KUMARAGURU COLLEGE OF TECHNOLOGY,

An Autonomous Institution affiliated to Anna University, Chennai

COIMBATORE – 641 049

B.E. CIVIL ENGINEERING

REGULATION 2024

IV Semester

Department of Civil Engineering

VISION

The Department of Civil Engineering is striving to become a world class Academic Centre for quality education and research in diverse areas of Civil Engineering, with a strong social commitment

MISSION

The Mission of the department is to

- Producing highly competent and technologically capable professionals and motivatedyoung Academicians
- Providing quality education in undergraduate and post graduate levels, with strongemphasis on professional ethics and social commitment.
- Developing a scholastic environment for the state – of –art research, resulting in practical applications. Undertaking professional consultancy services in diverse areas of Civil Engineering

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

Our graduates will be able to

PEO 1: To provide strong foundation to graduates to pursue a successful profession or higher studies and take part in providing feasible solution for societal problems resulting in sustainable development of infrastructures.

PEO 2: To enrich competence of graduates to implement emerging techniques for planning, analysis, design and execution of civil engineering projects through lifelong learning

PEO 3: To imbibe ethics and professionalism among the graduates that is to be practiced in their profession

PROGRAM SPECIFIC OUTCOMES (PSOs)

Our Graduates will be able to:

PSO 1: The graduates will be able to Plan, Analyze, Design and Prepare technical reports for Civil Engineering structures as per BIS.

PSO 2: The graduates will be able to apply technical and management skills for the execution

PROGRAM OUTCOMES (POs)

Our Graduates will be able to:

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering

problems.

PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.

PO8: Individual and team work: Function effectively as an individual, and as a member or leaderin diverse teams, and in multidisciplinary settings.

PO9: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO10: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

PO11: Life-long learning: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

IV Semester Curriculum

Semester IV - Strength of Materials, Fluids & Geomatics									
S.No	**Course code**	**Course Title**	**Course Mode**	**CT**	**L**	**T**	**P**	**J**	**C**
1	24HSP006	Mastering Group Discussion and Presentation Skills	Practical	HS	0	0	2	0	1
2	24MAI241	Numerical Methods and Probability	Embedded	BS	3	0	2	0	4
3	24INP202	Innovation Practicum-4	Practical	ES	0	0	2	0	1
4	24INO___	FCLF Technical Stack -I	Practical	OE	0	0	2	0	1
5	24INO___	FCLF Emerging Stack -I	Practical	OE	0	0	2	0	1
6	24INT102	Indian Knowledge System in Science and Engineering	Theory	HS	1	0	0	0	1
7	24INM202	Environmental Science and Sustainability	Embedded	HS	1	0	2	0	2
8	24CEP206	Fluid Mechanics Lab	Practical	PC	0	0	2	0	1
9	24CEI207	Remote Sensing & Geographic Information System	Embedded	PC	2	0	2	0	3
10	24CET208	Strength of Materials	Theory	PC	3	0	0	0	3
11	24CEI209	Highway Engineering	Embedded	PC	3	0	2	0	4
Total Credits									**22**
Total Contact Hours/week									**31**

24MAI241	NUMERICAL METHODS AND PROBABILITY (Common to AE, AU, CE, ME, MR)	L	T	P	J	C
		3	0	2	0	4
BS		SDG	4, 8, 9			

Pre-requisite courses	-	Data Book / Codes books (If any)	Normal table

Course Objectives:

The purpose of this course is to:

1	Solve algebraic and transcendental equations where analytical solutions are impractical or impossible.
2	Develop the ability to solve engineering problems and other real-world applications using interpolation and integration methods for both data analysis and numerical solutions.
3	Develop problem-solving skills by using these numerical methods to model and solve real-world engineering and scientific problems involving first-order differential equations.
4	Critically analyze the performance of different numerical methods in terms of accuracy, stability, and computational efficiency for solving partial differential equations in practical engineering applications.
5	Apply probability theory to model and solve real-world problems involving uncertainty, risk analysis, and decision-making in engineering, business, and science.

