixed and Working, Equity Shares and Debenture Capital, FDI in Infrastructure.

Unit 5: Project Risk Management [6 Hrs]

Definition, Types, Risk Identification Process, Sources of Risk, Risk Classification, Formalising the Risk Management Plan, Risk Mitigation- Risk Reduction, Risk Acceptance, Risk Avoidance

Unit 6: Computer Application in Project Management [7 Hrs]

Microsoft project, BIM and Primavera Project Planner (P6) and its application, detailed Case studies, Application of advance project planning and management practices.

Reference Books:

1. Cleland, D. I. and Ireland. L. R. (2002). "Project Management: Strategic Design and Implementation". 4th Edition, McGraw-Hill, New York.
2. Kumar Neeraj Jha (2016) "Construction Project Management: Theory and Practices" 2nd Edition, Pearson Education Publishers.
3. Willis. E.M.(1986). "Scheduling Construction Projects". Wiley New York.
4. Danny Myers (2004). "Construction Economics: A New Approach". 2nd Edition. Routledge (Taylor and Francis) Publisher.
5. James C Van Horne (2001). "Financial Management and Policy". 12th Edition. Prentice Hall, New Delhi.
6. Prasanna Chandra (2007) "Finance Management", 7th Edition. Tata McGraw Hill Publishing Co. Ltd. New Delhi.
7. Riggs, J.L., Bedworth, D.D., and Randhawa, S.U. (2005). Engineering Economics Tata-

McGraw Hill Publishing Co Ltd.
8. Project Management—Khatua—Oxford University
9. Construction Project Management-Planning, Scheduling and Controlling by K. K. Chitkara, Tata McGraw Hill Publishing Company, New Delhi.
10. 3Construction Management and Planning by B. Sengupta and H. Guha, Tata McGraw Hill Publishing Company, New Delhi.
11. The Essentials of Project Management by Dennis Lock, Gower Publishing Ltd. UK.
12. Essentials for Decision Makers by Asok Mukherjee, Scitech Publication, New Delhi.
13. Total Quality Management - Dr. S.Rajaram and Dr. M. Sivakumar-- Biztantra
14. Total Engineering Quality Management – Sunil Sharma – Macmillan India Ltd.

- Give the mapping of COs with POs and PSOs - indicating dash- no mapping, 1- Low, 2 - Med, 3 - High.

POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3
COs															1
CO 1	3	2													
CO 2								3	2			2			
CO 3			3					1					3		
CO 4						3					3				
CO 5					3							2		2	

Honors

[VII Semester] GROUND WATER ENGINEERING

Teaching Scheme

Lectures: 3 Hrs/ week

Examination Scheme:

T1 and T2 - 20 marks each

End Sem. Exam. - 60 marks

Course Outcomes: At the end of the course, the students are able to

CO 1 : Demonstrate the different terminologies related with groundwater engineering **[PEO1][PO1]; [PEO1][PSO1]**

CO 2 : Identify suitable method of determination of aquifer parameters **[PEO1][PO1]; [PEO1][PSO2]**

CO 3 : Choose suitable ground water exploration techniques and assess ground water potential **[PEO1][PO3]; [PEO1][PSO2]**

CO 4 : Compare and contrast suitable ground water quality management methods and ground water model. **[PEO1][PO1]; [PEO1][PSO1]**

CO 5 : Select particular type of well and design it in a given situation **[PEO1][PO3]; [PEO2][PSO3]**

Unit 1: Introduction to Ground Water [7 Hrs]

Ground water and surface water advantages and disadvantages, porosity, specific yield and specific retention of water in rocks/aquifers, compressibility of rock, zone of aeration and saturation, fluctuation of water table and piezometric surfaces, storage coefficients of aquifers, specific yield, specific retention, unconfined and confined aquifer, ground water potential in India, geophysical methods for groundwater explorations.

Unit 2: Groundwater Flow [7 Hrs]

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

Unit 3: Evaluation of Aquifer Properties [6 Hrs]

Aquifer tests, control well, observation well, Solution of aquifer parameters for confined aquifer by Theis method, Jacob and Chow’s method, Theis’ recovery method, bounded aquifer, interference among wells, aquifer properties for bounded aquifers by theory of images..

Unit 4: Construction of Wells [6 Hrs]

Types of wells and method of construction, tube well design and well drilling: well screen, development and completion of wells, well performance test, well loss, Rotary drilling and Rotary percussion drilling, maintenance of wells.

