GOVERNMENT COLLEGE OF TECHNOLOGY, COIMBATORE – 641 013

B.E. CIVIL ENGINEERING

2021 batch admitted students (2018A Regulation)

PROFESSIONAL ELECTIVE COURSES: VERTICALS

Vertical I	Vertical II	Vertical III	Vertical IV	Vertical V
Structural Engineering	**Environmental Engineering**	**Geotechnical Engineering**	**Infrastructure Engineering**	**SUSTAINABILITY ENGINEERING**
18CPE$01 Steel Structures	18CPE$11 Design and Drawing (Irrigation and Environmental Engineering)	18CPE$15 Ground Improvement Techniques	18CPE$09 Safety in Civil Engineering Practices	18CPE$37 IOT IN CONSTRUCTION
18CPE$02 Concrete Technology	18CPE$12 Environmental Legislations in India	18CPE$29 Slope Stability and Landslides	18CPE$10 Valuation	18CPE$39 GIS IMPLEMENTATION IN SMART CITY DEVELOPMENT
18CPE$03 Finite Element Method	18CPE$13 Industrial Wastewater Management	18CPE$30 Earth Retaining Structures	18CPE$16 Pavement Engineering	18CPE$40 SUSTAINABLE INFRASTRUCTURE DEVELOPMENT
18CPE$04 Advanced Concrete Design	18CPE$14 Sustainable Engineering and Technology	18CPE$31 Foundations in Expansive Soil	18CPE$17 Airport, Docks and Harbour Engineering	18CPE$41 SUSTAINABLE ENVIRONMENTAL MANAGEMENT
18CPE$05 Basics of Dynamics and AseismicDesign of Structures	18CPE$20 Fundamentals of Remote Sensing and GIS Applications	18CPE$32 Land Reclamation	18CPE$18 Highways – State of Art	18CPE$42 MATERIALS FOR ENERGY SUSTAINABILITY
18CPE$06 Concrete Structures	18CPE$22 Irrigation Engineering and Hydraulic Structures	18CPE$33 Environmental Geotechnology	18CPE$19 Traffic Engineering and Management	18CPE$43 GREEN TECHNOLOGY
18CPE$07 Bridge Engineering	18CPE$23 Hydrology	18CPE$34 Reinforced Soil Structures	18CPE$21 Highway and Railway Engineering	18CPE$44 BUILDING INFORMATION MODELING SYSTEMS
18CPE$08 Earthquake Engineering	18CPE$26 Environmental Management	18CPE$35 Design of Underground Excavations	18CPE$37 IoT in Construction	18CPE$45 MODERN CONSTRUCTION EQUIPMENTS
18CPE$24 Maintenance and Rehabilitation of Structures	18CPE$27 Air Pollution Management	18CPE$36 Geotechniques for infrastructure	18CPE$38 Intelligent Building Techniques	–
18CPE$25 Prefabricated Structures	18CPE$28 Integrated Urban Water Management	–	18CPE$39 GIS implementation in smart city development	–

Vertical I: Structural Engineering

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem. Marks	Total Marks	Hours/Week			
							L	T	P	C
1.	18CPE$01	Steel Structures	PE	40	60	100	3	0	0	3
2.	18CPE$02	Concrete Technology	PE	40	60	100	3	0	0	3
3.	18CPE$03	Finite Element Method	PE	40	60	100	3	0	0	3
4.	18CPE$04	Advanced Concrete Design	PE	40	60	100	3	0	0	3
5.	18CPE$05	Basics of Dynamics and Aseismic Design of Structures	PE	40	60	100	3	0	0	3
6.	18CPE$06	Concrete Structures	PE	40	60	100	3	0	0	3
7.	18CPE$07	Bridge Engineering	PE	40	60	100	3	0	0	3
8.	18CPE$08	Earthquake Engineering	PE	40	60	100	3	0	0	3
9.	18CPE$24	Maintenance and Rehabilitation of Structures	PE	40	60	100	3	0	0	3
10.	18CPE$25	Prefabricated Structures	PE	40	60	100	3	0	0	3

Vertical II: Environmental Engineering

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem. Marks	Total Marks	Hours/Week			
							L	T	P	C
1.	18CPE$11	Design and Drawing (Irrigation and Environmental Engineering)	PE	40	60	100	2	0	2	3
2.	18CPE$12	Environmental Legislations in India	PE	40	60	100	3	0	0	3
3.	18CPE$13	Industrial Wastewater Management	PE	40	60	100	3	0	0	3
4.	18CPE$14	Sustainable Engineering and Technology	PE	40	60	100	3	0	0	3
5.	18CPE$20	Fundamentals of Remote Sensingand GIS Applications	PE	40	60	100	3	0	0	3
6.	18CPE$22	Irrigation Engineering and Hydraulic Structures	PE	40	60	100	3	0	0	3
7.	18CPE$23	Hydrology	PE	40	60	100	3	0	0	3
8.	18CPE$26	Environmental Management	PE	40	60	100	3	0	0	3
9.	18CPE$27	Air Pollution Management	PE	40	60	100	3	0	0	3
10.	18CPE$28	Integrated Urban Water Management	PE	40	60	100	3	0	0	3

Vertical III: Geotechnical Engineering

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem. Marks	Total Marks	Hours/Week			
							L	T	P	C
1.	18CPE$15	Ground Improvement Techniques	PE	40	60	100	3	0	0	3
2.	18CPE$29	Slope Stability and Landslides	PE	40	60	100	3	0	0	3
3.	18CPE$30	Earth Retaining Structures	PE	40	60	100	3	0	0	3
4.	18CPE$31	Foundations in Expensive Soil	PE	40	60	100	3	0	0	3
5.	18CPE$32	Land Reclamation	PE	40	60	100	3	0	0	3
6.	18CPE$33	Environmental Geotechnology	PE	40	60	100	3	0	0	3
7.	18CPE$34	Reinforced Soil Structures	PE	40	60	100	3	0	0	3
8.	18CPE$35	Design of Underground Excavations	PE	40	60	100	3	0	0	3
9.	18CPE$36	Geotechniques for infrastructure	PE	40	60	100	3	0	0	3

Vertical IV: Infrastructure Engineering

Sl. No.	Course Code	Course Title	CAT	CA Marks	End Sem. Marks	Total Marks	Hours/Week			
							L	T	P	C
1.	18CPE$09	Safety in Civil Engineering Practices	PE	40	60	100	3	0	0	3
2.	18CPE$10	Valuation	PE	40	60	100	3	0	0	3
3.	18CPE$16	Pavement Engineering	PE	40	60	100	3	0	0	3
4.	18CPE$17	Airport, Docks and Harbour Engineering	PE	40	60	100	3	0	0	3
5.	18CPE$18	Highways – State of Art	PE	40	60	100	3	0	0	3
6.	18CPE$19	Traffic Engineering and Management	PE	40	60	100	3	0	0	3
7.	18CPE$21	Highway and Railway Engineering	PE	40	60	100	3	0	0	3
8.	18CPE$37	IoT in Construction	PE	40	60	100	3	0	0	3
9.	18CPE$38	Intelligent Building Techniques	PE	40	60	100	3	0	0	3
10.	18CPE$39	GIS implementation in smart city development	PE	40	60	100	3	0	0	3

VERTICAL – I

STRUCTURAL ENGINEERING

18CPE$01	STEEL STRUCTURES

Category : PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1 Mechanics and Properties of Solids
2 Strength of Materials
3 Basic Structural Design I (Steel)

COURSE OBJECTIVES:

* To study the behaviour and design of Beam Column subjected to eccentric force and design of base plate.
* To study the design of Gantry girder, welded plate girder, stiffeners and connections.
* To understand the behaviour of cold formed steel.
* To introduce the concept of plastic analysis and Corrosion and fire resistant design.

UNIT – I : PLASTIC ANALYSIS (9 Periods)

Introduction to Plastic analysis - ductility - plastic bending of beams - stages of bending - shape factor - plastic hinge - load factor - failure mechanism - upper and lower bound theorems of plastic analysis - collapse load for beams and frames.

UNIT – II : BEAM COLUMNS (9 Periods)

Introduction to beam - column behaviour - equivalent moment factor - strength interaction - design of beam column - beam - column subjected to tension and bending - moment resistant base plate.

UNIT – III : PLATE GIRDERS AND GANTRY GIRDERS (9 Periods)

Analysis and Design of Welded plate girders – curtailment of flange plates –stiffeners – Splices - analysis and design of gantry girder.

UNIT – IV : COLD FORMED STEEL STRUCTURES (as per IS Codes) (9 Periods)

Types of cross sections-concepts of local buckling, and Effective width-Design of compression and tension members- concepts of lateral buckling –Design of Beams. (Simple Problems only)

UNIT – V : CORROSION AND FIRE RESISTANT DESIGN (9 Periods)

Corrosion Protection : Introduction - Corrosion of Steel - Corrosion - protection Methods - Atmospheric - Corrosion-Resistant Steels- Corrosion Allowance
Fire-resistant Design: Introduction - Fire Research - Design Curves and Fire Models - Fire Engineering Design Problems - Fire Engineering Design of Steel Structures - Calculation Approach - Calculation of Temperature Rise in Steel Members - Mechanical Properties of Steel at Elevated Temperatures - Time to reach Limiting Temperature - Passive Protection for Steelwork - Fire resistant Steels - Fire Performance Assessment.

Contact Periods: Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1 *SubramanianN.,* ***"Design of steel structures"*** *,Oxford university press, 2008.*
2 *DuggalS.K.,* ***"Limit State Design of Steel Structures"****, Tata McGraw Hill., 1st Edition, NewDelhi, 2010.*
3 ***"Teaching Resources for Structural Steel Design – Volume I and II"****, INSDAG, Kolkatta, 2009.*

REFERENCE BOOKS:

1 *Arya A.S. and Ajmani J.L.,* ***"Design of Steel structures"*** *Nem Chand and Bros.Roorkee, 2000.*
2 *Ramachandra,* ***"Design of Steel structures"*** *Vol I & II. Standard Book House, New Delhi,2005.*
3 *IS:800-2007 - Code of practice for general construction in steel (Third revision).*
4 *P.Dayaratnam,* ***"Design of steel structures"****, S.Chand Publishers 2011-12.*
5 *M.R. Shiyekar,* ***"Limit State Design of Steel Structures"****, PHI Learning Private Ltd, NewDelhi, 2011.*

COURSE OUTCOMES:

On Completion of the course, the students will be able to

CO1: Perform the plastic analysis on beams and frames.
CO2: Identify the behaviour and design of Beam Column subjected to eccentric force
CO3: Design the Gantry girder, welded plate girder, stiffeners and connections.
CO4: Design the cold formed steel structures as per IS codes
CO5: Perform Corrosion and Fire Resistant Design.

COURSE ARTICULATION MATRIX:

PO/PSO CO	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	PSO 2	PSO 3	PSO 4
CO1	H	L	L	L	-	-	-	-	-	-	L	M	-	M	L	-
CO2	M	M	M	M		-	-	-	-	-	L	M	-	-	L	-
CO3	M	H	H	H	M	-	-	-	-	-	L	M	-	H	H	M
CO4	H	H	M	M		-	-	-	-	-	L	M	-	M	H	H
CO5	M	M				-	-	-	-	-	L	M	-	M	M	M
18CPE $01	H	H	H	H	M	-	-	-	-	-	L	M	-	M	H	H

L-Low, M-Moderate (Medium), H-High

18CPE$02	CONCRETE TECHNOLOGY

Category : PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1 Construction Materials and Technology

COURSE OBJECTIVES:

* To learn the tests to be carried out on various concrete making materials as per IS codal provisions and to understand their properties.
* To study the properties of fresh and hardened concrete
* To know about various methods of mix design for concrete.
* To have an exposure on various special concretes.

UNIT – I : INGREDIENTS OF CONCRETE (9 Periods)

Cement – constituents- Hydration – Tests on cement – Types of cement – Aggregates – properties and uses – Classification of aggregates – Properties and test on aggregates – gradation – Quality of water – Admixtures – Chemical Admixtures and mineral admixtures.

UNIT – II : FORMWORK AND PRODUCTION OF CONCRETE (9 Periods)

Requirements of formwork – Economy in formwork – Materials for forms – Arrangement of forms for slabs, beam, column, walls, culverts, stairs etc – Removal of forms – Design considerations. Measurement of materials – batching – Mixing –Transportation – Placing of concrete in cold weather, hot weather and under water concreting – Compaction – Curing.

UNIT – III : PROPERTIES OF CONCRETE (9 Periods)

Properties of fresh concrete – Workability – Segregation – Bleeding – Test for fresh concrete properties - Properties of hardened concrete – Strength – Stress - Strain characteristics – Modulus of Elasticity – Shrinkage – Creep – Thermal properties – Permeability – Test for hardened concrete properties – Test for micro structural properties of concrete - Non-Destructive Test.

UNIT – IV : CONCRETE MIX DESIGN AND QUALITY CONTROL OF CONCRETE (9 Periods)

Quality Control - Frequency of sampling – Statistical analysis of test results – standard deviation – Coefficient of variation – Characteristic strength – Acceptance and rejection Criteria – Importance of water cement ratio – Importance of cover to concrete. Nominal mixes – Design Mixes – factors influencing the design mix – Mix Design by ACI method, IS method and DOE method.

UNIT – V : SPECIAL CONCRETES (9 Periods)

High Strength concrete - High Performance Concrete - reactive powder concrete - Light weight, heavy weight and mass concrete – Self Compacting Concrete – Self Curing Concrete – Polymer Concrete – Fibre Reinforced Concrete - Ready Mixed Concrete – Geo polymer concrete.

Contact Periods:Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1 *Shetty M.S and Jain A.K,* ***"Concrete Technology - Theory and Practice"****, S.Chand & Company, New Delhi, 2018.*
2 *Santhakumar A.R,* ***"Concrete Technology"****, S.Chand Publishers, 2018.*
3 *Gambhir M.L,* ***"Concrete Technology - Theory and Practice"****, Tata Mc-Graw Hill Company, 2013.*

REFERENCE BOOKS:

1 *IS 10262 – 2019, Concrete Mix Proportioning – Guidelines.*
2 *ACI 211.1-91, Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete, American Concrete Institute.*
3 *Neville A.M* ***"Properties of Concrete"****, Pearson Education India,, 2012*
4 *Povindar K. Mehta, Paulo J. M. Monteiro,* ***"Concrete: Microstructure, Properties, and Materials"****, Mc-GrawHill Company, 2014.*

COURSE OUTCOMES:

On the Completion of the course, the students will be able to

CO1: Identify the properties and role of ingredients like cement, aggregate, admixtures in concrete.
CO2: Choose the suitable formwork for construction **.**
CO3: Infer the behavior of fresh and hardened concrete.
CO4: Proportion the concrete using various mix design concepts.
CO5: Select appropriate type of concrete for specific requirements.

COURSE ARTICULATION MATRIX:

PO/PSO CO	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	PSO 2	PSO 3	PSO 4
CO1	H	-	M	-	-	-	-	-	-	-	-	M	H	L	-	-
CO2	M	-			M	-	-	-	-	-	-	-	H	L	M	-
CO3	M	-	M	H		-	-	-	-	-	-	-	H	L		-
CO4	M	M		H	M	-	-	-	-	-	-	-	H	L	M	-
CO5	M	-	-	-	-	L	L	-	-	-	-	H	H	L	-	M
18CPE $02	M	M	M	H	M	L	L	-	-	-	-	H	H	L	M	M

L-Low, M-Moderate (Medium), H-High

18CPE$03	FINITE ELEMENT METHOD

Category : PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1 Transform Calculus and Partial Differential Equations
2 Strength of Materials

COURSE OBJECTIVES:

* To apprise the students about the basics of Finite Element theory, computer implementation of this theory and its practical applications.
* To understand various basic energy and weighted residual methods.
* To familiarise with the principles of structural mechanics.
* To acquire knowledge on isoparametric and axisymmetric elements.

UNIT – I : INTRODUCTION (9 Periods)

Concepts of Finite Element methods – Steps involved - Advantages & Disadvantages - Direct Stiffness Method - Steps in direct method of FEA - Problems on simple beams and Trusses - Discretization – Finite Element Techniques - Variational approach – Weighted mean residual methods like Collocation method, Subdomain method, Galerkin method and Least square method – Simple problems only.

UNIT – II : ELEMENTS OF ELASTICITY (9 Periods)

Introduction – Elastic Theory – Displacements and Strains – Equilibrium – Compatibility – Constitutive law – Plane Stress - Plane Strain- Basic principles of structural mechanics– Principles of Virtual work and minimum potential energy.

UNIT – III : FINITE ELEMENTS (9 Periods)

Concept of an element - Basic element shapes - Element properties - Displacement models – Approximation displacements by Polynomials - Convergence requirements – Generalised co-ordinates – Natural co-ordinates – Shape functions for linear & quadratic models – Stiffness matrix – Nodal load vector – Static condensation – Simple problems.

UNIT – IV : INTRODUCTION TO ISOPARAMETRIC ELEMENTS (9 Periods)

Concept of sub, iso, super parametric elements – Gauss quadrature – Examples in one and two dimensional elements – Stress analysis of three Dimensional elements.

UNIT – V : AXISYMMETRICELEMENTS (9 Periods)

Analysis of solids of revolution under axisymmetric loading – Formulation of axisymmetric solid element–Simple examples - Introduction to Finite Element Software packages.

Contact Periods:Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1 *Krishnamoorthy C.S.,* ***"Finite Element Analysis -Theory and Programming, Second Edition"****, Tata McGraw Hill Publishing Co., 2004.*

2 *Tirupathi R. Chandrupatla and Ashok D. Belugundu,* ***"Introduction to Finite Elements in Engineering, Third Edition"****, Prentice Hall India Pvt Ltd, 2011.*

3 *P.Seshu,* ***"Textbook of Finite Element Analysis"****, Prentice Hall India Pvt Ltd, 2008.*

REFERENCE BOOKS:

1 Rajasekaran.S., ***"Finite Element Analysis in Engineering Design"****, Wheeler Publishing,2008.*

2 ChandrapatlaTirupathi.R and Belegundu, Ashok. D., ***"Introduction to Finite Elements in Engineering, Second edition"****, Prentice Hall of India, 2014.*

3 S.S.Rao, ***"The Finite Element Method in Engineering"****, Buttersworth - Heinemann publishing, 2017.*

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: Familiarize the basic concepts involved in FEM theory and acquire knowledge on direct and formal (basic energy and weighted residual) methods.

CO2: Recognize the basic principles of structural mechanics and to apply the concepts on simple structural elements.

CO3: Interpret the role and significance of shape functions in finite element formulations

CO4: Familiarize the formulation of isoparametric elements.

CO5: Analyse elements subjected to axisymmetric stresses.

COURSE ARTICULATION MATRIX:

PO/PSO CO	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	PSO 2	PSO 3	PSO 4
CO1	H	-	M		H	-	-	-	-	-	-	-	-	-	-	-
CO2	H	M	M		H	-	-	-	-	-	-	-	-	M	M	-
CO3	H	M	M	M	H	L	-	-	-	-	-	L	-	L	M	M
CO4	H	M	H		H	H	-	-	-	-	-	L	-	M	L	L
CO5	H	H	H		H	H	-	-	-	-	-	L	-	M	M	M
18CPE $03	H	M	M	M	H	H	-	-	-	-	-	L	-	M	M	M

L-Low, M-Moderate (Medium), H-High

18CPE$04	ADVANCED CONCRETE DESIGN

Category : PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1 Basic Structural Design II (Concrete)

COURSE OBJECTIVES:

* To create an awareness on yield line theory of slabs.
* To understand the design principles of Grid floors, ribbed slabs and bunkers and silos.
* To understand the design of slender columns, RC walls, bridges and deep beams.

UNIT – I : YIELD LINE THEORY OF SLABS AND INELASTIC BEHAVIOUR OF CONCRETE BEAMS (9 Periods)

Yield line theory- Assumptions made in analysis – analysis of isotropically and orthotropically reinforced slabs – virtual work method and equilibrium method. Inelastic behaviour of concrete beams moment rotation curves –moment redistribution.

UNIT – II : DESIGN OF SPECIAL RC ELEMENTS (9 Periods)

Design of slender columns – Braced and Unbraced columns – design considerations of RC walls – design of deep beams.

UNIT – III : GRID FLOORS AND RIBBED SLABS (9 Periods)

Grid floors – design principles – analysis of grid floor by approximate method –Ribbed slabs – analysis and design of ribbed slab for moment and shear.

UNIT – IV : BUNKERS AND SILOS (9 Periods)

Design of Bunkers – Design of Silo - Detailing of reinforcements.

UNIT – V : DESIGN OF BRIDGES (9 Periods)

Types of bridges – IRC loadings – Design of single span slab bridge deck for class A loading – Design of T– beam bridge for class AA loading.

Contact Periods: Lecture: 45 Tutorial: 0 Practical: 0 Total : 45 Periods

TEXT BOOKS:

1 *Varghese.P.C,* ***"Advanced Reinforced Concrete Design"****, Prentice Hall of India Private Ltd, NewDelhi, 2010.*

2 *Krishnaraju,* ***"Advanced Reinforced Concrete Design – S.I units"****, C.B.S., New Delhi, 2017.*

REFERENCE BOOKS:

1 *IS 456-2000,* ***"Indian standard code of practice for plain and reinforced concrete".***
2 *SP 34(1987),* ***"Handbook on Concrete Reinforcement and Detailing"****, BIS, New Delhi.*
3 *IRC 6 – 2014, Standard Specifications and Code of Practice for Road Bridges*
4 *Pillai, S. U. and Menon, D,* ***"Reinforced Concrete Design"****, Tata McGraw Hill, 2017*
5 *DayaratnamP.,* ***"Design of Reinforced Concrete Structures"****, Oxford & IBH publishing Co.Pvt.Ltd., 2011.*
6 *Subramanian N,* ***"Design of Reinforced Concrete Structures"****, Oxford University Press, 2014.*

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: Analyse slabs using yield line theory and understand the concepts of inelastic behaviour of beams.
CO2: Analyse and design slender columns, RC walls and deep beams as per Indian Standards.
CO3: Design Grid floors and ribbed slabs using various methods.
CO4: Design bunkers and silos.
CO5: Perform analysis and design of bridges as per Indian Standards.

COURSE ARTICULATION MATRIX:

PO/PSO CO	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	PSO 2	PSO 3	PSO 4
CO1	H	M	M	M	-	-	-	-	L	-	-	M	L	H	M	-
CO2	H	H	M	H	-	L	H		L	-	-	M	H	H	H	-
CO3	H	M	H	M	-	L	-	-	M	-	-	M	H	M	M	-
CO4	H	M	H	M	-	L	-	-	M	-	-	M	H	H	H	-
CO5	H	H	L	M	-	M	H	-	L	-	-	M	L	M	M	-
18CPE $04	H	M	H	M	-	L	H	-	L	-	-	M	H	H	M	-

L-Low, M-Moderate (Medium), H-High

18CPE$05	BASICS OF DYNAMICS AND ASEISMIC DESIGN OF STRUCTURES

Category : PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1 Engineering Mechanics for Civil Engineers
2 Engineering Geology
3 Basic Structural Design II (Concrete)

COURSE OBJECTIVES:

* To learn the basics of various dynamic forces and its effects on the structure.
* To enhance the ability to identify the mode shapes of the structure under dynamic loading
* To learn the causes and effects of earthquake and its measurement.
* To enhance the ability to design an earthquake resistant structures by using IS codal provisions.

UNIT – I : THEORY OF VIBRATIONS (9 Periods)

Concept of inertia and damping – Types of damping – Difference between static forces and dynamic excitation –degrees of freedom – SDOF idealization – Equations of motion of SDOF system of mass as well as base excitation –Free vibration of SODF system – response to harmonic excitation – Impulse and response to unit impulse–Duhamel integral.

