ADVANCED STRUCTURAL ANALYSIS

Course Code:	**21CV501**	**Year**	2023-24	**Semester**	V
Course Category:	PC	**Branch**	Civil Engineering	**Course Type**	Core
Credits:	3	**L-T-P-C**	2-1-0-3		
Continuous Internal Evaluation:	50	**Semester End Evaluation**	50	**Total Marks**	100

Course Outcomes

COs	**At the end of the course the student will be able to**	**Mapping to POs**
CO1	Analyze the structures subjected to moving loads	PO1, PO2, PO3
CO2	Carryout analysis of indeterminate structures by slope deflection	PO2, PO3, PO4
CO3	Analyze indeterminate structures by moment distribution method	PO2, PO3, PO4
CO4	Analyze indeterminate structures by moment distribution method	PO2, PO3, PO4

Mapping of course outcomes with Program outcomes (CO/PO/PSO Matrix)
Note:1-Weak correlation 2-Mediumcorrelation 3-Strongcorrelation
*-Average value indicates course correlation strength with mapped PO

COs	**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**
CO1	3	2	1											
CO2		3	2	1										
CO3		3	2	1										
CO4		3	2	1										
Average * (Rounded tonearestintege r)	3	3	2	1										

MODULE 1

Influence lines and moving loads: Definition & importance of influence line diagram, Influence line diagram for reactions, shear force & bending moment for simple supported beams, Determination of maximum shear force & bending moment at a section and absolute maximum shear force & bending moment in simply supported beams due to moving UDL & series of point loads. **Analysis of continuous beams by Slope Deflection Method:** Development of Slope- Deflection equations - Analysis of Continuous Beams with kinematic indeterminacy not morethanthree. **11 Hrs.**

Self-study component: Students shall visit different types of structures subjected to moving loads and should observe behaviour of structures.

MODULE 2

Analysis of frames by Slope Deflection Method: Analysis of orthogonal rigid jointed Plane frames with kinematic indeterminacy not more than three. (both sway & non-sway type). **Analysis of continuous beams by Moment Distribution Method:** Definition of terms distribution factor, carry over factor, Analysis of Continuous Beams with kinematic indeterminacy not morethanthree.

10 Hrs.

Self-study component: Students shall work on a standard software for structural analysis and compare the results for simple structural units like continuous beams and portal frames

MODULE 3

Analysis of frames by Moment Distribution Method: Analysis of orthogonal rigid jointed Plane frames with kinematic indeterminacy not more than three (both sway & non-sway type). **Analysis of continuous beams by Kani's Rotation Contribution Method:** Definition of terms rotation factor, rotation contribution, Analysis of Continuous Beams with kinematic indeterminacy not morethanthree.

11 Hrs.

Self-study component: Students shall work on a standard software for structural analysis and compare the results for simple structural units like continuous beams and portal frames

MODULE 4

Analysis of frames by Kani's Rotation Contribution Method: Analysis of orthogonal rigid jointed Plane frames with kinematic indeterminacy not more than three. (only non-sway type). **Introduction to Plastic analysis of structures:** Ductility of materials, Plastic deformation, Plastic hinge, Plastic analysis of continuous beams and simple quadrangular frames.

10 Hrs.

Self-study component: Students shall work on development of plastic hinge development of structures.

Textbooks:

1. Vazirani V. N. &Ratwani M. N. – "Analysis of Structures" – Vol. II, 15th Ed., Khanna publications, New Delhi, 2002 (Ch.1 to8)
2. Reddy C. S., "Basic Structural Analysis" second Ed., Tata Mc Graw Hill Publishing Co.ltd, 2006 (Ch.3,4,5,7)

Reference Books:

1. Ramamrutham. S, "Theory of Structures" Dhanpath Rai Publications, New Delhi –2008
2. Wang C.K., "Statically indeterminate structures" Tata McGraw Hill Publishing Co. Ltd, Tokyo, 1952.
3. STAAD.Pro -Manual

DESIGN & DETAILING OF RC STRUCTURES

Course Code:	**21CV502**	**Credit:**	**04**
Teaching Hours/Week (L:T:P:C):	**2-1-1-4**	**CIE Marks:**	**50**
Total Number of Teaching Hours:	**28+28+14**	**SEE Marks:**	**50**

CO1	Limit state philosophy related to flexure, shear, bond, torsion. Analysis of singly reinforced & doubly reinforced rectangular sections, as per the provisions of IS 456 -2000 in limit state of flexure	PO1,PO2, PO3
CO2	Describe the mechanism of RC sections in limit state of serviceability indeflection and cracking. Design of beams as per IS: 456-2000	PO1,PO2, PO3,PO6
CO3	Describe the limit state of compression - short and long RC columns. Design of slabs and columns as per IS: 456-2000	PO1,PO2, PO3,PO6
CO4	Evaluate various types of footings and staircase as per IS: 456-2000	PO1,PO2, PO3,PO6

Mapping of course outcomes with Program outcomes (CO/PO/PSO Matrix)
Note:1-Weak correlation 2-Mediumcorrelation 3-Strongcorrelation
*-Average value indicates course correlation strength with mapped PO

COs	**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**
CO1	1	3	2											
CO2	1	3	1			2								
CO3	3		2			2								
CO4	1	3	1			1								
Average * (Rounded tonearestintege r)	1.5	3	1.5			1.67								

Module-1	**Hours**
General Features of Reinforced Concrete - Introduction – Design loads – Materials for reinforced concrete – Code requirements for concrete reinforcements – Elastic theory of RC section – Moment of resistance of section – Balanced, under reinforced and over reinforced sections **Principles of Limit State Design and Ultimate Strength RC Section** – Philosophy of limit state design – Concept of limit states – Factor of safety – Characteristic and design loads – Characteristic and design strength – General aspects of ultimate strength – Stress block parameters for limit state of collapse. Limit state of flexural strength of singly and doubly reinforced rectangular sections. Limit state of flexural strength of flanged sections. Limit state of shear strength of RC sections. Limit state of torsional strength of RC sections – Concepts of bond, development length and anchorage – Examples on analysis of rectangular and flanged RC sections. Durability requirements, minimum grade of concrete for design as per IS:456, reinforcement cover requirements. Detailing	**7+7**
Structural Detailing	
1. Singly Reinforced Beams C/S 2. Doubly Reinforced Beam C/S (NOTE: Drawings to be prepared for given structural details. Also Bar Bending Schedule should be prepared for above beams using drafting software)	**3**
Self-Study Component: Students shall visit an ongoing construction project site to observe the casting of RC components.	
Module-2	

Serviceability Limit State – Serviceability Limit State – General and durability aspects – Deflection limits in IS: 456-2000 – Calculation of deflection (Theoretical method) – Cracking in structural concrete members – Calculation of deflections and crack width as per IS:456-2000. **Design of Beams** – Practical requirements of an RCC beam – size of the beam – Cover to the reinforcement – Spacing of bars – Design procedure – Critical sections for moments and shear – Anchorage of bars : check for development length – Reinforcement requirements – Slenderness limits for beams to ensure lateral stability – Design examples for simply supported beams and cantilever beams- singly and doubly reinforced	**7+7**
Structural Detailing	
1. Singly Reinforced Beams L/S and C/S 2. Doubly Reinforced Beam L/S and C/S 3. Flanged Beam L/S and C/S 4. Beams – Simply supported, Cantilever and Continuous. (NOTE: Drawings to be prepared for given structural details. Also Bar Bending Schedule should be prepared for above beams)	**4**
Self-Study Component: Students shall visit an ongoing construction project site to observe the design details of RC beams	
Module-3	
Design of Slabs – Introduction – General consideration of design of slabs –deflection criteria- rectangular slabs spanning in one direction – Rectangular slabs spanning in two directions for various boundary conditions – Design of simply supported slabs – cantilever slabs and continuous slabs- one way and two-way. **Design of Columns** – General aspects –restraints and boundary conditions- Effective length – Loads on columns – Slenderness limits for columns – Minimum eccentricity –Design of short axially loaded columns – Design of column subjected to combined axial load and uniaxial moment using SP 16	**7+7**
Structural Detailing	
1. Slab – One way, Two way and One way continuous slab 2. Column (Square Rectangle, and circular). (NOTE: Drawings to be prepared for given structural details. Also Bar Bending Schedule should be prepared for above drawings)	**3**
Self-Study Component: Students shall visit an ongoing construction project site to observe the design details of RC slabs and columns.	
Module - 4	
Design of Footings – Introduction – Load on foundation –Design of isolated rectangular footing for axial load, eccentric, uniaxial moment–Design of pedestal. **Design of Stair Case** – General features – Types of Stair cases – Loads on stair cases – Effective span as per IS 456-2000. – Distribution of loading on stairs – Design of dog-legged stair cases	**7+7**
Structural Detailing	
1. Column footing - Column and footing (Square and Rectangle). 2. Staircase – Doglegged and open well staircase (NOTE: Drawings to be prepared for given structural details. Also Bar Bending Schedule should be prepared for above drawings)	**4**
Self-Study Component: Students shall visit an ongoing construction project site to observe detailing of RC footings and staircase.	

Text Books:

1. Krishna Raju N., "Design of Reinforced Concrete Structures (IS 456 2000)", 3rd Ed. CBS Publishers and Distributors, New Delhi (Ch.1,2,3,4)
2. Varghese, P.C., "Limit State Design of Reinforced Concrete", 2nd Ed.– Prentice Hall of India, New Delhi – 2008 (Ch.5,6,7,8).

Reference Books:

1. Dr. B. C. Pumnia ,Er. Ashok kumarjain and Dr. Arun k. jain, Reinforced Concrete Design, 10th edition, Lakshmi Publications, New Delhi
2. Jain A K, Reinforced Concrete: Limit State Design 7th Edition,Nem Chand and Brothers, Roorkee
3. S Unnikrishna Pillai, DevdasMenon, Reinforced Concrete Design, 4th Edition, TMH, 2021
4. Karve S R and Shah V L, Limit State Theory And Design Of Reinforced Concrete – VidyarthiPrakashan, Pune.
5. N Subramannaya, Design of RC Structures, Oxford IBH
6. IS 456 – 2000, SP – 24-1983, SP – 16-1984, SP -34 -1989 BIS Publications.

APPLIED GEOTECHNICAL ENGINEERING

Course Code	21CV503	Year	2023 – 24	Semester	IV
Course category	PC	Branch	Civil Engg.	Course Type	Core
Credits	03	L-T-P-C	2-1-0-3		
Continuous Internal Evaluation:	50 Marks	Semester End Evaluation:	50	Total Marks:	50

Course Outcomes	At the end of the course the student will be able to:	Mapping to POs
CO1	Analyse retaining wall by computing the lateral earth pressure for active and passive cases and stability of earth slope in the construction of canals, road embankments and earthen dams.	PO1, PO4, PO6
CO2	Evaluate the vertical stress under the loaded area using the concept of stress distribution in soil	PO2, PO4
CO3	Analyse the bearing capacity of different variety of soils subjected to different types of loading conditions and field methods for suitability of different types of foundations and ground conditions	PO1,PO2, PO4,
CO4	Apply the concept of ground improvement techniques for different types of foundation soils	PO1, PO2, PO4, PO7, PO12

MappingofcourseoutcomeswithPrograoutcomes(CO/PO/PSOMatrix)
Note:1-Weakcorrelation 2-Mediumcorrelation 3-Strongcorrelation
*-Averagevalueindicatescoursecorrelationstrengthwithmapped PO

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2			2		3								
CO2		2		2		3								
CO3		3		2		2								
CO4	3					2	2							
Average *(Rounded tonearestinteger)	2.5	2.5		2		2.5	2							

MODULE – 1

Earth Pressure: Active & Passive earth pressure, earth pressure at rest, earth pressure coefficient and their range. Rankine's and coulombs theories of earth pressure – Assumptions and limitations. Lateral earth pressure in cohesive and cohesionless soil. **Stability of Earth Slopes:** Types of slopes, Causes and types of failure of slopes. Definition of factor of safety. Stability of finite and infinite slopes - Method of slices, Friction circle method, Fellineous method. Taylor's stability number. **12 Hrs.**

Self-study component: Students shall visit the site and study the overview of the site conditions and know the different parts of the structures like retaining walls, highway or railway embankments and earthen dams etc., Also they shall assess the earth pressures exerted on the structures, use of standard software

MODULE – 2

Stresses in Soil: Boussinesq's and Westergaard's theories for concentrated, circular load, rectangular loads, strip load. Pressure bulb (Isobar) concept. Contact pressure - Newmark's chart. **Bearing Capacity**: Definitions of ultimate, net and safe bearing capacities. Allowable bearing pressure. Rankine's, and Terzaghi's analysis, Assumptions and limitations of Terzaghi's bearing capacity. Types of failures. Brinch Hansen's bearing capacity equation. Effect of groundwater table on bearing capacity of soil. **10 Hrs.**

Self study component: Students shall visit the site and study the ground conditions and types of soils. They shall obtain the soil samples from field and conduct the laboratory tests and calculate the safe bearing capacity of soil and submit the report.

MODULE – 3

Bearing Capacity from Field Tests: Plate-load test: Procedure, limitations of plate load tests use of N values for calculating bearing capacity and allowable soil pressure, Static and Dynamic cone penetration test. **Shallow Foundations:** Definition of foundation, General types of foundation, types of shallow foundation, settlement of foundation – concept and types - immediate, consolidation and secondary settlements (No derivations), BIS specification for total and differential settlement for footings and rafts. **10 Hrs.**

Self-study component: Students shall visit the site and study the ground conditions and asses the suitability of different types of foundations for different types of soil conditions. They shall also know the different components of the foundations

MODULE – 4

Pile Foundations: Necessity of pile foundations, classification of pile foundations, different types of piles and their advantages and limitations. Simple methods of estimating bearing capacity of piles – Dynamic formulae, static formulae, and pile load test. Negative skin friction. Introduction to **Ground Improvement Techniques** - Importance, methods - vibrofloatation, stone column, pre-compression, blasting, compaction piles, cement grout, thermal treatment and electro-osmosis.

