B. Tech (Regular-Full Time)

(Effective for the students admitted into I year from the Academic Year **2023-24** onwards)

CIVIL ENGINEERING

IV YEAR COURSE STRUCTURE

IV B.Tech I Semester

S.No.	Course code	Title	L	T	P	Credits
1	23CET21	Finite Element Methods	3	0	0	3
2	23MBTU4a 23MBTU4b 23MBTU4c	**Management Course-II** 1.Business Ethics and Corporate Governance 2.E-Business 3.Management Science	2	0	0	2
3	23CET22a 23CET22b 23CET22c	**Professional Elective-IV** 1.Geo-synthetics and Reinforced Earth Structures 2.Railways, Airports, Docks and Harbour Engineering 3. Experimental Stress Analysis	3	0	0	3
4	23CET23a 23CET23b 23CET23c	**Professional Elective-V** 1. Ground Improvement Techniques 2. Subsurface Investigation and Instrumentation 3. Transportation Economics	3	0	0	3
5	23EET22	**Open Elective-III** Smart Grid Technologies	3	0	0	3
6	23CST23d	**Open Elective-IV** Internet of Things	3	0	0	3
7	23CEP14	**Skill oriented course** Skills in Civil Engineering software (STAADPRO/CAD/TEKL)	0	1	2	2
8	23BST39	**Audit Course** Gender Sensitization	2	0	0	-
9	23CEP15	Evaluation of Industry Internship	-	-	-	2
Total			**19**	**1**	**2**	**21**

Open Elective – III

S.No	Course Code	Course Name	Offered by the Dept.
1	23EET22	Smart Grid Technologies	EEE
2	23MET23	3D Printing Technologies	ME
3	23ECT12	Microprocessors and Microcontrollers	ECE
4	23CST32	Data Base Management Systems	CSE & Allied/IT
5	23CST18b	Cyber Security	
6	23BST30	Wavelet Transforms and its Applications	Mathematics
7	23BST31	Smart Materials and Devices	Physics
8	23BST34	Introduction to Quantum Mechanics	
9	23BST32	Green Chemistry and Catalysis for Sustainable Environment	Chemistry
10	23BST33	Employability Skills	Humanities

Open Elective – IV

S.No	Course Code	Course Name	Offered by the Dept.
1	23EET25	Electric Vehicles	EEE
2	23MET24	Total Quality Management	ME
3	23ECT29	Transducers and Sensors	ECE
4	23CST33	Introduction to Computer Networks	CSE & Allied/IT
5	23CST23d	Internet of Things	
6	23CST34	Introduction to Quantum Computing	
7	23BST35	Financial Mathematics	Mathematics
8	23BST36	Sensors and Actuators for Engineering Applications	Physics
9	23BST37	Chemistry Of Nanomaterials and Applications	Chemistry
10	23BST38	Literary Vibes	Humanities

IV B.Tech. II Semester

S.No.	Course code	Title	Category	L	T	P	Credits
1	23CEP16	Internship		-	-	-	4
		Project		-	-	-	8
Total							**12**

CIVIL ENGINEERING

IV B.Tech – I Semester

Course Code	**FINITE ELEMENT METHODS**	L	T	P	C
23CET21		3	0	0	3

Course Objectives:

The objectives of this course are to make the student to:

1. **Understand** the fundamental principles of the Finite Element Method (FEM) and its applications in structural analysis.
2. **Apply** the concepts of elasticity, stress-strain relationships, and displacement functions in FEM.
3. **Develop** finite element formulations for1D, 2D, and 3D elements.
4. **Analyze** bar, beam, and plane stress/strain problems using shape functions and stiffness matrices.
5. **Implement** solution techniques such as numerical integration, static condensation, and element assembly.

Course Outcomes (COs):

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

1. **Explain** the basic principles, advantages, and limitations of FEM in engineering applications.
2. **Derive** shape functions and stiffness matrices for 1D bar and beam elements.
3. **Analyze** continuous beams and plane stress/strain problems using FEM.
4. **Develop** isoparametric formulation for 2D elements such as CST and LST.
5. **Implement** solution techniques for assembling elements and solving FEM equations.

CO – PO Articulation Matrix:-

Course Outcomes	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
CO -1	3	2	2	2	2	-	-	-	-	-	-	2	3	3
CO -2	3	3	3	3	3	-	-	-	-	-	-	2	3	3
CO -3	3	3	3	3	3	-	-	-	-	-	-	2	3	3
CO -4	3	3	3	3	3	-	-	-	-	-	-	2	3	3
CO -5	2	2	2	2	3	-	-	-	-	1	-	2	2	2

UNIT – I

Introduction to Finite Element Method – Basic Equations in Elasticity Stress – Strain Equation – Concept of Plane Stress – Plane Strain Advantages and Disadvantages of FEM. Element Shapes – Nodes – Nodal Degree of Freedom Displacement Function – Natural Coordinates – Strain Displacement Relations.

UNIT – II

Lagrangian– Serendipity Elements – Hermite Polynomials – Regular, Irregular 2 D &3D – Element – Shape Functions Up to Quadratic formulation. Finite Element Analysis (FEA) of – One-Dimensional Problems – Bar Element – Shape Functions Stiffness Matrix – Stress –
Strain Relation

UNIT – III

FEA Beam Elements – Stiffness Matrix - Shape Function– Analysis of Continuous Beams.