UNIT – II : MULTIPLE DEGREE OF FREEDOM SYSTEM (9 Periods)

Two degree of freedom system – Normal modes of vibration – Natural frequencies – Mode shapes – Introduction to MODF systems – Decoupling of equations of motion – Concept of mode superposition (No derivations).

UNIT – III : ELEMENTS OF SEISMOLOGY AND SEISMIC DESIGN CONCEPT (9 Periods)

Causes of earthquake – Geological faults – tectonic plate theory –Elastic rebound – Epicentre – Hypocentre – primary, shear and Raleigh waves – seismogram – magnitude and intensity of earthquake – magnitude and intensity scales– Spectral acceleration – Information on some disastrous earthquakes – concept of earthquake resistant design –strong column weak beam concept – guide lines for seismic resistant construction – effects of structural irregularities – seismic resistant building architecture.

UNIT – IV : RESPONSE OF STRUCTURES TO EARTHQUAKES (9 Periods)

Response and design spectra –Design earthquake – concept of peak acceleration – Site specific response spectrum –Effect of soil properties and damping – Liquefaction of soils – Importance of ductility – Methods of introducing ductility into RC structures.

UNIT – V : DESIGN METHODOLOGY (9 Periods)

IS 1893, IS 13920 and IS 4326 – Codal provisions – design as per the codes – Base isolation techniques – Vibration control measures – Important points in mitigating effects of earthquakes on structures.

Contact Periods:Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1 *Chopra, A.K., **"Dynamics of structures – Theory and Applications to Earthquake Engineering, Fifth Edition"**, Pearson Education, 2017.*

2 *Pankaj Agarwal & Manish Shrikhande, **"Earthquake Resistant Design of Structures"**, PHI Learning privated Limited, NewDelhi, 2011.*

3 *S.K.Duggal, **"Earth Quake Resistant Design of Structures"**, Oxford university Press, 2013.*

4 *Damodarasamy S. R, Kavitha S, **"Basics of Structural Dynamics and Aseismic Design"**, PHI Learning Private limited, New Delhi, 2009.*

REFERENCE BOOKS:

1 *Bruce A Bolt, **"Earthquakes"** W H Freeman and Company, New York, 2004*

2 *C. A. Brebbia, **"Earthquake Resistant Engineering Structures VIII"**,WIT Press, 2011*

3 *Indian Standard Codes: IS: 1893, IS: 4326 and IS:13920, Bureau of Indian Standards, New Delhi.*

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: Determine response of SDOF System subjected to different types of vibration..

CO2: Determine response of MDOF System subjected to different types of vibration

CO3: Gain knowledge on elements of seismology and seismic design concept.

CO4: Analyze the structures which can overcome earthquake forces

CO5: Apply Indian codal provisions in the planning, design and detailing of structures.

COURSE ARTICULATION MATRIX:

PO/PSO CO	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	PSO 2	PSO 3	PSO 4
CO1	H	M	-	L	-		-	-	-	-	-	M	-	M	M	-
CO2	H	H	-	M	-	H	-	-	L	M	M	H	-	M	H	-
CO3	M	-	M	-	-	M	-	-	-	M	M	L	L	M	M	-
CO4	H	-	H	-	-	-	-	-	-	M	M	L	L	M	M	-
CO5	H	-	H	-	L	L	-	-	-	M	H	L	L	M	M	-
18CPE $05	H	H	H	M	L	H	-	-	-	M	M	M	L	M	M	-

L-Low, M-Moderate (Medium), H-High

18CPE$06	CONCRETE STRUCTURES

Category : PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1 Basic Structural Design I (Steel)
2 Basic Structural Design II (Concrete)

COURSE OBJECTIVES:

* To learn the types of footings, choice of foundation and its design concept.
* To learn the design procedures for complex structures like retaining walls, flat slabs and water tanks
* To make the students to know about the earthquake resistant design and ductile detailing of structures.

UNIT – I : FOOTINGS (9 Periods)

Design of Eccentrically loaded footings for columns – Combined rectangular footings – Combined trapezoidal footings for axially loaded column - Strap beam footings – Design steps of raft foundations.

UNIT – II : RETAINING WALLS (9 Periods)

Types of retaining walls – Structural behaviour of retaining walls- Stability of retaining wall against over-turning sliding and pressure developed under the base - Design of Cantilever retaining wall and Counterfort retaining wall.

UNIT – III : FLAT SLAB DESIGN (9 Periods)

Design loads other than earthquake loads (only an introduction) – Imposed loads, wind loads, construction loads. Design of Flat slabs by BIS code – Middle panel and End panel – Column strip – Middle strip – with and without column head –reinforcement details.

UNIT – IV : WATER TANKS DESIGN (WORKING STRESS METHOD) (9 Periods)

Design of underground and on ground rectangular and circular tanks – Overhead tanks of rectangular shape and circular shape with flat roof – BIS code method -Design of all components including staging and foundation

UNIT – V : EARTHQUAKE FORCES – DUCTILE DETAILING (9 Periods)

Earthquake forces – Bureau of Indian standards for Earthquake resistant design – earthquake magnitude and intensity – Basic seismic coefficients and seismic zone factors – design forces – design factors – Analysis of structures– choice of method for multistoried buildings. Ductile detailing of frames for seismic forces – general principles.

Contact Periods:Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1 *Pillai and Menon, **"Reinforced Concrete Design"**, McGraw Hill Education (India) Private Ltd., 2016.*
2 *Sinha.S.N., **"Reinforced Concrete Design"**, Tata McGraw Hill publishing company Ltd., 2003.*
3 *Pankaj Agarwal and Manish ShriKhande, **"Earthquake Resistant Design of Structures"**, Prentice- Hall of India, New Delhi, 2006.*

REFERENCE BOOKS:

1 *BIS 456 – 2000, Indian Standard code of Practice for plain and Reinforced concrete.*
BIS 3370-Part 4 - Indian Standard Code of practice for concrete structures for the storage of liquids.
2 *BIS 1893-2016- Indian Standard Code of practice for Criteria for Earthquake resistant design of structures.*
3 *IS 13920(2016), Indian Standard Code of practice for "Ductile detailing of Reinforced concrete structures subjected to seismic forces".*
4 *Ramachandra, **"Design of Concrete Structures – Vol 1"**, Standard Book House, Delhi-6, 2002.*
5 *V.L.Shah and S.R.Karve **"Limit state theory and design of reinforced concrete"**, Structure Publications, 2005.*
6 *Vazirani & Ratwani, **"Design of R.C.C Structures"**, Khanna Publishers, 2006.*

COURSE OUTCOMES:

On completion of this course, Students will be able to

CO1: Make the choice of foundation and its design as per BIS code
CO2: Select the choice of retaining walls and its design as per BIS code.
CO3: Design of Flat slabs as per BIS code.
CO4: Design of various water tanks and its design as per BIS code.
CO5: Apply the provisions of earthquake resistant design and ductile detailing of structures

COURSE ARTICULATION MATRIX:

PO / CO	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	PSO 2	PSO 3	PSO 4
CO1	M	L	L	L	--	--	--	--	--	L	--	--	--	H	M	--
CO2	M	L	L	L	--	--	--	--	--	L	--	--	--	H	M	--
CO3	M	L	L	L	--	--	--	--	--	L	--	--	--	H	M	--
CO4	M	L	L	L	--	--	--	--	--	L	--	--	--	H	M	--
CO5	H	L	L	L	--	--	--	--	--	L	--	--	--	H	M	--
18CPE $06	H	L	L	L	--	--	--	--	--	L	--	--	--	H	M	--

L-Low, M-Moderate(Medium), H-High

18CPE$07	BRIDGE ENGINEERING

Category : PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1 Structural Analysis I
2 Basic Structural Design II (Concrete)

COURSE OBJECTIVES:

* To familiarize with types and choice of bridges.
* To understand the design concepts of bridge structures and culverts.
* To obtain the knowledge of bearings and sub structures.

UNIT – I : INTRODUCTION (9 Periods)

Components of a bridge structure – inspection and site investigations for a bridge – Determination of linear waterway, design discharge and scour depth – Economical span – Types and choice of bridges. IRC loading classifications – simple problems.

UNIT – II : SLAB BRIDGE AND T- BEAM BRIDGES (9 Periods)

Slab Bridge - Distribution of concentrated loads by IRC and Pigeaud's Method – Design of T- beam bridge – design of main girder– Design of cross girders – Load distribution by Courbon's Method – Skew slab Bridge.

UNIT – III : BRIDGE AND BOX CULVERT (9 Periods)

Single span rigid frame bridge (barrel or slab type only) – box culvert (single vent only). Balanced cantilever RC bridges– Design of articulations.

UNIT – IV : MODERN BRIDGES (9 Periods)

Temporary and movable bridges. RC Arch bridge (open spandrel and string girder type only) – Cable stayed bridges –Suspension bridges – design principles only.

UNIT – V : SUBSTRUCTURE, BEARING, AINTENANCE AND INSPECTION OF BRIDGES (9 Periods)

Bearings – types, functions – simple problems – substructures – abutment, pier – materials-stability requirements -Rebuilding of bridges – replacement – pier tops – girders – side sleeving and end launching methods – Joints in bridges. Case studies.

Contact Periods:Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1 *Jhonson Victor .D., **"Bridge Engineering"**, Oxford & IBH publishing Co., Ltd, New Delhi, 2003.*

2 *Jagadeesh T.R.andJeyaram M.R., **"Design of Bridge Structures"**, Prentice Hall of India, 2011.*
3 *NPTEL notes - https://nptel.ac.in/courses/105105165.*

REFERENCE BOOKS:

1 *Vazirani V.N., Ratwani M.M., & Vaswani, **"Bridge Engineering"**, Khanna publishers, 2000.*
2 *Bindra S.P., **"Principles and practice of Bridge Engineering"**, Dhanpat Rai & Sons, New Delhi,1995.*
3 *KrishnarajuN., **"Design of bridges"**, New age international publishing ltd, NewDelhi, 2005.*
4 *Ponnuswamy.S, **"Bridge Engineering"**, 3rd edition, Tata McGraw Hill Publishing Co., Ltd, New Delhi, 2017.*

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: Describe components and types of bridges and understand economical span.
CO2: Design of slab bridge by Pigeaud's method load distribution.
CO3: Apply the principles in the design of rigid frame and balanced cantilever bridges.
CO4: Apply the principles in the design of modern bridges.
CO5: Design the sub structures.

COURSE ARTICULATION MATRIX:

PO/PSO CO	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	PSO 2	PSO 3	PSO 4
CO1	H	M	H	M	-	-	-	-	-	-	-	-	-	L	-	-
CO2	H	M	H	M	-	-	-	-	H	-	-	-	-	-	H	-
CO3	H	M	H	L	-	-	-	-		-	-	-	-	L	-	-
CO4	H	M	H	L	-	-	-	-		-	-	-	-	-	-	L
CO5	H	M	H	M	-	-	-	-	M	-	-	-	-	-	M	
18CPE $07	H	M	H	M	-	-	-	-	H	-	-	-	-	L	H	L

L-Low, M-Moderate (Medium), H-High

18CPE$08	EARTHQUAKE ENGINEERING

Category : PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1 Engineering Mechanics for Civil Engineers
2 Strength of Materials
3 Basic Structural Design II (Concrete)
4 Structural Analysis I

COURSE OBJECTIVES:

* To learn the causes and effects of earthquake and its measurement.
* To understand the concepts of seismic resistant design of structures.
* To enhance the ability to design earthquake resistant structures by using IS codal provisions.
* To know about the modern techniques of earthquake resistant structures.

UNIT – I : SEISMOLOGY (9 Periods)

Elements of engineering seismology – Structure of earth, causes of earthquakes, plate tectonic theory, continental drift theory, elastic rebound theory, seismic waves, magnitude, intensity and energy release – Indian seismology –Earthquake history – Seismic zone Map of India – seismographs – seismogram – accelerograph – prominent earthquakes in India.

UNIT – II : SEISMIC DESIGN CONCEPTS (9 Periods)

Concept of earthquake resistant design –strong column weak beam concept – guide lines for seismic resistant construction – effects of structural irregularities – seismo resistant building architecture, Response and design spectra, Design earthquake – concept of peak acceleration – Site specific response spectrum, Planning Aspects, Liquefaction of soils, Methods of introducing ductility into RC structures.

UNIT – III : DESIGN METHODOLOGY (9 Periods)

Introduction to methods of seismic analysis – Equivalent static analysis IS 1893 provisions – Design horizontal seismic coefficient – design base shear – distribution – idealization of building frames - seismic analysis and modeling – determination of lateral forces – equivalent static lateral force method – response spectrum method.

UNIT – IV : ASEISMIC CODAL PROVISIONS (9 Periods)

Behaviour of unreinforced masonry and reinforced masonry, RC bands, Vertical reinforcement, Openings, Provisions of IS 4326, Repairs and strengthening of masonry and RC members. Ductile detailing of reinforcement in RC Buildings as per IS 13920.

UNIT – V : MODERN TECHNIQUES (9 Periods)

Introduction to Earthquake resistant modern techniques - Base isolation techniques – Elastometric, Sliding, Combined - Seismic Dampers, Friction Dampers, Visco elastic dampers. Vibration control measures – Important points in mitigating effects of earthquakes on structures.

Contact Periods: Lecture: 45 Tutorial: 0 Practical: 0 Total : 45 Periods

TEXT BOOKS:

1 *Chopra, A.K.,* ***"Dynamics of structures – Theory and Applications to Earthquake Engineering, Second Edition"****, Pearson Education, 2015.*

2 *Pankaj Agarwal & Manish Shrikhande,* ***"Earthquake Resistant Design of Structures"****, Prentice Hall of India, NewDelhi, 2009.*

3 *S.K.Duggal,* ***"Earth Quake Resistant Design of Structures"****, Oxford university Press, 2013.*

4 *Damodarasamy S R and Kavitha S,* ***"Basics of Structural Dynamics and Aseismic Design"****, Prentice Hall India Publishers, 2009*

REFERENCE BOOKS:

1 *Bruce A Bolt,* ***"Earthquakes"****, W H Freeman and Company, New York, 2004.*

2 *C. A. Brebbia,* ***"Earthquake Resistant Engineering Structures VIII"****,WIT Press, 2011*

3 *Indian Standard Codes: IS: 1893:2016 (part 1 to 5), IS: 4326 :2013, IS 13828:1993(R2008) and IS:13920:2016, Bureau of Indian Standards, New Delhi.*

COURSE OUTCOMES:

On the Completion of the course, the students will be able to

CO1: Analyse the causes and effects of earthquake.
CO2: Familiarize the design concepts for earthquake resistant structures.
CO3: Plan the structures to resist earthquake forces.
CO4: Apply Indian codal provisions in the planning, design and detailing of structures.
CO5: Execute vibration control techniques modern techniques in various structures.

COURSE ARTICULATION MATRIX:

PO/PSO CO	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	PSO 2	PSO 3	PSO 4
CO1	H	-	-	-	-	H	M	L	L	L	L	L	L	-	L	M
CO2	H	H	H	L	-	M	L	L	L	-	L	-	L	H	H	-
CO3	H	L	H	-	-	M	-	-	L	-	-	-	-	H	H	-
CO4	H	L	L	L	H	L	L	-	L	-	-	-	M	M	M	M
CO5	H	M	H	H	H	H	-	-	M	L	M	L	H	L	M	M
18CPE $08	H	H	H	L	H	H	L	L	L	L	L	M	M	H	H	M

L-Low, M-Moderate (Medium), H-High

18CPE$24	MAINTENANCE AND REHABILITATION OF STRUCTURES

Category : PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1 Construction Materials and Technology

COURSE OBJECTIVES:

* To gain the knowledge on quality of concrete, durability aspects and causes of deterioration.
* To understand the assessment procedure of distressed structures, repairing of structures.
* To understand the demolition procedures for damaged structures.

UNIT – I : MAINTENANCE AND REPAIR STRATEGIES (9 Periods)

Maintenance – repair and rehabilitation – Facets of Maintenance – Importance of Maintenance – Various aspects of Inspection – Assessment procedure for evaluating a damaged structure – Structural audit –Causes of deterioration – Diagnosis of causes and preventive measures.

UNIT – II : SERVICEABILITY AND DURABILITY OF CONCRETE (9 Periods)

Quality assurance for concrete construction – Factors affecting concrete properties – Strength, permeability, thermal properties – Effects due to climate, temperature, chemicals, aggressive environment – Design and construction errors –Types of cracks – Causes and effects of cracks – Causes and effects of corrosion – Cover thickness requirements.

UNIT – III : MATERIALS FOR REPAIR (9 Periods)

Materials for accelerated strength gain – Concrete chemicals – Expansive cement – Ferro cement, Polymer concrete – Sulphur infiltrated concrete – Foamed concrete – Fibre reinforced concrete.

UNIT – IV : TECHNIQUES FOR REPAIR AND DEMOLITION (9 Periods)

Rust eliminators and polymer coating for rebars during repair – Mortar and dry pack method – Vacuum concreting – Guniting and Shotcreting – Epoxy injection – Shoring and underpinning – Methods of corrosion protection – Corrosion inhibitors, coating and cathodic protection – Engineered demolition techniques for Dilapidated structures – Case studies.

UNIT – V : REPAIRS, REHABILITATION AND STRENGTHENING OF STRUCTURES (9 Periods)

Repairs to overcome deflection, cracking, chemical disruption, weathering corrosion, wear, fire, leakage and marine exposure – Strengthening of Super Structures – Jacketing – Reinforcement addition, Plating, Conversion to composite construction – Post stressing – Strengthening of substructures– Case studies.

Contact Periods:Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1 *Dr. B. Vidivelli,* ***"Rehabilitation of concrete structures"****, Standard Publishers, 2011.*
2 *Hand Book on* ***"Repairs and Rehabilitation of RCC Buildings"*** *published by CPWD, Govt. of India, New Delhi, 2011.*

REFERENCE BOOKS:

1 *Bhattecharjee,* ***"Concrete Structures Repair Rehabilitation and Retrofitting"****, CBS Publishers and Distributors, New Delhi, 2017.*
2 *Poonam I. Modi, Chirag N. Patel,* ***"Repair & Rehabilitation of Concrete Structures"****, PHI Learning Pvt. Ltd., New Delhi, 2016.*
3 *Dr. R. Saravanan R. Dineshkumar,* ***"Repair and Rehabilitation of Structures"****, Lakshmi Publications, Chennai, 2013.*
4 *M. S. Shetty,* ***"Concrete Technology – Theory and Practice"****, S. Chand and Company, New Delhi, 2008.*

COURSE OUTCOMES:

On completion of the course, the students will be able to
CO1: Identify the causes of deterioration and carryout structural audit.
CO2: Assess the quality assurance of the construction.
CO3: Identify and propose the appropriate materials and techniques for various repair conditions.
CO4: Execute various engineered demolition techniques for dilapidated structures.
CO5: Rehabilitate and strengthen the various elements of a structure subjected to deterioration.

COURSE ARTICULATION MATRIX:

PO/PO CO	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	PSO 2	PSO 3	PSO 4
CO1	M	--	L	M	L	M	--	--	--	--	--	M	--	--	H	--
CO2	M	--	L	L	L	H	--	--	--	--	--	L	M	--	L	M
CO3	M	--	L	M	L	M	--	--	--	--	--	M	L	--	--	L
CO4	M	--	--	M	L	H	--	--	--	--	--	L	L	--	M	H
CO5	M	--	--	M	L	M	--	--	--	--	--	L	--	--	M	--
18CPE $24	M	--	L	M	L	M	--	--	--	--	--	L	L	--	M	M

L-Low, M-Moderate (Medium), H-High

18CPE$25	PREFABRICATED STRUCTURES

Category : PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1 Construction Materials and Technology
2 Basic Structural Design I (Steel)
3 Basic Structural Design II (Concrete)

COURSE OBJECTIVES:

* To impart knowledge to students on modular construction and prefabricated components.
* To get exposure on the design concepts of prefabricated elements.
* To understand the methods of construction and installation of precast elements

UNIT – I : INTRODUCTION (9 Periods)

Prefabrication- Need of prefabrication - Comparison with monolithic construction – Advantages and Disadvantages - Methods of prefabrication – site and plant prefabrication – Types of precast systems - Modular coordination – Standardization- Tolerance.
Precast concrete – Materials-Cement, SCM, Aggregate, Water, chemical Admixtures, Pigments, reinforcement, Prestressing Tendons, Concrete and properties, Grouting and mortars.

UNIT – II : PREFABRICATED COMPONENTS (9 Periods)

Beams-Columns- Roof units- Floor units- wall panels – footings-Dimensions of prefabricated elements.

UNIT – III : PRODUCTION TECHNOLOGY (9 Periods)

Choice and planning of production setup – Manufacturing methods – Production process-Moulds – Acceleration of concrete hardening, Curing.

UNIT – IV :ANALYSIS, DESIGN AND JOINTS IN STRUCTURAL MEMBERS (9 Periods)

Loads-Load combination, - Disuniting of structures- Analysis of precast frames- Design of inverted Tee beam and L beam
Connection in precast building – Column to foundation connections, Wall panel to foundation connections, Beam to Column Connections, Column to column Connections, Floor to Beam Connections, Wall panel to Wall Panel Connection.

UNIT – V : HANDLING AND ERECTION (9 Periods)

Storage of precast elements - Equipments for hoisting and erection –Installation of precast element – Column, Wall, Beam, Slab – Transportation- Handling Equipments and Handling Devices - Vacuum lifting pads.

Contact Periods:Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *L. Mokk,* ***"Prefabricated Concrete for Industrial and Public Structures"****, Publishing House of the Hungarian Academy of Sciences, Budapest, 2007.*
2 *K.M. Elliott,* ***"Precast concrete structures"****, Butterworth Heinmann, 2002.*

REFERENCE BOOKS:

1 *Structural Design Manual,* ***"Precast Concrete Connection Details"****, Society for the Studies in the use of Precast Concrete, Netherland Betor Verlag, 2009.*
2 *Ganesan and Latha,* ***"Prefabricated structures"****, Sree Kamalamani Publications, Chennai, 2014.*

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: Select materials and methods of prefabrication.
CO2: Outline the components of the prefabricated structures.
CO3: Plan the production process and identify the methods of prefabricated elements.
CO4: Carryout the analysis and design of members and joints of precast building.
CO5: Monitor the handling and installation of elements.

COURSE ARTICULATION MATRIX:

PO/PSO CO	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	PSO 2	PSO 3	PSO 4
CO1	L	L	-	M	-	-	M	H		-	M	M	M	H	-	L
CO2	L	L	-	M	-	M	L	H		-	L	L	L	H	L	-
CO3	H	L	L	M	L	L	L	L	L	-	L	L	-	H	L	L
CO4	L	L	H	H	-	M	-	-	L	-	-	-	-	H	M	-
CO5	L	-	H	-	-	H	L	M	L	-	-	L	-	H	-	L
18CPE $25	L	L	H	M	L	M	L	H	L	-	L	L	M	H	L	L

L-Low, M-Moderate (Medium), H-High

VERTICAL – II

ENVIRONMENTAL ENGINEERING

18CPE$11	DESIGN AND DRAWING (IRRIGATION AND ENVIRONMENTAL ENGINEERING)

Category : PE

L	T	P	C
2	0	2	3

PRE-REQUISITES:

1 Water Supply Engineering
2 Waste Water Engineering

COURSE OBJECTIVES:

* To understand the various irrigation structures and unit processes of a water and wastewater treatment plants.
* To gain knowledge on different Irrigation Engineering and Environmental Engineering structures.
* To train the students in preparation of drawings for Irrigation and Environmental Structures and its necessity for the implementation work.