10Hrs.

Self-study component: Students shall visit the site and study the site conditions and collect the geological information. Also, they shall apply the knowledge to adopting different techniques for different types soil for ground improvement technique.

Text Books:

1. Venkataramaiah,C.,"Geotechnical Engineering", Revised third Ed., New Age International publishers, 2006.
2. Punmia, B.C. Ashok Kumar Jain &Arun Kumar Jain, "Soil Mechanics and Foundations", Laxmi Publishing Co., New Delhi.2003.

Reference Books:

1. Bowles,I.E.,"FoundationAnalysisandDesigns",5th Ed.,McGrawHillPublishing,NewYork,1996.
2. Murthy, V.N.S., " Principles of Soil Mechanics and Foundation Engineering", 5th Revised Ed., UBS Publishers and Distributors ltd, New Delhi,2001
3. Foundation design manual by NVNayak.

ENVIRONMENTAL ENGINEERING – THEORY & PRACTICE

Course Code	21CV504	**Year**	2023-24	**Semester**	V
Course Category	PLCC	**Branch**	Civil	**Course Type**	Integrated
Credits	4	**L-T-P-C**	2-1-1-4		
Continuous Internal Evaluation:	50	**Semester End Evaluation:**	50	**Total Marks:**	100

At the end of the course the student will be able to:

CO1	Estimate average and peak water demand for a community.	PO1,PO2, PO6
CO2	Evaluate water quality and plan suitable treatment system	PO1,PO2, PO6
CO3	Estimate average and peak wastewater from a community and design suitable conveyance systems for sewage and storm water	PO1,PO2,PO3,
CO4	Evaluate wastewater quality and Design a comprehensive wastewater treatment system	PO1,PO2,PO3

Mapping of course outcomes with Program outcomes (CO/ PO/PSO Matrix)
Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation
* - Average value indicates course correlation strength with mapped PO

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO1	2	3				1								
CO2	2	3				1								
CO3	1	2	3											
CO4	1	2	3											
Average * (Rounded to nearest integer)	2	3	3			1								

MODULE 1

Introduction: Need for protected water supply, Factors affecting water supply scheme and benefits. **Demand Of Water:** Types of water demands - domestic demand, institutional and commercial, public uses, fire demand. Factors affecting per-capita demand, variations in demand of water, Peak factor, Design periods and factors governing the design period. Different methods of Population forecasting. **Sources:** Concept of hydrological cycle, Surface and subsurface sources - suitability with regard to quality and quantity. Factors governing the selection of particular source of water. **Collection and Conveyance of Water:** Intake structures - different types of intakes; factors for the selection and location of intakes.

MODULE 2

Quality of Water: Concept of safe water: wholesomeness, palatability and potable. Physico Chemical characteristics.

Water Treatment: Objectives and Treatment flowchart – significance of each unit. **Aeration –** Principle and types of aerators. **Sedimentation**: Theory, settling tanks, types and design. **Filtration**: Mechanism - theory of filtration, types of filters- slow sand, rapid sand and pressure filters **Disinfection**: Definition, Requirements, methods of disinfection.

Softening: Definition, methods of removal of hardness by lime soda-process and zeolite process with merits and demerits

MODULE 3

Wastewater: Wastewater disposal - Necessity for sanitation, types of sewerage systems and their suitability. Quantification of sewage and estimation of storm water flow **Sewer:** Sewer pipe materials, Shapes of sewers, laying of sewers, jointing and testing of sewers, ventilation and cleaning of sewer. **Sewer Appurtenances:** Catch basins, Manholes, Flushing tanks, oil and grease traps, Drainage traps, Basic principles of house drainage, typical layout plan showing house drainage connections

MODULE 4

Analysis of Sewage: Physical, chemical, and biological characteristics. **Treatment of Sewage:** Flow diagram of municipal sewage treatment plant. **Primary treatment:** screening, grit chambers, skimming tanks and design of primary sedimentation tank.

Secondary treatment: Trickling filter, Activated sludge process -Principle and flow diagram. Methods of sludge disposal: Sludge digestion and Sludge drying beds. **Miscellaneous Treatment Methods:** Septic tanks and Oxidation Pond. Introduction to RBC, UASB, Anaerobic filters.

EXPERIMENTS

Experiments to be carried out are:

1. Determination of Alkalinity and Acidity
2. Determination Total Hardness
3. Determination Chloride
4. Determination of Dissolved Oxygen
5. Determination of percentage of available chlorine in bleaching powder
6. Jar Test for Optimum Dosage of Alum
7. Determination of BOD

Self Study Component: *Visit to intake structure, water and wastewater treatment plant and report working of each unit. Design of water and wastewater treatment plant units and distribution system with population forecasting for the given city. Water conservation methods.*

Text Books:

1. Water Supply Engineering: Environmental Engineering - Vol. I – 2017 Santosh Kumar Garg, Khanna Publisher, ISBN-10: 9788174091208
2. Punmia B.C. and Ashok Kumar Jain, **"Environmental Engineering- I**",Arihant Publications
3. S. K. Garg ―Environmental Engineering: Sewage Disposal and Air Po llution Engineering (Volume - 2), 33 Edition, 2015, Khanna Publishers, ISBN: 9788174092304, 8174092307.
4. Punmia B. C. and Jain A., "Environmental Engineering-II, ArihantPublications, 1995 (Ch. 1 & 2)

Reference Books:

1. Hammer and Hammer, "**Water Technology",** Mc Graw Hill Publications Howard S. Peavy, Donald R. Rowe. George Tchobanoglous, **"Environmental Engineering"** - McGraw Hill International Ed. ISBN-10: 9351340260
2. CPHEEO Manual on water supply and treatment engineering, Ministry of Urban Development, Government of India, New Delhi, 3rd Edition, 2018, Akalank Publications; ISBN-10: 8176393819
3. Waste Water Treatment, Disposal and Reuse -Metcalf and Eddy inc, Tata McGraw Hill Publications (2008 Edition), ISBN-10: 0071008241, ISBN-13: 978-0071008242
4. Wastewater treatment Concepts and Design Approach by Karia G.L., C hritian R.A. Second Edition, 2013. Prentice Hall India Private limited, ISBN-10: 8120328604, ISBN-13: 978-8120328600.

IRRIGATION ENGINEERING

Course Code:	21CV505	**Year**	2023-24	**Semester**	V
Course Category:	PCC	**Branch**	Civil Engineering	**Course Type**	Core
Credits:	3	**L-T-P-C**	2-1-0-3		
Continuous Internal Evaluation:	50	**Semester End Evaluation**	50	**Total Marks**	100

Course Outcomes

COs	**At the end of the course the students will be able to**	**Mapping POs**
CO1	Estimate crop water requirements for irrigation	PO1, PO2
CO2	Design various minor irrigation and hydraulic structures	PO2, PO3
CO3	Estimate the storage capacity of reservoirs	PO2, PO3
CO4	Analyse the stability of different types of dams	PO1, PO2

Mapping of course outcomes with Program outcomes (CO/ PO/PSO Matrix)
Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation
* - Average value indicates course correlation strength with mapped PO

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO1	2	3												
CO2		2	3											
CO3		3	2											
CO4	3	2												
Average *(Rounded to nearest integer)	3	3	3											

MODULE - 1

Introduction: Definition of irrigation, Benefits and ill effects of irrigation, Sources of water for irrigation. Systems of irrigation: Surface and ground water irrigation, flow irrigation, and lift irrigation. Methods of irrigation in India–Potential and its development. **Irrigation Water Requirements of Crops:** Definition of Duty, Delta and Base period and Relationship between them, factors affecting the duty of water. Field capacity, Frequency of irrigation and Irrigation efficiency. Consumptive Use and its estimation, Soil-Moisture Regime Concept.

12 Hours

MODULE - 2

Canal Irrigation System: Definition and types of canals, Alignment of canals, Design of canals by Kennedy's and Lacey's methods. Types of Canal work, Classification and suitability of Canalregulators. Canal drops: Types of canal drops and Hydraulic design for notch-type drop. Cross drainage works: Classification.

Diversion Head Works: Definition, Layout, Types of weirs and Barrages. Design of Impermeable floors - Bligh's and Lame's theories - simple design problems. Khosla's theory-Method of independent variable Exit gradients (Only hydraulic design).

10 Hours

MODULE - 3

Reservoirs: Definitions, Investigation for reservoir sites. Capacity contours, Estimation of storagevolume, Volume elevation and Area elevation curve. Storage zones. Determination of storage capacity and yield of a reservoir using mass curve. **Gravity Dams:** Definition. Forces acting on a Gravity dam. Modes of failures. Elementary and practical profile. Low and high gravity dams. Simple analysis problems, Principal stresses, Drainage galleries

10 Hours

MODULE - 4

Earthen Dams: Types of earthen dams. Failure of earthen dams. Preliminary design. Drainage arrangements. Phreatic line. Stability analysis under sudden draw down using Swedish slip circlemethod. **Spillways:** Definition. Types of Spillways. Design Principles for an Ogee Spillway. Energy dissipaters: Types and Introduction to IS Stilling basins (No design problems).

10 Hours

Self-study Component: **Evaluated for 20 marks**

Students are expected to complete at least two activities including but not limited to -

1. Visit an irrigated field at a nearby place in Hassan of the different typesof crop grown, types / methods of irrigation adopted, techniques used and submit a report with geotagged photographs.
2. Visit a nearby ongoing / completed minor irrigation project and collect information about the potential of the existing and ongoing projects. The department of minor irrigation shall be visited and submit a report with geotagged photographs on the same. The visit may be planned in consultation with the faculty incharge.
3. Visit Gorur Dam (Hemavathy River Irrigation Project) / Yagachi Dam / any other relevant projects as a part of a field visit to collect the information about the irrigation potential of the project and submit a report with geotagged photographs on the same.
4. Visit any irrigation project having an earthen dam and submit a report on the same.

Textbooks:

1. Punmia, B. C., Basi Lal, P. B., Jain, A. K., Jain, A. K. (2009). Irrigation and Water Power Engineering. India: Laxmi Publications Pvt Limited. ISBN: 9788131807637
2. Garg, S. K. (2009). Irrigation Engineering and Hydraulic Structures. India: Khanna. ISBN: 9788174090478

Reference Books:

1. Newell, F. H. (2021). Principles of Irrigation Engineering – Arid Lands, Water Supply, Storage Works, Dams, Canals, Water Rights and Products. United Kingdom: Read Books Limited. ISBN: 9781528769167
2. Raghunath, H. M. (2011). Irrigation Engineering. India: Wiley India Pvt. Limited. ISBN: 9788126528813
3. Sharma, S. K. (2017). Irrigation Engineering and Hydraulic Structures. India: S Chand & Company Limited. ISBN: 9789352533770
4. Asawa, G. L. (2006). Irrigation and Water Resources Engineering. India: New Age International (P) Ltd. Publishers. ISBN: 9788122416732

PROGRAMMING IN CIVIL ENGINEERING

Course Code	**21CV506**	**Year**	2023-24	**Semester**	V
Course Category	Lab	**Branch**	Civil	**Course Type**	Core
Credits	1	**L-T-P-C**	0-0-1-1		
Continuous Internal Evaluation:	50	**Semester End Evaluation:**	50	**Total Marks:**	100

Course Outcomes	**At the end of the course the student will be able to:**	**Mapping to POs**
CO1	Develop programs to solve problems in Civil Engineering using C/C^{++}programming / Matlab	PO12, PO5
CO2	Develop Excel program to solve typical problems in Civil Engineering and use of commercially available software packages for analysis and design of structures in Civil Engineering applications	PO12, PO5

Mapping of course outcomes with Program outcomes (CO/ PO/PSO Matrix)
Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation
* - Average value indicates course correlation strength with mapped PO

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO1					3							2		
CO2					2							3		
Average * (Rounded to nearest integer)					2.5							2.5		

1. Develop the programs to calculate shear force and bending moment and to draw BMD and SFD for the following cases subjected to both point load and UDL - Cantilever ,Simply supported ,Propped cantilever and Fixed beams.

12 Hrs

2. Develop the programs for Design of Rectangular Singly and Doubly Reinforced RC beams by limit state method.

04 Hrs.

3. Use of commercial software packages for analysis of beams and frames.

05 Hrs.

4. Use of Spread Sheet for - Design of horizontal and vertical alignment of curves - Design of super-elevation - Computation of earthwork - Balancing of closed traverse using transit rule.

5. Water hammer analysis- Head over Ogee weir -Verification of stability of dams - most economical section of canal, derivation of unit hydrograph and hydrograph of different base periods.