UNIT – IV

FEA Two-Dimensional Problem – CST – LST Element – Shape Function – Stress – Strain. Isoparametric formulation – Concepts of, Isoparametric Elements for2D Analysis -

Formulation of CST Element.		
UNIT – V		
Solution Techniques: Numerical Integration, Static Condensation, Assembly of Elements and Solution Techniques for Static Loads.		
TEXT BOOKS:		
1. A first course in Finite Element Method by Daryl L. Logan, 5th Edition, Cengage Learning India Pvt. Ltd. 2. Introduction to finite Elements in Engineering by Tirupathi R. Chandrupatla, and Ashok D. Belegundu, Prentice Hall of India		
REFRENCE BOOKS:		
1. Finite Element Analysis by P. Seshu, PHI Learning Private Limited 2. Concepts and applications of Finite Element Analysis by Robert D. Cook et al., Wiley India Pvt. Ltd. 3. Applied Finite Element Analysis by G. Ramamurty, I.K. International Publishing House Pvt. Ltd.		
Online Learning Resources:		
https://archive.nptel.ac.in/courses/105/105/105105041/# **https://archive.nptel.ac.in/noc/courses/noc22/SEM1/noc22-me43/**		

CIVIL ENGINEERING

IV B.Tech – I Semester

Course Code	GEO SYNTHETICS AND REINFORCED EARTH STRUCTURES Professional Elective-IV	L	T	P	C
23CET22a		3	0	0	3

Course Objectives:

The objectives of this course are to make the student to:

1. Understand the concept and applications of reinforced earth, including friction coefficient determination.
2. Analyze the classification, functions, and durability aspects of geosynthetics and their advantages over conventional materials.
3. Design reinforced earth retaining walls considering stability mechanisms and material selection.
4. Evaluate the performance of reinforced embankments and their foundation mattresses for settlement and stability control.
5. Develop reinforced soil beds and analyze reinforced pavements using standard design approaches.

Course Outcomes (COs):

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

1. Explain the fundamentals of reinforced earth and analyze the effects of reinforcement on soil properties.
2. Compare different types of geosynthetics, their functions, and durability aspects in geotechnical applications.
3. Design reinforced earth retaining walls considering stability mechanisms and reinforcement layouts.
4. Evaluate reinforced embankments and foundation mattresses with respect to settlement and load-bearing capacity.
5. Design and analyze reinforced pavements and soil beds using standard methodologies.

CO – PO Articulation Matrix:-

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO -1	2	1	1	1	-	1	1	-	-	1	-	1	1	1
CO -2	2	1	2	1	1	-	1	-	-	-	-	1	1	1
CO -3	2	1	2	1	1	-	1	-	-	-	-	1	1	1
CO -4	2	1	2	1	1	1	1	-	-	-	-	1	1	1
CO -5	2	1	2	1	1	1	2	-	-	-	-	1	2	1

UNIT – I

Reinforced Earth: Concept, Effects of Reinforcement On Soils – Equal Confining andPsuedo Cohesion Concepts, Materials, Friction Coefficient – Definition, Laboratory Determination, Factors Affecting Fiction Coefficient; Application of Reinforced Earth

UNIT – II

Geosynthetics - Advantages Over Conventional Materials - Classification Based On Material Type and Function - Types of Geosynthetics - Functions of Geosynthetics - Tests On Geosynthetics - Durability Aspects of Geosynthetics - Applications of Geosynthetics

UNIT – III		
Reinforced Earth Retaining Walls: Introduction, Stability Mechanisms, Design of Reinforced Earth Retaining Wall - Selection of Materials - Geotechnical Analysis - Reinforcement Layout and Spacing - Stability Analysis - Advantages Over Conventional Retaining Walls		
UNIT – IV		
Reinforced Embankments: Introduction, Design of Reinforced Embankment, Foundation Mattress Below the Embankment - Purpose and Function of Foundation Mattresses - Components of Reinforced Mattress - Design of Reinforced Mattress - Design Calculations for Settlement Control, Bearing Capacity, and Long-Term Performance. Field Implementation and Monitoring Techniques		
UNIT – V		
Reinforced Soil Beds: Introduction, Factors Affecting the Behaviour of Reinforced Soil Beds, Analysis and Design Reinforced Pavements: Benefits of Placing Reinforcement in Flexible Pavement Layers, Design of Reinforced Pavements by Giroud and Noiray Approach and Modified CBR Method.		

TEXT BOOKS:

1. An Introduction to Soil Reinforcement and Geosynthetics‖ By G.L. Siva Kumar Babu, University Press
2. Fundamentals of Geosynthetics Engineering, Sanjay Kumar Shukla and Jian-Hua Yin, CRC Press, 2017, 1st edition.
3. Reinforced Soil and its Engineering Applications, Swami Saran, I.K. International Publishing House Pvt. Ltd., 2019, 1st edition.

REFRENCE BOOKS:

1. Designing with Geosynthetics by Robert M Koerner, R.M. Pearson Education Inc., 2012, 6th edition
2. Advances in Geosynthetics by G. Venkatapparao, Sai Master Geo environmental Services Pvt. Ltd. Publications
3. Designing with Geosynthetics, Koerner, R.M., Pearson Education Inc., 2012, 6th edition
4. IS:13162-1992; IS:14293& 94-1995; IS:14324-1995; IS:14714-1999, Geotextiles – Methods of Tests
5. IRC: SP:102-2014: Guidelines for design and construction of reinforced soil walls

Online Learning Resources:

https://archive.nptel.ac.in/courses/105/106/105106052/
https://onlinecourses.nptel.ac.in/noc20_ce06/preview

CIVIL ENGINEERING

IV B.Tech – I Semester

Course Code	**RAILWAYS, AIRPORTS, DOCKS AND HARBOR ENGINEERING** **Professional Elective-IV**	L	T	P	C
23CET22b		3	0	0	3

Course Objectives:

The objectives of this course are to make the student to:

1. Understand the components and geometric design principles of railway tracks.
2. Analyze the principles of railway track design, signaling, and interlocking.
3. Evaluate airport site selection, runway orientation, and terminal area planning.
4. Design runways and taxiways based on aircraft characteristics and geometric elements.
5. Assess the requirements and classification of ports, harbors, docks, and navigation aids.