PART A : IRRIGATION ENGINEERING (30 Periods)

Tank Surplus Weir (Type A and D) - Tank Sluice with a Tower Head - Direct Sluice - Notch type Canal Drop - Canal Regulators and river regulators - Cross-Drainage Works (Syphon Aqueduct type II & III)

PART B : ENVIRONMENTAL ENGINEERING (30 Periods)

Intake tower - Screening device - Primary sedimentation tank – Clariflocculator - Slow and Rapid sand filters - Secondary settling tanks - Trickling filter - Activated sludge process - Sludge digestion tank - Septic tank with dispersion trench and soak pit - Infiltration gallery.

Note: Assignments include the design and drawings of various Irrigation and Environmental Engineering Structures.

QUESTION PAPER PATTERN:

Question paper shall consist of two questions from each part. Part A consists of 60 marks and Part B consists of 40 marks and the students have to answer one question from each part.

Contact Periods: Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1 *Sathya Narayana Murthy Challa,* ***"Water Resources Engineering Principles and Practice"****, New Age International (P) Ltd., New Delhi, 2009.*
2 *Rangwala.S.C,* ***"Water Supply and Sanitary Engineering"****, Charotar Publishing, New Delhi, 2016.*

REFERENCE BOOKS:

1 *Santosh Kumar Garg,* ***"Irrigation Engineering and Hydraulics Structures"****, Khanna Publications Pvt. Ltd, New Delhi, 2017.*

2 *Birde.G.S and Birde.J.S,* ***"Water Supply and Sanitary Engineering"****, Dhanpat Rai Publications Pvt. Ltd, New Delhi, 2018.*

COURSE OUTCOMES:

On Completion of the course, the students will be able to:

CO1: Design the different Hydraulic structures in the field.
CO2: Prepare drawings for Irrigation Structures.
CO3: Know the functions of different Environmental Engineering structures in the field.
CO4: Design and detailing of the Environmental Structures.
CO5: Evaluate the performance of Irrigation and Environmental Structures in real life.

COURSE ARTICULATION MATRIX:

PO/PSO CO	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	PSO 2	PSO 3	PSO 4
CO1	H	-	M	M	-	L	L	-	-	H	L	-	L	H	M	L
CO2	H	L	L	L	-		M	L	-	M	-	-	-	M	L	-
CO3	H		M	M	-	L	L		-	H	L	-	L	H	M	L
CO4	H	L	L	L	-	-	M	L	-	M	-	-	-	M	L	-
CO5	L	-	M	M	-	L	L		-	H	L	-	L	H	M	L
18CPE $11	H	L	M	M	-	L	M	L	-	H	L	-	L	H	M	L

L-Low, M-Moderate (Medium), H-High

18CPE$12	ENVIRONMENTAL LEGISLATIONS IN INDIA

Category : PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1 Water Supply Engineering
2 Waste Water Engineering

COURSE OBJECTIVES:

* To impart knowledge of National and international Environmental Policies.
* To know the pollution control acts for water and air pollution
* To understand the management and handling of Industrial solid waste and E- waste.

UNIT – I : THE WATER (PREVENTION & CONTROL OF POLLUTION) ACT, 1974 (9 Periods)

Definitions-Salient features-Powers & functions of Regulatory agencies–Responsibilities of occupier, provisions relating to prevention & control-procedures to obtain consent-Monitoring and compliance mechanisms-legal provision for violation of Water(P&CP)Act-Case studies on water polluting industries-Textile dyeing, Paper mills-Electroplating, Starch industries-inventorisation of new water polluting industry and its management-field visits.

UNIT – II : THE AIR (PREVENTION & CONTROL OF POLLUTION) ACT, 1981 (9 Periods)

Definition-Salient features- Powers & functions of Regulatory agencies -National ambient Air quality standards-Emission standards for industries specific- Responsibilities of occupier, provisions relating to prevention & control-procedures to obtain consent Monitoring and compliance mechanisms- legal provision for violation of Air(P&CP)Act- Case studies on Air polluting industries-Foundries, Cement, Thermal power plants- inventorisation of new Air polluting industry and its management-field visits.

UNIT – III : THE ENVIRONMENT (PROTECTION) ACT, 1986 (9 Periods)

Genesis of the Act-Salient features-Role of Central Government-various notifications and rules – prohibition on import of genetically modified organisms-chemicals-hazardous wastes- Batteries management-Restriction on Ozone depleting substances-EIA notification-Sitting of industries-State level EIA Authorities-eco-mark-Control on noise pollution-coastal regulations- Monitoring and compliance mechanisms-Role of National Green Tribunals(NGT),Environmental courts & Public interest litigation -Case studies

UNIT – IV : REGULATIONS ON INDUSTRIAL SOLID WASTE MANAGEMENT (9 Periods)

Restriction on Hazardous waste-Bio-medical wastes-Recycled plastic wastes-Municipal solid wastes-e-waste-Salient features-Responsibilities of occupier/generator/local bodies/PCBs- Monitoring and compliance mechanisms-consent clearance, Authorization, Registration procedures for industry specific-Issues & Challenges-Best practices-Case studies on lead refining, engineering units, hospitals, plastic units, Municipal landfills -field visits.

UNIT – V : ELECTRONIC WASTE (MANAGEMENT AND HANDLING) RULES 2011 **(9 Periods)**

Definition-Environmental & Occupational Health hazards of e-waste-Salient features of E-waste Rules-Extended producers responsibility-issues and challenges –Compliance and Consent Clearance mechanisms-Best practices of E-waste management-Case studies on E-waste recycling units, Bulk consumers, Collection Centers-field visits.

Contact Periods:Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1 *P.Leelakrishnan.,* ***"Environmental Law in India"****, Lexis Nexis 4th edition 2016.*
2 *Stuart Bell and Donald.,* ***"Environmental Law"****, McGillinary sixth edition 2005.*
3 *Shyam Divan and Armin Roseneranz,* ***"Environmental law and policy in India"****, Oxford University Press, New Delhi, 2017.*
4 *K.R.Gupta.* ***"Environmental legislation in India"****, Atlantic 2006.*
5 *E WASTE MANAGEMENT IN INDIA (2009), Electronics for you, www. efymag.com.*

REFERENCE BOOKS:

1 *Hilary Theisen and Samuel A, Vigil, George Tchobanoglous,* ***"Integrated Solid Waste Management",*** *McGraw- Hill, New York, 1993*
2 *CPHEEO, Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization, Government of India, New Delhi, 2000*
3 *Michael D. LaGrega, Philip L Buckingham, Jeffrey C. E vans,* ***"Environmental Resources Management, Hazardous waste Management"****, Mc-Graw Hill International edition, New York, 2001.*
4 *Vesilind P.A., Worrell W and Reinhart,* ***" Solid waste Engineering"****, Thomson Learning Inc., Singapore, 2002.*
5 *David ong.,* ***"Source book on environmental Law"****, 2001*
6 *www.envfor.nic.in*

COURSE OUTCOMES:

On Completion of the course, the students will be able to:

CO1: Apply various act related to Environmental issues.
CO2: Plan and take decisions related to Environmental policies.
CO3: Summarize the pollution control acts for water and air pollution
CO4: Perform management and handling of Industrial solid waste and E- waste
CO5: Choose the management and handling of E- waste

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO1	PO2	PO 3	PO4	PO5	PO6	PO 7	PO 8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
CO1	-	-	-	-	-	-	M	-	-	-	L	L	-	L	L	-
CO2	H	L	M	-	-	L	H	L	-	-	-	L	L	M	-	-
CO3	-	L	-	-	-	M	H	M	-	-	L	L	-	L	L	-
CO4	M	H		M	-	-	M	L	-	L	M	L	M	L	-	L
CO5	-	M	L	H	-	L	L	L	-	L		L		M	-	-
18CPE $12	H	M	L	M	-	L	H	L	-	L	L	L	L	L	L	L

L-Low, M-Moderate (Medium), H-High

18CPE$13	INDUSTRIAL WASTEWATER MANAGEMENT

Category : PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1 Water supply engineering
2 Waste water engineering

COURSE OBJECTIVES:

* To understand the Qualitative and quantitative assessment of industrial wastewater
* To analyze the effect of disposal of industrial wastewater
* To understand the principles of waste minimization technique on environment
* To gain Knowledge about Pollution from major industries and treatment Technologies

UNIT – I : SOURCES (9 Periods)

Sources and types of industrial wastewater – Environmental impacts – Regulatory requirements – Industrial wastewater monitoring and sampling – generation rates – characterization and variables – Toxicity and Bioassay tests. Prevention vs Control of Industrial Pollution – Source reduction techniques - effect of Industrial Effluents on Streams, Sewer and Human health – Waste Audit Evaluation of pollution prevention options. Industrial scenario in India – Industrial activity and environment – Uses of water by Industry

UNIT – II : TREATMENT (9 Periods)

Waste minimization - Equalization - Neutralization – Oil separation – Flotation – Precipitation – Heavy metal removal – Adsorption – Aerobic and anaerobic biological treatment – Sequencing batch reactors – High Rate reactors - Chemical oxidation – Ozonation – Photocatalysis – Wet Air Oxidation - Evaporation – Ion Exchange – Membrane Technologies – management of RO reject - Nutrient removal – Cost benefit analysis – payback period - Implementing and promoting pollution prevention programs in industries.

UNIT – III : DISPOSAL (9 Periods)

Individual and Common Effluent Treatment Plants – Advantages – Joint treatment of Industrial and domestic wastewater - zero polluting industry concept –Reduce, Reuse and Recycle of wastewater – Disposal of effluent on land – Quantification, characteristics and disposal of sludge

UNIT – IV : INDUSTRIAL WASTEWATER TREATMENT-I (9 Periods)

Industrial manufacturing process description, wastewater characteristics, source reduction points and effluent treatment flow sheet for Textiles - Sugar mill – distilleries - Thermal power plant - Nuclear power plant - Petroleum refineries - Fertilizers – Dairy - Pharmaceutical industry

UNIT – V : INDUSTRIAL WASTEWATER TREATMENT-II (9 Periods)

Industrial manufacturing process description, wastewater characteristics, source reduction points and effluent treatment flow sheet for , Pulp and Paper mill - Chemical industries - Metal finishing

industries - Iron and Steel industries - Meat packing industries and Poultry plant - Automobile Industry- Industrial estates and Industrial Clusters.

Contact Periods:Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1 *Garg S.K.,* ***"Sewage Disposal and Air Pollution Engineering"****, Khanna Publishers, New Delhi, 2018*

2 *Patwardhan, A.D.,* ***"Industrial Waste Water Treatment"****, PHI Learning, 2009*

3 *Metcalf and Eddy,* ***"Waste Water Engineering- Treatment and Reuse"****, Tata Mc-Graw Hill Company, New Delhi 2007*

4 *Duggal. K.N.,* ***"Elements of public Health Engineering"****, S.Chand and Co, 2007.*

5 *M.N.Rao, A.K.Datta,* ***"Wastewater treatment"****, McGraw Hill, 2017.*

REFERENCE BOOKS:

1 *Eckenfelder, W.W.,* ***"Industrial Water Pollution Control"****, McGraw-Hill, 2014.*

2 *Soli. J Arceivala, Shyam. R Asolekar* ***"Wastewater Treatment for Pollution Control and Reuse"****, McGraw-Hill, 2006.*

3 *Frank Woodard,* ***"Industrial waste treatment Handbook"****, Butterworth Heinemann, New Delhi, 2006.*

4 *Nemerow N. L.,* ***"Industrial Water Pollution"****, Addison - Wesley Publishing Company Inc., USA, 2007.*

5 *Mahajan S. P.* ***"Pollution Control in process industries"****, Tata McGraw Hill Publishing Co Ltd., New Delhi, 2008.*

6 *NPTEL,* ***"Industrial waste water treatment"****, Prof BS Murty., IIT Madras.*

COURSE OUTCOME:

On Completion of the course, the students will be able to

CO1: Carry out qualitative and quantitative assessment of industrial wastewater
CO2: Apply the principles of waste minimization techniques
CO3: Identify and select appropriate disposal methods
CO4: Manage the effluent treatment from major industries
CO5: Apply the concept of industrial clusters

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO2	PO3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2	PSO3	PSO4
CO1	H	-	-	L	-	-	L	-	-	-	-	-	-	H		L
CO2	H	-	-	L	-	L	M	-	-	-	-	L	-	H	M	L
CO3	H	-	-	L	-	L	M	-	-	-	-	L	-	H	M	L
CO4	H	L	M	M	-	L	M	-	-	-	-	-	-	H	M	L
CO5	H	L		M	-		L	-	-	-	-	-	-	-	-	L
18CPE $13	H	L	M	L	-	L	M	-	-	-	-	L	-	H	M	L

L-Low, M-Moderate (Medium), H-High

18CPE$14	SUSTAINABLE ENGINEERING AND TECHNOLOGY

Category : PE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

* To understand the role of engineering and technology within sustainable development
* To know the methods, tools, and incentives for sustainable product-service system development
* To establish a clear understanding of the role and impact of various aspects of engineering and engineering decisions on environmental, societal, and economic problems.

UNIT – I : INTRODUCTION TO SUSTAINABILITY (9 Periods)

Sustainability - Introduction, Need and concept of sustainability, Social environmental and economic sustainability concepts. Sustainable development, Nexus between Technology and Sustainable development, Challenges for Sustainable Development. Multilateral environmental agreements and Protocols - Clean Development Mechanism (CDM)

UNIT – II : GLOBAL ENVIRONMENTAL ISSUES (9 Periods)

Air Pollution, Effects of Air Pollution; Water pollution- sources, Sustainable wastewater treatment, Solid waste - sources, impacts of solid waste, Zero waste concept, 3 R concept. Global environmental issues- Resource degradation, Climate change, Global warming, Ozone layer depletion, Regional and Local Environmental Issues. Carbon credits and carbon trading, carbon foot print.

UNIT – III : LIFE CYCLE ANALYSIS AND ENVIRONMENT IMPACT ASSESSMENT (9 Periods)

Environmental management standards, ISO 14000 series, Life Cycle Analysis (LCA) - Scope and Goal, Bio-mimicking, Environment Impact Assessment (EIA) - Procedures of EIA in India. Environmental legislations in India - Water Act, Air Act.

UNIT – IV : SUSTAINABLE HABITAT (9 Periods)

Basic concepts of sustainable habitat, Green buildings, green materials for building construction, material selection for sustainable design, green building certification, Methods for increasing energy efficiency of buildings. Sustainable cities, Sustainable transport.

UNIT – V : SUSTAINABLE ENERGY SOURCES (9 Periods)

Basic concepts-Conventional and non-conventional, solar energy, Fuel cells, Wind energy, Small hydro plants, bio-fuels, Energy derived from oceans, Geothermal energy.

Contact Periods:Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1 *Allen, D. T. and Shonnard, D. R.,* ***"Sustainability Engineering: Concepts, Design and Case Studies"****, Prentice Hall, 2011.*

2 *Twidell, J. W. and Weir, A. D.****,"Renewable Energy Resources"****, Taylor & Francis Ltd, 2015.*

3 *Bradley. A.S; Adebayo,A.O., Maria, P.****"Engineering applications in sustainable design and development"****, Cengage learning, 2015.*

REFERENCE BOOKS:

1 *ECBC Code 2007,* ***"Bureau of Energy Efficiency"****, New Delhi Bureau of Energy Efficiency Publications*

2 *Ni bin Chang,* ***"Systems Analysis for Sustainable Engineering: Theory and Applications"****, McGraw-Hill Professional, 2010.*

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: Explain the need for sustainable development
CO2: Identify different types of environmental pollution problems and their sustainable solutions
CO3: Perform Life Cycle Analysis and Environment Impact Assessment
CO4: Apply the concepts of sustainable habitat while designing an infrastructure
CO5: List and explain sustainable energy sources

COURSE ARTICULATION MATRIX:

PO/PSO CO	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	PSO 2	PSO 3	PSO 4
CO1	H	-	-	M	-	H	H	-	-	-	-	M	-	M	-	L
CO2	H	-	H	M	-	H	H	-	-	-	-	-	-	M	H	L
CO3	H	-	M	H	M	H	H	-	-	-	-	L	-	M	H	L
CO4	H	-		M		H	H	-	-	-	-	-	-	M	-	L
CO5	H	-	-	-	-	H	H	-	-	-	-	-	-	M	-	-
18CPE $14	H	-	H	M	M	H	H	-	-	-	-	M	-	M	H	L

L-Low, M-Moderate (Medium), H-High

18CPE$20	FUNDAMENTALS OF REMOTE SENSING AND GIS APPLICATIONS

Category : PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1 Surveying

COURSE OBJECTIVES:

* To introduce the students to the basic concepts and principles of various components of remote sensing.
* To provide an exposure to GIS and its practical applications in civil engineering.
* To acquire knowledge on the application of GIS in the areas of water resources, land use studies, soil science, Agriculture, forestry and Oceanography.

UNIT – I : PRINCIPLES OF REMOTE SENSING (9 Periods)

Definition – Historical background – Basic principles and methods of remote sensing – Electromagnetic radiation and source – Electromagnetic spectrum – Wave and particle theory – energy equations – Interference - Atmospheric effects on remote sensing – Atmospheric windows – Energy interaction with surface features – Reflectance – Specular and diffuse reflection surfaces – Spectral signatures – Spectral signature curves – Thermal and microwave.

UNIT – II : REMOTE SENSING DATA ACQUISITION (9 Periods)

Data acquisition – Active and passive remote sensing – Platforms – Aerial and space platforms – Aircraft and satellites– Synoptivity and Repetivity – Sensors – Aerial camera – Non-photographic optical sensors – Multispectral scanners –Thermal scanners, Imaging radars – SLAR and SAR LIDAR.

UNIT – III : SATELLITE REMOTE SENSING AND DIGITAL IMAGE PROCESSING (9 Periods)

Satellites – Classification – Based on orbits – Based on purpose – Remote sensing satellites – LANDSAT, SPOT, IRS and IKONOS – Their orbital characteristics – Sensors onboard – Characteristics of thermal imagery and radar imagery– Comparison with image types – Characteristics of digital image processing – Pre-processing – Image enhancement –Filtering – Classification.

UNIT – IV : GEOGRAPHIC INFORMATION SYSTEM (9 Periods)

GIS – Components of GIS – Hardware, Software and organizational set up – Data – Spatial and Non spatial – Maps –Types of maps – Map Projection – Types of projection – Data input – Digitization – Editing – Raster and Vector data structures – Comparison – Analysis using Rastor and Vector data – Retrieval, Reclassification, Overlying, Buffering –Data output – Printers and plotters.

UNIT – V : SATELLITE IMAGERY AND GIS APPLICATIONS (9 Periods)

Application of satellite imagery – Merits – Limitations – Comparison with aerial photographs – Visual interpretation of satellite imagery – Elements of interpretation – Interpretation keys-
GPS and its Applications- Application of remote sensing and GIS in Surveying, Water resources exploration – Land use/Land cover studies – Geology –Agriculture, Disaster Management, Coastal zone Management and Environmental Engineering.

Contact Periods:Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1 *A M Chandra, S.K.Ghosh,* ***"Remote Sensing and Geographical Information system"****, Narosa, Publishing house New Delhi, 2006.*

2 *Patel A.N and Surendrasingh,* ***"Remote Sensing Principles and applications"****, Scientific Publishers, Jodhpur , 2001.*

3 *AnjiReddy,* ***"Remote Sensing and Geographical Information system"****, BS Publications 2014*

4 *M.G. Srinivas, (Edited by)* ***" Remote sensing applications"****, Narosa publishing House, 2001*

REFERENCE BOOKS:

1 *Thomas M.Lille sand & Raiph W.Kiefer,* ***"Remote sensing and Image Interpretation"****, John Wiley Sons,2004*

2 *Burrough P.A, Principles of GIS for land resources assessment, Oxford, 2002.*

3 *Fundamentals of Remote sensing, S.C.Bhatia, Atlantic Publishers & Distributions (P) Ltd, 2008.*

COURSE OUTCOMES:

On completion of the course, students will be able to:

CO1: Use the principles and methods of remote sensing.

CO2: Apply the concept of satellite remote sensing, Data acquisition.

CO3: Recognize LANDSAT, SPOT and IRS series, types and characteristics of imageries.

CO4: Categorize the hardware and software of GIS.

CO5: Utilize the application of GIS in the areas of water resources, land use studies, soil science, Agriculture, forestry and Oceanography.

COURSE ARTICULATION MATRIX:

PO/PSO CO	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	PSO 2	PSO 3	PSO 4
CO1	H	-	-	-	L	-	-	-	M	-	H	M	L	H	L	M
CO2	H	H	-	-	M	L	-	H	-	-	-	-	-	-	-	-
CO3	H	-	-	-	H	-	-	-	-	L	-	-	-	H	-	-
CO4	H	-	-	-	H	-	H	-	M	-	H	-	M	H	M	M
CO5	H	-	M	M	H	-	-	M	-	-	-	H	-	H	-	-
18CPE $20	H	H	M	M	H	L	H	-	M	L	H	-	-	H	-	M

L-Low, M-Moderate (Medium), H-High

18CPE$22	IRRIGATION ENGINEERING AND HYDRAULIC STRUCTURES

Category : PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. Water Resources Engineering

COURSE OBJECTIVES:

* The student shall understand the need and mode of irrigation practiced in Tamil Nadu.
* To get an idea about the functions and design of different hydraulic structures.
* To select the appropriate type of canal regulation works for various hydraulic structures.

UNIT – I : IRRIGATION PRACTICE (9 Periods)

Necessity – Advantages and types of irrigation – methods of irrigation – Soil- water- plant relations - main crops and their seasons – saline, alkaline soils and their reclamation – root zone depth – Duty and Delta – relationship – Factors affecting duty – optimum utilization of water – Consumptive use of water by a crop – Estimation - assessment of irrigation water – Irrigation efficiencies – Problems.

UNIT – II : DIVERSION HEAD WORKS (9 Periods)

Functions of diversion head works – Types – Layout of diversion head works – Component parts – functions - Weir – types – Causes of failure of weirs and their remedies – Design of impervious floor by Creep theories – Bligh's theory - Khosla's theory – Design of a vertical drop weir – Design principles for under sluices.

UNIT – III : GRAVITY DAM (9 Periods)

Forces acting and their computation – Modes of failures - Elementary profile of a gravity of a dam – Practical profile - High and Low gravity dams — Stresses acting on dam - Design procedure for a gravity dam – Zoning method – Function of Gallery and Joints in gravity dam - Problems to check stability Analysis – Spillways – Main types of Spillway.

UNIT – IV : ARCH, BUTTRESS AND EARTH DAMS (9 Periods)

Types of Arch dams – forces acting on it – advantages - Buttress dams – types and uses of buttress dams. Earth dam - types of earth dams – Method of construction - Section of earth dams – Causes of failure of earth dams - criteria for safe design of earth dams – Cross sections of earth dam according to materials- seepage control measures in earth dam.

UNIT – V : CANAL REGULATION WORKS (9 Periods)

Canal falls – types – Design of vertical drop fall – Functions of Regulators - Design of head and cross regulators – Cross drainage works – types of cross drainage works – Selection of suitable types of cross drainage works – Classification of aqueducts and syphon aqueducts – Design procedure of cross drainage works.