05 Hrs.

Self-study component: **Students shall visit construction site and observe (1) the types of load and different support conditions for beam element (2) Structural steel members and their connections**

Reference Books:

1. Suresh.G.S and Sheshaprakash, "CAD Laboratory (Civil Engg)" - C-Graphics & Excel, Jawaharlal Nehru National College of Engineering, Shimoga, 2004
2. Jayaram.M.A, Rajendraprasad.D.S, "CAD Laboratory" – Sapna Publications, 2003.
3. Sham Tickoo, "AUTOCAD 2004" A beginner's Guide, Wiley Dreamtech India Pvt. Ltd, 2004.
4. Ramesh Bangia "Learning Excel 2002" Khanna Book Publishing Co (P) ltd, 2002.
5. MATLAB Manual
6. Computer and Structural Analysis",Oxford & IBW, 1

Course Code-21CV601 **L-T-P-C: 3-0-0-3**
CIE -50marks **Hours/week-3**
SEE - 50 marks **Total Hours: 40 Hrs**

CONSTRUCTION PLANNING AND MANAGEMENT

COs	At the end of the course the student will be able to:	Mapping to POs
CO1	Illustrate the basic concepts of engineering economic analysis for deciding project feasibility by comparison of alternative project proposals	PO2, PO6, PO11
CO2	Apply linear programming as a tool for optimization by graphical and simplex method	PO1, PO6, PO11
CO3	Distinguish the concept of construction management and employ construction planning methods to achieve optimum cost by CPM and PERT	PO1, PO6, PO11
CO4	Describe the sequential process of construction, project management and transportation problems for optimum results.	PO2, PO6, PO11

Mapping of course outcomes with Program outcomes (CO/ PO/PSO Matrix)
Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation
* - Average value indicates course correlation strength with mapped PO

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1		3				1					3			
CO2	2					1					3			
CO3	2					1					3			
CO4		3				1					3			
Average * (Rounded to nearest integer)	2	3				1					3			

MODULE-1

Introduction to Engineering Economics – Basic concepts of engineering Economic analysis – Micro and Macro analysis – project feasibility –economic and financial feasibility**. Engineering Planning Methods**: Time value of money - interest formulae – present worth – future worth - annual equivalent – rate of return and benefit cost ratio methods for comparison of alternative project proposals – breakevenanalysis. **10Hrs**

Self-study component: Students shall visit a construction site and discuss the points pertaining to project planning, financing and time schedule, prepare a report andsubmit.

MODULE-2

Linear Programming: Standard form of a linear programming– problem Formulation – graphical solution – simplex method – maximization and Minimization-application problems. **Construction Industry and Management:** Introduction – value engineering Time management – labor and material management – contractand contractor-organization andadministration **10Hrs**

Self-study component: Students shall visit a construction site and discuss the points pertaining to project management in terms of time, labor and material management, prepare a report and submit.

MODULE-3

Construction Planning: Introduction – time estimates – Bar and Milestone Charts – CPM and PERT network analysis – cost analysis – direct cost indirect cost – total cost – optimum cost – optimum duration of project. **Construction Equipment:** Introduction – factors for selecting equipment – economic life of equipment - various earth moving equipment – hoisting equipment – trenchingmachines. **11Hrs**

Self-study component: Students shall visit a construction site and observe bar charts exhibited at the site, various construction equipment, prepare a report andsubmit.

MODULE-4

Work Study in Construction, Project control during construction – Project supervision -safety measures. **Transportation Problems:** Introduction – Mathematical formulation Optimal solution of transportation problems – methods for initial basic feasible solution – summary of methods of initial BFS – North west corner method – Lowest cost entry method – Vogel's approximation method –optimality test – Degeneracy in Transportation Problems 09 **Hrs**

Self-study component: Students shall use any typical construction management software and prepare critical path for the execution of the project.

Text Books:

1. Subramaniam.K"ConstructionManagement",AnuradhaPublishers,Madras,1989(Ch.1–5)
2. Peurifoy, R L "Construction Planning equipments and methods" McGraw Hill Publications 3rdedition,1985

Reference Books:

1. Mahesh Varma "Construction Planning and Management" Metropolitan Book Co.Delhi1982
2. Sharma.S.D. "Operation Research" Khanna Publishers, NewDelhi.

DESIGN AND DETAILING OF STEEL STRUCTURES

Course Code	**21CV602**	**Year**	2023-24	**Semester**	VI
Course Category	Core	**Branch**	Civil	**Course Type**	PCC
Credits	4	**L-T-P-C**	2-1-1-4		
Continuous Internal Evaluation:	50	**Semester End Evaluation:**	50	**Total Marks:**	100

Course Outcomes	**At the end of the course the student will be able to:**	**Mapping to POs**
CO1	Illustrate the basic concepts of limit state design of steel structural members both in collapse and in serviceability as per IS 800 – 2007	PO1, PO2, PO8
CO2	Analysis and design of bolted & welded steel connections	PO2, PO5, PO8
CO3	Analysis and design of Tension members and compression members	PO2, PO8 PO5
CO4	Analysis of flexural members	PO2, PO3, PO8

Mapping of course outcomes with Program outcomes (CO/ PO/PSO Matrix)
Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation
* - Average value indicates course correlation strength with mapped PO

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO1	2	3						1						
CO2		3			1			2						
CO3		3			1			2						
CO4		3	2					1						
Average * (Rounded to nearest integer)	1.0	3.0	1.0		1.0			1.5						

MODULE-1

Introduction: Advantages and disadvantages of Steel structures, Limit state method of design, Partial safety factors for material and loads, Loads and load combinations, Design concepts, Code and Specifications, Section classifications. **Structural Fasteners**: Bolted connections – Standard notations, specifications, advantages, behavior of bolted joints - strength of bolts, Design of simple bolted connections – Block and HSFG Bolts. (Excluding moment resistant connections) **10 Hrs**

Lab components: Drawings (plan and elevation) to be prepared for the following simple bolted connections:

1. Lap joints
2. Butt joints
3.Truss joints

Self-Study Component: Students shall visit an ongoing construction project site to observe the types of bolted connections

MODULE-2

Structural Fasteners (contd..) Welds – Standard notations, advantages and disadvantages of welded connections, fillet and butt welds - defects in welds - welding symbols - strength of welds, design of simple welded connections, welded bracket connections. **Design of Welded Beam** Connections**:** Beam to column - seated, stiffened and un-stiffened connections (Excluding moment resistant connections) **10 Hrs**

Lab components: Drawings (front & side views) to be prepared for the following welded connections:

1.Bracket connections,

2.Unstiffened Beam-column connections

3.Stiffened seated connections Beam-column connections

Self-Study Component: Students shall visit an ongoing construction project site to observe the types of welded connections

MODULE-3

Design of Tension Members: Modes of failures, Axially loaded tension members and their connections, Design of lug angles, Design of truss ties and joints. **Design of Compression Members**: End restraints, effective length, Standard Rolled sections, splices.

10Hrs

Lab components: Drawings (elevation and sectional views) to be prepared for the following:

1. ***Bolted and welded tension members***
2. ***Welded truss joint***
3. ***Splices***

Self-Study Component: Students shall visit an ongoing construction project site to observe the connection details of steel structures

MODULE-4

Design of Compression Members (Contd..) Standard Built-up sections- Lacing and battening system, Column bases – Design of Slab and gusseted base. **Design of Flexural Members**: design of Laterally restrained beams – check for flexure, shear , Web crippling, web buckling and deflection. **10 Hrs**

Lab components: Drawings (plan and elevation) to be prepared for the following:

1.Laced Columns

2.Battened columns

3.Slab base and gusseted base.

Self-Study Component: Students shall visit an ongoing construction project site to learn about pre-engineered buildings.

Note: The designs shall be done as per IS 800-2007 - limit state method.

Text Books:

1. Subramanian. N "Limit State Design of Steel Structures" Oxford University press, New Delhi – 2012 [Ch. 2,3,5,6,7,9,10]
2. S K Duggal "Limit State Design of Steel Structures" Mc Graw Hill Education Pvt.Ltd, New Delhi – 2015 [Ch. 1,2,3,4,5,6,7,8,9,11]

Reference Books:

1. Ramachandra "Design of Steel Structures" Standard Book House, New Delhi. 2016
2. Prof. Shah V.L and Prof. Veena Gore "Limit State Design of Steel Structures" Structures Publications, New Delhi - 2009 [Ch.1,2,3,4,5,6]
3. IS 800–2007 and SP6 (a) – 1984 or Standard Steel table

Course Code-21CV603 **Exam Hours-3 Hrs**
L-T-P-C 2-1-0-3 **CIE -50marks**
Hours/week-3 **SEE -50 marks**
Total Hours: 42 Hrs

DESIGN OF BRIDGES AND FLYOVERS

COs	At the end of the course the student will be able to:	Mapping to POs
CO1	Apply fundamental knowledge about bridges-their components, Compute the design discharge for a given bridge site	PO1, PO2 PO3
CO2	Analyze the types of abutments and piers - compute the forces acting on them.	PO1, PO2 PO3
CO3	Design of slab culvert and pipe culvert for given IRC loading	PO1, PO3
CO4	Design the RC- T beam bridge and steel composite bridge for given IRC loading	PO1, PO2, PO3

Mapping of course outcomes with Program outcomes (CO/ PO/PSO Matrix)
Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation
* - Average value indicates course correlation strength with mapped PO

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	2	3	1											
CO2	2	3	2											
CO3	1	2	3											
CO4	1	2	3											
Average * (Rounded to nearest integer)	2	3	3											

MODULE -1

Introduction: Definition of a bridge - Components of a bridge and a flyover - Classification of bridges and flyovers - Requirements of an ideal bridge- Forces to be considered for the design of bridges and flyovers - IRC loading standards- Impact effect**.**
Hydraulic Design: Design discharge- Afflux, Natural waterway- Linear waterway - Economicspan.

10Hrs.

Self-study component: Students shall visit different types of bridges and flyovers and identify the various components, types of bridges, water way and number of spans etc., prepare a report and submit.

MODULE -2

Substructures: Abutments, Piers - Wing walls- Forces on substructures- Stability Considerations

- Empirical design. **Foundations:** Depth of foundation – Pile and well foundation - Depth of scour**.**

10 **Hrs.**

Self-study component: Students shall visit a typical bridge construction site and identify the substructures and type of foundation, prepare a report and submit.

MODULE -3

RC Slab Culverts: Design of superstructure for IRC class AA loading. **Pipe Culverts:** Design for both shallow and deep embankment for IRC class AA wheel loading.

11Hrs.

Self-study component: Students shall visit a typical slab culvert and pipe culvert construction sites and identify various components, prepare a report and submit. They shall also observe the type of vehicular loading on the Culverts.

MODULE -4

RC T Beam Bridge: Design of slab by using Pigeaud's curves- Design of longitudinal girders by Morice Little method for IRC class AA or 70R loading. **Composite Bridge:** Design of RC slab and steel girder for equivalent loading- Design of shear connectors. **Flyovers:** Introduction, Advantages and disadvantages, types of flyover bridges, simpleflyoverdesign.

11 Hrs.

(Drawings of bridges providing all details shall be given asassignment)

Self-study component: Students shall visit a typical RC T Beam Bridge and composite bridge and identify the components and, prepare a report and submit. They shall also observe the type of vehicular loading on the above- mentionedbridges.

Text Books:

1. Jhonson Victor. "Essentials of Bridge Engineering" Oxford IBH Publication 2008 (Ch. 1, 4, 5 & 7).
2. Bindra S.P. "Principles and Practice of Bridge Engineering" Dhanapat Rai Publications 2008 (Ch. 2, 3, 6&8).

Reference Books:

1. Krishna Raju N. "Design of Bridges" Oxford IBHPublication2008
2. Jagadeesh, T. R. & Jayaram, M. A. "Design of Bridge Structure" II Edn. PHI Learning Pvt.Ltd., 2009
3. IRC 21- R2000

Relevant Design charts to be supplied in SEE

ADVANCED SURVEY TRAINING

Course Code-21CV604 **L-T-P-C 0-0-1-1**

Course Outcomes	At the end of the course the student will be able to:	Mapping to POs
CO1	Carryout reconnaissance survey & conduction of required surveying operations by using Total station instrument & preparation of detailed drawings and reports for Highway project & layout planning of house colony project	PO1, PO2, PO3, PO4, PO5, PO9, PO11
CO2	Carryout reconnaissance survey & conduction of required surveying operations by using Total station instrument & preparation of detailed drawings & reports for Survey of an existing Old Tank project & marking of proposed building centre line project	PO1, PO2, PO3, PO4, PO5, PO9, PO11

Mapping of course outcomes with Program outcomes (CO/ PO/PSO Matrix)
Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation
* - Average value indicates course correlation strength with mapped PO

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1		3			3			2		3		3		
CO2		3			3			2		3		3		
Average * (Rounded to nearest integer)		3			3			2		3		3		

MODULE-1

Preliminary Training: During the Preliminary Training, the students will learn the following survey exercises using total station: Measurement of the distance, vertical and horizontal angles, bearings, heights, reduced Levels (RL), Transfer of data from total station to computer and vice- versa, Preparation of drawings after processing of the data. **Highway Project:** Preliminary and detailed investigations to align a new road between two arbitrary points. The investigations shall consist of topographic surveying of strip of land for considering alternative routes and for deciding final alignment. Preparation of report to justify the selected alignment with details of all geometric design details. Preparation of Drawings including key plan initial alignment, final alignment, longitudinal section along with final alignment and typical cross sections ofroad.

4 Hours

MODULE-2

Layout planning of a housing colony: Works involved - Preparation of site map, Planning and marking of sites, roads, cross drainage works and amenities like: water supply, electricity, sanitation, location of GLSR, overhead tank and UGD system withSTP**.**

5 Hours

MODULE-3

New tank project and Survey of an existing Old Tank: Works involved -Survey of existing bund, longitudinal and cross sections showing the details of Sluice, Waste-weir and other facilities. Plotting of capacity contours. Measurement of gradient of existing channel. Preparation of drawings, indicating cross sections and locations of waste weir andsluice.

4 Hours

MODULE-4

Marking of proposed building centre line: Works involved - Selection of location for setting of the instrument. Working out the coordinates of points on centerline with reference to the instrument location. Transferring of the coordinates on to the ground.