Course Outcomes

After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO 1	Apply numerical methods such as Newton–Raphson and Gauss–Jordan techniques to solve algebraic, transcendental, and linear systems of equations arising in engineering applications.	Ap
CO 2	Construct interpolation polynomials and use them for numerical differentiation and integration employing Trapezoidal and Simpson's rules to approximate functions and definite integrals.	Ap
CO 3	Implement numerical techniques including Taylor series, Euler, Improved Euler, Runge–Kutta, and Milne's predictor–corrector methods for solving ordinary differential equations (ODEs).	Ap
CO 4	Solve two-dimensional Laplace's equations using finite difference techniques and visualize potential distributions on rectangular domains relevant to engineering and electrostatics problems.	Ap
CO 5	Analyze and model real-world problems involving uncertainty using fundamental probability concepts.	An
CO 6	Examine the Normal distribution and its properties, and apply it to model and solve engineering and scientific problems involving random variations.	Ap

	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)											Program Specific Outcomes (PSO)
	1	2	3	4	5	6	7	8	9	10	11	

Course Outcomes (CO)	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	PSO-1	PSO-2
1	3	2	-	-	1	-	-	-	-	-	1	-	-
2	3	3	-	-	2	-	-	-	-	-	1	-	-
3	3	2	-	-	2	-	-	-	-	-	2	-	-
4	3	3	-	-	3	-	-	-	-	-	2	-	-
5	3	3	-	-	3	-	-	-	-	-	2	-	-
6	3	2	-	-	3	-	-	-	-	-	2	-	-

Course Content

NUMERICAL SOLUTION OF ALGEBRAIC AND TRANSCENDENTAL EQUATIONS Fixed point Iteration method, Newton's method –Solution of linear system by Gauss Jordan method - Iterative method: Gauss Seidel method – Inverse of a matrix by Gauss Jordan method-Jacobi method for finding eigenvalues. **Practical Component** • Gauss Jordan method. • Newton Raphson method.	**9 Hours** **6 Hours**
INTERPOLATION, NUMERICAL DIFFERENTIATION AND INTEGRATION Newton's forward, backward and divided difference interpolation, Cubic spline interpolation – Approximation of derivatives using interpolation polynomials – Numerical integration using Trapezoidal and Simpson's 1/3 and 3/8 rules. **Practical Component** • Newton's divided difference interpolation • Numerical integration by Simpsons rule	**9 Hours** **6 Hours**
NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS Taylor's series method – Euler and Improved Euler methods, fourth order Runge-Kutta method for solving first order equations – Multistep method: Milne's predictor and corrector method, Adams Bashforth method **Practical Component** • Numerical solution of ODE by Euler's method. • Numerical solution of ODE by Milne's method.	**9 Hours** **6 Hours**
SOLUTION OF PARTIAL DIFFERENTIAL EQUATIONS Solution of one-dimensional heat equation using Bender Schmidt and Crank Nicholson difference schemes –Solution of one-dimensional wave equation by explicit scheme. Finite difference techniques for the solution of two-dimensional Laplace's equation on rectangular domain. **Practical Component** • Solution of one-dimensional heat equation using Bender Schmidt method.	**9 Hours** **6 Hours**

• Solution of one-dimensional wave equation by explicit scheme	
PROBABILITY AND RANDOM VARIABLES Axioms of probability - Conditional probability – Total probability – Bayes' theorem – Random variable – Distribution function – properties – Probability mass function-Probability density function –Normal distributions – Properties. **Practical Component** • Introduction to R Programming • Normal distribution.	**9 Hours** **6 Hours**

Theory Hours: 45	Tutorial Hours: 0	Practical Hours: 30	Project Hours: 0	Total Hours: 75

Learning Resources

Textbooks

1. Steven C. Chapra and Raymond P. Canale., Numerical Methods for Engineers with Programming and Software Applications., McGraw-Hill ,7th Edition (2021).
2. Johnson R.A., Miller I and Freund J., Miller and Freund's Probability and Statistics for Engineers., PearsonEducation, Asia 8th Edition (2015).

Reference books

1. Numerical Methods for Scientific and Engineering Computation by M.K. Jain, S.R.K.Iyengar and R.K. Jain, New Age International Publishers 2019.
2. Gupta S.C and Kapoor V.K, "Fundamentals of Mathematical Statistics", 11th extensively revised edition, Sultan Chand & Sons, 2020.
3. Conte S.D and Carl de Boor., Elementary Numerical Analysis - An Algorithmic Approach., McGraw-Hill (2018)
4. John H. Mathews and Kurtis D. Fink., Numerical Methods using Matlab, Prentice Hall of India,4th Edition (2021).