Course Outcomes (COs):

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

1. Explain railway track components, functions, and requirements.
2. Apply geometric design principles to railway track layout and interlocking systems.
3. Evaluate airport planning aspects, including site selection, runway design, and terminal planning.
4. Design runways and taxiways based on geometric standards and safety regulations.
5. Analyze ports and harbor structures, including docks, breakwaters, and navigation aids.

CO – PO Articulation Matrix

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO -1	3	1	1	-	-	1	-	-	-	1	-	1	1	1
CO -2	3	2	2	1	2	-	-	-	-	-	-	1	2	1
CO -3	3	2	3	2	2	-	1	-	-	-	-	1	2	2
CO -4	3	1	2	2	3	1	-	-	-	-	-	1	2	2
CO -5	3	2	2	1	2	1	-	-	-	-	-	1	2	1

UNIT – I

Railway Engineering

Introduction – Permanent Way Components – Cross Section of Permanent Way – Functions and Requirements of Rails, Sleepers and Ballast – Types of Gauges – Creep of Rails – Theories Related to Creep – Coning of Wheels – Adzing of Sleepers – Rail Fastenings

UNIT – II

Geometric Design of Railway Track

Gradients – Grade Compensation – Cant and Negative Super Elevation – Cant Deficiency – Degree of Curves – Safe Speed on Railway Track – Points and Crossings – Layout and Functioning of Left Hand Turn Out and Right-Hand Turn Outs – Station Yards – Signaling and Interlocking

UNIT – III

Airport Engineering

Airport Site Selection – Factors Affecting Site Selection and Surveys- Runway Orientation – Wind Rose Diagram – Basic Runway Length – Correction for Runway Length – Terminal

Area – Layout and Functions – Concepts of Terminal Building – Simple Building , Linear Concept, Pier Concept and Satellite Concept – Typical Layouts

UNIT – IV

Geometric design of runways and taxiways

Aircraft Characteristics – Influence of Characteristics on Airport Planning and Design – Geometric Design Elements of Runway – Standards and Specifications - Functions of Taxiways – Taxiway Geometric Design – Geometric Elements and Standard Specifications – Runway and Taxiway Lighting.

UNIT – V

Ports and Harbors

Harbours - Requirements of Ports and Harbors – Types of Ports – Classification of Harbors – Docks and Types of Docks – Dry Docks, Wharves and Jetties – Breakwaters: Layouts of Different Types of Harbors and Docks – Dredging Operations – Navigation Aids

TEXT BOOKS:

1. A Text Book of Railway Engineering-S.C.Saxena andS.Arora, Dhanpatrai and Sons, New Delhi 2010
2. Highway, railway, Airport and Harbour Engineering – K.P. Subramanian, Scitech Publishers

REFRENCE BOOKS:

1. Harbour, Dock and Tunnel Engineering – R. Srinivasan, Charotar Publishing House Pvt. Limited, 200
2. Railway Track Engineering by J.S.MundreyMcGraw Hill Education 5th edition 2017
3. A Text book of Transportation Engineering – S.P.Chandola – S.Chand& Co. Ltd. – (2001)

Online Learning Resources:

https://nptel.ac.in/courses/105107123
https://archive.nptel.ac.in/courses/114/106/114106025/
https://www.mkube.co.in/product-detail/railways-airports-docks-and-harbour-engineering

CIVIL ENGINEERING

IV B.Tech – I Semester

Course Code	**EXPERIMENTAL STRESS ANALYSIS** **Professional Elective-IV**	L	T	P	C
23CET22c		3	0	0	3

Course Objectives:

The objectives of this course are to make the student to:

1. Understand the principles and advantages of experimental stress analysis.
2. Explain strain measurement techniques using strain gauges and their applications.
3. Analyze strain rosettes and apply non-destructive testing methods for concrete.
4. Understand the fundamental principles of photoelasticity and its applications.
5. Apply two-dimensional photoelasticity methods for stress analysis in materials.

Course Outcomes (COs):

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

1. Explain the principles and merits of experimental stress analysis.
2. Demonstrate strain measurement using various strain gauge techniques.
3. Analyze strain rosette data and evaluate concrete structures using NDT methods.
4. Apply the theory of photoelasticity to determine stress distributions in materials.
5. Utilize two-dimensional photoelasticity techniques for experimental stress analysis.

CO – PO Articulation Matrix:-

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO -1	3	2	-	-	-	2	-	-	-	1	-	1	1	1
CO -2	3	2	2	2	2	3	-	-	-	-	-	1	2	2
CO -3	2	2	3	2	2	3	2	-	-	-	-	1	2	2
CO -4	3	2	2	2	2	3	2	-	-	-	-	1	2	2
CO -5	2	2	2	2	2	3	2	-	-	-	-	1	2	2

UNIT – I

PRINCIPLES of EXPERIMENTAL APPROACH

Merits of Experimental Analysis Introduction, Uses of Experimental Stress Analysis Advantages of Experimental Stress Analysis, Different Methods –Simplification of Problems

UNIT – II

STRAIN MEASUREMENT USING STRAIN GAUGES

Definition of Strain and Its Relation of Experimental Determinations Properties of Strain-Gauge Systems-Types of Strain Gauges –Mechanical, Acoustic and Optical Strain Gauges. Introduction to Electrical Strain Gauges - Inductance Strain Gauges – LVDT – Resistance Strain Gauges – Various Types –Gauge Factor – Materials of Adhesion Base

UNIT – III

STRAIN ROSSETTES and NON – DESTRUCTIVE TESTING of CONCRETE

Introduction – The Three Elements Rectangular Rosette – The Delta Rosette Corrections for Transverse Strain Gauge. Ultrasonic Pulse Velocity Method –Application to Concrete. Hammer Test – Application to Concrete.