3 Hours

Note: Use Total Station, Commuter Aided Drawing, E-Surveying software for the work; Six days Advanced Training: during the vacation between Vthand VIth semesters

Reference Materials:

1. Basak. N. N., "Surveying", Tata McGraw Hill Publishing Co., ltd,2004
2. Punmia,B.C,"IrrigationandWaterPowerEngineering",LaxmiPublications,NewDelhi,1992
.
3. Khanna, S. K. & Justo CES, "Highway Engineering", Nemchand Brothers, Roorkee,2003
4. Garg, S. K., "Water Supply Engineering", Khanna Publishers, New Delhi,2007

Course Code - 21CV641 **L-T-P-C 3-0-0-3**
Exam Hours-3 **Hours/week-3**
CIE-50 marks **Total hours-42**
SEE-50 marks

ALTERNATIVE BUILDING MATERIALS & TECHNOLOGIES

Course Outcomes	At the end of the course the student will be able to:	Mapping to POs
CO1	Analyze embodied energy of a building component	PO1, PO2, PO4
CO2	Evaluate the effect of construction on the surrounding environment.	PO2, PO3, PO7
CO3	Summarize the specific information about different alternative building materials used in construction and alternative building technologies suitable for a given project.	PO1, PO2, PO4
CO4	Interpret the mechanism of structural masonry, cost effective constructions and the concept of mass housing and self-employment opportunities in the field of pre-cast construction.	PO2, PO4, PO6, PO12

Mapping of course outcomes with Program outcomes (CO/ PO/PSO Matrix)
Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation
* - Average value indicates course correlation strength with mapped PO

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	2	1				3								
CO2		2				2	3							
CO3	3	1				2								
CO4	3					2	2							
Average * (Rounded to nearest integer)	2.6	1.33				2.25	2.5							

MODULE - 1

Introduction: Energy in building materials – Environmental issues concerned to building materials – Global warming and construction industry – Environmentally friendly and cost-effective building technologies - Requirements of buildings for different climatic regions, embodied energy of materials, Green buildings, Carbon credit. **Alternative Building Materials – Building blocks:** Characteristics of building blocks for walls – Stones and Laterite blocks, Bricks and hollow clay blocks – concrete blocks, mud blocks, stabilized mud blocks and steam cured blocks, AAC blocks, interlocking blocks.

12 Hrs.

Self-study component: The Students shall Visit nearby precast units and learn different methods of precasting and products.

MODULE - 2

Alternative Building Materials (Continued): Fly ash Bricks, Lime pozzolana cement raw materials – manufacturing process – properties and uses. **Alternative Building Technologies:** wall construction – types, light weight precast panels, shotcreted panels, puff panels, construction methods, masonry mortars – types, preparation and properties, Ferro cement and ferro concrete building components – materials and specifications, properties, construction methods and applications.

10 Hrs.

Self-study component: The Students shall Visit any nearby Nirmithi Kendra and observe the making of

stabilized mud blocks and other products.

MODULE - 3

Alternative Building Technologies (Continued): Roofing systems – concepts, filler slabs, composite beam panel roofs, Masonry vaults and domes. **Structural Masonry:** Compressive strength of masonry elements, Factors affecting compressive strength, strength of units, prisms / wallets and walls**.**

10 Hrs.

Self-study component: The Students shall visit nearby Nirmithi Kendra and learn about precast units like concrete blocks, concrete slabs etc.,

MODULE - 4

Structural Masonry (Continued): Effect of Bond/joint strength on strength of masonry – Flexure and shear – Elastic properties of masonry materials and masonry – IS Code provisions – Design of masonry elements – axial, eccentric compression and lateral loads. **Cost effective Construction:** Mass housing – economic construction planning- need for using precast housing components – usage of alternative materials and technologies for mass Construction

10 Hrs.

Self-study component: The Students shall visit nearby HUDCO / Housing Board office and learn about mass housing schemes and usage of alternative materials and technologies.

Text Books:

1. Jagadish.K.S, VenkataramaReddy.B.V and NanjundaRao.K.S. "Alternative Building Materials and Technologies" , New Age Int. Pub. New Delhi – 2008.(Ch.1 to 8)
2. Hendry A.W., "Structural Masonry", 2nd Ed., Palgrave Macmillan Publishers, 1988.(Ch.7 & 8)

Reference Books:

1. Manuals published by HUDCO.9ch. 7 & 8)
2. Relevant IS 2250: 1985, IS 3466 : 1999, IS 4098 : 1999, IS 2116 :1998, IS 1095 : 1998

Course Code - 21CV642 **L-T-P-C 3-0-0-3**
Exam Hours-3 **Hours/week-3**
CIE-50 marks **Total hours-42**
SEE-50 marks

MATRIX METHODS OF STRUCTURAL ANALYSIS

Course Outcomes	At the end of the course the student will be able to:	Mapping to POs
CO1	Discuss matrix operations relating to structural analysis by Flexibility method, Element Flexibility matrix, Principle of Contragradience, Force Transformation matrix, structure flexibility matrix and construction of structure flexibility matrix.	PO1,PO2 ,PO3
CO2	Analysis of Pin jointed trusses using Force transformation matrix. Fundamentals of Stiffness Method: equivalent joint loads, Displacement transformation matrix, Member stiffness matrix, total or system stiffness matrix	PO2,PO3 ,PO4
CO3	Analysis of frames by stiffness method and introduction to direct stiffness method.	PO2,PO3 ,PO4
CO4	Analysis of trusses and continuous beams by displacement transformation method and direct stiffness method.	PO2,PO3 ,PO4

Mapping of course outcomes with Program outcomes (CO/ PO/PSO Matrix)
Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation
* - Average value indicates course correlation strength with mapped PO

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	1	2											
CO2		1	3	2										
CO3		1	3	2										
CO4		1	2	3										
Average * (Rounded to nearest integer)	3	1	3	2										

MODULE-1

Introduction: Introduction to Flexibility method, Element Flexibility matrix, Principle of Contragradience, Force Transformation matrix, structure flexibility matrix, construction of structure flexibility matrix. Analysis of Pin jointed trusses using Force transformation matrix. Fundamentals **of Stiffness Method:** equivalent joint loads, Displacement transformation matrix, Member stiffness matrix, Total or system stiffness matrix

10 Hrs

Self-study component: The Students shall learn the available facilities for matrix operations on MATLABPlatform

MODULE-2

Analysis of Trusses: Truss analysis by Stiffness method using Displacement transformation matrix. **Analysis of Continuous Beams** by Stiffness method using Displacement transformation matrix.

10 Hrs

Self-study component: The Students shall learn to write simple programmes for matrix

formulation and solve the analysis problems of trusses and continuous beams.

MODULE-3

Analysis of Rigid Frames: with axially rigid members by Stiffness method using Displacement transformation matrix. **Introduction to Direct Stiffness Method:** Local and Global co-ordinate system, Transformation of variables, Transformation of member displacement matrix, Transformation of member force matrix, transformation of member stiffness matrix. Overall stiffness matrix, Boundary conditions and Computation of internal forces

10 Hrs

Self-study component: The Student shall learn using direct stiffness method for the analysis of trusses and continuous beams.

MODULE-4

Analysis of Trusses: by Direct Stiffness Method. **Analysis of Continuous Beams:** by Direct Stiffness Method.

12 Hrs

Self-study component: The Students shall learn to write simple programmes using direct stiffness method for the analysis of trusses and continuous beams.

Text Books:

1. Reddy, C. S., "Basic Structural Analysis", Tata Mc Graw- Hill, 1996. (Ch. 2 to 8)
2. Rajashekharan. S and Sankarasubramanian G, "Computational Structural Mechanics", Prentice Hall of India , 2001. (Ch. 1,4,6,7 & 8)

Reference Books:

1. Weaver, W, J.M.Gere, "Matrix Analysis of Framed Structures", CBS publishers and distributors,1986.
2. Mukhopadhyay, "Matrix Finite Element, Computer and Structural Analysis",Oxford & IBW, 1984.

GROUND IMPROVEMENT TECHNIQUES

Course code	**21CV643**	**Year**	2023-24	**Semester**	VI
Course category	PE	**Branch**	Civil Engineering	**Course Type**	Elective – 1
Credits	**03**	**L-T-P-C**	**3-0-0-3**		
Continuous Internal Evaluation:	**50 Marks**	**Semester End Evaluation:**	**50 Marks**	**Total Marks:**	100 Marks

Course Outcomes	**At the end of the course the student will be able to:**	**Mapping to POs**
CO1	Discuss the method of mechanical modification of the ground by various methods of compaction in ground improvement techniques.	PO1, PO2, PO4
CO2	Apply the concept of preloading technique by hydraulic modification of the ground improvement.	PO2, PO4
CO3	Review the basic principles of chemical modifications of the ground by incorporating cement, lime, flyash stabilization & other methods.	PO1, PO4, PO6
CO4	Illustrate the grouting technology and other advanced methods such as soil reinforcement, Crib walls, Gabions and Mattresses, ground anchors, rock bolts and soil nailing for ground improvement.	PO2, PO4, PO7

Mapping of course outcomes with Program outcomes (CO/PO/PSO Matrix)
Note:1-Weakcorrelation 2-Mediumcorrelation 3-Strongcorrelation
*-Average value indicates course correlation strength with mapped PO

COs	**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**
CO1	3	2		1										
CO2		3		2										
CO3	2			1		3								
CO4	1			2			3							√
Average *(Rounded tonearestintege r)	2	2.5		1.5		3	3							

MODULE – 1

Ground Improvement: Definition, Objectives of ground improvement, Classification of ground improvement techniques. Factors to be considered for selection of the soil improvement technique. **Mechanical Modification: Compaction-** Mechanism of compaction. Densification. Engineering behaviour of compacted fine - grained soils. Dynamic compaction, Vibroflotation. Effect of compaction on engineering behaviour like compressibility, swelling and shrinkage, permeability, relative density, liquefaction potential. Field compaction – static, dynamic and vibratory type. Shallow and deep compaction techniques

16 Hrs.

Self-study component: The Students shall visit nearby construction sites and observe the necessity of ground improvement techniques, problematic sites.

MODULE – 2

Hydraulic Modification: Objectives and techniques. Dewatering: Concept of dewatering, Interceptor ditches, Single - stage well points, Multi - stage well points and vacuum dewatering. Design of dewatering system. **Drainage & Preloading: Drainage** of slopes, vertical drains, sand drains, prefabricated drains. Efficiency of vertical drains. Concept of preloading. Assessment of ground condition for preloading techniques. Methods of preloading techniques.

08 Hrs.

Self-study component: The Students shall collect the information and photos on hydraulic modification of soils, by visiting the various internet websites.

MODULE - 3

Chemical Modification: Concept of chemical modification / stabilization, Construction techniques: Sandwich technique, Lime column techniques. Admixtures - Cement stabilization: soil - cement - water reactions. Factors affecting cement stabilization. Flyash stabilization: Flyash stabilization with lime, cement and aggregates. Soil modified with flyash and cement or lime. Lime stabilization: Soil - lime reactions. Engineering benefits of lime stabilization. Other chemicals like chlorides, hydroxides, lignin, hydrofluoric acid.

10 Hrs.

Self-study component: The Students shall collect the information and photos on chemical modification of soils, by visiting the various internet websites.

MODULE - 4

Grouting: Introduction, characteristics of grouting, methods of grouting, Grouting techniques, Applications of grouting. **Modification by inclusive or Confinement (Only Concepts):** Soil reinforcement. Ground improvement by confinement – Crib walls, Gabions and Mattresses. Ground anchors, Rock bolts and soil nailing, geo cells**.**

08 Hrs

Self-study component: The Students shall collect the information and photos on grouting and miscellaneous methods of ground improvement by visiting the various internet websites.

Text Books

1. PurushothamaRaj.P,"GroundImprovementTechniques"LaxmiPublications,NewDelhi,1999.
2. Koerner.R.M., "Construction and Geotechnical Methods in Foundation Engineering" McGraw Hill Publ., New York,1985.

Reference Books:

1. Manfred Hausmann, "Engineering Principles of Ground Modification", McGraw Hill Pub., New York,1990
2. Nelson, J. D and Miller, D. J., "Expansive Soils" John Wiley and Sons,1992.

INDUSTRIAL WASTEWATER TREATMENT

Course Code	21CV644	**Year**	2023-24	**Semester**	VI
Course Category	PE	**Branch**	Civil	**Course Type**	Elective
Credits	3	**L-T-P-C**	3-0-0-3		
Continuous Internal Evaluation	50	**Semester End Evaluation**	50	**Total Marks**	100

Course Outcomes	**At the end of the course the student will be able to:**	**Mapping to POs**
CO1	Discuss the concept of industrial wastewater quality and impact of untreated effluents on the receiving environment	PO1,PO2, PO6
CO2	Analyze the role of Civil engineer in designing and adopting different treatment technologies for industrial effluents	PO1, PO2,PO3
CO3	Describe advanced methods of treatment of effluents	PO1, PO6, PO7
CO4	Illustrate various methods of treatment available for selected Industrial Wastes	PO1,PO6, PO7

Mapping of course outcomes with Program outcomes (CO/ PO/PSO Matrix)
Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation
* - Average value indicates course correlation strength with mapped PO

COs	**PO1**	**PO2**	**PO3**	**PO 4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO1	3	2				1								
CO2	3	2	1											
CO3	3					1	2							
CO4	3					1	2							
Average * (Rounded to nearest integer)	3	2	1			1	2							

MODULE 1

Introduction: Difference between Domestic and Industrial Wastewater, Effect on Streams and on Municipal Sewage Treatment Plants**. Quality:** Stream quality, Dissolved Oxygen Sag curve in Stream, Streeter-Phelps formulation, Stream Sampling, effluent and stream Standards and Legislation to Control Water Pollution.