Contact Periods:Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1 *Santosh Kumar Garg,* ***"Irrigation Engineering and Hydraulics Structures"****, Khanna Publications Pvt.Ltd. New Delhi, 2017.*

2 *Punmia .B.C. and Pande B.B.Lal,* ***"Irrigation and Water Power Engineering"****, Laxmi Publications, Pvt. Ltd, New Delhi, 2016.*

REFERENCE BOOKS:

1 *Sharma. R.K. and Sharma.T.K* ***"Irrigation Engineering and Hydraulics Structures"****, S.Chand& Company Pvt.Ltd, New Delhi, 2008.*

2 *Michel A.M.,* ***"Irrigation Engineering"****, Vikas Publishing House Pvt. Ltd, New Delhi, 2006*

3 *Madan Mohan Das and Mimi Das Saikia,* ***" Irrigation and water power Engineering"****, PHI Learning Ltd, Delhi, 2014.*

COURSE OUTCOMES:

On completion of the course, the students will be able to:

CO1: Recognize the necessity and methods of irrigation system.
CO2: Identify the importance of diversion head works in water distribution system.
CO3: Check the forces acting and stability analysis of gravity dam.
CO4: Apply the design principles and importance of arch dam, buttress dam and earth dams.
CO5: Select the appropriate type of canal regulation structures in different situations.

COURSE ARTICULATION MATRIX:

PO/PSO CO	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	PSO 2	PSO 3	PSO 4
CO1	M	L	L	L	-	-	-	-	-	M	M	-	-	M	L	H
CO2	L	-	-	-	-	L	L	-	M	M		L	L	H	L	M
CO3	L	H	M	H	L		M	-	-	-	L	-	-	M	L	M
CO4	M	-	L	H		L	-	-	L	-	-	-	L	H	M	L
CO5	L	L	-	M	L	-	-	M		H	-	L	-	H	M	L
18CPE $22	L	L	L	H	L	L	M	M	M	M	M	L	L	H	L	M

L-Low, M-Moderate (Medium), H-High

18CPE$23	HYDROLOGY

Category : PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1. Water Resources Engineering

COURSE OBJECTIVES:

* To impart knowledge on hydrological cycle, spatial and temporal variations of rainfall and their analysis.
* To understand the importance of hydrographs for flood frequency analysis.
* To obtain the knowledge on the design of well system and predict the future floods and identify their routing.

UNIT – I : HYDROMETEOROLOGY (9 Periods)

Hydrological cycle – Hydrometeorological factors – Cloud formation – Winds and their movement – Types of precipitation– Forms of pecipitation – Density and Adequacy of rain gauges – Recording and non - recording rain gauges – Optimum number of rain gauges.

UNIT – II : PRECIPITATION AND ABSTRACTIONS (9 Periods)

Spatial distribution – Consistency analysis – Frequency analysis – Intensity, duration, frequency relationships – Evaporation– Infiltration – Horton's equation – Infiltration indices – measurement of infiltration – abstraction loss.

UNIT – III : HYDROGRAPH ANALYSIS (9 Periods)

Flood Hydrograph – Components of flood hydrograph – Factors affecting shape of Hydrograph - Base flow separation– Unit hydrograph – Advantages – Instantaneous Unit hydrograph - S curve Hydrograph - Synthetic unit hydrograph –Applications.

UNIT – IV : GROUND WATER HYDROLOGY (9 Periods)

Occurrence of ground water – Types of aquifer – Dupuit's assumptions – Darcy's law – Estimation of aquifer parameters – Pump tests – Steady and unsteady state conditions - Discharge in a Confined and Unconfined Aquifers – Leaky aquifer – well loss – aquifer loss– problems.

UNIT – V : FLOOD ANALYSIS (9 Periods)

Flood estimation – Gumbel's method – Log Pearson type III method – Reservoir flood routing – Channel routing – Types of streams – Stage discharge relationships - Flow measurements – Current meter method for velocity measurements.

Contact Periods:Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1 *Santosh Kumar Garg, **"Hydrology and Water Resources Engineering"**, Khanna Publications Pvt. Ltd., NewDelhi, 2017.*
2 *Jayaramy Reddy. P., **"Hydrology"**, Tata McGraw-Hill Publications Pvt.Ltd, New Delhi, 2016.*

REFERENCE BOOKS:

1 *Subramanya. K., **"Engineering Hydrology"**, Tata McGraw-Hill Publications Pvt. Ltd, New Delhi, 2017.*
2 *Warren Viessman and Gary L. Lewis, **"Introduction to Hydrology"**, Prentice Hall of India Pvt. Ltd, New Delhi, 2003.*
3 *David K. Todd and Larry W. Mays, **"Groundwater Hydrology"**, Wiley Publications Pvt. Ltd, New Delhi, 2011.*

COURSE OUTCOMES:

On Completion of the course, the students will be able to:

CO1: Identify the behavior of water molecules in atmosphere.
CO2: Outline the meteorological data for forecasting analysis.
CO3: Identify the needs and importance of hydrographs in Run-off studies.
CO4: Obtain the knowledge on the design of open and tube wells for different aquifers.
CO5: Predict the future floods and identify the importance of flood routing.

COURSE ARTICULATION MATRIX:

PO/PSO CO	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	PSO 2	PSO 3	PSO 4
CO1	M	M	-	L	-	L	-	-	L	-	-	-	-	H	L	M
CO2	H	-	-	M	-	-	L	-	-	L	M	-	-	M	L	H
CO3	L	M	-	-	-	-	L	L	-	-	H	M	-	H	M	L
CO4	L	H	-	H	L	-	H	-	L	M		-	L	H	M	L
CO5	M		-	L	L	M	-	-	M	M	L	-	-	M	L	-
18CPE $23	M	M	-	L	L	M	L	L	L	M	H	M	L	H	L	L

L-Low, M-Moderate (Medium), H-High

18CPE$26	ENVIRONMENTAL MANAGEMENT

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:
1. Environmental Science and Engineering

COURSE OBJECTIVES:

To understand the importance of nature and study about the water, air and soil pollution control as well as solid waste management.

UNIT – I NATURE AND SCOPE OF ENVIRONMENTAL PROBLEMS (9 Periods)
Environment and sustainable development – Natural and human environmental disturbances – Global warming –acid rain – ozone depletion – effects and control - climate change conventions – Kyoto protocol – India's efforts for Environmental protection – Public policy and role of NGO's

UNIT – II WATER POLLUTION AND CONTROL (9 Periods)
Fresh water and its pollution – Natural processes – sources and pollutants – pollution due to industrial, agricultural and municipal wastes – effects on streams - limitations of disposal by dilution – BOD consideration in streams – Oxygen Sag Curve – Strategies for sustainable water management Water management – Marine environment and its management – Water acts

UNIT – III AIR AND NOISE POLLUTION (9 Periods)
Pollutant emissions - sources and sink – effects of air pollution on human health, vegetation and climate– Global effects – prevention and control of air pollution – Control of particulates – Air pollution surveys and sampling – Air quality monitoring - Air Act – Management of air pollution – Sound level – Effect of noise on people – Environmental noise control- noise pollution rules

UNIT–IV SOLID WASTE MANAGEMENT AND SOIL POLLUTION (9 Periods)
Sources – Characteristics – Quantities – Collection methods – Processing and disposal techniques– Onsite Handling, storage and processing – sanitary landfill – Incineration and pyrolysis – Composting –aerobic and anaerobic of compositing – Recycling and reuse of solid wastes – Hazardous wastes – Definition – Sources & types only – Integrated system for waste management – The Basel convention Land use and degradation – Management problems – strategies for sustainable land management – soil pollution –wetland conservation

UNIT–V ENVIRONMENTAL MANAGEMENT SYSTEM (9 Periods)

Terminology – installation and common motives of EMS – Environmental standards – ISO 14000 (Series) – basic principles – Environmental Audit – Environmental Impact assessment - Trade rules and environmental protection– Practices for Waste Minimization and Cleaner Production.

Contact Periods: Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOK:
*1. N.K.Uberoi, **"Environmental Management"**, Excel Books, New Delhi, 2006.*

REFERENCE BOOKS:

1. S.Vigneahwaran, M.Sundaravadivel and D.S.Chaudhary, ***"Environmental Management"****, SCITECH Publications(India) Pvt.Ltd, Chennai & Hyderabad ,2004.*

2. Technobanoglous, ***"Environmental management"****, Mc Graw Hill Book Company ,2006.*

COURSE OUTCOMES:

On completion of the course, the students will be able to:

CO1: Know common issues related with environment.
CO2: Know the sources, causes and effects of water pollution.
CO3: Attain knowledge related with air and noise pollution.
CO4: Identify the various management techniques of solid waste and soil Pollution.
CO5: Aquire knowledge on Environmental Management Systems.

COURSE ARTICULATION MATRIX:

PO/PSO CO	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	PSO 2	PSO 3	PSO 4
CO1	M	L	-	-	-	-	M	-	-	-	-	-	L	H	-	L
CO2	L	M	-	-	L	-	H	-	-	-	-	L	H	H	L	L
CO3	L	M	-	-	L	-	H	-	-	-	-	L	H	H	L	L
CO4	L	M	-	-	L	-	H	-	-	-	-	L	H	H	L	L
CO5	M	L	-	-		-	M	-	-	-	-		L	H	L	L
18CPE$26	M	M	-	-	L	-	H	-	-	-	-	L	H	H	L	L

L- Low, M – Moderate (Medium) , H – High

18CPE$27	AIR POLLUTION MANAGEMENT

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

NIL

COURSE OBJECTIVES:

The course is aimed at imparting knowledge of sources and effects of air pollution and to understand the control measure adopted for removal of air pollutant.

UNIT – I: SOURCES AND EFFECTS OF AIR POLLUTANTS (9 Periods)

Atmosphere as a place of disposal of pollutants – Definition- Air Pollution – Air Pollutants – Source and classification of pollutants - Ambient air quality standards - Air pollution indices - Air pollution and its effects on human beings, plants and animals - Economic effects of air pollution.

UNIT – II: SAMPLING AND MODELLING OF AIR POLLUTNANTS (9 Periods)

Ambient air sampling and measurement of particulate and gaseous pollutants Environmental factors - Meteorology - temperature lapse rate and stability – Adiabatic lapse rate – Wind Rose - Inversion – Wind velocity and turbulence - Stack sampling - Plume behaviour - Dispersion of air pollutants - Maximum mixing depth –Gaussian Dispersion model - Estimation of plume rise - Stack design.

UNIT – III: CONTROL OF PARTICULATE CONTAMINANTS (9 Periods)

Factors affecting Selection of Control Equipment – Gas Particle Interaction, – Working Principle of Gravity Separators, cyclones, Fabric filters, Particulate Scrubbers, Electrostatic Precipitators – Operational Considerations - Process Control and Monitoring – Case studies for stationary and mobile sources.

UNIT – IV: CONTROL OF GASEOUS CONTAMINANTS (9 Periods)

Factors affecting Selection of Control Equipment – Working principle of absorption, Adsorption, condensation, Incineration, Bio scrubbers, Bio filters – Process control and Monitoring - Operational Considerations -– Case studies for stationary and mobile sources.

UNIT – V: INDOOR AIR QUALITY (9 Periods)

Sources, types and control of indoor air pollutants, sick building syndrome and Building related illness Sources and Effects of indoor air Pollution – Measurement – Standards –Control and Preventive measures.

Contact Periods:Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1 *Noel de Nevers,* ***"Air Pollution Control Engineering",*** *Waveland press, Inc 2017.*
2 *Dr. Y. Anjaneyulu,* ***"Air Pollution and Control Technologies",*** *Allied publishers (P) Ltd., 2nd edition,2018.*

REFERENCE BOOKS:

1 *Noel de Nevers, "**Air Pollution Control Engg**", McGraw Hill, New York, 2016.*
2 ***Air Pollution, Climate Change, and Human Health in Indian Cities**: A Brief Review, August 2021.*
3 *Howard S. Peavy, Donald R. Rowe and Geroge Tchobanoglous, "**Environmental Engineering**", McGraw - Hill Co., 2013.*
4 *M.N Rao and HVN Rao, "**Air Pollution**",TataMcgraw Hill Publishing Company limited,2007.*

COURSE OUTCOMES:

On completion of the course, the students will be able to:

CO1: Compare the status of global and analysis of air pollutant scenario and their effects.
CO2: Interpret the modeling and analysis of air pollutants
CO3: Implement the concepts of control strategies adopted for removal of particulate pollutants
CO4: Implement the concepts of control strategies adopted for removal of gaseous pollutants
CO5: Interpret the indoor air pollution and their effects

COURSE ARTICULATION MATRIX:

PO/PSO CO	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	PSO 2	PSO 3	PSO 4
CO1	-	L	L	L	-	M	-	-	-	-	-	-	-	-	-	
CO2	-	M	L	M	-	M	L	-	-	-	-	-	-	-	-	
CO3	M	L	L	M	-	M	M	-	-	-	-	-	L	L	L	
CO4	M	L	L	M	-	M	M	-	-	-	-	-	L	L	-	
CO5	L	L	L	M	-	M	L	-	-	-	-	-	M	M	L	
18CPE$27	M	L	L	M	-	M	M	-	-	-	-	-	M	M	L	

L- Low, M – Moderate (Medium) , H – High

18CPE$28	INTEGRATED URBAN WATER MANAGEMENT

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1.WATER SUPPLY ENGINEERING

COURSE OBJECTIVES:

To impart knowledge on basic concepts of integrated urban water and wastewater management and automation in water supply and wastewater management systems.

UNIT – I: INTRODUCTION (9 Periods)

Concept of Integrated urban water management - Influencing factor and associated issues for the rapid urbanizations - Principles of IUWM – Introduction to water supply and sanitation - Storm and Flood - Overview and challenges to urban areas.

UNIT – II: URBAN WATER RESOURCES MANAGEMENT (9 Periods)

Water in urban ecosystem – Urban water cycle - Storm water management practices – Water harvesting structures – IWRM concepts and applications to Urban Water management - Integrated urban water planning – Water Resources management models - Water policy of developed nations - National water policy - Water pricing – Case studies.

UNIT – III: URBAN WASTEWATER MANAGEMENT (9 Periods)

Status of Wastewater treatment and disposal - Impacts on ecosystem - Eco friendly treatment systems- Concept of decentralization – Bioremediation – Phytoremediation - Wastewater management policy - Models of developed nations – Eco restoration of rivers – Case studies.

UNIT – IV: SMART WATER MANAGEMENT TECHNOLOGY (9 Periods)

Core elements of smart water management - Automation in water supply – Smart metering - Real time monitoring and control – SCADA - Case studies of water treatment plant automation - Automation in distribution systems - Concept of Smart water supply system for Indian cities – Case studies.

UNIT – V: DRAINAGE AND WATER DISTRIBUTION NETWORKS (9 Periods)

Storm water drainage system - Flood routing through channels and reservoir - Sectorization of distribution networks – DMA demarcation – Software applications – Recent Initiatives in smart wastewater systems – Case studies.

Contact Periods:Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1 *Howard S. Peavy, Donald R. Rowe and George Tchobanoglous., "**Environmental Engineering**" McGraw-Hill Publishing Company, New Delhi, 2015.*
2 *Neil S. Grigg., "**Water, Wastewater and Storm water Infrastructure Management**", Lewis Publishing Company, 2002.*

REFERENCE BOOKS:

1 *Policy brief note "**Integrated Urban Water Management (IUWM): Toward Diversification and Sustainability**", Global Water Partnership, 2013.*
2 *Report on "**Integrated Urban Water Management (IUWM) in Peninsular Malaysia**", Academy of Sciences, 2018.*
3 *UNU/IAS Report, "**Defining an Ecosystem Approach to Urban Management and Policy Development**" March 2003.*
4 *Zhifeng Yang, "**Eco- Cities: A Planning Guide (Applied Ecology and Environmental Management)**" CRC Press, 2017.*
5 *Neil S. Grigg., "**Water Resources Management: Principles, Regulations and Cases**", McGraw-Hill Publication, 2009.*

COURSE OUTCOMES:

On completion of the course, the students will be able to:

CO1: Relate the basic concepts of integrated urban water management.
CO2: Apply the concepts of urban water management in integrated water planning.
CO3: Analyze the various methods and techniques in the design of urban wastewater systems.
CO4: Plan the city level smart water technology system.
CO5: Utilize the different software for urban water drainage and distribution networks.

COURSE ARTICULATION MATRIX:

PO/PSO CO	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	PSO 2	PSO3
CO	M	L	-	-	-	-	L	-	-	-	-	-	-	L	-
CO2	M	M	-	-	-	-	L	-	-	-	-	-	-	L	-
CO3	M	M	L	L	L		L	-	-	-	-	-	-	L	L
CO4	M	L	-	-	-	-	L	-	-	-	-	-	-	L	L
CO5	M	M	-	L	L	-	L	-	-	-	-	-	-	L	-
18CPE$28	M	M	L	L	L	-	L	-	-	-	-	-	-	L	L

L- Low, M – Moderate (Medium) , H – High

VERTICAL – III

GEOTECHNICAL ENGINEERING

18CPE$15	GROUND IMPROVEMENT TECHNIQUES

Category : PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1 Mechanics of Soils

COURSE OBJECTIVES:

* To understand the various dewatering techniques
* To know the in-situ treatment of cohesionless and cohesive soils
* To gain knowledge on the different stabilization methods
* To know the various types of grouts and grouting techniques

UNIT – I : DEWATERING (9 Periods)

Scope and necessity of ground improvement – Methods of ground improvement – Selection based on soil conditions – Dewatering by well point system – Deep well-Vacuum and Electro - Osmotic method.

UNIT – II : COMPACTION AND VERTICAL DRAINS (9 Periods)

In-situ densification of granular soils and consolidation of cohesive soils – Shallow and deep compaction – Vibration methods – Vibrocompaction, Blasting, Vibroflotation – Factors influencing compaction –Heavy Tamping – Vertical drains – Preloading with sand drains, Wick drains –Relative merits and limitations of different methods.

UNIT – III : STONE COLUMN AND CONSOLIDATION (9 Periods)

Stone columns and lime piles – Construction methods – merits and demerits – Precompression and consolidation – simple design-Dynamic consolidation – Electro-osmotic consolidation -Earth reinforcement – types and applications of Geosynthetics – filtration – drainage – separation – reinforcement – Soil Nailing.

UNIT – IV : SOIL STABILIZATION (9 Periods)

Stabilization methods – Mechanical, Chemical stabilisation-Cement, Lime, Bitumen – Electro - kinetic stabilization – Stabilization of expansive clays.

UNIT – V : GROUTING (9 Periods)

Types of grouts – Suspension and solution grouts –Basic requirements – Displacement grouting – Compaction grouting – Permeation grouting –Cement grouting-Lime grouting-Grouting equipment and methods – Grout monitoring schemes.

Contact Periods:Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1 *Purushothama Raj, P.,* ***"Ground Improvement Techniques"****, Laxmi Publications (P) Ltd., New Delhi, 2005.*
2 *Nihar Ranjan Patra.,* ***"Ground Improvement Techniques"****, Vikas publishing House Pvt. Ltd., 2012.*

REFERENCE BOOKS:

1 *Day,R.W.,* ***"Foundation Engineering Handbook"****, Mc-Graw Hill Companies, Inc. 2006.*
2 *Rowe, R.K.,* ***"Geotechnical and Geoenvironmental Engineering Handbook"****, Kluwer Academic Publishers, 2001.*
3 *Peter G. Nicholson,* ***"Soil Improvement and Ground Modification Methods"****, Butterworth Heinemann, 2015.*
4 *Klaus Kirsch and Alan Bell,* ***"Ground Improvement, Third Edition"****, CRC Press, Taylor and Francis Group, 2013.*

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: Select suitable ground improvement techniques and different dewatering techniques
CO2: Acquire knowledge on various in-situ treatment of cohesionless and cohesive soils.
CO3: Implement the constructional aspects of stone column and earth reinforcement.
CO4: Identify and implement suitable stabilization methods.
CO5: Select and apply different grouting techniques.

PO/PSO CO	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	PSO 2	PSO 3	PSO 4
CO1	H	-	L	-	-	M	-	-	-	-	-	-	-	H	H	-
CO2	H	-	L	-	-	-	-	-	-	-	-	-	-	H		-
CO3	H	M	M	-	-	M	-	-	-	-	-	-	-	H	H	-
CO4	H	-	-	-	-	-	-	-	-	-	-	L	-	H	-	-
CO5	H	-	-	-	-	-	-	-	-	-	-	L	-	H	H	-
18CPE $15	H	M	L	-	-	M	-	-	-	-	-	L	-	H	H	-

COURSE ARTICULATION MATRIX:

L-Low, M-Moderate (Medium), H-High

18CPE$29	SLOPE STABILITY AND LANDSLIDES

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

NIL

COURSE OBJECTIVES:

To impart knowledge on investigation, analysis and design of slopes. Also gain knowledge on landslides and acquaint with instrumentation in slope safety and slope stabilization measures.

UNIT -I: STABILITY OF SLOPES (9 Periods)

Introduction – Importance – General characteristics – Types of failures – Causes of failures – Purpose of stability computation – Investigation of failures – Procedure – Case studies.

UNIT- II: STABILITY ANALYSIS (9 Periods)

Stability analysis – Method of slices – Friction circle method – Soils with cohesion – Soils with cohesion and angle of internal friction. Critical states for design for embankments – Stability computations

UNIT- III: IRREGULAR SLOP (9 Periods)

Non-uniform soils – Janbu's analysis – Taylor's analysis – Bishop's analysis – Total stress and effective stress approaches – Composite surfaces of sliding – Block sliding.

UNIT-IV: LAND SLIDES (9 Periods)

Engineering problems involving the stability of slopes – Cuts in sand – Homogeneous and soft clay slopes – Sudden spreading of clay slopes – Clay flows – Clays containing pockets and sand masses — Slopes on weathered rock.

UNIT -V: FIELD OBSERVATIONS AND SLOPE STABILIZATION (9 Periods)

Field instrumentation - Observation studies during Construction – Post construction, piezometers – Settlement plates – Inclinometer – Compaction of natural masses of soil and existing fills – Drainage as a means of stabilization – Use of geotextiles – Soil nailing.

Contact Periods: Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Y.M.Cheng and C.K.Lau.,* ***Slope Stability Analysis and Stabilization****, CRC Press Inc;,2014*

REFERENCE BOOKS:

2. *Robin Chowdhury., **Geotechnical Slope Analysis**(1st edition),, CRC Press; 2009*
3. *Dr.K.R.Arora., **Soil Mechanics and Foundation Engineering** (2nd edition), Standard Publisher Distributor,2020*

COURSE OUTCOMES:

At the end of the course, students will be able to

CO1: Gain knowledge about the purpose of computing slope stability.
CO2: Analyse stability of slopes in cohesive and cohesionless soils.
CO3: Familiarize on the analysis of irregular slopes with different approaches
CO4: Reasoning about causes of landslides in different soil conditions**.**
CO5: Identify the use of instrumentation in the slope stability and execute suitable ground improvement techniques in the field.

COURSE ARTICULATION MATRIX :

PO/PSO CO	PO1	PO2	PO3	PO4	PO 5	PO 6	PO 7	PO 8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M	L	L	L	-	-	-	-	-	-	-	-	-	M	--	L
CO2	M	L	L	-	-	-	-	-	-	-	-	-	-	M	L	-
CO3	L	L	L	-	-	-	-	-	-	-	-	-	-	L	-	L
CO4	L	-	L	L	-	-	-	-	-	-	-	-	-	L	L	-
CO5	L	L	L	L	-	-	-	-	-	-	-	-	-	M	L	-
18CPE$29	M	L	L	L	-	-	-	-	-	-	-	-	-	M	L	L

L-Low, M-Moderate (Medium), H-High

18CPE$30	EARTH RETAINING STRUCTURES

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:
NIL

COURSE OBJECTIVES:
To impart knowledge on earth pressure theories, design of retaining walls, sheet pile walls, Computation of lateral earth pressure for braced excavations and principles of reinforced earth retaining wall.

UNIT–I: EARTH PRESSURE THEORIES (9Periods)

Introduction – State of stress in retained soil mass – Classical earth pressure theories – Active and Passive earth pressures – Earth pressure at rest – Earth pressure due to external loads – Empirical methods – Wall movements and complex geometry – Graphical method of computing earth pressure – Rehbann's and Culmann's approach.