Unit 5: Groundwater Modeling Techniques [7 Hrs]

Groundwater flow, objectives of ground water modeling, physical models, analog models such as viscous flow models, membrane model, thermal model, electric analog model, numerical model with emphasis on finite difference method

Unit 6: Groundwater Recharge, Development and Management [7 Hrs]

Components of ground water balance, estimation of recharge component, ground water storage changes, conjunctive use, artificial recharge of groundwater- different methods, subsurface dam, recharge by urban storm runoff, percolation from tanks, recharge from irrigated fields, groundwater quality, estimation of ground water discharge, ground water resource evaluation in India.

Text Books:

1. Todd, D.K. "Ground Water Hydrology", John Wiley & Sons, Singapore.
2. Raghunath, H.M. "Ground Water" New Age International (P) Limited, New Delhi (20100
3. Bhagu R Chahar, "Groundwater Hydrology", McGraw Hill Education (India) Private Limited, New Delhi (2015)

Reference Books:

1. Karanth, K. R. "Ground Water Assessment Development and Management", Tata McGraw Hill Publishing Company Limited, New Delhi
2. Domenico "Concepts and Models in Groundwater Hydrology", McGraw Hill Inc., NewYork
3. L. Harvil and F. G. Bell, *Ground Water Resources and Development*, Butterworth's, London.
4. Herbert F Wang and Mary P. Anderson "Introduction to Ground Water Modeling", W.H. Freeman and Company, NewYork
5. Garg S.P. "Groundwater and Tube wells", Oxford and IBH Publishing Co. New Delh
    a. Waltin W.C "Groundwater Resources Evaluation", McGraw Hill Inc. N York

- Mapping of COs with POs and PSOs - indicating dash- no mapping,

1- Low, 2 - Med, 3 - High

POs & PSOs COs	PO1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3	PEO1	PEO2	PEO3
CO1	2	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-		1	-	-	-	-
CO3	-	2	3	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-
CO4	-	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CO5	-	-	2	-	-	-	-	-	-	-	-		2	3	-	-	2	-

Minor
[VII Semester] [CE(M1)18001] STRUCTURAL ANALYSIS

Teaching Scheme

Lectures: 3 Hrs/ week

Examination Scheme:

T1 and T2 - 20 marks each

End Sem. Exam. - 60 marks

Course Outcomes: At the end of the course, the students are able to

CO 1 : Convert given practical problem into structural model by applying knowledge of various types of structures and supports.

CO 2 : Analyse isotropic structural skeletal members subjected to loading.

CO 3 : Analyse statically determinate beams, frames and trusses for deflection.

CO 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, generalized Hook's law, elastic constants end 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 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]

(a) 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

Text 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.

Reference Books:

1. Reddy, C. S., "Basic Structural Analysis", Tata McGraw Hill Publishing Company Limited
2. Hearn E. J., "Mechanics of Materials", Butterworth Heinemann, Publications (Third Edition), 1997.
3. Devdas Menon, "Structural Analysis", Alpha Science, 2008.

- Give the mapping of COs with POs and PSOs - indicating dash- no mapping, 1- Low, 2 - Med, 3 - High.

POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 11	PS O1	PS O2	PS O3
COs															
CO 1															
CO 2															
CO 3															
CO 4															
CO 5															

Honors

[VIII Semester] [CE] RCC Design of Foundations

Teaching Scheme

Lectures: 3 Hrs/ week

Examination Scheme:

T1 and T2 - 20 marks each

End Sem. Exam. - 60 marks

Course Outcomes: At the end of the course, the students are able to

CO 1 : Design the shallow isolated combined and raft foundations.

CO 2 : Design the flat slab raft foundations with and without beams.
CO 3 : Design the cantilever and counterfort retaining walls and basement walls.
CO 4 : Design the abutment, piers foundations for bridges.
CO 5 : Design pile foundations and shallow machine foundations.

Unit 1: RCC design of Shallow isolated and combined Foundations [10 Hrs]
Isolated column footing with vertical loads and moments, combined footings with and without beams - rectangular and trapezoidal. Strap beam footing for two columns, Strip footings foundations.

Unit 2: RCC design of raft foundations [9 Hrs]
Design of flat slab raft foundation. Design of beam and slab raft foundations.