11Hrs.

Self-study component: The Students shall visit an industrial plant and learn about the effluent treatment method adopted by the industry. They shall try to witness the effect of flow of treated effluent on stream quality.

MODULE 2

Treatment Methods: Volume Reduction, Strength Reduction, Neutralization, Equalisation and Proportioning. Removal of Inorganic and organic solids, Removal of colloidal and suspended solids. **Combined Treatment:** Feasibility of combined Treatment of Industrial Raw Waste with Domestic Waste. Treatment and Disposal of Sludge Solids.

10 Hrs.

Self-study component: The Students shall visit the effluent treatment plant and learn about the method of treatment adopted.

MODULE 3

Advanced Wastewater Treatment and Reuse: Chemical oxidation, ozonation, wet air oxidation, evaporation, nutrient removal, management of RO rejects. **Treatment process of Industrial Wastes:** Process flow sheet showing origin/sources of waste water, Characteristics of waste, alternative treatment methods, disposal, reuse and recovery along with flow sheet. Effect of disposal on receiving bodies - streams and land.

Self-study component: The Students shall visit Hassan Dairy and learn the specific method of effluent treatment adopted.

MODULE 4

Treatment of Selected Industrial Wastes: Cotton Textile Industry. Tanning Industry, Sugar Industry, Dairy Industry, Canning Industry, Brewery and Distillery Industry Paper and Pulp Industry, Pharmaceutical Industry.

10 Hrs.

Self-study component: The Students shall visit Hassan Dairy and learn the specific method of effluent treatment adopted. Similarly, they shall visit the paper industry to learn about method of effluent treatment.

Text Books:

1. Nemerow, N.L. "Industrial WasteWater Treatment." Edison–Wesley 1980 (Ch.1, 3, 5, 6, 7 & 8)
2. Metcalf & Eddy , "Wastewater Engineering : Treatment, Disposal & Reuse" – Tata McGraw Hill Publishing Company, Third Ed. 1998 (Ch.2 & 4)
3. M.N Rao . A.K Datta' " Wastewater Treatment" Oxford & IBH Publishing Company Pvt Ltd. ISBN: 9878117120

Reference Books:

1. Haward. S Peavy, Donald R Rowe, Environmental Engineering – George Tchnobanglous McGraw Hill International Ed. - 1987
2. Arceivala S.J. "Wastewater treatment for pollution control" 1990
3. Vivek Ranade, Vinay Bhandari , "Industrial Wastewater Treatment, Recycling and Reuse". ISBN: 9780080999685

TRAFFIC ENGINEERING

Course Code	21CV645	**Year**	2023–24	**Semester**	VI
Course Category	PE	**Branch**	Civil	**Course Type**	Professional Elective – 1
Credits	3	**L-T-P-C**	3 – 0 – 0 – 3		
Continuous Internal Evaluation:	50 Marks	**Semester End Evaluation:**	50 Marks	**Total Marks:**	100

Course Outcomes (COs)

Course Outcomes	**At the end of the course the student will be able to:**	**Mapping to POs**
CO1	Identify the characteristics of traffic engineering & to evaluate the feasibility of road by using traffic volume studies & speed studies	PO1, PO2, PO3
CO2	Categorize the road based on LOS and to judge road safety by analyzing accident studies.	PO1, PO2
CO3	Evaluate the arrival pattern of vehicle by traffic flow theories and to develop statistical techniques for minimizing congestion.	PO1, PO2, PO3
CO4	Propose suitable traffic regulation methods, design relevant signal and rotary and to develop a theme of green traffic.	PO1, PO3

Mapping of course outcomes with Program outcomes (CO/PO/PSO Matrix)
Note:1-Weakcorrelation 2-Mediumcorrelation 3-Strongcorrelation
*-Average value indicates course correlation strength with mapped PO

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	2	1											
CO2	3	2												
CO3	3	2	1											
CO4	3		2											
Average *(Rounded tonearestinteger)	3	2	2											

MODULE – 1

Scope of Traffic Engineering: Objectives and scope of traffic engineering, components of road traffic - the vehicle, driver and road, road user characteristics – factors governing, vehicular characteristics, power performance of the vehicle, concepts of passenger car units for mixed traffic flow.

Traffic Engineering Studies and Analysis: Sampling in Traffic Studies, methods of traffic study, equipment, data collection, analysis and interpretation of (i) Spot speed (ii) Speed and delay (iii) Volume (iv) Origin - Destination (v) Parking studies.

12 Hrs

Self-study component: Students shall visit local Traffic control office and discuss the traffic problems and vehicular characteristics and shall calculate the instantaneous speed of vehicle.

MODULE – 2

Traffic capacity studies: Basic capacity, Possible capacity, Practical capacity, LOS concept, Factors affecting capacity & LOS, Capacity of multilane rural highways, urban streets & signalised intersections.

Crash Studies: Objectives – causes – records – preparation of accident report – Condition diagram – Collision diagram – Accident investigations. Analysis of individual traffic accidents – Analysis of speed from skid resistance – Collision of moving vehicle with parked vehicle – Two vehicles approaching at right angles collide–Numerical examples, Measures for reduction in accident rates.

10 Hrs

Self-study component: Students shall collect information on traffic volume, traffic density, causes of accidents, measure for reduction of accidents from local traffic control office.

MODULE – 3

Traffic Flow Theories: Definition – relationship between speed, flow and concentration – Fundamental diagram of traffic flow, Queuing theory – applications, assumptions - Arrival pattern – service facility characteristics, numerical examples, Traffic simulation.

Statistical Analysis: Importance, various statistical methods **-** Regression methods, Poisson distribution, use of chi – squared test, numerical examples on these methods.

10 Hrs.

Self-study component: Students shall study the applications of different probability distributions to traffic problems.

MODULE – 4

Traffic Regulation and Control: Measures to meet the problems, Vehicle, Driver and Road Control – Traffic Regulation – Traffic signs, Traffic Signals – advantages, types, Principles of signal design – methods. Trial cycle method, Webster method and IRC method with numerical examples, Traffic rotary intersection, design guidelines with numerical examples.

ITS in Urban Traffic: Intelligent Transport System**,** Necessities, Application in the present traffic scenario.

10 Hrs.

Self-study component: Students shall visit a traffic junction and observe the working of signals during different times of a day and shall study emerging technologies in urban traffic.

TEXT BOOKS

1. Kadiyali, L. R. (2019). "Traffic Engineering and Transport Planning". Khanna Publishers. ISBN: 978-8174092205
2. Khanna, S. K, Justo, C. E. G, and Veeraragavan A. (2019). Highway Engineering, Nem Chand and Bros, Roorkee. ISBN: 9788185204321, 8185240930

REFERENCES

1. Papacostas, C.A. (2001). "Fundamentals of Transportation Engineering", Prentice-Hall of India Pvt. Ltd., New Delhi. ISBN: 0133448703
2. Kumar, R. S. (2019). "Introduction to Traffic Engineering", University Press. ISBN: 9386235471
3. Partha Chakroborty and Animesh Das (2011), 'Principles of Transportation Engineering', Prentice Hall (India), New Delhi, ISBN: 9788120353459
4. Pignataro, Louis; 'Traffic Engineering-Theory and Practice', John Wiley. Prentice Hall, ISBN: 0139262202.

THEORY OF ELASTICITY

Course Code	**21CV651**	**Year**	2023-24	**Semester**	VI
Course Category	Theory	**Branch**	Civil	**Course Type**	Elective
Credits	3	**L-T-P-C**	3-0-0-3		
Continuous Internal Evaluation:	50	**Semester End Evaluation:**	50	**Total Marks:**	100

Course Outcomes	**At the end of the course the student will be able to:**	**Mapping to POs**
CO1	List the differential equation of equilibrium & boundary conditions- principal stresses & strains in 2 & 3-dimensional stress field for the mathematical representation of stresses & strains at a point.	PO1, PO2, PO3
CO2	Discuss the measurement of surface strains, strain rosettes, compatibility equation. Airy's stress function. 2D problems in rectangular coordinates under different loading conditions.	PO1, PO2, PO3
CO3	Formulate the basic equations of elasticity in polar coordinate system and the stress distribution under axisymmetric loading in thick discs and cylinders-rotating discs and cylinders	PO1, PO2, PO3
CO4	Analyze the stress concentration factor for effect of circular holes on stress distribution in plates	PO1, PO2, PO3

Mapping of course outcomes with Program outcomes(CO/PO/PSOMatrix)
Note:1-Weakcorrelation 2-Mediumcorrelation 3-Strongcorrelation
*-Average value indicates course correlation strength with mapped PO

COs	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO1 0**	**PO1 1**	**PO1 2**	**PSO 1**	**PSO 2**
CO1	3	2	1											
CO2	3	2	1											
CO3	2	3	1											
CO4	2	3	1											
Average *(Rounded tonearestinteger)	2.5	2.5	1.0											

MODULE- 1

Introduction to Mathematical theory of elasticity – Definition of Continuum – Stress and strain at a point – Constitutive laws – Generalized Hooke's law – Strain-displacement relations. **Analysis of Stress:** Introduction – differential equations of equilibrium – Boundary conditions – Principal stresses and principal Planes –Mohr'sCircle.

11Hrs.

Self-study component: Students shall revise the portions from differential calculus and the significance of differential equations, Hooke's Law, elastic constants, stress and strain relations from basic strength of materials.

MODULE- 2

Analysis of Strain: Introduction - Plane stress and Plane strain – Principal planes – measurement of surface strains – Strain rossetes – Compatibility concept – need and physical significance – Compatibility equation in terms of strains. **Two-dimensional Problems in Rectangular Coordinates** –compatibility equations for plane stress and plane strain cases – Airy's stress function – Polynominal stress functions. Bending of a cantilever beam subjected to end load and u.d.l – Simply supported beam subjected to UDL – Displacements in Cantilever and S.S.Beams

11Hrs.

Self-study component: Students shall revise stress - strain relations, beam bending theory, bending stresses from basic strength of materials. They shall also compare the solution from strength of material with that from theory of elasticity, for stressdistribution.

MODULE- 3

Two dimensional problems in polar coordinates: Strain-displacement relations – Equations of equilibrium

– Compatibility equation – Stress-function. Axis**ymmetric problems–** Thick discs and cylinders – Rotating discsandcylinder.

10Hrs.

Self-study component: Students shall revise stress - strain relations, for thin and thick cylinders, stress distribution radial and circumferential.

MODULE- 4

Effect of Circular Holes on Stress Distribution in Plates- Subjected to Tension, compression and shear – Stress concentration factor. **Stresses Due to a Knife Edge Load on the straight edge of a semi-infinite plate:**Boussinesq'sproblem– Problemsofwedgessubjectedtodifferentloadconditions.

10Hrs.

Self-study component:
Students shall revise stress strain relations, for beams intension, compression and shear - stress concentration - stress distribution in semi-infinite plates.

Text Books:

1. Timoshenko S P and Goodier.J.N. " Theory of Elasticity" International Students' Education McGraw Hill Book Co Inc. New Delhi, Third edition 2007[Ch.1,2,3,4,5,6,7,8]
2. Sadhu Singh "Theory of Elasticity". Khanna Publishers, New Delhi, 2007 [Ch.2,3,4,5,6,7)

Reference Books :

1. Valliappan, C "Continuum Mechanics Fundamentals" Oxford and IBH, Publishing Co.Ltd, New Delhi -2003
2. Srinath, L.S. "Advanced Mechanics of Solids" Tata McGraw Hill Publications Co., Ltd., New Delhi- Third edition- third reprint2009.

DESIGN OF MASONRY STRUCTURES

Course Code 21CV652 **L-T-P-C 3-0-0-3**
Exam Hours-3 **Hours/week-3**
CIE-50 marks **Total hours-42**
SEE-50 marks

Course Outcomes	At the end of the course the student will be able to:	Mapping to POs
CO1	Learn different types of masonry units, properties, suitability and types of mortars as per IS 1905	PO1,PO2,PO4
CO2	Comprehend the possible causes of defects in masonry, factors affecting strength of masonry, and permissible stresses in masonry	PO1,PO2,PO4
CO3	Comprehend design parameters like effective height, slenderness ratio, load dispersion, arch action in masonry and design of lintels	PO1,PO2,PO3
CO4	Learn the design of walls subject to both axial and eccentric load as per IS 1905, Design masonry buildings up to three floors as per IS 1905 and SP-20 & Comprehend the concept of reinforced masonry and design reinforced masonry lintels and slabs	PO1, PO2, PO3

Mapping of course outcomes with Program outcomes (CO/ PO/PSO Matrix)
Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation
* - Average value indicates course correlation strength with mapped PO

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	1	3		2										
CO2	1	3		2										
CO3	1	3	2											
CO4	1	2	3											
Average * (Rounded to nearest integer)	1	3	3	2										

MODULE 1

Introduction: Types of masonry units – properties – suitability and applications-classification and properties of mortars-description of types of mortar as per IS 1905; **Masonry Construction:** Defects and errors in masonry constructions causes of cracks in masonry-methods of controlling and prevention of cracks in masonry.

10 Hrs

Self study component: Students shall visit masonry construction site and study different types of masonry units and their usage - different types of mortars used at site (Masonry wall - 1:6, ceiling pestering 1:4) - observe cracks in masonry, direction of crack, origin of cracks etc.,

MODULE 2

Strength of Masonry: Factors affecting strength of masonry – unit strength, joint thickness – rate of absorption, effects of curing etc. – stresses in masonry under direct compressive force- derivation of formulae; **Permissible Stresses**: Permissible basic compressive stress in masonry-stress reduction factor – area reduction factor – shape modification factor-increase in permissible stresses for eccentric – vertical and lateral

loads-permissible tensile stress and shear stress.