Online Resources (Web Links)

1. https://nptel.ac.in/courses/111106101
2. https//nptel.ac.in/courses/111105041

Assessment

SA I and SA II, Activity and Learning Task(s), MCQ, End Semester Examination (ESE), Lab Workbook, Experimental Cycle tests, viva-voce

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert(s)
1. Mr. Ramesh V.S., STEPS Knowledge Services Private Limited, Coimbatore.	1. Dr. M. Sivakumar Assistant Professor Sr. Grade Vellore Institute of Technology, Vellore 2. Dr. Ramesh Babu Assistant Professor (SG) Amrita University Coimbatore, Tamil Nadu.	1. Dr. S.Meena Priyadarshini Assistant Professor II Department of Mathematics,KCT 2. Ms.S.Sivasakthi Assistant Professor (SRG) Department of Mathematics, KCT

Recommended by BoS on	28.11.2025		
Academic Council Approval	No:	**Date**	

24CEP206	FLUID MECHANICS LAB	L	T	P	J	C
		0	0	2	0	1
Professional Core		SDG	6,7,9,11			

Pre-requisite courses	24CET201	Data Book / Code book (If any)	NIL

Course Objectives:	
The purpose of taking this course is to:	
1	To experimentally verify the fundamental principles of fluid mechanics.
2	To familiarize students with various flow measurement devices and techniques.
3	To analyze the performance characteristics of hydraulic machines such as pumps and turbines.
4	To enable basic exposure to flow simulation tools used in engineering practice.

Course Outcomes		
After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO 1	Apply fundamental principles to analyze fluid flow systems	Ap
CO 2	Calibrate and use various flow measurement devices.	Ap
CO 3	Evaluate the performance of different types of pumps and turbines	An

Course Outcomes (CO)	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)											Program Specific Outcomes (PSO)	
	1	2	3	4	5	6	7	8	9	10	11		
	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	PSO-1	PSO-2
1	3	2	3	1	3	1	1	2	2	2	2	3	2
2	3	2	3	1	3	1	1	2	2	2	2	3	3
3	2	1	3	1	3	2	1	3	3	3	2	3	2

Course Content	
Practical Component: **Flow Measurement** 1. Determine the coefficient of discharge and compare theoretical vs actual flow using a venturimeter. 2. Determine the coefficient of discharge and compare theoretical vs actual flow using a Orificemeter.	**30 Hours**

3. Determination of velocity using Pitot Tube. 4. Measure flow rate over v-notch and determine its coefficient of discharge **Losses in Pipes** **5.** Measure the frictional losses in pipes and determine the Darcy-Weisbach friction factor. 6. Evaluate head losses and loss coefficients in various pipe components **Laminar and Turbulent Flow** 7. Determine Reynolds number and Visualize the flow behaviour. **Hydraulic Machines** 8. Analyze the performance characteristics of a Pelton wheel turbine. 9. Study the performance characteristics of reaction turbine (Kaplan or Francis). 10. Determine the efficiency and plot the characteristic curves of centrifugal pump. 11. Determine the efficiency and plot the characteristic curves of reciprocating pump. **Computational Fluid Dynamics** 12. CFD simulation of laminar pipe flow using OpenFOAM or ANSYS Fluent.	

Theory Hours:	**0**	**Tutorial Hours:**	**0**	**Practical Hours:**	**30**	**Project Hours:**	**0**	**Total Hours:**	**30**

Learning Resources
Textbooks:
1. Modi, P.N., and Seth, S.M., *Hydraulics and Fluid Mechanics*, Standard Book House, New Delhi, 2017. 2. Fox, R.W., McDonald, A.T., and Pritchard, P.J., *Introduction to Fluid Mechanics*, Wiley, 2020.
References:
1. White, F.M., *Fluid Mechanics*, McGraw-Hill Education, 2015. 2. Hydraulic Laboratory Manual, Centre for Water Resources, Anna University, 2015. 3. Anil W. Date, "Introduction to Computational Fluid Dynamics", Cambridge University Press
Online Educational Resources:
1. https://fmc-nitk.vlabs.ac.in/List%20of%20experiments.html 2. https://doc.cfd.direct/openfoam/user-guide/ 3. https://elearn.nptel.ac.in/shop/masterclasss-workshops/masterclass-series-closed/introduction-to-cfd-using-openfoam/