UNIT–II: RETAINING WALLS (9Periods)

Retaining walls – Uses and types – Forces on retaining walls – Design of retaining walls by limit state method – General principles – Design of solid gravity walls, cantilever walls – Stability of retaining walls – Drainage arrangements and its influence.

UNIT–III: SHEET PILE WALLS (9Periods)

Earth retaining structures – Selection of soil parameters – Analysis and design of cantilever and anchored sheet pile walls.

UNIT–IV: BRACED EXCAVATION (9Periods)

Braced cuts in sand and clay – Lateral pressure on sheeting in Braced excavation – Stability against piping and bottom heaving – Procedure for computation of lateral earth pressure for braced cuts.

UNIT–V: REINFORCED EARTH RETAINING WALL (9Periods)

Reinforced earth retaining wall – General principles, Concepts and Mechanism of reinforced earth – Design consideration of reinforced earth – Geotextile, geogrids, metal strips and facing elements.

Contact Periods: Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Clayton C.R.I. Militisky, J and Woods R., **"Earth pressure and earth retaining structures** (third edition), CRC Press, 2014*
2. *Jones, **" Earth Reinforcements and Soil structures"**,Third Edition,Thomas Telford, 1996*

REFERENCE BOOKS:

3. *Dr.K.R.Arora.,**"Soil Mechanics and Foundation Engineering** (Geotechnical Engineering), Standard Publishers Distributors, 2020*
4. *Das B.M., **"Principles of Geotechnical Engineering"** (Eighth edition), Cengage learning India Private Limited, 2015*

COURSE OUTCOMES:

At the end of the course, students will be able to

CO1: Comprehend earth pressure theories and calculate earth pressure
CO2: Compute the forces acting on retaining walls and design the retaining walls
CO3: Carry out analysis and design of sheet pile walls
CO4: Identify the basics of braced excavations and calculate the lateral earth pressure for braced cuts
CO5: Apply concepts of reinforcement in earth retaining structures

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO1	PO 2	PO3	PO4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M	L	L	L	-	-	-	-	-	-	-	-	-	M	L	-
CO2	M	L	L	L	-	-	-	-	-	-	-	-	-	L	-	-
CO3	M	L	L	L	-	-	-	-	-	-	-	-	-	M	L	-
CO4	L	L	L	L	-	-	-	-	-	-	-	-	-	L	-	-
CO5	M	L	L	L	-	-	-	-	-	-	-	-	-	M	L	-
18CPE$30	M	L	L	L	-	-	-	-	-	-	-	-	-	M	L	-

L-Low, M-Moderate (Medium), H-High

18CPE$31	FOUNDATIONS IN EXPANSIVE SOILS

Category: PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

NIL

COURSE OBJECTIVES:

To get exposure on the mineralogical composition and properties of expansive soils, the techniques of controlling swelling of soils and to select suitable foundations on such soils.

UNIT – I: GENERAL PRINCIPLES (9 Periods)

Origin of expansive soils – Physical properties of expansive soils –Mineralogical composition – Identification of expansive soils – simple laboratory tests- Classification of expansive soils– Consequences of swelling.

UNIT – II: SWELLING CHARACTERISTICS (9 Periods)

Swelling Mechanism, Swelling measurements – factors affecting - Laboratory methods – Prediction of swelling characteristics.

UNIT – III: TECHNIQUES FOR CONTROLLING SWELLING (9 Periods)

Moisture barriers –Surface and subsurface drainage – Prewetting– Soil replacement- Sand cushion techniques – CNS layer technique.

UNIT – IV: FOUNDATIONS ON EXPANSIVE SOILS (9 Periods)

Belled piers – Bearing capacity and skin friction – Advantages and disadvantages – Design of belled piers – Under – reamed piles – Design and construction.

UNIT – V: MODIFICATION OF SWELLING CHARACTERISTICS (9 Periods)

Lime stabilization – Mechanisms – Limitations – Lime injection – Lime columns – Mixing – Chemical stabilization–Construction.

Contact Periods: Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *R.K.Katti, D.R KAtti, A.R.Katti,* ***"Behaviour of Saturated Expansive Soil& Control Methods",*** *CRC Press, 2002.*
2. *Fu Hua Chen,* ***"Foundations on Expansive Soils",*** *Elsevier Scientific Publishing Company, New York, 2012.*

REFERENCE BOOKS:

1. *Hand Book on **"Underreamed and Bored Compaction Pile Foundation"**, CBRI, Roorkee. 2001.*
2. *Gopal Ranjan and A.S.R Rao, **"Basic and Applied Soil Mechanics"**, NewAge, International Publishers,NewDelhi, 2018.*

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: Assess the occurrence and distribution of expansive soils.
CO2: Study the properties of expansive soils and the controlling techniques.
CO3: Get exposure on various methods of stabilization of expansive soils.
CO4: Design different types of foundations in expansive soil.
CO5: Select suitable techniques and learn the mechanism of treatment of swelling Soils.

COURSE ARTICULATION MATRIX

PO/PSO / CO	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	PSO2	PSO 3	PSO4
CO1	M	-	M	L	L	-	M	-	M	M	-	-	H	H	-	-
CO2	H	M	H	L	M	H	M	-	M	M	-	M		H	H	-
CO3	H	M	H	M	M	L	H	-	M	-	H	M	H	H	H	-
CO4		H	H	L	H	H	H	-	M	-	H	H	H	H	H	H
CO5	M	L	M	M	H	M	H	-	H	-	H	H	L	H	H	M
18CPE$31	H	M	H	L	H	H	H	-	M	M	H	H	H	H	H	H

L-Low, M-Moderate (Medium),H-High

18CPE$32	LAND RECLAMATION

Category PE

L	T	P	C
3	0	0	3

PREREQUISITES

NIL

COURSE OBJECTIVES:

To get an idea of characteristic of waste, processes and remediation techniques

UNIT – I INTRODUCTION (9 Periods)

Soil around us, Soil Water Characteristics, Soil Erosion, Soil and Pollution, Water resources, Irrigation and Wetlands, Soil Pollution Management, Nuclear Waste Management, Solid Waste Management

UNIT – II TRANSPORTATION OF WASTES (9 Periods)

Handling and segregation of wastes at source- storage and collection of municipal solid wastes- Analysis of collection systems- Need for transfer and transport- Transfer stations Optimizing Waste allocation- compactability, storage, labelling and handling of hazardous wastes- hazardous waste manifests and transport

UNIT – III TREATMENT OF WASTES (9 Periods)

Objectives of waste processing- material separation and processing technologies- biological and chemical conversion technologies-method and controls of composting- thermal conversion technologies and energy recovery- incineration- solidification and stabilization of hazardous wastes- treatment of biomedical wastes.

UNIT – IV LANDFILLS (9 Periods)

Waste disposal options- Disposal in landfills- Landfill Classification, types and methods- site selection- design and operation of sanitary landfills, secure landfills and landfill bioreactors leachate and landfill gas management- landfill closure and environmental monitoring- closure of landfills- landfill remediation.

UNIT – V WASTE MANAGEMENT AND BIOREMEDIATION (9 Periods)

Types and Sources of solid and hazardous wastes-Need for solid and hazardous waste management- Elements of integrated waste management and roles of stakeholders- Salient features of Indian legislations on management and handling of municipal solid wastes, hazardous wastes, biomedical wastes-Bioremediation- techniques-field applications

Contact Periods:Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1 *GeorgeTchobanoglous, Hilary Theisen and Samuel A, Vigil* ***"Integrated Solid Waste Management,*** *McGraw- Hill International edition, New York, 1993.*
2 *Vesilind P.A., Worrell W and Reinhart,* ***Solid Waste Engineering****, Thomson Learning Inc., Singapore, 2002.*

REFERENCE BOOKS:

1 *CPHEEO* ***"Manual on Municipal Solid waste management, Central Public Health and Environmental Engineering Organization,*** *Government of India, New Delhi, 2000.*
2 *.Micheael D. Lagrega, Philip L Buckingham, Jeffrey C. E vans and Environmental Resources Management,* ***Hazardous waste Management,*** *McGraw- Hill International edition, New york, 2001.*

COURSE OUTCOMES:

On completion of the course, the students will be able to:

CO1 Recall the fundamentals of solid and hazardous wastes and also the types, need and sources of solid and hazardous wastes.
CO2 Apply the methods of waste characterization and source reduction and to study the various methods of generation of wastes.
CO3 Describe in detail about the storage, collection handling, segregation and transport of wastes.
CO4 Gain the knowledge on the waste processing techniques which includes incineration, solidification and stabilization of hazardous wastes
CO5 Explain about the basics of various waste disposal methods.

COURSE ARTICULATION MATRIX:

PO/PSO CO	**PO 1**	**PO 2**	**PO 3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**	**PSO3**	**PSO4**
CO1	H	-	-	H	H	-	-	-	-	-	-	-	-	-	-	-
CO2	M	-	L	-	H	-	-	-	-	-	-	-	-	L	L	-
CO3	M	-	M	M		-	-	-	L	-	-	-	-	L	M	-
CO4	H	-	L	-	-	-	-	-	-	-	-	-	-	M	L	-
CO5	H	-	-	-	M	-	-	-	H	-	-	-	-			-
18CPE$32	H	-	M	H	H	-	-	-	H	-	-	-	-	L	M	-

L – Low, M – Moderate (Medium), H – High

18CPE$33	ENVIRONMENTAL GEOTECHNOLOGY

Category PE

L	T	P	C
3	0	0	3

PREREQUISITES:

NIL

COURSE OBJECTIVES:

To acquire knowledge on the geotechnical engineering problems associated with contaminated soil, transport of contaminants and to select suitable remediation technologies.

UNIT – I: SOIL POLLUTION AND INTERACTION (9 Periods)

Introduction to Geo-environmental engineering – Environmental cycle– Sources, production and classification of waste – Causes of soil pollution – Classification, identification and characterization of contaminated soils - Factors governing soil – Pollutant interaction– Failures of foundations due to pollutants.

UNIT – II: SITE SELECTION AND SAFE DISPOSAL OF WASTE (9 Periods)

Safe disposal of waste – Site selection for landfills – Characterization of landfill sites – Risk assessment – Stability of landfills – Current practice of waste disposal – Monitoring facilities – Passive containment system– Leachate contamination – Application of geosynthetics in solid waste management– Rigid and flexible liners.

UNIT – III: TRANSPORT OF CONTAMINANTS (9 Periods)

Contaminant transport in subsurface – Advection – Diffusion – Dispersion – Governing equations – Contaminant transformation – Sorption – Biodegradation – Ion exchange – Precipitation – Ground water pollution – Foundation for waste fill ground – Pollution of aquifers by mixing of liquid waste – Protection of aquifers.

UNIT – IV: WASTE STABILIZATION AND DISPOSAL (9 Periods)

Hazardous waste control and storage system – Stabilization/Solidification of wastes –Micro and Macro encapsulation – Absorption, adsorption, precipitation – Detoxification – Mechanism of stabilization – Organic and inorganic stabilization – Utilization of solid waste for soil improvement.

UNIT – V: REMEDIATION OF CONTAMINATED SOILS (9 Periods)

Rational approach to evaluate and remediate contaminated sites – Monitored natural attenuation – Ex-situ and in-situ remediation – Solidification, Bio-remediation, incineration, soil washing, electro-kinetics, soil heating, Vitrification, bio-venting – Ground water remediation – Pump and treat ,air sparging, reactive-well.

Contact Periods: Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1 *Martin N. Sara, "**Site Assessment and Remediation Handbook",** Second Edition, Lewis Publishers, 2008*
2 *Asante-Duah, "**Management of Contaminated Site Problems",** Taylor and Francis Ltd, 2019*

REFERENCE BOOKS:

1. *Jo Strange and Nick Langdon, "**Contaminated Land: Investigation, Assessment and Remediation – Design and Practice Guides**," ICE, 2008.*
2. *Maria C. Hernandez Soriano, "**Environmental Risk Assessment of Soil Contamination",** Intech Open, 2014.*

COURSE OUTCOMES:

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

CO1: Learn about soil contamination and soil pollutant interaction
CO2: Select suitable sites for safe disposal of wastes
CO3: Assess different mechanisms of transport of contaminants
CO4: Adopt appropriate waste stabilization techniques
CO5: Remediate contaminated soils using different methods

COURSE ARTICULATION MATRIX

PO/PSO CO	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	PS O4
CO1	H	-	H	L	H	H	L	--	L	-	M	H	-	H	L	-
CO2	H	-	M	M	-	-	L	-	M	-	M	M	-	H	L	-
CO3	M	-	H	-	H	H	H	--	M	-	H	M	-	H	M	-
CO4	H	-		H	M	-	H	-	H	-	H	H	H	H	H	M
CO5	H	-	M	H	M	-	H	-	H	-	H	H	H	H	H	M
18CPE$33	H	-	H	H	H	H	H	-	H	-	H	H	H	H	H	M

L – Low, M – Moderate (Medium), H – High

18CPE$34	REINFORCED SOIL STRUCTURES

Category: PE

L	T	P	C
3	0	0	3

PREREQUISITES:

NIL

COURSE OBJECTIVES:

To impart knowledge on the principles and mechanisms of reinforced soil, the materials used and its design principles and also to select appropriate reinforcement materials for different projects.

UNIT – I: PRINCIPLES AND MECHANISMS (9 Periods)

Historical background – Initial and recent developments – Principles – Concepts and mechanisms of reinforced soil – Factors affecting behaviour and performance of soil – reinforcement interactions.

UNIT – II: MATERIALS AND MATERIAL PROPERTIES (9 Periods)

Materials used in reinforced soil structures – Fill materials, reinforcing materials - Geotextile, Geogrids, Geomembranes, Geocomposites, Geojutes, Geofoam, natural fibres, coir Geotextiles — Facing elements – Properties – Methods of testing – Advantages and disadvantages.

UNIT – III DESIGN PRINCIPLES AND APPLICATIONS (9 Periods)

Design aspects of reinforced soil – Soil reinforcement- functions –Design and applications of reinforced soil of various structures – Retaining walls – Foundations – Embankments and slopes.

UNIT – IV GEOSYNTHETICS AND APPLICATIONS (9 Periods)

Introduction – Historical background – Applications – Design criteria – Geosynthetics in roads –Geo synthetics in landfills – Geosynthetic clay liner – Design of landfills – Barrier walls.

UNIT – V SOIL NAILING AND CASE HISTORIES (9 Periods)

Soil nailing – Introduction – Soil-Nail interaction – Behavior – Design procedure - Performance studies of reinforced embankments, Pavements and Foundations.

Contact Periods:Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Koerner, R.M., **"Designing with Geosynthetics"**, (Third Edition), Prentice Hall, 1997.*
2. *G.V.Rao, P K Baneee, J.T.Shahu,G.V.Ramana**"Geo synthetics-New Horizons",**, Asian Books Private Ltd., NewDelhi,2004.*

REFERENCE BOOKS:

3. *Gray, D.H., and Sotir, R.B**., "Biotechnical and Soil Engineering Slope Stabilization. A Practical Guide for Erosion Control"**, John Wiley & Son Inc., New York, 1996.*
4. *Koerner, R.M., **"Designing with Geosynthetics"**, (Third Edition), Prentice Hall, 1997.*
5. *Shukla,S.K..**"Geo synthetics and its applications"**,Thomas Telford, London, 2002.*
6. *G.V.Rao, P K Baneee, J.T.Shahu,G.V.Ramana**"Geo synthetics-New Horizons",**, Asian Books Private Ltd., NewDelhi,2004.*

COURSE OUTCOMES:

On completion of the course, the students will be able to:

CO1: Acquire knowledge on the soil - reinforcement interaction mechanism.
CO2: Gain knowledge on properties, testing methods of geosynthetics.
CO3: Assess the functions of soil reinforcement and its applications.
CO4: Carry out the design of geosynthetics as liners
CO5: Design and adopt soil nailing techniques.

COURSE ARTICULATION MATRIX

PO/PSO CO	PO1	PO2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	M	-	-	-	M	-	H	-	M	-	H	-	-	H	M	-
CO2		-	H	H	M	M	H	-	H	-	H	-	H	H	H	-
CO3	M	-	L	-	-	-	H	-	H	-	-	-		H	-	-
CO4		-	-	-	H	-	H	-	H	-	-	-	H	H	H	H
CO5	M	-	-	-	M	L	H	-	H	-	H	-	H	H	H	H
18CPE$34	M	-	H	H	M	M	H	-	H	-	H	-	H	H	H	H

L – Low, M – Moderate (Medium), H – High

18CPE$35	DESIGN OF UNDERGROUND EXCAVATIONS

Category PE

L	T	P	C
3	0	0	3

PRE-REQUISITES

NIL

COURSE OBJECTIVES:

To get exposure to analysis, design of underground support system and to learn about the various field tests conducted during and after construction of underground structures.

UNIT – I PLANNING AND EXPLORATION (9 Periods)

Introduction, planning and exploration for various underground construction projects, stereographic projection method, principle and its application in underground excavation design.

UNIT – II ANALYSIS AND DESIGN OF UNDER GROUND STRUCTURES (9 Periods)

Elastic stress distribution around tunnels, stress distribution for different shapes and under different in-situ stress conditions, Greenspan method, design principles, multiple openings, openings in laminated rocks, elasto-plastic analysis of tunnels, Daemen's theory.

UNIT – III TUNNELLING METHODS (9 Periods)

Application of rock mass classification systems, ground conditions in tunneling, analysis of underground openings in squeezing and swelling ground, empirical methods, estimation of elastic modulus and modulus of deformation of rocks; uniaxial jacking / plate jacking tests, radial jacking and Goodman jacking tests, long term behaviour of tunnels and caverns, New Austrian Tunneling Method (NATM), Norwegian Tunneling Method (NTM),construction dewatering

UNIT – IV ROCK MASS (9 Periods)

Rock mass-tunnel support interaction analysis, ground response and support reaction curves, Ladanyi's elasto-plastic analysis of tunnels, design of various support systems including concrete and shot Crete linings, steel sets, rock bolting and rock anchoring, combined support systems, estimation of load carrying capacity of rock bolts

UNIT – V INSTRUMENTATION (9 Periods)

In-situ stress, flat jack, hydraulic fracturing and over coring techniques and USBM type drill hole deformation gauge, single and multi-point bore hole extensometers, load cells, pressure cells, etc. Instrumentation and monitoring of underground excavations, during and after construction, various case studies

Contact Periods:Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1 *Hoek, E and and Brown, E. T., "**Underground Excavations in Rocks",** Institute of Mining Engineering, U.K., 1981.*
2 *Obvert, L. and Duvall, W.I.,Rock ,"**Mechanics and Design of Structures in Rocks"**, John Wiley,1967.*

REFERENCES:

1 *Wittke, W., **"Rock Mechanics:Theroy and Applications with Case Histories",** Springerverlag, Berlin, 1990.*

2 *Bazant, Z.P., **Mechanics of Geomaterials Rocks, Concrete and Soil**, John Wiley and Sons, Chichester, 1985.*

COURSE OUTCOMES:

On completion of the course, the students will be able to:

CO1 Apply the use of elastic and plastic analysis in the design of underground support system.
CO2 Have idea about the field tests generally conducted during and after construction of underground structures
CO3 Critically analyse the behaviour of underground structures
CO4 Understand the different methods of tunnelling suited to different ground conditions.
CO5 Gain knowledge about instrumentation during and after construction of underground construction

COURSE ARTICULATION MATRIX:

CO/ PO	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	PSO 2	PSO 3	PS0 4
CO1	H	-	L	M	H	-	-	-	-	-	-	-	-	-	-	-
CO2	M	-	L	L	H	-	-	-	-	-	-	-	L	M	M	-
CO3	H	M	M	M	-	-	-	-	L	-	-	-	M	L	M	-
CO4	H	L	L	-	-	-	-	-	M	-	-	-	-	M	L	-
CO5	H	M			M	-	-	-		-	-	-	-	-	-	-
18CPE$35	H	M	M	M	H	-	-	-	M	-	-	-	L	M	M	-

L – Low, M – Moderate (Medium), H – High

18CPE$36	GEOTECHNIQUES FOR INFRASTRUCTURE

Category PE

L	T	P	C
3	0	0	3

PREREQUISITES
NIL

COURSE OBJECTIVES

To impart knowledge on soil investigation and sampling techniques
Understand different ground improvement techniques
To analyze alternative solutions to difficult site conditions
To acquire knowledge on recent trends in soil improvement

UNIT-I: SITE INVESTIGATION (9Periods)

Site investigation – principles and planning –Methods of soil exploration – Samplers and sampling techniques – Bore log – Preparation of soil report – site investigations in difficult ground.

UNIT-II: GROUND WATER AND FOUNDATIONS (9Periods)

General Principles – Effective stress theory –Dewatering techniques – Open sumps and ditches- well points – vacuum dewatering – Electro osmosis- Foundations on sea bed.

UNIT-III: GROUND TREARMENT (9Periods)

Soil improvement using mechanical, chemical, thermal, electrical methods – Tamping – Vibro floatation-Grouting methods

UNIT-IV: OFFSHORE STRUCTURES (9Periods)

Offshore soil investigation, General characteristics of offshore soil exploration sampling using free corer, gravity corer, tethered systems and manned submersibles –deep penetration sampling using wire line techniques – Foundation for gravity structures-Types, Installation techniques

UNIT-V: RECENT TRENDS IN INFRASTRUCTURE PROJECTS (9Periods)

Use of Geo synthetics - Soil nailing – Gabion walls – Reinforced earth – Case studies.

Contact Periods: Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1. *Purushotham Raj, "**Ground improvement techniques**", Laxmi Publications, 2002*

REFERENCEBOOKS:

2. *Murthy, V.N.S, "**A text book of Soil Mechanics and Foundation Engineering**", UBS Publishers & Distributors Pvt. Ltd., New Delhi 1999.*
3. *ArousDA ,(Ed),"**Offshore site Investigation**", Graham Trotman*

COURSEOUTCOMES:

At the end of the course, students will be able to

CO1: Comprehend the importance of site investigation and prepare borelog report
CO2: Choose specific dewatering technique suiting the site requirement.
CO3: Be familiar with various ground improvement techniques
CO4: Recommend suitable offshore investigation techniques
CO5: Recommend alternative solutions to sustain earth pressure.

COURSE ARTICULATION MATRIX:

PO/PSO CO	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	PSO 2	PSO 3	PSO 4
CO1	M	L	L	L	-	-	-	-	-	-	-	-	-	M	-	-
CO2	M	L	L	L	-	-	-	-	-	-	-	-	-	-	M	-
CO3	M	L	L	L	-	-	-	-	-	-	-	-	-	M	-	-
CO4	M	L	L	L	-	-	-	-	-	-	-	-	-	M	M	-
CO5	M	L	L	L	-	-	-	-	-	-	-	-	-	M	M	-
18CPE$36	M	L	L	L	-	-	-	-	-	-	-	-	-	M		-

L-Low, M-Moderate (Medium), H-High

VERTICAL – IV

INFRASTUCTURE ENGINEERING

18CPE$09	SAFETY IN CIVIL ENGINEERING PRACTICES

Category : PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1 Construction Materials and Technology

COURSE OBJECTIVES:

* To impart the basic knowledge about safety requirement at every stage of construction work.
* To follow the basic protective measures and safety aspects during construction
* To acquire knowledge on equipments needed for safety during construction.

UNIT – I : PRE-CONSTRUCTION (9 Periods)

Planning and scheduling – Housekeeping – Safe access – Site safety – Basic checklist – Electrical Safety – Electrical power lines –Temporary Wiring – Overhead high-voltage and low-voltage electricity – Underground electrical hazards.