UNIT – IV		
THEORY of PHOTOELASTICITY Introduction –Temporary Double Refraction – The Stress Optic Law –Effects of Stressed Model in A Polar Scope for Various Arrangements – Fringe Sharpening. Brewster's Stress Optic Law		
UNIT – V		
TWO-DIMENSIONAL PHOTOELASTICITY Introduction – Isochramic Fringe Patterns- Isoclinic Fringe Patterns Passage of Light Through Plane Polariscope and Circular Polariscope - Isoclinic Fringe Patterns – Compensation Techniques – Calibration Methods – Separation Methods – Scaling Model to Prototype Stresses – Materials for Photo – Elasticity Properties of Photo elastic Materials.		
TEXT BOOKS:		
1. Experimental stress analysis by J.W.Dally andW.F.Riley, College House Enterprises2005 2. Experimental stress analysis by Dr.SadhuSingh.khanna Publishers 4th edition		
REFRENCE BOOKS:		
1. Experimental Stress analysis by U.C.Jindal, Pearson Publications 2012 edition 2. Experimental Stress Analysis by L.S.Srinath, Mc.Graw Hill Company Publishers		
Online Learning Resources:		
https://archive.nptel.ac.in/courses/112/106/112106068/# **https://archive.nptel.ac.in/courses/112/106/112106198/#**		

CIVIL ENGINEERING					
IV B.Tech – I Semester					
Course Code	**GROUND IMPROVEMENT TECHNIQUES** **Professional Elective-V**	L	T	P	C
23CET23a		3	0	0	3

Course Objectives:

The objectives of this course are to make the student to:

1. **Understand** various dewatering methods, including sumps, well points, and electro-osmosis, for effective groundwater control.
2. **Analyze** the properties and applications of grouts, grouting techniques, and post-grouting tests for soil and rock stabilization.
3. **Evaluate** different densification techniques for granular and cohesive soils, such as vibro-compaction, preloading, and thermal methods.
4. **Apply** stabilization techniques, including mechanical, chemical, and bituminous stabilization, to improve soil properties.
5. **Assess** the design principles of reinforced earth walls and the role of geosynthetics in soil improvement and slope stability. (Bloom's Level: **Evaluate - L5**

Course Outcomes (COs):

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

1. **Explain** the methods of dewatering and grouting and their importance in foundation engineering.
2. **Analyze** densification techniques for granular and cohesive soils to enhance soil strength.
3. **Evaluate** the effectiveness of soil stabilization methods for different ground conditions.
4. **Apply** reinforced earth principles and geosynthetics for soil retention and foundation stability.
5. **Assess** expansive soil problems, their identification methods, and suitable foundation techniques like under-reamed piles.

CO – PO Articulation Matrix

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO -1	3	2	2	2	1	-	-	-	-	2	-	1	2	2
CO -2	3	3	2	2	2	-	-	-	-	2	-	2	2	2
CO -3	3	3	3	2	2	-	-	-	-	2	-	2	3	2
CO -4	3	2	3	3	3	-	-	-	-	2	1	2	3	3
CO -5	3	3	3	3	3	-	-	-	-	2	1	2	3	3

UNIT – I

EXPANSIVE SOILS: Problems of Expansive Soils – Tests for Identification – Methods of Determination of Swell Pressure. Improvement of Expansive Soils – Foundation Techniques in Expansive Soils – Under Reamed Piles.

UNIT – II

DEWATERING: Methods of De-Watering- Sumps and Interceptor Ditches- Single, Multi Stage Well Points - Vacuum Well Points- Horizontal Wells-Foundation Drains-Blanket Drains - Criteria for Selection of Fill Material Around Drains –Electro-Osmosis .

GROUTING: Objectives of Grouting- Grouts and Their Properties- Grouting Methods-

Ascending, Descending and Stage Grouting- Hydraulic Fracturing in Soils and Rocks- Post Grout Test

UNIT – III

DENSIFICATION METHODS in GRANULAR SOILS:-

In – Situ Densification Methods in Granular Soils:– Vibration at The Ground Surface, Impact at The Ground Surface, Vibration at Depth, Impact at Depth.

DENSIFICATION METHODS in COHESIVE SOILS:–

In – Situ Densification Methods in Cohesive Soils:– Preloading or Dewatering, Vertical Drains – Sand Drains, Sand Wick Geodrains – Stone and Lime Columns – Thermal Methods

UNIT – IV

STABILISATION: Methods of Stabilization-Mechanical-Cement- Lime-Bituminous-Chemical Stabilization with Calcium Chloride, Sodium Silicate and Gypsum

UNIT – V

REINFORCED EARTH: Principles – Components of Reinforced Earth – Factors Governing Design of Reinforced Earth Walls – Design Principles of Reinforced Earth Walls.

GEOSYNTHETICS: Geotextiles- Types, Functions and Applications – Geogrids and Geo Membranes – Functions and Applications

TEXT BOOKS:

1. Engineering Principles of Ground Modification, Haussmann M.R. , McGraw-Hill International Edition(1990).
2. Ground Improvement Techniques, Dr.P.Purushotham Raj. Laxmi Publications, New Delhi University science press, New Delhi 2nd edition 2016

REFRENCE BOOKS:

1. Ground Improvement, Moseley M.P. Blackie Academic and Professional, Boca Taton, Florida, USA(1993).
2. Ground Improvement Techniques, NiharRanajanPatraVikas Publications, New Delhi
3. Ground Control and Improvement, Xanthakos P.P, Abramson, L.W and Brucwe, D.A (1994) John Wiley and Sons, New York, USA.