Unit 3: RCC design of retaining walls and basement walls [6 Hrs]
Design of cantilever and counterfort retaining walls, basement walls

Unit 4: RCC design of pile foundations [5 Hrs]
Design of pile and pile caps for different pile groups

Unit 5: RCC design of bridge foundations [6 Hrs]
Design of bridge - abutment, return wall and pier foundations.

Unit 6: Introduction to design of machine foundations [4 Hrs]
Introduction to RCC design of shallow machines foundations

Text Books:

1. P. C. Varghese, Designs of Reinforced concrete Foundations, PHI Learning Publication.
2. N. P. Kurian, Design of Foundation Systems- Principles and Practices, Third Edition, Narosa Publishing

- Give the mapping of COs with POs and PSOs - indicating dash- no mapping, 1- Low, 2 - Med, 3 - High.

POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 11	PS O1	PS O2	PS O3
COs															
CO 1															
CO 2															
CO 3															
CO 4															

POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 11	PS O1	PS O2	PS O3
CO 5															

Honors

[VIII Semester] [CE(HO)18005] ADVANCED TRANSPORTATION ENGINEERING

Teaching Scheme

Lectures: 3 Hrs/ week

Examination Scheme:

T1 and T2 - 20 marks each

End Sem. Exam. - 60 marks

Course Outcomes: At the end of the course, the students are able to

CO 1 : Select different modes of transportation under given situation.
CO 2 : Analyse and design different types of pavements.
CO 3 : Estimate traffic and cost of transport.
CO 4 : Suggest appropriate solutions to given traffic problems.
CO 5 : Understand the advantages and limitations of different urban transport modes

Unit 1: Transportation System Planning : [6 Hrs]

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: Urban Transport Technologies [6 Hrs]

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: A) Cost of Transport: [6 Hrs]

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: Traffic Systems: [7 Hrs]

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: Analysis and Design of Flexible Pavement: [6 Hrs]

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: Design of Rigid Pavement: [6 Hrs]

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 Cahnd 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.

- Give the mapping of COs with POs and PSOs - indicating dash- no mapping, 1- Low, 2 - Med, 3 - High

POs & PSOs COs	PO1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO1	3	1	1	1	1		3							2	2

POs & PSOs COs	PO1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO2	2	3	1	1	1		3						2	2	1
CO3	1	3	1	1	1		3							2	1
CO4	2	3	1	1	1		1						2	2	1
CO5	3	1	1	1	1		3							2	2

Honors

[VIII Semester] [CE(HO)18007] INFRASTRUCTURE MANAGEMENT

Teaching Scheme

Lectures: 3 Hrs/ week

Examination Scheme:

T1 and T2 - 20 marks each

End Sem. Exam. - 60 marks

Course Outcomes: At the end of the course, the students are able to	
CO 1 :	Identify the importance of Infrastructure management in the construction industry.
CO 2 :	Apply knowledge as a professional engineer in infrastructure asset lifecycle management.
CO 3 :	Recognize the economic constraints to develop a management plan for critical infrastructure structures and systems for the needs of society
CO 4 :	Explain the importance of Risk Management in infrastructure.
CO 5 :	Analyze and apply appropriate strategies for successful implementation of infrastructure project

Unit 1: **Basic Concepts Related to Infrastructure** **[6Hrs]**

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

Unit 2: **Construction Management and Maintenance of Infrastructure Assets** **[7 Hrs]**

Scheduling, contract management, quality and safety management, the economics of construction, and financing of infrastructure projects. Impact of failure, risk analysis, monitoring, performance, resilience, service life, repair, condition assessment, no-

destructive testing, and evaluation

Unit 3: **Planning and Creation of Infrastructure Assets** **[7 Hrs]**

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

Unit 4: **Private Involvement in Infrastructure** **[6 Hrs]**

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

Unit 5: **Risks in Infrastructure Planning and Implementation** **[6 Hrs]**

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

Unit 6: **Strategies for Successful Infrastructure Project Implementation** **[6 Hrs]**

Sustainable contracts, introduction to fair process and negotiation, negotiation with multiple stakeholders on infrastructure projects, sustainable infrastructure development, 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
3. Donald Coffelt, Carnegie Mellon University "Fundamentals of Infrastructure Management" Publisher: Donald Coffelt and Chris Hendrickson
4. Waheed Uddin, W. Ronald Hudson "Infrastructure Management: Integrating Design, Construction, Maintenance, Rehabilitation, and Renovation."
5. S. Goodman and M. Hastak, Infrastructure planning handbook: Planning, engineering, and economics, McGraw-Hill