UNIT – II : CONSTRUCTION (9 Periods)

Personal Safety – Basic personal protective equipment and clothing – Eye and Face protection, Foot protection, Hand protection, Head protection and Hearing protection – Safety related work practices – Safety measures during Excavation – General requirements for trenches and excavations, Sloping and shoring requirements, Underground construction.

UNIT – III : FORMWORK AND POURING (9 Periods)

Safety measures for Formwork – Slip forms – Working platforms – Materials Hoist – Concrete pouring and pumping – General framing – Guardrails – Floor and roof openings – Lifting appliances – Fall protection.

UNIT – IV : TRUSS AND ROOF WORK (9 Periods)

Trusses – Instruction for truss installers, Truss erection – Roof work – Roof jacks and toe-holds (slide guards) Scaffolds – General provision – Guardrails, Toe boards for scaffolds – Erection requirements – Wood scaffolds erection guidelines – Other types of scaffolds, Ladder-jack scaffolds Trestle scaffolds, Shore and lean-to scaffolds, Suspended scaffolds, Rolling scaffolds.

UNIT – V : EQUIPMENT SAFETY (9 Periods)

Ladders Safety – General requirements – Job-built ladders, Stepladders – Portable tools – Hand tools, Pneumatic tools, Power tools-saws – Compressed air for cleaning – Pneumatic nailing and stapling equipment, Construction site hazards.

Contact Periods: Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1 *Allen St.John Hot, **"Principles of Construction Safety"**, John Wiley & Sons, 2005.*
2 *Mark Mc.Guire Moran, **"Construction Safety Hand Book"**, 2003.*
3 *David L.Geotsch, **"Construction Safety and Health"**, 2003.*

REFERENCE BOOKS:

1 *Grimaldi Simonds **"Safety Management"**, AITBS Publishers, 2001.*
2 *Tim Howarth, Paul Watson, **"Construction Safety Management"**, 2008.*
3 *John Schaufelberger **"Construction Project Safety"**, Wiley Publications, 2013.*

COURSE OUTCOMES:

On completion of this course, the students will be able to

CO1: Adopt the safety measures during pre-construction work.
CO2: Follow the basic protective measures during construction.
CO3: Assess safety measure during concreting work.
CO4: Choose protective measures during truss and roof construction.
CO5: Select equipments needed for safety during construction.

COURSE ARTICULATION MATRIX:

PO/PSO CO	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	PSO 2	PSO 3	PSO 4
CO1	H	-	-	-	-	H	M	L	L	L	L	L	L	-	L	M
CO2	H	H	H	L	-	M	L	L	L	-	L	-	L	H	H	-
CO3	H	L	H		-	M	-	-	L	-	-	-	-	H	H	-
CO4	H	L	L	L	H	L	L	-	L	-	-	-	M	M	M	M
CO5	H	M	H	H	H	H	-	-	M	L	M	L	H	L	M	M
18CPE $08	H	H	H	L	H	H	L	L	L	L	L	M	M	H	H	M

L-Low, M-Moderate (Medium), H-High

18CPE$10	VALUATION

Category : PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1 Construction Materials and Technology
2 Computer Aided Civil Engineering Drawing

COURSE OBJECTIVES:

* To understand the fundamentals and the various concepts of valuation
* To determine the depreciation of any property
* To know the methods of valuation for Fields, open lands and building

UNIT – I : COST, PRICE AND VALUE (9 Periods)

General - Real properties and personal properties - Differences between the real properties and personal properties - Valuation - Cost, price and value - Concept of the term value - Purposes of valuation - Different forms of value - Factors affecting changes in market value - Classification of the valuers - Role of the valuer - New horizons of valuation.

UNIT – II : MORTGAGE, FREEHOLD AND LEASEHOLD PROPERTIES (9 Periods)

General - Types of interests - Freehold interests - Leasehold interests - Difference between freehold and leasehold property - Mortgage - Reverse mortgage - Typical problems.
Outgoings and Net income - Definition - Usual types of outgoings - Typical problems - Gross income and net income.

UNIT – III : DEPRECIATION (9 Periods)

Meaning of the term - Depreciation as cost in operation - Depreciation as decrease in worth - Physical conditions - Functional obsolescence - Economic obsolescence - Difference between depreciation and obsolescence - Methods for estimating cost depreciation - Cost of construction - Cost depreciation and value depreciation - Reproduction cost and replacement cost - Depreciation and depletion - Typical problems.

UNIT – IV : VALUATION FOR AGRICULTURAL LANDS & RENT (9 Periods)

Importance - Crop loans - Investment loans - Development loans - Factors affecting value of agricultural land - Cottages and buildings - Size of farm - Fencing and gates - Title of land - General situation - Types of crops - Quality of soil - Water supply and electricity - Roads and approaches - Methods of valuation of agricultural lands - Income capitalisation method - Sales statistics method -

Cottages and buildings - Valuation date - Field-to-field valuation - Agricultural land and direct tax laws. STANDARD RENT - Forms of rent - Objects of Rent Act - Meaning of standard rent - Exemptions from the Rent Act - Process of fixing standard rent - Methods of ascertaining standard rent - Important factors - Inheritance of tenancy right - Typical problems.

UNIT – V : METHODS OF VALUATION (9 Periods)

General - Methods of valuation for open lands - Methods of valuation for lands with buildings - Rental method - Direct comparisons of the capital value - Valuation by reference to profits - Valuation based on the cost or contractor's method - Residual or development method - Typical problems - Valuation of Licensed Premises - General principle of valuation - Valuation of a cinema - Valuation of a hotel - Typical problems.

Contact Periods:Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1 *B. N. Dutta,* ***"Estimating and Costing in Civil Engineering"****, UBS Publishers Distributors Ltd. 2016*
2 *S. C. Rangwala, Estimatin,* ***"Costing and valuation"****, Charotar Publishing House, 2009.*
3 *G. S. Biridi,* ***"Textbook of Estimating & Costing"****, Dhanapat Rai & Sons. Delhi, 2016.*
4 *M.Chakraborti,* ***"Estimating Costing Specification And Valuation In Civil Engineering"*** *Chakraborti 2006.*
5 *P.W.D. Hand Book.*

REFERENCE BOOKS:

1 *Patil, B.S.,* ***"Civil Engineering Contracts, Vol. – I"****, Orient Longman Publication, 1998.*
2 *Rangwala, S.C.,* ***"Elements of Estimating and Costing"****, Professional practice, Charotar Publishing House, Anand. 2009*
3 *Aggarwal, A., Upadhyay, A.K.,* ***"Civil Estimating, Costing & Valuation"****, S.K Kataria& Sons, New Delhi, 2013*
4 *Chandola, S.P. and Vazirani,* ***"Estimating and Costing"****, Khanna Publication, 2001.*

COURSE OUTCOMES:

On Completion of the course, the students will be able to

CO1: Explain principle of valuation and cost.
CO2: Calculate outgoings and net income.
CO3: Assess the depreciation of any property.
CO4: Determine the valuation of agriculture land.
CO5: Evaluate the actual value of any property.

COURSE ARTICULATION MATRIX:

PO/PSO CO	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	PSO 2	PSO 3	PSO 4
CO1	M	-	-	-	M	-	-	-	-	-	-	-	-	M	M	-
CO2	H	M	-	-	M	-	-	-	-	-	-	-	-	L		-
CO3	M		-	-	L	-	-	M	-	-	-	-	-	M	M	-
CO4	M	M	-	-	M	-	-	-	-	-	-		-	L		
CO5	H	M	-	-	M	-	-	-	-	-	-	-	-	M	M	-
18CPE $10	M	M	-	-	M	-	-	M	-	-	-	-	-	M	M	-

L-Low, M-Moderate (Medium), H-High

18CPE$16	PAVEMENT ENGINEERING

Category : PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1 Mechanics of soils

COURSE OBJECTIVES:

* To gain knowledge on various IRC guidelines for designing flexible and rigid pavements.
* To assess the quality and serviceability conditions of roads.
* To learn about the evaluation of pavements and strengthening methods

UNIT – I : BASIC CONCEPTS (9 Periods)

Pavement – Types and components – Comparison – Function of components – Factors affecting design and performance of pavements – Vehicle and traffic factors – Design wheel load – Maximum wheel load –contact pressure – ESWL – Repetition of loads – Stresses and deflections in homogeneous masses.

UNIT – II : FLEXIBLE PAVEMENT (9 Periods)

Various approaches of design – Empirical, Semi-empirical and theoretical methods – IRC design guidelines – Applications of different pavement design methods

UNIT – III : RIGID PAVEMENT (9 Periods)

Stresses in rigid pavement – Evaluation –IRC design guidelines– Types of joints and their functions– Design of joints.

UNIT – IV : QUALITY CONTROL (9 Periods)

Field compaction – Rammers – Rollers – Compaction control – insitu density –pavement materials - Bitumen – Ductility– Viscosity – Binder content and Softening point tests – Aggregate – Crushing – Abrasion – Impact Tests – Water absorption – Flakiness and Elongation indices.

UNIT – V : EVALUATION AND REHABILITATION (9 Periods)

Distress in flexible and rigid pavements – Pavement evaluation – Present Serviceability Index – Structural evaluation – Evaluation by deflection measurements – Strengthening of pavements – Flexible and rigid overlays.

Contact Periods:Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1 *S.K.Khanna, C.E.G.Justo and Dr.A.Veeraraghavan, **"Highway Engineering"**, Khanna Publishers,Tenth Edition,2013*
2 *Yoder, E.J and Witchak, M.W, **"Principles of Pavement Design"**, e print, Newyork wiley, 2010.*
3 *Yang, **"Design of functional Pavements"**, McGraw Hill Publishing Company, 2004.*
4 *NPTEL-https://nptel.ac.in/courses/105105107/24*

REFERENCE BOOKS:

1 *Kadiyali, L.R and N.B.Lal., **"Transport planning & Traffic Engineering"**, Khanna Publishers, 2016.*
2 *S.K Sharma, **"Principles, Practice and Design of Highway Engineering"**, S. Chand & Co., Ltd., New Delhi, 2014.*
3 *Guidelines for the Design of Flexile Pavements, IRC: 37-2012, The Indian roads congress, New Delhi.*
4 *Guidelines for the Design of Plain Jointed Rigid Pavements for Highways, IRC: 58-2015, The Indian Roads Congress, New Delhi.*
5 *IRC SP20-2002, Design and specification of Rural Roads (Manual), Ministry of rural roads, Government of India, New-Delhi, Reprint 2013.*

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: Gain knowledge on the types and components of pavements and calculate stresses in flexible pavement.
CO2: Use different methods for designing flexible pavements.
CO3: Calculate the stresses and design of rigid pavement using IRC guidelines
CO4: Execute various quality control tests on pavement materials.
CO5: Evaluate the strength of existing pavements and design the overlays.

COURSE ARTICULATION MATRIX:

PO/PSO CO	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	PSO 2	PSO 3	PSO 4
CO1	H	-	-	-	-	-	-	-	-	-	-	-	-	H	-	-
CO2	H	M	-	M	-	-	-	-	-	-	-	M	-	H	H	H
CO3	H	M	-	M	-	-	-	-	-	-	-	M	-	H	H	H
CO4	H		M	L	-	M	-	-	-	-	-	-	-	H	-	H
CO5	H		M	L	-	M	-	-	-	-	-	-	-	H	H	
18CPE $16	H	M	M	M	-	M	-	-	-	-	-	M	-	H	H	H

L-Low, M-Moderate (Medium), H-High

18CPE$17	AIRPORT, DOCKS AND HARBOUR ENGINEERING

Category : PE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

* To expose the students to design principles of Airports.
* To know various components of a harbor, docks and their functions.
* To gain knowledge on break water construction methods and functions of navigational lights

UNIT – I : AIRPORTS SUB STRUCTURE CONSTRUCTION (9 Periods)

Air transport-development in India and importants in national transportation sector-airport planning and site selection for landing and terminal areas – layout of their components and locational requirements- airport classification- design standards of airports.

UNIT – II : AIRPORT COMPONENTS AND DRAINAGE (9 Periods)

Runways – Orientation – types, pattern layout- basic runway length-runway design – orientation, geometric design and corrections- Taxiways and apron - general principles of design, layout, construction and maintenance terminal area- terminal buildings, hangers and auxiliary structures. Airport drainage- various types, materials and construction features- airport marking and lighting.

UNIT – III : DOCKS AND HARBOUR (9 Periods)

Historical development of docks, harbours and seaports- Basic definition - Requirements and classification- recent trends in seaport planning and construction including container and special purpose terminals- inland water transport. Types of wet and dry docks- their functional design and usage

UNIT – IV : BREAK WATER AND QUAYS (9 Periods)

Types, uses and general construction methods of break water- layout and construction of quays and jetties and wharves.

UNIT – V : NAVIGATIONAL AIDS AND DREDGING (9 Periods)

Necessity and types of signals including floating signals – buoys and beacons- mooring and mooring accessories – Types of dredging and its application – Cargo handling.

Contact Periods:Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1 *Khanna.S.K and Arora.M.G., **"Airport planning and design"**, S.Chand and bros, 2006.*

2 *Vazirani.V.N and Chandola.S.P.,* ***"Transportation and Engineering, Vol.2"****, Khanna publishers, New Delhi,2005.*

REFERENCE BOOKS:

1 *Shahani .P.B,* ***"Airport techniques"****, second edition- Oxford publishing, NewDelhi,1990.*
2 *Srinivasan.R.,* ***"Harbour, Dock and Tunnel Engineering"****, Chartor publishing house, Anand, India,2004.*

COURSE OUTCOMES:

On completion of the course, students will be able to

CO1: Prepare the airport layout by choosing appropriate site.
CO2: Design the run way with required facilities.
CO3: Identify various components of a docks, harbour and their functions.
CO4: Adopt suitable break water construction methods.
CO5: Choose suitable navigational aids and mooring accessories.

COURSE ARTICULATION MATRIX:

PO/PSO CO	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	PSO 2	PSO 3	PSO 4
CO1	M	M	-	-	-	M	-	M	-	M	-	M	L	L	-	L
CO2	H	M	H	-	L	L	-	-	H	-	M	-	-	M	M	-
CO3	M	-	-	-	-	M	-	M		M	-	M	-	L	-	L
CO4	M	M	L	-	-	L	-	-	M	-	M	-	L	L	-	-
CO5	M	-	L	-	-	M	-	M	-	-	M	M	-	-	-	L
18CPE $17	M	M	L	-	L	M	-	M	H	M	M	M	L	L	M	L

L-Low, M- Moderate (Medium), H-High

18CPE$18	HIGHWAYS - STATE OF ART

Category : PE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

* To impart an overview about the design and construction of various types of highways
* To gain knowledge about the procedures adopted in the Department of Tamil Nadu Highways.
* To get exposure on tendering and accounting procedures of Tamil Nadu Highways department.

UNIT – I : HIGHWAYS - BIRD'S EYE VIEW (9 Periods)

Highway Planning in India:
Classification and Authorities of roads in India – Function and duties of Ministry of Road Transport and Highways (MORT&H) and Indian Roads Congress (IRC) - Highways Research centers in India – Financing of Highways Infrastructures.

Tamilnadu Highways Department organizational setup and duties - Project Announcements - Financial Allotment - Government Orders - Issue of Letter of Credit.

Geometric elements of Highways:
Terrain, Land width, Building lines and Control lines, Right of Way, Carriage Way, Camber, Kerbs, Shoulders, Side slopes, Footpaths, Sight distances, horizontal and vertical alignments [IRC Standards] – Typical cross section - Components of bridge structures.

UNIT – II : DESIGN AND CONSTRUCTION OF HIGHWAY PAVEMENTS (9 Periods)

Desirable properties and quality assurance tests of materials for flexible and rigid pavements - Design of bituminous paving mixes - Design factors for flexible and rigid pavements - Design of flexible pavement using IRC:37-2012 – Design of bituminous overlay using IRC:81-1997 - Design of rigid pavements using IRC:58-2015.

UNIT – III : DESIGN AND CONSTRUCTION OF BRIDGES (9 Periods)

Engineering Surveys for Alignment of road bridges - Investigations for bridge works and preparation of field particulars - linear waterway calculation.
Classification of bridges – Basics of bridge design and drawings – Construction practices in Bridges - RMC site machineries and operations – Construction site machineries and operations - Quality Assurance activities at plant and construction sites.

Grade Separators and Elevated Structures:
Basics - Common types of Interchanges - Trumpet interchange, Diamond interchange, Cloverleaf interchange, Rotary interchange and Directional interchange - General features and Geometric Standards – Construction problems.

UNIT – IV : HIGHWAY MAINTENANCE (9 Periods)

Road maintenance:
Basic objectives – Classification of maintenance activities – Procedure for inspection and planning maintenance works – Surface and subsurface drainage of roads – Road markings and appurtenances.

Pavement failures:
Defects in Flexible pavements – Surface defects, Cracks, Deformation, Disintegration – Symptoms, Causes and Treatments; Failures in Rigid Pavements – Scaling, Shrinkage, Warping, Structural cracks, Spalling of joints and Mud pumping - Treatments.

Hill roads:
Construction and maintenance - V shaped drains, Shadow and swamp areas, landslide - causes, investigation, preventive and remedial measures - protection of embankment and cut slopes – flood damage and emergency works – problems and remedial measures in hill road construction.
Applications of geosynthetics, reinforced earth and soil nailing in highways.

UNIT – V : TENDERING AND ACCOUNTING PROCEDURES (9 Periods)

Tendering:
Estimate preparation and sanctions – tendering and contracting procedures, laws of contracts – COT approval – agreements.

Accounting:
Recording measurements – bill preparation and processing – Working estimates – RAS – disputes and arbitration - Completion Certificates - Completion Report - Internal Audit and Accountant General Audit.

Contact Periods:Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1 *T.F. Fwa, **"The Handbook of Highway Engineering"**, CRC Press, 2006.*
2 *Nicholas J. Garber, Lester A. Hoel, **"Traffic and Highways Engineering"**, Cengage Learning,2015*
3 *S.K.Khanna, C.E.G.Justo and Dr.A.Veeraraghavan, **"Highway Engineering"**, Khanna Publishers, Tenth Edition, 2013.*

REFERENCE BOOKS:

1 *Fred L. Mannering, Scott S. Washburn, **"Principles of Highway Engineering and Traffic analysis"**, John Wiley and Son, 2017.*
2 *E.J.Yoder and M.W.Witczak, **"Principles of Pavement Design"**, e- Print, Newyork Wiley,2010.*
3 *Kadiyali L R, **"Principles & Practice of Highway Engineering"**, Khanna Publishers, 2005.*
4 *IRC codes (IRC:37–2012, IRC-SP:19-2001, IRC-SP:90-2010, IRC:81-1997, IRC-SP:48-1998, IRC:58-2015, etc.,).*
5 *Specifications for Road and Bridge works, MORT&H (Fifth Revision)April 2013*

COURSE OUTCOMES:

On completion of the course, students will be able to

CO1: Categorize about different types of highways and geometric elements of highways.

CO2: Design and construct both flexible and rigid pavements based on IRC guidelines.

CO3: Apply the knowledge on engineering surveys for road bridges and construction procedures in bridge design.

CO4: Acquaint on different aspects of pavements and hill roads.

CO5: Prepare the tender documents as per the specifications of Tamil Nadu Highways department.

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COURSE ARTICULATION MATRIX:

PO/PSO CO	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	PSO 2	PSO 3	PSO 4
CO1	H	M		M	L	H	H	L	L	-	L	M	H	H	M	L
CO2	H	H	H	M	M	H	H	L	M	-	H	M	H	H	H	L
CO3	H	M	H	H	M	H	M	L	M	M	H	M	H	H	H	L
CO4	H	M	-	M	H	H	H	L	-	-	L	-	H	M	-	L
CO5	H	M	-	-	-	M	M	M	L	M	M	M	H	M	-	M
18CPE $18	H	M	H	M	M	H	H	L	M	M	H	M	H	H	H	L

L-Low, M-Moderate (Medium), H-High

18CPE$19	TRAFFIC ENGINEERING AND MANAGEMENT

Category : PE

L	T	P	C
3	0	0	3

PRE-REQUISITES: NIL

COURSE OBJECTIVES:

* To learn about Traffic elements, surveys, traffic regulation, management and traffic safety with integrated approach in traffic planning as well.
* To get familiarize in design principles of traffic signals, design of parking facilities, clover leaf intersection and traffic rotary.

UNIT – I : INTRODUCTION (9 Periods)

Scope– Properties of traffic engineering elements – vehicle, driver and road characteristics - skid resistance and breaking efficiency – simple problems. Components of traffic Engineering – control mechanisms.

UNIT – II : TRAFFIC SURVEYS (9 Periods)

Surveys – Classification - Volume, Speed and delay, origin and destination - parking, accidents – stastical methods for traffic engineering – simple problems – analysis-capacity of roads-level of service – interpretation of traffic studies and conclusions.

UNIT – III : TRAFFIC CONTROL (9 Periods)

Traffic signs – location and design recommendations - Road markings – Classification and design of traffic signals –signal co-ordination – Traffic islands and rotaries – Traffic control aids and street furniture – Regulation of traffic –Modern methods of traffic control.

UNIT – IV : TRAFFIC SAFETY AND MANAGEMENT (9 Periods)

Road accidents – types - causes and prevention with emphasis on engineering factor s – Traffic management, Transport system management (TSM) and Transport Demand Management (TDM), restrictions on turning movements, one way streets, traffic segregation, tidal flow operation, exclusive bus lanes and other management measures – introduction to intelligent transport systems (ITS).

UNIT – V : TRAFFIC MANAGEMENT PROJECTS (9 Periods)

Design of parking facilities, on street and off street parking – case studies on area traffic management – street lighting –noise and air pollution abatement – Basis of comprehensive traffic and transport studies – intersection improvements including design of roundabouts.

Contact Periods: Lecture: 45 Tutorial: 0 Practical: 0 Total : 45 Periods

TEXT BOOKS:

1 *Kadiyali.L.R,* ***"Traffic Engineering and Transport planning"****, Khanna Publishers, 2011.*
2 *Salter.R.I., and Hounsell.N.B,* ***"Highway Traffic Analysis and Design"****, Macmillan Press Ltd., 2000.*

REFERENCE BOOKS:

1 *Manual of Transportation Engineering studies, Institution of Transportation Engineering, Prentice hall Publications, 1994.*
2 *Indian Roads Congress (IRC) Specifications: Guidelines and Special Publications on Traffic Planning And Management*
3 *John.E.Tyworth.,* ***"Traffic Management Planning"****, Operation and Control, Addison Wesley Publishing Company, 1997.*

COURSE OUTCOMES:

On completion of the course, students will be able to

CO1: Express the detail about traffic elements and their characteristics
CO2: Conduct various traffic surveys
CO3: Perform design of traffic signals.
CO4: Analyse the causes of road accidents and take controlling measures.
CO5: Design of parking facilities with improved intersection points.

COURSE ARTICULATION MATRIX:

PO/PSO CO	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	PSO 2	PSO 3	PSO 4
CO1	H	-	L	-	-	L	L	-	-	-	-	L	H	L	-	-
CO2	H	H	-	L	M	L	-	-	M	M	M	L	-	M	L	-
CO3	H	M	H	L	L	L	-	-	L	H	L		-	M	-	-
CO4	H	H	H	M	L	L	-	-	M	M		L	-	L	L	L
CO5	H	M	H	L	L	L	-	-	L	H	L	L	-	L	L	-
18CPE $19	H	H	H	M	M	-	-	-	M	H	M	L	-	M	L	L

L-Low, M-Moderate (Medium), H-High

18CPE$21	HIGHWAY AND RAILWAY ENGINEERING

Category : PE

L	T	P	C
3	0	0	3

PRE-REQUISITES:

1 Surveying

COURSE OBJECTIVES:

* To understand the basics of highway planning design and gain knowledge on design of road geometrics.
* To gain knowledge on components of pavement, understand the principles and design the flexible and rigid pavement using relevant IRC codes.
* To learn the properties and testing procedures of highway materials and understand the construction and maintenance on different types of roads.
* To understand the basics of railway planning and to gain knowledge on railway geometrics.
* To understand the functions of various components of railways, concepts of track maintenance, points and crossings and signals.