Online Learning Resources:

https://archive.nptel.ac.in/courses/105/108/105108075/
https://archive.nptel.ac.in/courses/105/105/105105210/

CIVIL ENGINEERING

IV B.Tech – I Semester

Course Code		L	T	P	C
23CET23b	**SUBSURFACE INVESTIGATION AND INSTRUMENTATION** **Professional Elective-V**	3	0	0	3

Course Objectives:

The objectives of this course are to make the student to:

1. **Understand** the fundamental concepts of soil formation, classification, and stratification processes.
2. **Analyze** various soil exploration methods, including boring, drilling, and sampling techniques.
3. **Evaluate** borehole logging methods and groundwater observations for site investigation.
4. **Apply** field testing techniques such as SPT, PLT, PMT, CPT, and geophysical methods to assess soil properties.
5. **Assess** soil exploration report preparation, including instrumentation and data interpretation.

Course Outcomes (COs):

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

1. **Explain** soil formation processes, classification methods, and stratification phenomena.
2. **Analyze** soil exploration methods and sampling techniques for various geotechnical applications.
3. **Evaluate** borehole logging, groundwater observations, and their influence on soil properties.
4. **Apply** field testing procedures, including penetration tests and geophysical methods, to assess subsurface conditions.
5. **Assess** soil exploration report writing and field instrumentation techniques for site investigations.

CO – PO Articulation Matrix

Course Outcomes	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
CO -1	3	2	1	2	1	2	2	1	-	2	-	2	2	2
CO -2	3	3	2	3	2	2	3	1	-	2	-	2	2	2
CO -3	3	3	3	3	3	2	3	2	-	2	-	2	3	3
CO -4	3	2	3	3	3	3	3	2	-	2	2	2	3	3
CO -5	3	3	3	3	3	3	3	2	-	2	2	2	3	3

UNIT – I

Introduction: Soil formation, Types of Soils, Physical and Chemical Weathering, Soil Transport, Deposition and Stratification Phenomena and Soil Classification.

UNIT – II		
Methods of Soil Exploration: Methods of Boring, Auguring and Drilling. Machinery Used for Drilling, Types of Augers and Their Usage for Various Projects. Soil Sampling: Sampling Methods, Types of Samples, Storage of Samples and Their Transport. Sample Preparation, Sample Sizes, Types of Samplers' Specifications for Testing.		
UNIT – III		
Borehole Logging: Logging of Boreholes - Logging Methods - Groundwater Observations – Water Table Fluctuations and Effects - Preparation of Soil Profiles and Exploration Report.		
UNIT – IV		
Field Testing of Soils: Methods and Specifications – Visual Identification Tests, Standard Penetration Test (SPT), Plate Load Test (PLT), Pressure Meter Test (PMT) Dilatometer Test (DMT) Vane Shear Test (VST), Cone Penetration Test (CPT), Becker Penetration Test (BPT), Analysis of Test Results. Geophysical Methods of Soil Exploration- Seismic Refraction, Electrical Resistivity, Cross Hole Test.		
UNIT – V		
Report Writing: Soil Exploration Reports- Identification, Calculations and Preparation. Field Instrumentation: Strain Gauges, Piezometer, Pressure Cells, Inclinometers, Proving Ring, Load Cells, Displacement Gauges		
TEXT BOOKS:		
1. Site Investigation, Clayton C. R., Matthews M. C and Simons N. E., Blackwell Science. 2005 2. Geotechnical Instrumentation for Monitoring Field Performance, John Dunn cliff, WileyInterscience, 2008		
REFRENCE BOOKS:		
1. Basic and Applied Soil Mechanics- A.S. Rao and Gopal Ranjan, New Age International. 2. IS:1892-Code of Practice for subsurface investigation for foundation, 1979 3. IS: SP36 Part 1-Compendium of India Standards on Soil Engineering-Laboratory Testing of Soils for Civil Engineering Purposes, 1987. 4. IS: SP36 Part 2-Compendium of India Standards on Soil Engineering-Field Testing of Soils for Civil Engineering Purposes, 1988.		
Online Learning Resources:		
https://archive.nptel.ac.in/courses/105/103/105103182/ https://onlinecourses.nptel.ac.in/noc25_ce27/preview https://onlinecourses.nptel.ac.in/noc22_ce81/preview		

CIVIL ENGINEERING					
IV B.Tech – I Semester					
Course Code	**TRANSPORTATION ECONOMICS** **Professional Elective-V**	L	T	P	C
23CET23c		3	0	0	3

Course Objectives:

The objectives of this course are to make the student to:

1. Understand the fundamentals of transportation project development and decision-making.
2. Analyze transportation costs, including agency and user costs.
3. Evaluate vehicle operating costs and traffic congestion economics.
4. Apply economic evaluation methods for transportation projects.
5. Assess financing methods and risk analysis in transportation projects.

Course Outcomes (COs):

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

1. Describe the overall process of transportation project development and financial planning.
2. Analyze transportation cost structures, including demand and supply elasticity.
3. Evaluate vehicle operating costs and traffic congestion pricing strategies.
4. Apply economic analysis techniques to assess the feasibility of transportation projects.
5. Assess financial models, PPP strategies, and risk analysis for road projects.

CO – PO Articulation Matrix

Course Outcomes	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO1**	**PSO2**
CO -1	3	2	2	1	2	-	-	-	-	2	-	2	2	2
CO -2	3	3	3	3	3	-	-	-	-	2	-	2	3	2
CO -3	3	3	3	3	2	-	-	-	-	2	-	2	3	3
CO -4	3	3	3	3	2	-	-	-	-	2	-	2	3	3
CO -5	3	3	3	3	3	3	3	3	-	2	-	2	3	3

UNIT – I

Introductory Concepts in Transportation Decision Making: Overall Transportation Project Development, Budgeting, Financial Planning, The Process of Transportation Project Development, Models Associated with Transportation Impact Evaluation Professional Ethics.