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POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PS O2	PS O3
COs					1								1		
CO 1	3	2													2
CO 2				1				3	2			2			
CO 3			3					1							
CO 4						3					3			3	
CO 5	1				3							2			1

Honors

[VIII Semester] ADVANCED IRRIGATION ENGINEERING

Teaching Scheme

Lectures: 3 Hrs/ week

Examination Scheme:

T1 and T2 - 20 marks each

End Sem. Exam. - 60 marks

Course Outcomes: At the end of the course, the students are able to

CO 1 : Demonstrate the different terminologies related with irrigation techniques.
CO 2 : Interpret and analyze the data required for planning of micro irrigation system.
CO 3 : Design lined and unlined canals
CO 4 : Interpret and analyze the data required for the lift irrigation system
CO 5 : Plan drip irrigation and sprinkler 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.

Reference Books:

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.

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  [dash- no mapping, 1-Low, 2 -Med, 3 -High].

POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 11	PS O1	PS O2	PS O3
COs															
CO 1	1	3	2	3	2		3							2	
CO 2	1	3	2	3	2		3							2	

POs & PSOs	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 11	PS O1	PS O2	PS O3
CO 3	1	3	2	3	2		3							2	
CO 4	1	3	2	3	2		3							2	
CO 5	1	3	2	3	2		3							2	

Minor

[VIII Semester] BASICS OF TRANSPORTATION ENGINEERING

Teaching Scheme:
Lectures: 3 Hrs/ week

Examination Scheme:
T1 and T2 - 20 marks each
End Sem. Exam. - 60 marks

Course Outcomes: At the end of the course, the students are able to

CO 1 : Select different modes of transportation under given situations.
CO 2 : Select different types of construction materials based on ground conditions
CO 3 : Identify different elements used for proper traffic operation
CO 4 : Identify elements of railway track
CO 5 : Identify elements of airport terminals, docks & harbor, and urban transportation units

Unit 1: Introduction to Transportation Engineering [6 Hrs]

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

Unit 2: Highway Planning [6 Hrs]

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: Traffic Engineering [6 Hrs]

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

Unit 4: Highway Materials [7 Hrs]

Aggregates, tests on aggregates, bituminous materials: tar, cutback, 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 station and yards, signaling and interlocking, track junction–points and crossing

B) Airport Engineering

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

Unit 6: **[6 Hrs]**

A) Docks and Harbours

Types layout and planning principles, break waters, transit sheds, navigation 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 Cahnd 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 Publications
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.

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POs & PSOs COs	PO1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2	PSO3
CO1	1	3	3	3	2		2						3	2	
CO2	1	3	3	3	2		2						2	2	

CO3	1	3	2	2	3		2							2	
CO4	1	3	2	2	3		2						1	2	
CO5	1	3	3	3	3		2							2	

MAJOR PROJECT

Teaching Scheme:
Practical: 12 hrs/week

Examination Scheme:
Internal Assessment: 60 Marks
End semester Assessment - 40 marks

Course Outcomes: At the end of the course, the students are able to
CO 1: Formulate problem based on literature survey
CO 2: Identify social problems and provide viable engineering solutions
CO 3: Analyse, design, and develop civil engineering structures and schedule activities
CO 4: Communicate the importance of the selected topic effectively
CO 5: Present their ideas effectively

I 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.

II The Internal Continuous Assessment (ICA):

The Internal Continuous Assessment (ICA) shall be evaluated twice in the semester. A committee comprising of three examiners (one of them should be guide) nominated by head of department, will take the review of the project work twice in a semester. Committee shall judge the students on the principle of continuous evaluation and contribution of individual student in the group. Average of two reviews shall be considered as overall performance of the student. It shall be evaluated on the basis of deliverables of project and depth of understanding. Course coordinator shall maintain the record of continuous evaluation in appropriate format available with suggested rubrics. 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 the stages should be included in CD and submitted along with project report.

III End Semester Examination (ESE)

The End Semester Examination for this course shall be based on demonstration of the Complete work done by the project group, deliverables of project and depth of understanding (oral examination). It shall be evaluated by two examiners out of which one examiner shall be out of institute.