UNIT – I : HIGHWAY DEVELOPMENT, PLANNING AND GEOMETRICS (9 Periods)

Highway development and planning, Classification of Highways, Highway alignment, Highway Geometrics – Typical cross sections -Design of Cross sectional elements, Sight distance- Types- Horizontal and Vertical alignment- Design of curves – curve widening

UNIT – II : FLEXIBLE AND RIGID PAVEMENTS (9 Periods)

Components and their functions- Design principles of flexible and rigid pavements- Factors affecting the design of pavements- climate, subgrade, soil and traffic- Design of flexible pavements- Design of rigid pavements- Design of joints-IRC recommendations only

UNIT – III : HIGHWAY MATERIALS , CONSTRUCTION AND MAINTENANCE (9 Periods)

Properties and testing of Highway materials -Construction of roads – Earthen roads – W.B.M. roads – Bitumen roads –Cement concrete roads. Maintenance of all types of roads – Strengthening of pavements – Types of overlays

UNIT – IV : RAILWAY MATERIALS ,PLANNING AND DESIGN (9 Periods)

Location surveys and alignment - Conventional and Modern methods- Permanent way - Gauges - Components - Functions and requirements - Coning of Wheels -Geometric design- Gradients and Grade Compensation - Super-Elevation, Widening of Gauges in Curves, Transition Curves, Horizontal and Vertical Curves

UNIT – V : RAILWAY TRACK OPERATION AND MAINTENANCE (9 Periods)

Points and Crossings - Turnouts – Types - Working Principle Signalling, Interlocking and Track Circuiting - Construction and Maintenance – Conventional, Modern methods and Materials, Track Modernization– Automated maintenance and upgrading, Technologies, Re-laying of Track , Lay outs of Railway Stations and Yards.

Contact Periods: Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1 *S.K.Khanna, C.E.G.Justo and Dr.A.Veeraraghavan,* ***"Highway Engineering"****, Nemchand and Bros,Tenth Edition,2013.*

2 *Kadiyali, L.R. and N.B.Lal,* ***"Principles and practices of Highway Engineering"****, Khanna Publishers,2005.*

3 *Saxena S.C and Arora S.P.,* ***"Railway Engineering"****, DhanapatRai Publications, 6th Edition, 2010*

4 *Satishchandra & MM Agarwal.,* ***"Railway Engineering"****, Oxford University Press, Second Edition, 2013*

5 *NPTEL - https://nptel.ac.in/downloads/105101087*

REFERENCE BOOKS:

1 *Sharma S.K,* ***"Principles, Practice& Design of Highway Engineering"****, S.Chand and Co,2014.*

2 *Rangwala S.C & K.S.* ***"Railway Engineering"****, Charotar Publications, 14th Edition, 2008*

3 *K.P.Subramanian,* ***"Transportation Engineering: Highway Railway Airport & Harbour Engineering"****, Scitech publications (India) Pvt. Ltd, 2010.*

4 *Guidelines for the Design of Flexile Pavements, IRC: 37-2012, The Indian roads congress, New Delhi*

5 *Guidelines for the Design of Plain Jointed Rigid Pavements for Highways, IRC: 58-2015, The Indian Roads Congress, New Delhi*

COURSE OUTCOMES:

On completion of the course, the students will be able to

CO1: Illustrate the development, planning and geometric design standards for highways.

CO2: Execute the design of flexible and rigid pavements.

CO3: Comprehend the various desirable properties of highway materials, construction and maintenance of all types of roads

CO4: Outline the planning of railways and perform geometric design

CO5: Summarize the process of operation and maintenance of railway track.

COURSE ARTICULATION MATRIX:

PO/PSO CO	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	PSO 2	PSO 3	PSO 4
CO1	M	M	H	L	L	M	-	-	-	-	-	-	H	M	H	M
CO2	L	L	H	H	M	M	-	-	-	-	-	-	L		H	M
CO3	-	-	-	M	-	H	-	-	-	-	L	-	H	L	H	L
CO4	M	-	H	L	-	M	-	-	-	-	-	-	H	M	H	M
CO5	-	-	-	M	-	H	-	-	-	-	-	-	H	L	H	L
18CPE $21	M	-	H	H	-	M	L	-	-	-	L	-	H	M	H	M

L-Low, M-Moderate (Medium), H-High

18CPE$37	IOT IN CONSTRUCTION

Category PE

L T P C

3 0 0 3

PREREQUISITES:
NIL

COURSE OBJECTIVES:

To impart knowledge on the physical, logical design, components and standards of IoT along with the working platform for different systems**.**

UNIT – I INTRODUCTION TO IOT **(9 Periods)**

Definition and characteristics of IoT - Physical and logical design of IoT - IoT enabling technologies –IoT levels &deployment templates - IoT design methodology - Components of Internet of Thing devices: Control units – Sensors– Communication modules – Power sources. Communication technologies: RFID – Bluetooth – Zig Bee – Wi-Fi –RF links – Mobile Internet – Wired Communication. Safety – privacy – trust - security model.

UNIT – II IOT ARCHITECTURE **(9 Periods)**

IoT Architecture - Sensor Layer - Gateway and Network Layer - Management Service Layer - Application Layer –IoT Enabling Technologies - Addressing Schemes - Data Storage and Analytics – Visualization - Connected Domains –Connected Home -Connected Worker - Connected Automobile - Connected Industry**.**

UNIT – III IOT PLATFORMS DESIGN METHODOLOGY **(9 Periods)**

IoT Systems – Intel IoT Framework - Qualcomm IoT Framework - Microsoft IoT Framework - ARM IoT Framework -Logical Design - Programming IoT platform (eg: Python, Mono C# , Objective-C, Ruby), Raspberry Pi - Program for Firmware – Case Studies.

UNIT – IV IOT STANDARDS **(9 Periods)**

Need for the IOT standards - IOT and Smart City Standards and Policies: Global perspective – Policy Research and Standardization in Europe – Indian Standards formulation – Sectional committee and composition – Challenges in standardization - Digital infrastructure.

UNIT – V IOT APPLICATIONS **(9 Periods)**

Lighting as service – Smart Parking -Smart metering – Smart water management- Smart energy– Smart solid waste management - Smart mobility – Smart governance- Challenges in IoT Management.

Contact Periods:Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS :

1 Olivier Hersent, David Boswarthick and Omar Elloumi, "The Internet of Things: Key Applications and Protocols",Second Edition, Wiley Publisher, 2012.
2 Uckelmann, Dieter, Mark Harrison, and Florian Michahelles, "Architecting the Internet of Things". Springer Science & Business Media, 2011.

REFERENCE BOOKS :

1 Arshdeep Bahga, Vijay Madisetti, "Internet of Things: A Hands-on Approach", 2014.
2 Doukas, Charalampos, Building internet of things with the Arduino, CreateSpace Independent Publishing Platform, 2012.
3 Lu, Yan, Yan Zhang, Laurence T. Yang, HuanshengNing. "The Internet of Things: From RFID to the Next Generation Pervasive Networked Systems", CRC Press.
4 Massimo Banzi, "Getting Started with Arduino (Make: Projects)", O'Reilly Media. 2008.
5 Samuel Greengard, "The Internet of Things (The MIT Press Essential Knowledge series)", MIT Press, 2015.

COURSE OUTCOMES:

On completion of the course, the students will be able to:

CO1 **Analyze the different concepts and theories of Internet of Things.**
CO2 **Assess the various components of IoT architecture.**
CO3 Perform the IoT applications in programming platform.
CO4 Adopt the IoT standards for infrastructure planning.
CO5 Apply the understandings of IoT in different sectors of infrastructure planning

COURSE ARTICULATION MATRIX :

PO/PSO CO	PO 1	PO 2	PO3	PO4	PO5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	H	-	-	L	-	-	-	-	-	M	M	M	-	-	-	M
CO2	H	-	-	M	H	-	-	-	-	-	M	M	-	-	-	M
CO3	H	M	H	M	H	M	-	-	-	-	M	M	-	-	L	M
CO4	H	M	M	M		H	H	-	M	-	M	M	L	-	M	M
CO5	H	H	H	M	H	H	H	-	M	-	M	M	L	-	M	M
18CPE$37	H	M	H	M	H	H	H	-	M	M	M	M	L	-	M	M

L-Low, M-Moderate (Medium),H-High

18CPE$38	INTELLIGENT BUILDING TECHNIQUES

Category PE

L T P C

3 0 0 3

PREREQUISITES
NIL

COURSE OBJECTIVES:

1. To familiarize the concepts of intelligent materials and comfort systems and its components.
2. To know about the modern safety systems and the electronics and communication systems involved in the modern buildings.
3. To acquire knowledge on the factors influencing the performance of buildings.

UNIT – I INTELLIGENT BUILDINGS (9 Periods)

Basic concepts - Intelligent building automation - Cost analysis - Smart materials and embedded sensor technology - Building management system and energy savings – Benefits.

UNIT – II INTELLIGENT COMFORT SYSTEMS (9 Periods)

Basic Heating, Ventilation and Air Conditioning(HVAC) system - Human comfort - Sensor - Occupancy sensors and temperature sensors - Energy efficient HVAC systems - Thermal energy storage - Under floor air distribution - Chilled beams - Other emerging HVAC technologies for high performance buildings - Automated car parking management

UNIT – III INTELLIGENT SAFETY SYSTEMS (9 Periods)

Life safety factors - Intrusion sensors - Space sensors - Closed circuit television and surveillance systems - Access control management system - Portrait id, swipe card access control, biometric access control - Fire protection systems - Smoke detection, automatic fire alarm detection, sprinklers, hose reels hydrants, foam systems - Microprocessor based alarm - Emergency control of elevator, doors, HVAC systems - Security and alarm system

UNIT – IV BUILDING ELECTRONICS (9 Periods)

Microprocessor based control - Programmable logic controller - Communication principles - Telephone systems - Communal aerial broadcasting - Satellite communication - Fibre optic system

UNIT – V PERFORMANCE BUILDINGS (9 Periods)

High performance buildings - Control theory - Market trends - Energy efficiency - Environmental and greenhouse gas emission reduction - Clean development Mechanism - Practical benefits - Smart home - Smart office.

Contact Periods: Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1 *Shengwei Wang*, ***"Intelligent Buildings and Building Automation",*** *Spon Press, London, 2010.*
2 *Derek Clements Croome,* ***"Intelligent Building: Design, Management and Operations***", *3rd edition, Telford ICEP Publishers, London, 2014.*

REFERENCE BOOK:

1 *Ehrlich, C.*, ***"Intelligent Building Dictionary: Terminology for Smart, Integrated Green Building Design, Construction, and Management",*** *San Francisco, Handson-Guide, 2007.*

COURSE OUTCOMES:

On completion of the course, the students will be able to:

CO1: Analyse and fix the materials and technology involved in the intelligent buildings
CO2: Choose the appropriate comfort systems and fabricate the suitable HVAC system.
CO3: Execute ample safety measures that are required for the building in order to avert building accidents.
CO4: Select correct electronic components and construct a state of art built in electronic systems.
CO5: Assess and Improve the performance of buildings in terms of energy efficiency, clean environment and air pollution.

COURSE ARTICULATION MATRIX:

PO/PSO CO	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	PSO 2	PSO 3	PSO 4
CO1	M	M	-	L	-	-	-	-	-	-	-	M	M	L	L	L
CO2	M	M	-	L	-	-	-	-	-	-	-	M	M	L	L	L
CO3	M	M	-	L	-	-	-	-	-	-	-	M	M	L	L	L
CO4	M	M	-	L	-	-	-	-	-	-	-	M	M	L	L	L
CO5	M	M	-	L	-	-	H	-	-	-	-	M	H	L	M	L
18CPE$38	M	M	-	L	-	-	H	-	-	-	-	M	H	L	M	L

L - Low, M - Moderate (Medium), H - High

18CPE$39	GIS IMPLEMENTATION IN SMART CITY DEVELOPMENT

Category PE

L T P C

3 0 0 3

PREREQUISITES
NIL

COURSE OBJECTIVES:

- To provide an exposure of GIS role in smart city.
- To impart knowledge on fundamentals of GIS and Remote Sensing
- To gain knowledge about Types of infrastructures in smart city development.
- To gain the knowledge about Concepts of Land use mapping.
- To introduce the fundamentals of GIS enabled smart transportation techniques.

UNIT – I INTRODUCTION TO REMOTE SENSING AND GIS (9 Periods)

Geographical Information System – Remote Sensing Concepts Electro Magnetic Spectrum – Spectral Signature – Spectroradiometer – Types of Remote Sensing – Optical, Thermal, Hyper spectral, Microwave Remote Sensing.

UNIT – II FUNDAMENTALS OF URBAN DEVELOPMENT (9 Periods)

Smart city development – Fundamentals – Sustainability – Infrastructure – Physical Infrastructure Housing, Sewerage, Transport etc. – Social Infrastructure – Health, Education – Institutional Infrastructure – Planning and management – Economic Infrastructure – GDP and Employment.

UNIT – III LAND USE/ LAND COVER MAPPING (9 Periods)

Acquisition of digital image – Settlement – Land use/Land cover Mapping – Vector data – Digitization – Object delineation – Digital Elevation Model (DEM) Urban Sprawl – High resolution remote sensing data.

UNIT – IV GIS NAVIGATION TECHNIQUES (9 Periods)

Urban and regional transportation corridors Optimum route and plans / shortest path – Alignment planning – Traffic and flow management – Smart Street lights – Efficient Parking.

UNIT – V GIS IMPLEMENTATION (9 Periods)

Smart governance – Information and Communication Technology (ICT) – Use of sensors Water management – Waste management – Energy management– Air Pollution management GIS Role Revenue and Tax collection – Planning Facilities and Amenities – Accident Analysis – Crime Mapping.

Contact Periods:Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1 *Juliana Maantay, John Ziegler, John Pickles, "**GIS for the Urban Environment"**, Esri Press 2006.*
2 *Said Easa, Yupo Chan, **"Urban Planning and Development Applications of GIS"**, Amer Society of Civil Engineers, 1999.*

REFERENCE BOOKS:

1 *A M Chandra, S.K.Ghosh,* ***"Remote Sensing and Geographical Information system",*** *Narosa, Publishing house New Delhi, 2006.*

2 *Kang tsung Chang,* ***"Introduction to Geographic Information Systems",*** *9th Edition, 2019, McGraw Hill Book Company, ISBN: 9781259929649*

3 *S.C.Bhatia* ***,"Fundamentals of Remote sensing",*** *, Atlantic Publishers & Distributions (P) Ltd, 2008.*

4 *Paul A. Longley, Michael F. Goodchild, David J. Maguire, David W. Rhind,* ***"Geographic Information Science and Systems"****, Wiley 4th Edition , 2015.*

COURSE OUTCOMES:

On completion of the course, the students will be able to:

CO1: Know the principles of GIS of in smart city planning.
CO2: Plan the smart city and various types of infrastructure requirements.
CO3: Get idea of various existing terrain with the help of satellite images.
CO4: Apply various spatial analysis tools for deriving GIS based outcome
CO5: Implement the GIS ideologies across different sectors

COURSE ARTICULATION MATRIX:

PO/PSO CO	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	PSO 2	PSO 3	PSO 4
CO1	H	-	L	-	H	-	M	-	-		L	-	L	-	-	-
CO2	-	L	L	-	M	-	-	-	-	H	-	-	-	M	-	L
CO3	H			L	-	H	M	-	L		-	M	H	-	-	L
CO4	M	L	M	-	-	H	-	L	-		L		-	-	-	-
CO5	-	-	-	-	M	-	H		-	H			H	-	L	H
18CPE$ 39	H	L	L	L	M	H	M	L	L	H	L	M	H	M	L	L

L - Low, M - Moderate (Medium), H - High

VERTICAL – V

SUSTAINABILITY IN CIVIL ENGINEERING

18CPE$37	IOT IN CONSTRUCTION

Category PE

L T P C

3 0 0 3

PREREQUISITES:
NIL

COURSE OBJECTIVES:

To impart knowledge on the physical, logical design, components and standards of IoT along with the working platform for different systems**.**

UNIT – I INTRODUCTION TO IOT **(9 Periods)**

Definition and characteristics of IoT - Physical and logical design of IoT - IoT enabling technologies –IoT levels &deployment templates - IoT design methodology - Components of Internet of Thing devices: Control units – Sensors– Communication modules – Power sources. Communication technologies: RFID – Bluetooth – Zig Bee – Wi-Fi –RF links – Mobile Internet – Wired Communication. Safety – privacy – trust - security model.

UNIT – II IOT ARCHITECTURE **(9 Periods)**

IoT Architecture - Sensor Layer - Gateway and Network Layer - Management Service Layer - Application Layer –IoT Enabling Technologies - Addressing Schemes - Data Storage and Analytics – Visualization - Connected Domains –Connected Home -Connected Worker - Connected Automobile - Connected Industry**.**

UNIT – III IOT PLATFORMS DESIGN METHODOLOGY **(9 Periods)**

IoT Systems – Intel IoT Framework - Qualcomm IoT Framework - Microsoft IoT Framework - ARM IoT Framework -Logical Design - Programming IoT platform (eg: Python, Mono C# , Objective-C, Ruby), Raspberry Pi - Program for Firmware – Case Studies.

UNIT – IV IOT STANDARDS **(9 Periods)**

Need for the IOT standards - IOT and Smart City Standards and Policies: Global perspective – Policy Research and Standardization in Europe – Indian Standards formulation – Sectional committee and composition – Challenges in standardization - Digital infrastructure.

UNIT – V IOT APPLICATIONS **(9 Periods)**

Lighting as service – Smart Parking -Smart metering – Smart water management- Smart energy– Smart solid waste management - Smart mobility – Smart governance- Challenges in IoT Management.

Contact Periods:Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS :

1 Olivier Hersent, David Boswarthick and Omar Elloumi, "The Internet of Things: Key Applications and Protocols",Second Edition, Wiley Publisher, 2012.
2 Uckelmann, Dieter, Mark Harrison, and Florian Michahelles, "Architecting the Internet of Things". Springer Science & Business Media, 2011.

REFERENCE BOOKS :

1 Arshdeep Bahga, Vijay Madisetti, "Internet of Things: A Hands-on Approach", 2014.
2 Doukas, Charalampos, Building internet of things with the Arduino, CreateSpace Independent Publishing Platform, 2012.
3 Lu, Yan, Yan Zhang, Laurence T. Yang, HuanshengNing. "The Internet of Things: From RFID to the Next Generation Pervasive Networked Systems", CRC Press.
4 Massimo Banzi, "Getting Started with Arduino (Make: Projects)", O'Reilly Media. 2008.
5 Samuel Greengard, "The Internet of Things (The MIT Press Essential Knowledge series)", MIT Press, 2015.

COURSE OUTCOMES:

On completion of the course, the students will be able to:

CO1 **Analyze the different concepts and theories of Internet of Things.**
CO2 **Assess the various components of IoT architecture.**
CO3 Perform the IoT applications in programming platform.
CO4 Adopt the IoT standards for infrastructure planning.
CO5 Apply the understandings of IoT in different sectors of infrastructure planning

COURSE ARTICULATION MATRIX :

PO/PSO CO	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	PSO 2	PSO 3	PSO 4
CO1	H	-	-	L	-	-	-	-	-	M	M	M	-	-	-	M
CO2	H	-	-	M	H	-	-	-	-	-	M	M	-	-	-	M
CO3	H	M	H	M	H	M	-	-	-	-	M	M	-	-	L	M
CO4	H	M	M	M		H	H	-	M	-	M	M	L	-	M	M
CO5	H	H	H	M	H	H	H	-	M	-	M	M	L	-	M	M
18CPE$37	H	M	H	M	H	H	H	-	M	M	M	M	L	-	M	M

L-Low, M-Moderate (Medium),H-High

18CPE$39	GIS IMPLEMENTATION IN SMART CITY DEVELOPMENT

Category PE

L T P C

3 0 0 3

PREREQUISITES
NIL

COURSE OBJECTIVES:

- To provide an exposure of GIS role in smart city.
- To impart knowledge on fundamentals of GIS and Remote Sensing
- To gain knowledge about Types of infrastructures in smart city development.
- To gain the knowledge about Concepts of Land use mapping.
- To introduce the fundamentals of GIS enabled smart transportation techniques.

UNIT – I INTRODUCTION TO REMOTE SENSING AND GIS (9 Periods)

Geographical Information System – Remote Sensing Concepts Electro Magnetic Spectrum – Spectral Signature – Spectroradiometer – Types of Remote Sensing – Optical, Thermal, Hyper spectral, Microwave Remote Sensing.

UNIT – II FUNDAMENTALS OF URBAN DEVELOPMENT (9 Periods)

Smart city development – Fundamentals – Sustainability – Infrastructure – Physical Infrastructure Housing, Sewerage, Transport etc. – Social Infrastructure – Health, Education – Institutional Infrastructure – Planning and management – Economic Infrastructure – GDP and Employment.

UNIT – III LAND USE/ LAND COVER MAPPING (9 Periods)

Acquisition of digital image – Settlement – Land use/Land cover Mapping – Vector data – Digitization – Object delineation – Digital Elevation Model (DEM) Urban Sprawl – High resolution remote sensing data.

UNIT – IV GIS NAVIGATION TECHNIQUES (9 Periods)

Urban and regional transportation corridors Optimum route and plans / shortest path – Alignment planning – Traffic and flow management – Smart Street lights – Efficient Parking.

UNIT – V GIS IMPLEMENTATION (9 Periods)

Smart governance – Information and Communication Technology (ICT) – Use of sensors Water management – Waste management – Energy management– Air Pollution management GIS Role Revenue and Tax collection – Planning Facilities and Amenities – Accident Analysis – Crime Mapping.

Contact Periods:Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45 Periods

TEXT BOOKS:

1 *Juliana Maantay, John Ziegler, John Pickles, "**GIS for the Urban Environment"**, Esri Press 2006.*
2 *Said Easa, Yupo Chan, **"Urban Planning and Development Applications of GIS"**, Amer Society of Civil Engineers, 1999.*

REFERENCE BOOKS:

1 *A M Chandra, S.K.Ghosh, **"Remote Sensing and Geographical Information system",** Narosa, Publishing house New Delhi, 2006.*
2 *Kang tsung Chang, **"Introduction to Geographic Information Systems",** 9th Edition, 2019, McGraw Hill Book Company, ISBN: 9781259929649*
3 *S.C.Bhatia **,"Fundamentals of Remote sensing",** , Atlantic Publishers & Distributions (P) Ltd, 2008.*
4 *Paul A. Longley, Michael F. Goodchild, David J. Maguire, David W. Rhind, **"Geographic Information Science and Systems"**, Wiley 4th Edition , 2015.*

COURSE OUTCOMES:

On completion of the course, the students will be able to:

CO1: Know the principles of GIS of in smart city planning.
CO2: Plan the smart city and various types of infrastructure requirements.
CO3: Get idea of various existing terrain with the help of satellite images.
CO4: Apply various spatial analysis tools for deriving GIS based outcome
CO5: Implement the GIS ideologies across different sectors

COURSE ARTICULATION MATRIX:

PO/PSO CO	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	PSO 2	PSO 3	PSO 4
CO1	H	-	L	-	H	-	M	-	-		L	-	L	-	-	-
CO2	-	L	L	-	M	-	-	-	-	H	-	-	-	M	-	L
CO3	H			L	-	H	M	-	L		-	M	H	-	-	L
CO4	M	L	M	-	-	H	-	L	-		L		-	-	-	-
CO5	-	-	-	-	M	-	H		-	H			H	-	L	H
18CPE$ 39	H	L	L	L	M	H	M	L	L	H	L	M	H	M	L	L

L - Low, M - Moderate (Medium), H - High

18CPE$40	SUSTAINABLE INFRASTRUCTURE DEVELOPMENT

Category PE

L	T	P	C
3	0	0	3

PREREQUISITES
NIL

COURSE OBJECTIVES:

To understand and explain concepts of infrastructure, private involvement in infrastructure, challenges to successful infrastructure planning and implementation, strategies for successful infrastructure project implementation, sustainable development of infrastructure

UNIT – I AN OVERVIEW OF BASIC CONCEPTS RELATED TO INFRASTRUCTURE: (9 Periods)

Introduction to Infrastructure, an overview of the Power Sector in India., an Overview of the Water Supply and Sanitation Sector in India., an overview of the Road, Rail, Air and Port Transportation Sectors in India. , an overview of the Telecommunications Sector in India. ,an overview of the Urban Infrastructure in India, an overview of the Rural Infrastructure in India, an Introduction to Special Economic Zones, Organizations and layers in the field of Infrastructure, The Stages of an Infrastructure Project Lifecycle., an overview of Infrastructure Project Finance.