UNIT – II

Transportation Costs - Classification of Transportation Costs, Transportation Agency Costs, Transportation User Costs, General Structure and Behavior of Cost Functions and Road

Pricing. Estimating Transportation Demand and Supply - Supply Equilibration, Dynamics of Transportation Demand and Supply, Elasticity of Travel Demand and Supply, Classification of Elasticity

UNIT – III

Vehicle Operating Costs: Fuel Costs - Maintenance and Spares, Depreciation - Crew Costs - Value of Travel Time Savings - Accident Costs. Economics of Traffic Congestion - Pricing Policy

UNIT – IV

Economic Analysis of Projects - Methods of Evaluation - Cost-Benefit Ratio, First Year Rate of Return, Net Present Value, and Internal-Rate of Return Methods; Indirect Costs and Benefits of Transport Projects

UNIT – V

Financing of Road Projects - Methods – Private Public Partnership (PPP) - toll Collection - Economic Viability of Design-Build-Operate-Transfer Schemes – Risk Analysis – Value for Money Analysis - Case Studies.

TEXT BOOKS:

1. Winfrey, Economic analysis for Highways, International Textbook Company, Pennsylvania, 1969.
2. Sarkar, P. K., and Maitri, V., Economics in Highway and Transportation Planning, Standard Publisher, New Delhi, 2010.

REFRENCE BOOKS:

1. IRC, Manual on Economic Evaluation of Highway Projects in India, SP30, 2007
2. David, H., and Brewer, A., Transport: An Economics and Management Perspective. Oxford University Press, UK, 2000.
3. Quinet, E., and Vickerman, R., Principles of Transport Economics, Edward Elgar Pub, 2005
4. Button, K. J., Transport Economics, Elgar, 2010

Online Learning Resources:

https://archive.nptel.ac.in/courses/105/104/105104098/
https://archive.nptel.ac.in/content/storage2/courses/105101087/01-Ltexhtml/p2/p.html

CIVIL ENGINEERING					
IV B.Tech – I Semester					
Course Code	**Skills in Civil Engineering software. (STAADPRO/CAD/TEKLA)**	L	T	P	C
23CEP13		0	1	2	2

Course Objectives

The objectives of this course are to:

1. Provide fundamental knowledge of **Auto CAD** and **Tekla** for 2D drafting and 3D modeling.
2. Train students in **structural analysis and design** using **STAAD.Pro**
3. Develop skills in **reinforcement detailing and structural component modeling**.
4. Introduce **seismic and nonlinear analysis** for structural safety evaluation.
5. Enable students to apply **civil engineering software tools** for real-world projects.

Course Outcomes (COs):

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

1. Create **2D drawings and structural detailing** using **AutoCAD**.
2. Develop **3D building models** and analyze site to **photography** in **Revit**.
3. Perform **structural analysis and design** of **multi-story buildings** using **STAAD.Pro and ETABS**.
4. Conduct **seismic and performance-based analysis** for high-rise structures.
5. Apply **SAP2000** for **bridge modeling, water tank design, and advanced structural systems**.

CO – PO Articulation Matrix

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO -1	3	1	1	-	2	-	-	1	-	1	1	1	2	1
CO -2	3	1	2	-	3	-	-	2	-	2	2	2	1	1
CO -3	3	1	2	-	3	-	-	2	-	2	2	2	2	2
CO -4	3	1	1	-	3	-	-	1	-	1	1	1	1	2
CO -5	3	1	1	-	3	-	-	1	-	1	1	1	1	1

List of Experiments:-

1. Determination of Basic Drawing and Editing Commands in AutoCAD
2. Creation of a 2D Floor Plan for a Residential Building in AutoCAD
3. Development of Structural Detailing for Beams and Columns in AutoCAD
4. Application of Reinforcement Detailing for Slabs and Footings in AutoCAD
5. Creation and analysis of a steel column using TEKLA
6. Modelling a Roof Truss by TEKLA
7. Design of a Composite Beam by TEKLA
8. Column Base Plate Design by TEKLA
9. Determination of STAAD.Pro Interface and Structural Model Setup
10. Analysis and Design of a Simply Supported Beam in STAAD.Pro
11. Development of Structural Analysis for a Multi-Story RCC Building in STAAD.Pro
12. Application of Seismic Load Analysis on a Building Structure in STAAD.Pro

TEXT BOOKS:

1. George Omura, Brian C. Benton **–** ***Mastering AutoCAD 2025 and AutoCAD LT 2025*****,** Wiley**,** 2025 Edition
2. TEKLA Structural Designer 2023 Engineers Hand Book by Trimble Solutions Corporation

REFRENCE BOOKS:

1. Phil Read, Eddy Krygiel, James Vandezande **–** ***BIM Handbook: A Guide to Building Information Modeling for Owners, Designers, Engineers, and Contractors*****,** John Wiley & Sons**,** 4th Edition, 2023
2. Nighat Yasmin Ph.D.**,** ***Introduction to AutoCAD 2025 for Civil Engineering Applications*****,** SDC Publications**,** 2024 Edition**.**

OPEN ELECTIVES

IV B.Tech – I Semester

Course Code	BUILDING MATERIALS AND SERVICES (OPEN ELECTIVE – III)	L	T	P	C
23CET24		3	0	0	3

Course Objectives:

The objectives of this course are to make the student :

1. To understand the properties, classifications, and applications of building materials like stones, bricks, tiles, wood, aluminum, glass, paints, and plastics.
2. To analyze the composition, manufacturing process, and properties of cement and admixtures.
3. To apply knowledge of building components such as lintels, arches, walls, stairs, floors, roofs, foundations, and joinery.
4. To evaluate masonry, mortars, finishing techniques, and formwork systems.
5. To assess various building services including plumbing, ventilation, air conditioning, acoustics, and fire protection.

Course Outcomes:

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

1. Understand the properties, classifications, and applications of building materials like stones, bricks, tiles, wood, aluminum, glass, paints, and plastics.
2. Analyze the composition, manufacturing process, and properties of cement and admixtures.
3. Apply knowledge of building components such as lintels, arches, walls, stairs, floors, roofs, foundations, and joinery.
4. Evaluate masonry, mortars, finishing techniques, and formwork systems.
5. Assess various building services including plumbing, ventilation, air conditioning, acoustics, and fire protection.