10 Hrs

Self study component: Students shall conduct tests on masonry prisms and determine the basic compressive strength of masonry - study the provisions in the code book. 1905 and SP-20.

MODULE 3

Design Considerations: Effective height of walls and columns-different cases- effective length- different design cases-effective thickness-slenderness ratio- eccentricity-load dispersion in masonry- aching action- lintels – design of lintels for different design situations; **Design of Structural Masonry- 1:** Design of walls subjected to axial load & eccentric load

11 Hrs

Self study component: Students shall take up illustrative examples in SP-20 and understand different design situations of structural masonry

MODULE 4

Design of Structural Masonry- 2: Design of walls with openings in different positions-free standing wall- design of load bearing masonry buildings up to 3 storeys as per provisions of IS 1905 and SP 20;

Reinforced Masonry: Applications –methods of placement of reinforcement in masonry-flexural and compression elements- design of reinforced masonry lintels and slabs

11 Hrs

Self study component: Students shall take up illustrative examples in SP-20 and understand different design situations of structural masonry - study the material from internet on reinforced masonry.

Text Books:

1. Hendry A.W. Structural Masonry, Mac Milan Education Ltd., 1990(Ch 1 – 6)
2. P.Dayarathnam- Brick and Reinforced Brick Structures – Oxford and IBH, 1987 (Ch – 1 -8)

Reference Books:

1. SP21 Summary of IS codes on Building Materials – BIS New Delhi
2. SP20 Hand book on Masonry design and Construction BIS New Delhi
3. IS 1905 Code of Practice for use of un-reinforced Masonry – BIS New Delhi
4. Sinha B.P., Davies S.R. " Design of Masonry Structures" E& FN spon – 1997

MODERN CONSTRUCTION METHODS AND MECHANIZATION

Course Code 21CV653 **L-T-P-C 3-0-0-3**
Exam Hours-3 **Hours/week-3**
CIE-50 marks **Total hours-42**
SEE-50 Marks

Course Outcomes	At the end of the course the student will be able to:	Mapping to POs
CO1	Empathize on various methods of advanced construction techniques of sub structure and super structure of the building	PO1, PO2, PO6, PO7
CO2	Know reliable techniques and implementation of the same in construction	PO1, PO2, PO6, PO7
CO3	Understand contemporary issues pertaining to construction methods, equipment usage and management	PO1, PO2, PO6, PO7
CO4	Understand the design of form work and selection of right material for manufacturing false work and form work suiting specific requirements	PO1, PO2, PO6, PO7

Mapping of course outcomes with Program outcomes (CO/ PO/PSO Matrix)
Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation
* - Average value indicates course correlation strength with mapped PO

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	2				1	1							
CO2	3	2				1	1							
CO3	3	2				1	1							
CO4	3	2				1	1							
Average * (Rounded to nearest integer)	3	2				1	1							

MODULE - 1

Sub Structure Construction: Box jacking, pipe jacking – under pinning, trenchless technology, innovative road construction techniques; immerse tube tunnelling. Smart tunnels: application and construction

08 Hrs

MODULE - 2

Super Structure Construction for Building: Vacuum dewatering of concrete flooring – concrete paving technology – techniques of construction for continuous concreting operation in tall buildings of various shapes and varying sections – launching erection techniques of tall structures, large span structures – launching techniques for heavy decks – in situ prestressing in high rise structures, aerial transporting handling erecting lightweight components on tall structures.

11 Hrs.

MODULE - 3

Construction of Special Structures: Erection of lattice towers and rigging of transmission line structures – construction sequence in cooling towers, silos, chimney, sky scrapers, bow string bridges, cable stayed bridges – launching and pushing of box decks

– Advanced construction techniques for offshore structures – construction sequence and methods in domes & prestress domes – support structure for heavy equipment & conveyor & machinery in heavy industries – erection of articulated structures, braced domes & space decks.

11 Hrs.

MODULE - 4

Form Works for Different Construction Techniques

Introduction: Formwork and false work, Temporary work systems, Construction planning and site constraints, Materials and construction of the common formwork and false work systems, Special and proprietary forms. Formwork – Design: Concrete pressure on forms, Design of timber and steel forms, Loading and moment of formwork. Design of Decks and False works: Types of beams, decking and column formwork, Design of decking, False work design, Effects of wind load, Foundation and soil on false work design. Special Forms: The use and applications of special forms. Construction Sequence and Safety in use of Formwork: Sequence of construction, Safety use of formwork and false work.

11 Hrs.

Textbooks:

1. Construction Dewatering: New Methods and Applications by Patrick Powers. J., John Wiley & Sons, 1992.
2. Advanced Construction Techniques by Jerry Irvine, CA Rocketr, 1984.

Reference Books:

1. Allen E, Iano, J, Fundamentals of Building Construction subscription E Book, Material and Method, John Wiley and Sons, 2011.
2. Cameron K. Andres, Ronald C. Smith, Principles and Practices of Commercial Construction, 8 th Ed., Prentice Hall, 2009.
3. Austin, C.K., Formwork for concrete, Cleaver - Hume Press Ltd., London, 1996
4. Robert L. Peurifoy and Garold D. Oberiender, Formwork for Concrete Structures, McGraw-Hill, 1996

URBAN TRANSPORTATION PLANNING

Course Code 21CV654 **L-T-P-C 3-0-0-3**
Exam Hours-3 **Hours/week-3**
CIE-50 marks **Total hours-42**
SEE-50 marks

Course Outcomes	At the end of the course the student will be able to:	Mapping to POs
CO1	Discuss the transport planning process and various techniques adopted to conduct transportation survey, to analyze and forecast future condition of the study area.	PO1, PO2, PO9
CO2	Analyze the factors governing trip generation by adopting statistical tools to understand the problem & different methods of trip distribution.	PO1, PO2,PO4, PO6
CO3	Analyze the general principles of traffic assignment and role of modal split in transport planning process.	PO1, PO2, PO4
CO4	Prepare planning schemes for pedestrians, cyclists and disabled people for transport infrastructure in the urban area	PO1, PO6, PO7

Mapping of course outcomes with Program outcomes (CO/ PO/PSO Matrix)
Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation
* - Average value indicates course correlation strength with mapped PO

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	2							1					
CO2	3	2				2								
CO3	3	2		1										
CO4	3													
Average * (Rounded to nearest integer)	3	2		1		2			1					

MODULE- 1

Transport Planning Process – Inter-dependence of the land use and traffic. Systems approach to transport planning. Stages in transport planning. Survey and analysis of existing conditions. Forecast, Analysis of future conditions and plan Synthesis, evaluation. Programme adoption and Implementation. **Transportation Survey**-Introduction, Definition of the Study Area, Zoning, Types of Surveys-Conventional and modern techniques.

10 Hrs.

Self-study component: The students shall learn various transportation survey techniques and to adopt the same in the smaller area of the city.

MODULE- 2

Trip Generation – Trip purpose – Factors governing Trip generation and Attraction on routes, Multiple linear regression analysis – Assumptions validity in trip generation studies. Aggregated and disaggregated analysis. Criteria for evaluation of Regression equations, category analysis – Assumptions. Critical appraisal of category analysis techniques. **Trip Distribution:** Method of trip distribution, Uniform factor method, Average factor method – Fratar method. Furness method, criticism of growth factor method, Gravity model, Calibration of gravity model, Tanner's model, Opportunity model with relevant numerical problems

10 Hrs

Self-study component: The students shall learn the trip generation and trip distribution methods and same to be adopted in the some ward of the city.

MODULE- 3

Traffic Assignment: General principles – Assignment techniques – All or nothing assignment – Multiple route assignment – capacity resistant assignment – Smock method –Diversion curve with numerical examples. **Modal Split -** Factors affecting modal split – Modal split in transportation planning process.

10 Hrs

Self-study component: The students shall learn traffic assignment techniques and importance of modal split and then adopt the same to the town/urban area.

MODULE- 4

Planning for pedestrians, cyclists and disabled people: Identifying the needs of pedestrians, cyclists and disabled people, identifying priorities of need, Pedestrian and cyclist characteristics and requirements influencing design, Special needs of elderly and disable people. **Planning for Public Transport**: Appropriate public transport modes, Commercial services, Subsidized services, Socially optimal pricing and service levels in public transport, Public transport provision in practice, Ownership and regulation.

10 Hrs

Self-study component: The students shall visit important roads and understand the available infrastructural facilities in the urban area. The student shall also visit Karnataka State Road Transport Corporation Limited and to study the public transport buses and implementation of the schedules in the urban area.

Text Books:

1. C. A. O'Flaherty, Transport Planning and Traffic Engineering, Elsevier Publishers, New Delhi, 2006. (Module-4).
2. Kadiyali.L.R. Traffic Engineering and Transport Planning, Ninth Edition, Khanna Publishers, New Delhi, 2017. (Module-1, 2 and 3).

Reference Books:

1. Black John, " Urban Transport planning", Croom Helm ltd, Landon 3rd edition, 2005.
2. DilipHalder, Studies in Urban Transport, Bookwell, New Delhi, 2007.
3. Hutchison B. G, Principles of Urban Transport Systems Planning, McGraw-Hill Book Company, 1974.
4. Peter Bonsall, Quasim Dalvi& Peter J Hills, Urban Transportation Planning: Current Themes and Future Prospects, Abacus Press, New Jersey, 1977.

GROUNDWATER HYDRAULICS

Course Code 21CV655 **L-T-P-C 3-0-0-3**
Exam Hours-3 **Hours/week-3**
CIE - 50 marks **Total hours-42**
SEE - 50 marks

Course Outcomes	At the end of the course the student will be able to:	Mapping to POs
CO1	Scope of Groundwater Resources utilization, planning, & conserving Ground water resources	PO1, PO2, PO3
CO2	Students will get the knowledge about Aquifer	PO2, PO3, PO4
CO3	Students will get the knowledge about underground flow characteristics	PO2, PO4, PO5
CO4	Students will get the knowledge about Aquifer recharge and utilization of ground water	PO3, PO4, PO5

Mapping of course outcomes with Program outcomes (CO/ PO/PSO Matrix)
Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation
* - Average value indicates course correlation strength with mapped PO

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	1	2											
CO2		2	3	1										
CO3		3		2	1									
CO4			3	2	1									
Average * (Rounded to nearest integer)	3	2	3	2	1									

MODULE-1

Introduction: Importance, Vertical distribution of sub-surface water. Occurrence in different types of rocks and soils. Definition of aquifer, Aquifuge, Aquitard and aquiclude. Confined and unconfined aquifers; **Aquifer Properties:** Aquifer Parameters-Specific yield, Specific retention, Porosity, Storage coefficient derivation of the expression. Determination of specific yield, Land subsidence due to ground water withdrawals.

10 Hrs

Self-study component: Students shall collect the ground water depilation information form the department of geology. Information from the observation well and their data of ground water level

MODULE-2

Darcy's Law and Hydraulic Conductivity: Introduction, Darcy's law, Hydraulic conductivity. Coefficient of permeability & Intrinsic permeability, Transmissibility, Permeability in Isotropic and Anisotropic layered soils. Steady one-dimensional flow, different cases with recharge of ground water; **Well Hydraulics – Steady Flow:** Introduction, Steady radial flow in confined and unconfined and unconfined aquifers, Pumping tests

10 Hrs.

Self-study component: Collect the information on the existing number of borewells

in Hassan districts & their classification on basis of ownership (government /private) and permission from the athority (with permission/without permission).

MODULE-3

Well Hydraulics – Unsteady Flow: Introduction, General equation derivation; Theis method, Cooper- Jacob method, Chow's method. Solution of unsteady flow equations; **Ground Water Development:** Types of wells, Method of constructions, Tube well design, Dug Wells, pumps for lifting water-working principles, Power & stages requirements. Sea water intrusion

10 Hrs.

Self-study component: Students shall collect the information on types of ground water recharge structures. Information on existing recharge structure in Hassan District.

MODULE-4

Ground water Explorations: Seismic method, Electrical resistivity method, Bore hole geophysical techniques- Electrical logging, Radio wave logging, Induction logging, Sonic logging, and Fluid logging; **Ground water recharge and Runoff**: Recharge by vertical leakage, Artificial recharge, Ground water runoff, Ground water budget.

10 Hrs

Self-study component: Review on Watershed development, different policies, and schemes by government (public and private). Best examples at district level, State level and national level

Textbooks:

1. Raghunath H.M "Ground Water" 4th Edition, New Age International Publishers, 2008
2. David K.Todd. Larry W.Mays "Groundwater Hydrology" 3rd Edition, Wiley India Pvt. Ltd, New Delhi.

Reference Books:

1. Jaya Rami Reddy P "Hydrology" 3rd Edition, Laxmi Publications Pvt. Ltd. New Delhi.
2. Rastogi A. K. "Numerical Groundwater Hydrology Hardcover" Penram International Publishing. (Ind) Pvt Ltd, Mumbai, 2008.