UNIT – II PRIVATE INVOLVEMENT IN INFRASTRUCTURE: (9 Periods)

A Historical Overview of Infrastructure Privatization. The Benefits of Infrastructure Privatization, Problems with Infrastructure Privatization, Challenges in Privatization of Water Supply: A Case Study, Challenges in Privatization of Power: Case Study, Privatization of Infrastructure in India: Case Study, Privatization of Road Transportation Infrastructure in India.

UNIT – III CHALLENGES TO SUCCESSFUL INFRASTRUCTURE PLANNING AND IMPLEMENTATION: (9 Periods)

Mapping and Facing the Landscape of Risks in Infrastructure Projects, Economic and Demand Risks: The Case study for Political Risks, Socio Environmental Risks, Cultural Risks in International Infrastructure Projects, Legal and Contractual Issues in Infrastructure, Challenges in Construction and Maintenance of Infrastructure.

UNIT – IV STRATEGIES FOR SUCCESSFUL INFRASTRUCTURE PROJECT IMPLEMENTATION: (9 Periods)

Risk Management Framework for Infrastructure Projects, Shaping the Planning Phase of Infrastructure Projects to mitigate risks, Designing Sustainable Contracts, Introduction to Fair Process and Negotiation, Negotiating with multiple Stakeholders on Infrastructure Projects.

UNIT – V SUSTAINABLE DEVELOPMENT OF INFRASTRUCTURE: (9 Periods)

Information Technology and Systems for Successful Infrastructure Management, Innovative Design and Maintenance of Infrastructure Facilities, Infrastructure Modeling and Life Cycle Analysis Techniques, Capacity Building and Improving the Governments Role in Infrastructure Implementation, An Integrated Framework for Successful Infrastructure Planning and Management Infrastructure Management Systems and Future Directions.

Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Periods Total: 45Periods

TEXT BOOKS:

1 *Verma S.P. ed.* ***"Infrastructure in India's Development: Power, Transport and Communication"****, Institute of Public Administration, New Delhi, 2004.*
2 *Dr. PravinJadhav and Dr Rahul NathChoudhury,* ***"Infrastructure Planning and Management in India: Opportunities and Challenges"****, Springer Verlag, Singapore; 1st ed. 2022 edition.*

REFERENCE BOOKS :

1 *Zimmerman, K. and F. Botelho,* ***"Pavement Management Trends in the United States,"*** *1st European Pavement Management Systems Conference, Budapest, September, 2000.*
2 *Goodman, Alvin S. and Makarand Hastak.* ***"Infrastructure Planning Handbook"****: 2006.*
3 *Grigg, Neil,* ***"Infrastructure engineering and management"****, Wiley, 1988.*
4 *Hudson, Haas, Uddin,* ***"Infrastructure management: integrating design, construction, maintenance, rehabilitation, and renovation"****, McGraw Hill, 1997.*

COURSE OUTCOMES:

On completion of the course, the students will be able to:

CO1: Explain the basic concepts related to Infrastructure Projects
CO2: Explain the role of private sector in infrastructure growth.
CO3: Describe the strategies for successful Infrastructure Project implementation**.**
CO4: Develop Infrastructure modeling and Life Cycle Analysis Techniques.
CO5: Explain Sustainable development of Infrastructure

COURSE ARTICULATION MATRIX:

PO/PSO / CO	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	PSO 2	PSO 3	PSO 4
CO1	H	L	L	L	-	H	H	-	-	-	-	L	H	M	-	-
CO2	H	L	L	L	-	H	H	-	-	-	-	L	H	M	-	-
CO3	H	L	L	L	-	H	H	-	-	-	-	L	H	M	-	-
CO4	H	L	L	L	-	H	H	-	-	-	-	L	H	M	-	-
CO5	H	L	L	L	-	H	H	-	-	-	-	L	H	M	-	-
18CPE$40	H	L	L	L	-	H	H	-	-	-	-	L	H	M	-	-

L - Low, M - Moderate (Medium), H - High

18CPE$41	SUSTAINABLE ENVIRONMENTAL MANAGEMENT

Category PE

L T P C

3 0 0 3

PREREQUISITES
NIL

COURSE OBJECTIVES

- To emphasize the need on sustainable development and cleaner production.
- To create awareness on carbon trading & environmental health and safety.
- To impart knowledge on green process management in Industries.

UNIT – I SUSTAINABLE DEVELOPMENT (9 Periods)
Concepts of Sustainable Development Indicators of Sustainability – Sustainability Strategies, Barriers to Sustainability Resource Degradation Industrialization and Sustainable Development Socio Economic Policies for Sustainable Development.

UNIT – II CLEANER PRODUCTION (9 Periods)
Clean Development Mechanism Principles and Concepts of Cleaner Production Definition Importance Historical Evolution Benefits Promotion Barriers Source Reduction Techniques Process and Equipment Optimization, Reuse, Recovery, Recycle, Raw Material Substitution.

UNIT – III CARBON TRADING (9 Periods)
Green House Gases and Carbon Credit Carbon Sequestration Sustainable Development through Trade Carbon Trading – Carbon footprint.

UNIT – IV ENVIRONMENTAL HEALTH AND SAFETY (9 Periods)
Eco toxicology Hazards by Industry and its Environmental Effects Relationship of Occupational Hygiene / Safety and Disease Overview, Planning, Hazard Identification and Risk Assessment Pesticides and Environment.

UNIT – V GREEN PROCESS MANAGEMENT (9 Periods)
Green Energy and Green Process Management in Construction, Cement, Iron and Steel Industries – Waste Audit in Industries.

Contact Periods: **Lecture: 45 Periods Tutorial: 0 Periods Practical: 0 Total: 45 Periods**

TEXT BOOKS:

1 *Prasad Modak, "**Environmental Management towards Sustainability**", CRC Press, 2017.*
2 ***"Safety, Health, and Environment"**,NAPTA, 2nd Edition, Pearson Publications, 2019.*

REFERENCE BOOKS:

1 *John Blewitt, "**Understanding Sustainable Development**", Third edition, Taylor & Francis Ltd., 2017.*
2 *Francisco Jose Gomes da Silva ,**"Cleaner Production: Toward a Better Future",** Ronny Miguel Gouveia , Springer Publications, 2020.*
3 *Subramanian Senthilkannan Muthu,**"The Carbon Footprint Handbook** "Taylor & Francis Ltd., 2015.*
4 *Jan Recker, Stefan Seidel, **"Green Business Process Management",** Springer Publications, 2012.*

COURSE OUTCOMES:

On completion of the course, the students will be able to:

CO1: Implement the sustainable development through various strategies.
CO2: Execute various practices of cleaner production.
CO3: Evaluate carbon footprint to achieve sustainable development.
CO4: Examine the toxicological and hazardous effects of Industries on Environment.
CO5: Apply green process management in various industrial sectors.

COURSE ARTICULATION MATRIX:

PO/PSO CO	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	PSO 2	PSO 3	PSO 4
CO1	H	L	L	L	-	H	H	-	-	-	-	L	H	-	-	-
CO2	H	L	L	L	-	H	H	-	-	-	-	L	H	-	-	-
CO3	H	L	L	L	-	H	H	-	-	-	-	L	H	-	-	-
CO4	H	L	L	L	-	H	H	-	-	-	-	L	H	-	-	-
CO5	H	L	L	L	-	H	H	-	-	-	-	L	H	-	-	-
18CPE$41	H	L	L	L	-	H	H	-	-	-	-	L	H	-	-	-

L - Low, M - Moderate (Medium), H - High

18CPE$42	MATERIALS FOR ENERGY SUSTAINABILITY

Category PE

L T P C

3 0 0 3

PREREQUISITES
NIL

COURSE OBJECTIVES:

- To acquire the knowledge on sustainable materials, energy consumption and utility of energy for the construction of green building.

UNIT – I INTRODUCTION (9 Periods)

Unsustainable use of materials Global warming Green building – Concept and necessity Merits and demerits – Classification Renewable energy in buildings Basic concepts and efficiency.

UNIT – II SUSTAINABLE MATERIALS (9 Periods)

Sustainability Material conservation: concept of embodied energy, low energy materials, sustainable materials, alternative materials – Handling non process waste – Waste reduction during construction – Materials with recycled waste Concept of carbon emission and its reduction.

UNIT – III SELECTION OF MATRIALS (9 Periods)

Wood Water Aggregates Raw materials Embodied energy of materials incorporation of pollutants and recycled materials alternative technologies in construction.

UNIT – IV ENERGY CONSUMPTION (9 Periods)

Role of energy in our lives – various sources of energy –Renewable and Non renewable energy difference, characteristics of resources, advantages and disadvantages – units of energy – small and large units of energy – magnitude of energy units – units for energy consumption of individual, institution and country.

UNIT – V UTILITY OF ENERGY IN BUILDINGS (9 Periods)

Concept Solar passive cooling techniques – Solar passive heating techniques – Low energy cooling techniques– Thermal comfort – Day lighting – Ventilation – Case studies.

Contact Periods: **Lecture: 45 Periods Tutorial: 0 Practical: 00 Periods Total: 45 Periods**

TEXT BOOKS:

1 *Ankur Mathur,* ***"Non Conventional Sources of Energy"****, Laxmi Publications Pvt. Ltd., 2015*
2 *Godfrey Boyle,* ***"Renewable Energy, Power for a Sustainable Future",*** *Oxford University Press, U.K., 3rd Revised Edition 2012*

REFERENCE BOOKS:

1 *Tester J. W. (et al.) (2012);* ***"Sustainable Energy: Choosing among Options",*** *Second Edition, The MIT Press*
2 *Wright, R.T., and Nebel, B.J.,* ***"Environmental Science Toward a Sustainable Future",*** *Prentice Hall of India Private Limited, New Delhi, 2002.*
3 *Jagadish, K.S., Venkatarama Reddy, B.V., NanjundaRao, K.S.****, "Alternative Building Materials and Technologies"****, New Age International (P) Limited, 2007.*
4 *Subramanian Senthilkannan****,"Handbook of Sustainability in Additive Manufacturing",*** *Springer, 2016.*

COURSE OUTCOMES:

On completion of the course, the students will be able to:

CO1: Gain knowledge on the aspects of unsustainable materials.
CO2: Plan buildings using various sustainable materials.
CO3: Apply the concepts on selection of materials.
CO4: Explain the concept of energy consumption in a building.
CO5: Apply the concept of energy usage with the help of solar energy in buildings

COURSE ARTICULATION MATRIX:

PO/PSO CO	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	PSO 2	PSO 3	PS O4
CO	H	L	L	-	-	M	M	-	-	-	-	-	H	M	L	L
CO2	H	L	L	-	-	M	M	-	-	-	-	-	H	M	L	L
CO3	H	L	L	-	-	M	M	-	-	-	-	-	H	M	L	L
CO4	H	L	L	-	-	M	M	-	-	-	-	-	H	M	L	L
CO5	H	L	L	-	-	M	M	-	-	-	-	-	H	M	L	L
18CPE$4 2	H	L	L	-	-	M	M	-	-	-	-	-	H	M	L	L

L - Low, M - Moderate (Medium), H - High

18CPE$43	GREEN TECHNOLOGY

Category: PE

L	T	P	C
3	0	0	3

PRE REQUISITES:

NIL

COURSEOBJECTIVES:

- To provide basic knowledge on green technology, Cleaner development mechanisms, various energy efficient systems and green buildings.

UNIT – I INTRODUCTION TO GREEN TECHNOLOGY (9 Periods)

Definition of Green Technology and its importance, History and evolution of green technology, advantages and disadvantages of green technologies, factors affecting green technologies, Role of Industry, Government and Institutions, introduction to Industrial Ecology and role of Industrial ecology in green technology.

UNIT – II CLEANER DEVELOPMENT TECHNOLOGIES AND LIFE CYCLE ASSESSMENT (9 Periods)

Cleaner development mechanisms, role of industry; reuse, reduce and recycle, raw material substitution; wealth from waste; carbon credits, carbon trading, carbon sequestration, eco labelling.
Introduction to Life Cycle Assessment (LCA) and elements of LCA

UNIT – III ENERGY EFFICIENT SYSTEMS AND PROCESSES (9 Periods)

Energy efficient motors, energy efficient lighting, control and selection of luminaries; bio fuels, fuel cells working, selection of fuels, Green manufacturing systems, selection of recyclable and environment friendly materials in manufacturing, design and implementation of sustainable green production

UNIT – IV GREEN BUILDINGS (9 Periods)

Definition Features and benefits, Fundamental planning decisions for energy efficient building site selection, buildings forms and orientations, building fabrics and insulation, ventilation, passive solar features. Ecofriendly and cost effective materials, Energy management, roof top solar photovoltaic system and solar tracking system, alternating roofing systems.

UNIT – V ENERGY CODES (9 Periods)

ECBE requirement, concepts of Overall Thermal Transfer Value (OTTV), Green performance rating, requirement of Leadership in Energy and Environmental Design (LEED), Green Rating for Integrated Habitat Assessment (GRIHA) and Indian Building Council (IGBC)

Contact Periods: **Lecture:45 Periods Tutorial:00 Practical: 0 Total: 45 Periods**

TEXT BOOKS:

1 *B.H. Khan*, **"*Non conventional energy resources"***, *Tata McGraw Hill, New Delhi 2017*
2 *Paul L. Bishop,* ***"Pollution prevention –Fundamentals and Practices"****, McGraw Hill International 2004.*

REFERENCE BOOKS:

1 *Ashok Sethuraman,****"Practical guide to Energy conservation & Management"****,Notion Press, Chennai,2020.*
2 *Anthony Floyd,****"Green Building: A Professional's Guide to Concepts, Codes and Innovation"****,Delmar Cengage Learning,NewDelhi,2015.*
3 *New Delhi Bureau of Energy Efficiency,* ***"GRIHA Rating System****", TERI Publications, 2007*
4 *David Allen,* ***"Sustainable Engineering: Concepts, Design and Case studies",*** *Prentice Hall, 2011.*

COURSE OUTCOMES:

On completion of the course, the students will be able to:

CO1: Realize the importance of green technologies in sustainable growth of Industry and society
CO2: Develop cleaner production and treatment mechanism for pollution prevention.
CO3: Design and implementation of suitable energy efficient processes.
CO4: Plan and use of selective materials for green buildings.
CO5: Refer and adopt the recommendations of various building councils.

COURSE ARTICULATION MATRIX:

PO/PSO CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO3	PSO4
CO	L	L	L		L		M	-	-	-	-	L	M	-	L	-
CO2	L		L	L	L	M	H	-	-	-	-	L	M	-	L	-
CO3	L	L	M	L	L	M	H	-	-	-	-	L	M	-	L	-
CO4	L	L	M	L	L	M	H	-	-	-	-	L	M	-	L	-
CO5	L	L	M	L	L	M	L	-	-	-	-	L	M	-	L	-
18CPE$43	L	L	M	L	L	M	H	-	-	-	-	L	M	-	L	-

L - Low, M - Moderate (Medium), H - High

18CPE$44	BUILDING INFORMATION MODELING SYSTEMS

Category PE

L	T	P	C
3	0	0	3

PRE REQUISITES:
1. Engineering Graphics

COURSE OBJECTIVES:

- To understand the role of BIM in construction management
- To offer an advanced education programme on BIM integrated design, construction and operation processes**.**

UNIT – I INTRODUCTIONTO BUILDING INFORMATION MODELLING (BIM): (9 Periods)

Background of Building Information Modelling (BIM); Components of BIM, BIM Focus, Users of BIM information and Project Delivery Methods using BIM.

UNIT – II BIM IN DRAFTING (9 Periods)

Conceptual Design in Terms Shape, Orientation, Site in Terms of Green Strategy, Architectural BIM, Architectural Drafting, Architecture 3D Rendering.

UNIT – III BIM IN STRUCTURAL DESIGN (9 Periods)

Structural BIM Design: Systems and Materials, Structural Rebar Detailing, Green Design Decisions. BIM Analysis: Day lighting, Energy Analysis and Energy Cost; Documentation.

UNIT – IV BIM IN PLANNING AND CONSTRUCTION PHASE (9 Periods)

BIM In Fabrication, BIM In Construction Gate keeping, 4D BIM – Construction Scheduling, 5D – Construction Cost Estimation, Quantity Take off, Clash Detection and Construction Logistics.

UNIT – V CASE STUDIES ON BIM (9 Periods)

Architectural BIM in Residential Buildings and 3D Rendering Services; Structural BIM Modelling for Multi Storey– Residential Building and BIM Implementation during New Construction.

Contact Periods: **Lecture: 45 Periods Tutorial: 0 Practical: 0 Total:45 Periods**

TEXT BOOKS:

1 *De Wilde, P., Mahdjoubi, L., &Garrigós, A. G.,* ***"Building Information Modelling (BIM) in Design, Construction and Operations",*** *WIT Press, Volume 192, 2019.*

2 *Kymmell, W., "****Building Information Modeling: Planning and Managing Construction Projects with 4D CAD and Simulations"****, McGraw Hill Education, First Edition. 2008.*

REFERENCE BOOKS:

1 *Elvin, G.,****"Integrated Practice in Architecture: Mastering Design Build, Fast Track, And Building Information Modelling"****, John Wiley & Sons, First Edition, 2007.*

2 *The BIM Manager's Handbook:* ***Guidance for Professionals in Architecture, Engineering, and Construction.***

3 *BIG BIM, little BIM:* ***The Practical Approach to Building Information Modelling****.*

4. *BIM Handbook:* ***A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors***

COURSE OUTCOMES:

On completion of the course, the students will be able to:

CO1: Study the background of BIM and its role in construction management

CO2: Identify the role of BIM approach in planning of building.

CO3: Comprehend the role of BIM approach in design coordination to aid in decision making

CO4: Apply BIM in construction design, planning and construction phases.

CO5: Apply BIM for case studies

COURSE ARTICULATION MATRIX:

PO/PSO CO	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	PSO 2	PSO 3	PSO 4
CO1	-		L	L	L	-	-	-	-	-	-	-	H	L	L	L
CO2	-	L	L	L	L	-	-	-	-	-	-	-	H	L	L	L
CO3	-	L	L	L	L	-	-	-	-	-	M	-	H	L	L	L
CO4	-	L	L	L	L	-	-	-	-	-	-	-	H	L	L	L
CO5	-	L	L	L	L	-	-	-	-	-	-	-	H	L	L	L
18CPE$44	-	L	L	L	L	-	-	-	-	-	M	-	H	L	L	L

L - Low, M - Moderate (Medium), H - High

18CPE$45	MODERN CONSTRUCTION EQUIPMENTS

Category PE

L	T	P	C
3	0	0	3

PRE REQUISITES
NIL

COURSE OBJECTIVES:

To study and understand the various types of equipment used for earthwork, compacting, concreting, tunneling, drilling, blasting, dewatering, material handling conveyors and its applications in construction projects.

UNIT – I CONSTRUCTION EQUIPMENT SELECTION (9 Periods)

Identification – Planning of equipment – Selection of Equipment Equipment Management in Projects Maintenance Management – Equipment cost – Operating cost – Cost Control of Equipment Depreciation Analysis – Replacement of Equipment Replacement Analysis – Safety Management.

UNIT – II EQUIPMENT FOR EARTHWORK (9 Periods)

Fundamentals of Earth Work Operations Earth Moving Operations Types of Earth Work Equipment Tractors, Motor Graders, Scrapers, Front end Waders – Dozer, Excavators, Rippers, Loaders, trucks and Hauling Equipment, Compacting Equipment, Finishing Equipment.

UNIT – III CONCRETING EQUIPMENT (9 Periods)

Aggregate production Different Crushers – Feeders Screening Equipment Handling Equipment Batching and Mixing Equipment Pumping Equipment – Ready Mix Concrete Equipment, Concrete Pouring Equipment.

UNIT – IV MATERIALS HANDLING EQUIPMENT (9 Periods)

Forklifts and related equipment Portable Material Bins – Material Handling Conveyors – Material Handling Cranes Industrial Trucks – Storage Handling Equipment – Bulk Material Handling.

UNIT – V OTHER CONSTRUCTION EQUIPMENT (9 Periods)

Equipment for Dredging, Trenching and Tunneling – Equipment for Drilling and Blasting Pile Driving Equipment Erection Equipment Equipment for Dewatering and Grouting – Equipment for Demolition Types of pumps used in Construction.

Contact Periods: **Lecture: 45 Periods Tutorial: 0 Practical: 0 Total:45 Periods**

TEXT BOOKS :

1 *Peurifoy, R.L., Schexnayder, C. and AviadShapira.,* ***"Construction Planning, Equipment and Methods"****, McGraw Hill Education , 2018.*
2 *Deodhar, S.V.,* ***"Construction Equipment and Job Planning",*** *Khanna Publishers,2012.*

REFERENCE BOOKS:

1 *Leonhard E. Bernold,* ***"Construction Equipment and Methods: Planning, Innovation, Safety",*** *2015.*
2 *Sharma S.C. Khanna Publishers, "****Construction Equipment and Management",*** *New Delhi, 2019.*
3 *GranbergG.,Popescu M Taylor and Francis Publishers,****"Construction Equipment and Management for Engineers Estimators and Owners",*** *New York, 2006.*
4 *Dr.Maheshvarma Metropolitian book company,* ***"Construction equipment and its planning and application",*** *New Delhi 1988.*

COURSE OUTCOMES:

On completion of the course, the students will be able to:

CO1: Develop knowledge on the planning and selection of equipment.
CO2: Explain the knowledge on fundamentals and working operations of earth work equipment.
CO3: Develop the knowledge on concreting equipment.
CO4: Apply the knowledge on material handling equipment techniques.
CO5: Select suitable construction equipment for different construction activities.

COURSE ARTICULATION MATRIX:

PO/CO CO	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	PSO 2	PSO 3	PSO 4
CO1	H	M	-	-	-	L	L	-	-	-	L	M	H	L	M	-
CO2	H	-	-	-	-	L	L	-	-	-	L	M	H	L	M	-
CO3	H	-	-	-	-	L	L	-	-	-	L	M	H	L	M	-
CO4	H	-	-	-	-	L	L	-	-	-	L	M	H	L	M	-
CO5	H	-	-	-	-	L	L	-	-	-	L	M	H	L	M	-
18CPE$45	H	M	-	-	-	L	L	-	-	-	L	M	H	L	M	-

L - Low, M - Moderate (Medium), H - High