CO – PO Articulation Matrix

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO -1	3	-	-	-	2	-	-	-	-	-	-	-	3	3
CO -2	3	3	-	-	2	-	-	-	-	-	-	2	3	3
CO -3	3	-	3	2	3	-	-	-	-	-	-	-	3	3
CO -4	-	-	3	3	3	-	2	-	-	-	-	-	3	3
CO -5	-	-	-	-	-	3	3	2	-	-	-	-	-	3

UNIT – I

Stones and Bricks, Tiles: Building Stones – Classifications and Quarrying – Properties – Structural Requirements – Dressing. Bricks – Composition of Brick Earth – Manufacture and Structural Requirements, Fly Ash, Ceramics. Timber, Aluminum, Glass, Paints and Plastics: Wood - Structure – Types and Properties – Seasoning – Defects; Alternate Materials for Timber – GI / Fiber – Reinforced Glass Bricks, Steel & Aluminum, Plastics.

UNIT – II

Cement &Admixtures: Types of Cement - Ingredients of Cement – Manufacture – Chemical Composition – Hydration - Field & Lab Tests – Fineness – Consistency – Initial &Final Setting – Soundness . Admixtures – Mineral & Chemical Admixtures – Uses

UNIT – III		
Building Components: Lintels, Arches, Walls, Vaults – Stair Cases – Types of Floors, Types of Roofs – Flat, Curved, Trussed; Foundations – Types; Damp Proof Course; Joinery – Doors – Windows – Materials – Types.		
UNIT – IV		
Mortars, Masonry and Finishing's Mortars: Lime and Cement Mortars Brick Masonry – Types – Bonds; Stone Masonry – Types; Composite Masonry – Brick-Stone Composite; Concrete, Reinforced Brick. Finishers: Plastering, Pointing, Painting, Claddings – Types – Tiles – ACP.form Work: Types: Requirements – Standards – Scaffolding – Design; Shoring, Underpinning.		
UNIT – V		
Building Services: Plumbing Services: Water Distribution, Sanitary – Lines &Fittings; Ventilations: Functional Requirements Systems of Ventilations. Air-Conditioning - Essentials and Types; Acoustics – Characteristic – Absorption – Acoustic Design; Fire Protection – Fire Hazards – Classification of Fire-Resistant Materials and Constructions.		
TEXT BOOKS:		
1. Building Materials and Construction – Arora & Bindra, Dhanpat Roy Publications. 2. Building Materials and Construction by G C Sahu, Joygopal Jena McGraw hill Pvt Ltd 2015.		
REFRENCE BOOKS:		
1. Building Construction by B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain - Laxmi Publications (P) ltd., New Delhi. 2. P. C. Varghese, Building Materials, Prentice Hall of India, 2015. 3. N. Subramanian ,‖Building Materials Testing and Sustainability‖, Oxford Higher Education, 2019. 4. R. Chudley, Construction Technology, Longman Publishing Group, 1973. 5. S. K. Duggal, Building Materials, Oxford & IBH Publishing Co. Ltd., New Delhi, 2019		
Online Learning Resources:		
https://archive.nptel.ac.in/courses/105/102/105102088/		

IV B.Tech – I Semester

Course Code	GEO-SPATIAL TECHNOLOGIES (OPEN ELECTIVE – IV)	L	T	P	C
23CEP25		3	0	0	3

Course Objectives:

The objectives of this course are to make the student :

1. To understand raster-based spatial analysis techniques, including query, overlay, and cost-distance analysis.
2. To analyze vector-based spatial analysis techniques such as topology, overlay, and proximity analysis.
3. To apply network analysis techniques for geocoding, shortest path analysis, and location-allocation problems.
4. To evaluate surface and geostatistical analysis methods, including terrain modeling, watershed analysis, and spatial interpolation.
5. To assess GIS customization, Web GIS, and mobile mapping techniques for real-world applications.

Course Outcomes:

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

1. Understand raster-based spatial analysis techniques, including query, overlay, and cost-distance analysis.
2. Analyze vector-based spatial analysis techniques such as topology, overlay, and proximity analysis.
3. Apply network analysis techniques for geocoding, shortest path analysis, and location-allocation problems.
4. Evaluate surface and geostatistical analysis methods, including terrain modeling, watershed analysis, and spatial interpolation.
5. Assess GIS customization, Web GIS, and mobile mapping techniques for real-world applications.

CO – PO Articulation Matrix

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO -1	3	-	-	-	2	-	-	-	-	-	-	-	3	3
CO -2	3	3	-	-	2	-	-	-	-	-	-	2	3	3
CO -3	3	-	3	2	3	-	-	-	-	-	-	-	3	3
CO -4	-	-	3	3	3	-	2	-	-	-	-	-	3	3
CO -5	-	-	-	-	3	3	3	2	-	-	-	-	3	3

UNIT – I

RASTER ANALYSIS

Raster Data Exploration: Query Analysis - Local Operations: Map Algebra, Reclassification,

Logical and Arithmetic Overlay Operations—Neighborhood - Operations: Aggregation, Filtering – Extended Neighborhood-Operations- Zonal Operations - Statistical Analysis – Cost-Distance Analysis-Least Cost Path.