SOLID WASTE MANAGEMENT

Course Code	**21CV656**	**Year**	2023-24	**Semester**	VI
Course Category	PE	**Branch**		**Course Type**	Elective
Credits	3	**L-T-P-C**	3-0-0-3		
Continuous Internal Evaluation	50	**Semester End Evaluation**	50	**Total Marks**	100

Course Outcomes	**At the end of the course the student will be able to:**	**Mapping to POs**
CO1	Analyze existing solid waste management systems and to identify their drawbacks.	PO1,PO2,PO7
CO2	Evaluate different elements of the solid waste management system.	PO1,PO6,PO7
CO3	Suggest suitable scientific methods for solid waste management elements.	PO1, PO2,PO7
CO4	Design a suitable processing system and evaluate disposal sites.	PO1,PO6, PO7

Mapping of course outcomes with Program outcomes (CO/ PO/PSO Matrix)
Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation
* - Average value indicates course correlation strength with mapped PO

COs	**PO1**	**PO2**	**PO3**	**PO 4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO1	3	2					1							
CO2	3					1	2							
CO3	3	2					1							
CO4	3					2	2							
Average * (Rounded to nearest integer)	3	2				2	2							

MODULE - 1

Introduction: Scope and importance of solid waste management – Classification, source and characteristics. Estimation of energy content and derivation of approximate chemical formula. Material flow and Functional elements of solid waste management.

Collection and transportation: Types of collection service. Systems of collection – hauled container and stationary container system. Estimation of solid waste quantities. Transport methods, Transfer station and route optimization techniques.

11 Hrs

Self- study component: Students shall visit various parts of the city and study the functional elements of solid waste management-systems of collection, submit a report

MODULE - 2

Solid waste Processing: Mechanical volume reduction, Chemical volume reduction, Mechanical size reduction, Component separation, Drying and dewatering.Life Cycle Assessment and Integrated Waste management using 3Rs and 4Rs concepts.

Thermal Treatment: Incineration (Process, advantages and disadvantages, 3T's of incineration process) and plasma arc.

Incineration Emission Control Technologies: Gravitational settling chambers, Cyclone separator, Fabric filters, Electrostatic precipitators and Scrubbers.

10 **Hrs**

Self- study component: Students shall visit various parts of the city and study the transportation, treatment and incineration process, submit a report

MODULE - 3

Biological Treatment: Objectives, Aerobic and anaerobic composting – process and design consideration. Bangalore process of composting and Indore process of composting. Factors affecting composting. Vermicomposting.

Engineered Land Filling: Different types – Trench, area and Ramp Method. Advantages and disadvantages, Site selection. Landfill gases and Leachate generation, Bioreactor Landfilling.

11 **Hrs**

Self- study component: Students shall visit town municipality office and collect information on composting processes, land filling methods, submit a report

MODULE - 4

Disposal Methods: Open dumping, Ocean disposal and feeding to hogs

Biomedical wastes and disposal: classification, potential implication and steps in waste management.

Electronic waste management: categories, composition, environmental and health hazard, e-waste management.

Waste management handling and rules, regulations and legislation.

10 Hrs

Self- study component: Students shall visit town municipality office and collect information on disposal methods, biomedical waste-environmental significance of reuse and recycling, submit a report.

Text Books:

1. Integrated Solid Waste Management: Engineering principles and management issues, George Tchobanoglous, Hilary Theisen , Samuel A Vigil, published by M/c Graw hill Education . Indian Edition 2014. ISBN – 13: 978- 9339205249, ISBN-10 : 9339205243
2. Environmental Engineering, Howard S Peavy, Donald R Rowe and George Tchobanoglous, Tata Mcgraw Hill Publishing Co ltd., 2013, ISBN-13 9789351340263.

Reference Books:

1. Municipal Solid Wastes (Management and Handling) Rules, 2000.Ministry of Environment and Forests Notification, New Delhi, the 25th September, 2000. Amendment – 1357(E) – 08-04-2016
2. Municipal Solid waste management manual, Part II published under Swachh Bharat Mission, Central Public Health And Environmental Engineering Organization (CPHEEO), 2016, Ministry of Urban Development, Government of India.
3. Handbook of Solidwaste management, Second Edition, George Tchobanoglous, Frank Kreith, published by M/c Graw hill Education, 2002, ISBN-13 978-0071356237 ISBN -10 0071356231

REMOTE SENSING AND GIS

Course Code 21OECV661 **L-T-P-C 3-0-0-3**
Exam Hours-3 **Hours/week-3**
CIE-50 marks **Total hours-42**
SEE-50 marks

Course Outcomes	At the end of the course the student will be able to:	Mapping to POs
CO1	Describe the concept of Remote Sensing and Energy interactions	PO2, PO4, PO6
CO2	Discuss Remote sensing Platforms, type of Sensors & data collection	PO3, PO5, PO6
CO3	Learning and understanding geographical information system	PO1, PO4, PO7
CO4	Data interpretation and data processing. Application of RS & GIS	PO5, PO4, PO8

Mapping of course outcomes with Program outcomes (CO/ PO/PSO Matrix)
Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation
* - Average value indicates course correlation strength with mapped PO

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1		2		3		1								
CO2			2		3	1								
CO3	3			2			1							
CO4				3	2			1						
Average * (Rounded to nearest integer)	3	2	2	3	3	1	1	1						

MODULE - 1

Remote Sensing: Basic concept of Remote sensing, Active and Passive Remote sensing (RS), Scope of remote sensing; Electromagnetic radiation and electromagnetic spectrum: Visible, Infra-Red (IR), Near IR, Middle IR, Thermal IR, and Microwave. Black body radiation and radiation laws; Interaction of EMR with atmosphere and Earth's surface features, Resolution, image registration and Image and False color composite, elements of visual interpretation techniques. **10 Hrs.**

Self - study component: Students shall collect the information on space research organizational structure, Types of Indian satellites, and data products

MODULE - 2

Remote Sensing Platforms and Sensors: Indian Satellites and Sensors characteristics, Remote Sensing Platforms, Sensor's resolutions (spatial, spectral, radiometric, and temporal) and Properties of Digital Data, Data Formats & products: IRS, LANDSAT, SPOT, CARTOSAT, IKONOS, ENVISAT etc. Basics of digital image processing, systematic errors (Scan Skew, Mirror-Scan Velocity, Panoramic Distortion, Platform Velocity, Earth Rotation) and non-systematic (random) errors, Image enhancements (Gray Level Thresholding, level slicing, contrast stretching), image filtering. **12 Hrs.**

Self-study component: Students shall collect the information on commercial and open-source Remote Sensing data for use in GIS. Download free DEM and LULC data.

MODULE - 3

Geographic Information System: Introduction to GIS; components of a GIS; Geographically Referenced Data, Spatial Data- Attribute Data-Joining Spatial and attribute data, GIS Operations: Spatial Data Input –

Attribute data Management, Geographic Coordinate System, Datum; Map Projections: Types of Map Projections, Projected Coordinate Systems. UTM Zones. **10 Hrs.**

Self-study component: Students shall collect the information on different commercial and open-source GIS software

MODULE - 4

Data Models: Vector data model: Representation of simple features – Topology and its importance; coverage and its data structure, Shape file; Relational Database, Raster Data Model: Elements of the Raster data model, Types of Raster Data, Raster Data Structure, Data conversion. Integrated Applications of Remote sensing and GIS: Applications in land use land cover analysis, change detection, water resources, urban planning, environmental planning, Natural resource management and Traffic management. Location Based Services and Its Applications. **10 Hrs.**

Self-study component: Students shall collect the information on different GPS system in world and their working.

Text Books:

1. Lillesand, Kiefer, Chipman, Remote Sensing and Image Interpretation, Wiley 2015.
2. Basudeb Bhatta, Remote sensing and GIS, Oxford University Press 2019.

Reference Books:

1. George Joseph, "Fundamentals of Remote Sensing" –Universities Press, Hyderabad, 2018
2. Narayan Panigrahi, "Geographical Information Science", University Press, New Delhi 2010.
3. Kang-Tsung Chang, "Introduction to Geographic Information System". Tata McGraw Hill Education Private Limited 2019.

ENGINEERING OPTIMIZATION

Course Code 21OECV662 **L-T-P-C 3-0-0-3**
Exam Hours-3 **Hours/week-3**
CIE-50 marks **Total hours-42**
SEE-50 marks

Course Outcomes	At the end of the course the student will be able to:	Mapping to POs
CO1	Discuss the concept and need of optimization in engineering.	PO2, PO3, PO4
CO2	Use conventional methods of optimization under constraints and the concept of linear programming to typical Engineering problems	PO2, PO3
CO3	Apply the numerical methods for design optimization problems	PO1, PO3
CO4	Apply genetic algorithms for optimum design of structural elements	PO2, PO4

Mapping of course outcomes with Program outcomes (CO/ PO/PSO Matrix)
Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation
* - Average value indicates course correlation strength with mapped PO

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO 1	PSO 2
CO1	3	2		1										
CO2	3	2		1										
CO3	2		3											
CO4		2		3										
Average * (Rounded to nearest integer)	3	2	2	2										

MODULE – 1

Classical Optimization Techniques: Engineering applications, Statement of optimization problem, Classification of optimization problems, Optimization techniques. Single variable optimization, Multivariable optimization with no constraints, with equality constraints - Lagrange multiplier - method, constrained variation method. **12 Hrs**

Self-Study Component- Students shall develop excel programming spreadsheets to solve classical methods by method of calculus.

MODULE – 2

Linear Programming: Standard form of linear programming problem, simplex method, two phase simplex method - application problems. **10 Hrs**

Self-Study Component- Students shall use any programming tools to solve Linear programming problem with graphical and simplex methods.

MODULE – 3

Design optimization of structural elements. Application Problems: Optimum design of steel structural elements. Algorithms for optimum designs **10 Hrs**

Self-Study Component- Students shall Visit the construction site to see the actual RC working drawings. Understand the same and compare with the theory and prepare the report on the same.

MODULE - 4

Genetic Algorithms: Introduction – fitness function, crossover and mutation - Application problems.

10 Hrs

Self-Study Component- Students shall write the flow-charts and algorithms for application of fitness function and mutation genetics.

Self-study component:

Text Books:

1. Rao, S.S. - Optimization Theory and Applications, Wiley Eastern Limited,1978.
2. Fox, R.L. - Optimization Methods for Engineering Design, Addison Wesley, 1971

Reference Books:

1. Stark. R.M. Nicholls.R.L., Mathematical Foundations for Design, McGraw Hill Book Company.
2. NarsingkDeo – System simulation with digital computer, Prentice – Hall of India Pvt, Ltd. New Delhi – 1989.

COMPOSITES AND SMART MATERIALS

Course Code	**21OECV663**	**Year**	2023 – 24	**Semester**	VI
Course category	OE	**Branch**	Civil Engg.	**Course Type**	Open Elective
Credits	03	**L-T-P-C**	**3-0-0-3**		
Continuous Internal Evaluation:	50 Marks	**Semester End Evaluation:**	50 Marks	**Total Marks:**	100

Course Outcomes	**At the end of the course the student will be able to:**	**Mapping to POs**
CO1	Comprehend the basic properties and manufacturing process along with their application in various industries for different types of Composites	PO2, PO3
CO2	Perceive different classes of ceramic and polymeric smart materials; development of actuators and sensors and their integration into a smart structure	PO2, PO3
CO3	Apply the principles to various fields like automobile, space, medical, automotive, building construction, etc	PO2, PO3
CO4	Design of embedded & surface mounted, piezoelectric devices	PO1, PO2, PO3

Mapping of course outcomes with Program outcomes(CO/PO/PSO Matrix)
Note:1-Weak correlation 2-Medium correlation 3-Strong correlation
*-Average value indicates course correlation strength with mapped PO

COs	**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**
CO1		3	2											
CO2		3	2											
CO3		2	1											
CO4	3	2	1											
Average *(Rounded to nearest integer)	3	2.5	1.5											

MODULE – 1

Introduction to Composite materials: Classifications and applications of fibers, volume fraction and load distribution among constituents, minimum & critical volume fraction, compliance & stiffness matrices. **Anisotropic elasticity** - Unidirectional and anisotropic lamina, thermo- mechanical properties, micromechanical analysis, classical composite lamination theory. **13Hrs.**

Self-Study component: Student shall gain knowledge about the innovative composite materials and their applications in civil engineering domain.

MODULE – 2

Anisotropic elasticity (Cont'd) - Cross and angle–ply laminates, symmetric, antisymmetric and general asymmetric laminates, mechanical coupling and laminate stacking. **09 Hrs**

Self-Study component: Student shall explore appropriate websites to observe the behaviour of composite material subject to varying temperature

MODULE – 3

Analysis of simple laminated structural elements - Ply-stress and strain, lamina failure theories - first fly failure, environmental effects and manufacturing of composites. **10 Hrs**

Self-Study component: Student shall learn different types of composite materials and their application in aircraft design

MODULE – 4

Smart materials - Introduction, Types of smart structures, actuators & sensors, embedded & surface mounted, piezoelectric coefficients, phase transition, piezoelectric constitutive relation. **10 Hrs**

Self-Study component: Student shall learn about self-healing materials used in aircraft industry etc

Textbooks:

1. Robart M Jones, "Mechanic of Composite Materials", McGraw Hill Publishing Co, ISBN 10: 0891164901 ISBN, 13: 9780891164906, Wonder book seller , Frederick, USA.
2. Bhagwan D Aggarwal and Lawrence J Broutman, "Analysis and Performance of Fiber Composites", ISBN: 978-1-119-38997-2, John Willy and Sons, NewYork.

References:

1. Crawley, E and de Luis, J., "Use of piezoelectric actuators as elements of intelligent structures", AIAA Journal, Vol. 25 No 10, Oct 1987, PP 1373-1385.
2. Crawley, E and Anderson, E., "Detailed models of Piezoceramic actuation of beams", Proc. of the 30th AIAA /ASME/ASCE/AHS/ASC- Structural dynamics and material conference, AIAA Washington DC, April 1989
3. Lecture notes on "Smart Structures", by Inderjith Chopra, Department of Aerospace Engg., University of Maryland.