UNIT – II

VECTOR ANALYSIS

Non-Topological Analysis: Attribute Database Query, Structured Query Language, Co-Ordinate Transformation, Summary Statistics, Calculation of Area, Perimeter and Distance – topological Analysis: Reclassification, Aggregation, Overlay Analysis: Point-In-Polygon, Line-In-Polygon, Polygon-On-Polygon: Clip, Erase, Identity, Union, Intersection – Proximity Analysis: Buffering

UNIT – III

NETWORK ANALYSIS

Network – Introduction - Network Data Model – Elements of Network - Building A Network Database - Geocoding – Address Matching - Shortest Path in A Network – Time and Distance Based Shortest Path Analysis – Driving Directions – Closest Facility Analysis – Catchment / Service Area Analysis-Location-Allocation Analysis

UNIT – IV

SURFACE and GEOSTATISTICAL ANALYSIS

Surface Data – Sources of X,Y, Z Data – DEM, TIN – Terrain Analysis – Slope, Aspect, Viewshed, Watershed Analysis: Watershed Boundary, Flow Direction, Flow Accumulation, Drainage Network, Spatial Interpolation: IDW, Spline, Kriging, Variogram.

UNIT – V

CUSTOMISATION, WEB GIS, MOBILE MAPPING

Customization of GIS: Need, Uses, Scripting Languages –Embedded Scripts – Use of Python Script - Web GIS: Web GIS Architecture, Advantages of Web GIS, Web Applications-Location Based Services: Emergency and Business Solutions - Big Data Analytics.

TEXT BOOKS:

1. Kang – Tsung Chang, Introduction to Geographical Information System, 4th Ed., Tata McGraw Hill Edition, 2008.
2. Lo, C.P. and Yeung, Albert K.W., Concepts and Techniques of Geographic Information Systems Prentice Hall, 2002.

REFRENCE BOOKS:

1. Michael N. Demers, Fundamentals of Geographic Information Systems, Wiley,2009
2. Ian Heywood, Sarah Cornelius, Steve Carver, Srinivasa Raju, —An Introduction to Geographical Information Systems, Pearson Education, 2nd Edition, 2007.
3. John Peter Wilson, The Handbook of Geographic Information Science, Blackwell Pub.,2008

Online Learning Resources:

https://archive.nptel.ac.in/courses/105/105/105105202/
https://onlinecourses.nptel.ac.in/noc19_cs76/preview

IV B.Tech – I Semester

Course Code	SOLID WASTE MANAGEMENT (OPEN ELECTIVE – IV)	L	T	P	C
23CEP26		3	0	0	3

Course Objectives:

The objectives of this course are to make the student :

1. To understand the types, sources, and characteristics of solid waste, along with regulatory frameworks.
2. To analyze engineering systems for solid waste collection, storage, and transportation.
3. To apply resource and energy recovery techniques for sustainable solid waste management.
4. To evaluate landfill design, construction, and environmental impact mitigation strategies.
5. To assess hazardous waste management techniques, including biomedical and e-waste disposal.

Course Outcomes:

1. Understand the types, sources, and characteristics of solid waste, along with regulatory frameworks.
2. Analyze engineering systems for solid waste collection, storage, and transportation.
3. Apply resource and energy recovery techniques for sustainable solid waste management.
4. Evaluate landfill design, construction, and environmental impact mitigation strategies.
5. Assess hazardous waste management techniques, including biomedical and e-waste

CO – PO Articulation Matrix

Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO -1	3	-	-	-	2	-	2	-	-	-	-	-	3	3
CO -2	3	3	-	-	2	-	3	-	-	-	-	2	3	3
CO -3	3	-	3	2	3	-	3	-	-	-	-	-	3	3
CO -4	-	-	3	3	3	-	3	2	-	-	-	-	3	3
CO -5	-	-	-	-	3	3	3	3	-	-	-	-	3	3

UNIT – I

Solid Waste: Definitions, Types of Solid Wastes, Sources of Solid Wastes, Characteristics, and Perspectives; Properties of Solid Wastes, Sampling of Solid Wastes, Elements of Solid Waste Management - Integrated Solid Waste Management, Solid Waste Management Rules 2016.

UNIT – II

Engineering Systems for Solid Waste Management: Solid Waste Generation; On-Site Handling, Storage and Processing; Collection of Solid Wastes; Stationary Container System and Hauled Container Systems – Route Planning - Transfer and Transport; Processing Techniques;

UNIT – III

Engineering Systems for Resource and Energy Recovery: Processing Techniques; Materials Recovery Systems; Recovery of Biological Conversion Products – Composting, Pre and Post Processing, Types of Composting, Critical Parameters, Problems with Composing - Recovery of Thermal Conversion Products; Pyrolysis, Gasification, RDF - Recovery of Energy From

Conversion Products; Materials and Energy Recovery Systems.

UNIT – IV

Landfills: Evolution of Landfills – Types and Construction of Landfills – Design Considerations – Life of Landfills- Landfill Problems – Lining of Landfills – Types of Liners – Leachate Pollution and Control – Monitoring Landfills – Landfills Reclamation.

UNIT – V

Hazardous Waste Management: – Sources and Characteristics, Effects on Environment, Risk Assessment – Disposal of Hazardous Wastes – Secured Landfills, Incineration - Monitoring – Biomedical Waste Disposal, E-Waste Management, Nuclear Wastes, Industrial Waste Management

TEXT BOOKS:

1. Tchobanoglous G, Theisen H and Vigil SA _Integrated Solid Waste Management, Engineering Principles and Management Issues‘ McGraw-Hill, 1993.
2. Vesilind PA, Worrell W and Reinhart D, _Solid Waste Engineering‘ Brooks/Cole Thomson Learning Inc., 2002.

REFRENCE BOOKS:

1. Peavy, H.S, Rowe, D.R., and G. Tchobanoglous, _Environmental Engineering‘, McGraw Hill Inc., New York, 1985.
2. Qian X, Koerner RM and Gray DH, _Geotechnical Aspects of Landfill Design and Construction‘ Prentice Hall, 2002.

Online Learning Resources:

https://archive.nptel.ac.in/courses/105/103/105103205/
https://archive.nptel.ac.in/courses/120/108/120108005/