URBAN DESIGN AND REGENERATION

Course Code	21OECV664	Year	3	Semester	6
Course Category	OE	Branch	CIVIL	Course Type	theory
Credits	03	L-T-P	3-0-0		
Continuous Internal Evaluation:	50 marks	Semester End Evaluation:	50 marks	Total Marks:	100

Course Outcomes	At the end of the course the student will be able to:	Mapping to POs
CO1	Discuss the strategies involved in Urban regeneration.	PO6, PO7
CO2	Interpret the various planning tools regarding the urban assets	PO6, PO8
CO3	Review the public and private sector roles and relationships and project phasing in the implementation of the urban regeneration projects	PO7, PO8
CO4	Report on the translation of the concepts of urban regeneration in a case study project.	PO9,PO10, PO12

Mapping of course outcomes with Program outcomes (CO/ PO/PSO Matrix)
Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation
* - Average value indicates course correlation strength with mapped PO

COs	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
CO1						3	2							
CO2						2		1						
CO3							2	1						
CO4									3	2		1		
Average * (Rounded to nearest integer)						2.5	2	1	3	2		1		

MODULE - 1

Definition, the three orientations, the interrelated groups of spaces in the domain of urban design, the eight elements of urban design. The process of urban regeneration projects. The fundamental first phase – Scoping: The key components, macro and microlevel scoping. The Planning Process: defining the planning framework, master planning, developing design standards, Setting the scene, defining the implementation process and Institutional arrangements, partnering arrangements with the private sector, defining early wins. The Financial tools: Municipal finance tools, land specific financial and regulatory tools for public land. Financial tools for private lands (non capital markets and capital markets), Regulatory tools for private lands (policy and fiscal).

Self- study component:

Study of the Review of the Book "The Urban Design Process" by Hamid Shirvani.

MODULE - 2

Urban assets – First asset land: ownership regimes, tools for land assembly (voluntary and involuntary), land

tools for public asset management, land regulatory frameworks. Second asset community: Tools for community participation, charrettes, using technology for public participation.. Third asset: Environment: Site assessment, site investigation, EIA and site remediation plan.

Self- study component: : Examine the tools for public participation in case studies from the world Bank report Regenerating Urban Land: A Practitioner's Guide to Leveraging Private Investment.

MODULE - 3

Social equity aspects of regeneration. Interventions for a more socially equitable regeneration project. The potential undesirable impacts of urban regeneration: Gentrification and Loss of social capital. Tools to mitigate the undesirable social impacts: resettlement, principle of minimizing displacement, compensation, Inclusionary zoning and housing vouchers.

Self- study component: Reading of the book "Uses of Disorder" by Richard Senett and short review writing on any one chapter of the book.

MODULE - 4

Implementation Phase. Political leadership, Public and private sectors roles and responsibilities, phases of implementation, Framework for assessing and mitigating risks : political, financial, technical environmental, Land ownership and regulation, stakeholders, fiduciary and commercial risks.

The parameters that influence the urban regeneration strategy: Landuse and zoning, historical preservation, environmental features, open spaces, building form, people participation, economic base, infrastructure and transportation networks, urban planning policies and political leadership. case study for each parameter

Self- study component: Collect information and read about Government of India strategies like Swachh Bharat Mission - Urban (SBM-U), Pradhan Mantri Awas Yojana - Urban (PMAY-U), Smart Cities Mission (SCM), Atal Mission for Rejuvenation and Urban Transformation (AMRUT), Deendayal Antyodaya Yojana - National Urban Livelihoods Mission (DAY-NULM) and Heritage City Development and Augmentation Yojana (HRIDAY)

Text Books:

1.Hamid Shirvani, "The Urban Design Process" Van Nostrand Reinhold, 1985

1. Amirtahmasebi, Rana, Mariana Orloff, Sameh Wahba, and Andrew Altman. Regenerating Urban Land: A Practitioner's Guide to Leveraging Private Investment. 2016. Urban Development Series. Washington, DC: World Bank. doi: 10.1596/978-1-4648-0473-1. License: Creative Commons Attribution CC BY 3.0 IGO

Reference Books:

1. Urban Regeneration, A Handbook, edited by Peter Roberts and Hugh Skyes. Sage Publications Limited 2008.
2. Ministry of Housing and Urban Affairs, Government of India, "Transforming Urban Landscape" 2014-19

RAILWAY ENGINEERING

Course Code	21OECV665	Year	2023–24	Semester	VI
Course Category	O E	Branch	Civil	Course Type	Open Elective
Credits	3	L-T-P-C	3 – 0 – 0 – 3		
Continuous Internal Evaluation:	50 Marks	Semester End Evaluation:	50 Marks	Total Marks:	100

Course Outcomes (COs)

CO's	At the end of the course the student will be able to:	Mapping to PO's
CO1	Illustrate the role of railways, comparing with other modes and highlight the initiatives by Indian railways towards tourism.	PO1, PO2
CO2	Explain the various key elements of a railway track, their types and methods of surveying.	PO1, PO2, PO3
CO3	Summarize the various methods of construction, types of gradients and superelevation concept.	PO1, PO2, PO3
CO4	Suggest the methods of maintenance of track, modernization concepts and methods of reducing railway expenses.	PO1, PO2

Mapping of course outcomes with Program outcomes (CO/PO/PSO Matrix)

Note:1-Weakcorrelation 2-Mediumcorrelation 3-Strongcorrelation

*-Average value indicates course correlation strength with mapped PO

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	2												
CO2	3	2	1											
CO3	3	2	1											
CO4	3	2												
Average *(Rounded to nearest integer)	3	2	1											

MODULE – 01

Introduction: Role of railways in transportation, Classifications of modes, Comparison with other modes of transportation. Historical development of railways in India. Advantages of railways. Selection of routes-preliminary and locations surveys. Classifications of Indian Railway lines, Organization of Indian Railways & production units. Initiatives by Indian Railways for development of tourism sector.

10 Hrs.

Self-study component: Students shall visit nearby Railway station, discuss with the staff regarding the zone of that particular station. Also, collect details on number of trains operating, financial aspects, prepare a report and submit.

MODULE – 02

Permanent way: Rail – functions, classifications and types. Sleepers – functions, classifications and requirements. Ballast – functions, requirements and types. Gauges – types. Cross section of permanent way, Coning of wheel, Creep of rail, Rail damage –defects, Failures and Wear of rail. Calculation of quantity of materials needed for laying of tracks.
Track alignment – Basic requirement factors. Surveying – types.

10 Hrs.

Self-study component: Students shall visit nearby Railway station and observe the components of railway track, rail joints, sleepers and other details, prepare a report and submit.

MODULE – 03

Geometric Design of Track: Gradient–necessity, ruling gradient, pusher gradient, momentum gradient, gradients in station yards. Superelevation– cant deficiency and negative cant – numerical examples.
Points and Crossings: Types of switches, types of crossings, Classification of Crossing According to Manufacturing Process, Turnouts – common layouts – Inspection and maintenance

10 Hrs.

Self-study component: Students shall visit nearby Railway station and discuss with the railway staff regarding track construction procedure, type of gradient, speed of train, prepare a report and submit.

MODULE – 4

Maintenance of track – Necessity, Advantages & types. Safety in railways – Railway accidents, Classifications, Causes and prevention. Emergency methods of restoring railway traffic. Nationalisation of railways, advantages & disadvantages. Zonal grouping of railways.
Modernization of railway track – Modern developments, High speed tracks.
Railway expenses, rates & fares – Characteristics, measures to reduce expenses & railway budget.

10 Hrs.

Self-study component: Students shall visit nearby Railway station and discuss with the railway staff regarding track maintenance, steps taken towards modernization prepare a report and submit.

Text Books:

1. S C Saxena and Arora "Railway Engineering" Dhanpath Rai and Sons, New Delhi-2015. ISBN: 978 – 9383182923
2. M M Agarwal, "Indian Railway Track" Oxford Publications, Bombay – 2018. ISBN-13: 978-0-19-568779-8.

Reference Books:

1. Rangawala, "Principles of Railway Engineering" Charotar Publishing House, New Delhi – 2017. ISBN: 8192869253.
2. Sathish Chandra, "Railway Engineering" Oxford University Press, New Delhi – 2013. ISBN-10: 0-19-568779-5.
3. Amith Gupta, "Railway Engineering" Standard Publishers Distributors, New Delhi – .2015. ISBN: 81–8014–011–3.

WATER SUPPLY AND SANITATION

Course Code	**21OECV666**	**Year**	2023-24	**Semester**	VI
Course Category	OE	**Branch**	Civil	**Course Type**	Open Elective
Credits	3	**L-T-P-C**	3-0-0-3		
Continuous Internal Evaluation	50	**Semester End Evaluation**	50	**Total Marks**	100

At the end of the course the student will be able to:

CO1	Estimate average and peak water demand for a community.	PO1,PO2, PO6
CO2	Evaluate water quality and plan suitable treatment system	PO1,PO2, PO6
CO3	Estimate average and peak wastewater from a community and design suitable conveyance systems for sewage and storm water	PO1,PO2,PO3,
CO4	Evaluate wastewater quality and Design a comprehensive wastewater treatment system	PO1,PO2,PO3,

Mapping of course outcomes with Program outcomes (CO/ PO/PSO Matrix)
Note: 1- Weak correlation 2-Medium correlation 3-Strong correlation
* - Average value indicates course correlation strength with mapped PO

COs	**PO1**	**PO2**	**PO3**	**PO 4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO 1**	**PSO 2**
CO1	2	3				1								
CO2	2	3				1								
CO3	1	2	3											
CO4	1	2	3											
Average * (Rounded to nearest integer)	2	3	3			1								

MODULE 1

Introduction: Need for protected water supply, Factors affecting water supply scheme and benefits. **Demand Of Water:** Types of water demands - domestic demand, institutional and commercial, public uses, fire demand. Factors affecting per-capita demand, variations in demand of water, Peak factor, Design periods and factors governing the design period. Different methods of Population forecasting. **Sources:** Concept of hydrological cycle, Surface and subsurface sources - suitability with regard to quality and quantity. Factors governing the selection of particular source of water. **Collection and Conveyance of Water:** Intake structures - different types of intakes; factors for the selection and location of intakes.

10 Hrs.

MODULE 2

Quality of Water: Concept of safe water: wholesomeness, palatability and potable. Physico Chemical characteristics.

Water Treatment: Objectives and Treatment flowchart – significance of each unit. **Aeration –** Principle and types of aerators. **Sedimentation**: Theory, settling tanks, types and design. **Filtration**: Mechanism - theory of filtration, types of filters- slow sand, rapid sand and pressure filters **Disinfection**: Definition, Requirements, methods of disinfection.

Softening: Definition, methods of removal of hardness by lime soda-process and zeolite process with merits and demerits

Hrs.

MODULE 3

Wastewater: Wastewater disposal - Necessity for sanitation, types of sewerage systems and their suitability. Quantification of sewage and estimation of storm water flow **Sewer:** Sewer pipe materials, Shapes of sewers, laying of sewers, jointing and testing of sewers, ventilation and cleaning of sewer. **Sewer Appurtenances:** Catch basins, Manholes, Flushing tanks, oil and grease traps, Drainage traps, Basic principles of house drainage, typical layout plan showing house drainage connections

10 Hrs.

MODULE 4

Analysis of Sewage: Physical, chemical, and biological characteristics. **Treatment of Sewage:** Flow diagram of municipal sewage treatment plant. **Primary treatment:** screening, grit chambers, skimming tanks and design of primary sedimentation tank.

Secondary treatment: Trickling filter, Activated sludge process -Principle and flow diagram. Methods of sludge disposal: Sludge digestion and Sludge drying beds. **Miscellaneous Treatment Methods:** Septic tanks and Oxidation Pond. Introduction to RBC, UASB, Anaerobic filters.

10 Hrs.

Self Study Component: *Visit to intake structure, water and wastewater treatment plant and report working of each unit. Design of water and wastewater treatment plant units and distribution system with population forecasting for the given city. Water conservation methods.*

Text Books:

1. Water Supply Engineering: Environmental Engineering - Vol. I – 2017 Santosh Kumar Garg, Khanna Publisher, ISBN-10: 9788174091208
2. Punmia B.C. and Ashok Kumar Jain, **"Environmental Engineering- I**",Arihant Publications
3. S. K. Garg ―Environmental Engineering: Sewage Disposal and Air Po llution Engineering (Volume - 2), 33 Edition, 2015, Khanna Publishers, ISBN: 9788174092304, 8174092307.
4. Punmia B. C. and Jain A., "Environmental Engineering-II, ArihantPublications, 1995 (Ch. 1 & 2)

Reference Books:

1. Hammer and Hammer, "**Water Technology",** Mc Graw Hill Publications Howard S. Peavy, Donald R. Rowe. George Tchobanoglous, **"Environmental Engineering"** - McGraw Hill International Ed. ISBN-10: 9351340260
2. CPHEEO Manual on water supply and treatment engineering, Ministry of Urban Development, Government of India, New Delhi, 3rd Edition, 2018, Akalank Publications; ISBN-10: 8176393819
3. Waste Water Treatment, Disposal and Reuse -Metcalf and Eddy inc, Tata McGraw Hill Publications (2008 Edition), ISBN-10: 0071008241, ISBN-13: 978-0071008242
4. Wastewater treatment Concepts and Design Approach by Karia G.L., C hritian R.A. Second Edition, 2013. Prentice Hall India Private limited, ISBN-10: 8120328604, ISBN-13: 978-8120328600.