Assessment (Practical course)
Lab Workbook, Experimental Cycle tests, viva-voce, etc…

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert(s)
Er.M.H.Salman Farish, Assistant Engineer Chennai Metropolitan Water Supply & Sewerage Board, Chennai	**Danish D R** Senior Project Scientist Global Water and Climate Adaptation Centre Aachen - Bangkok - Chennai - Dresden (ABCD Centre) Department of Ocean Engineering Indian Institute of Technology Madras, Chennai- 600 036	1. Ms.S.Rajalakshmi / 2. Mr.KRP.Satheesh Kumar AP/Civil KCT

Recommended by BoS on	05/12/2025		
Academic Council Approval	No.	**Date**	14/11/2025

24CEI207	Remote Sensing and Geographic Information Systems	L	T	P	J	C
		2	0	2	0	3
Professional Core		SDG	9,11			

Pre-requisite courses	24CEI203	Data Book / Code book (If any)	NA

Course Objectives:	
The purpose of taking this course is to:	
1	Understand the fundamental principles of remote sensing and the electromagnetic spectrum as it relates to Earth observation.
2	Familiarize with various satellite platforms, sensors, and image acquisition techniques used in environmental and civil engineering studies.
3	Develop skills in interpreting and analyzing satellite imagery using visual and digital image processing methods.
4	Gain proficiency in using GIS software to manage, analyze, and visualize spatial and attribute data
5	Apply knowledge of remote sensing and GIS to real-world civil engineering problems such as land use planning, infrastructure development, and environmental monitoring

Course Outcomes		
After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO 1	Understand and explain the fundamental principles of remote sensing, including electromagnetic spectrum interactions and the characteristics of various natural surfaces.	U
CO 2	Classify and analyze the types of sensors and satellite platforms and evaluate their suitability for specific Earth observation applications.	An
CO 3	Apply digital image processing techniques for image enhancement, classification, and interpretation using both supervised and unsupervised methods.	Ap
CO 4	Demonstrate the ability to use Geographic Information Systems (GIS) software tools to digitize, manage, and analyze spatial and non-spatial data.	Ap
CO 5	Perform integrated data analysis using GIS models, apply raster and vector data processing, and use GIS for solving civil engineering problems.	C
CO 6	Apply practical skills in map digitization, database integration, spatial data visualization, and layout preparation using industry-standard GIS and remote sensing software.	E

Co	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)											Program Specific Outcomes (PSO)
	1	2	3	4	5	6	7	8	9	10	11	

	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	PSO-1	PSO-2	PSO-3
1	3	2	1	1	1	1	1	1	1	1	2	3	2	1
2	3	3	3	2	3	1	1	2	2	1	2	3	2	1
3	3	3	3	3	2	1	1	2	2	1	2	3	2	1
4	3	2	2	3	3	1	1	2	2	2	2	3	2	1
5	3	2	2	2	3	1	1	2	2	2	2	3	3	1
6	3	2	2	2	3	1	1	2	2	1	2	3	3	1

Course Content	
MODULE 1: INTRODUCTION TO REMOTE SENSING Definition of remote sensing and its components – Electromagnetic spectrum – wavelength regions important to remote sensing – Wave theory, Particle theory, Stefan- Boltzmann and Wein's Displacement Law – Atmospheric scattering, absorption – Atmospheric windows. Spectral signature concepts –typical spectral reflective characteristics of water, vegetation and soil **Practical Component:** Projection, Re-projection and Coordinate Transformation of Maps.	**9 Hours** **3 Hours**
MODULE 2: PLATFORMS AND SENSORS Types of platforms – orbit types, Sun- synchronous and Geosynchronous Passive and Active sensors – resolution concept. Pay load description of important Earth Resources and Meteorological satellites – Airborne and space borne TIR and microwave sensors. **Practical Component:** Data Input – Onscreen Digitisation – Creation of Point, Line and Polygon layers. Linking External Database and Tabular Data Analysis using SQL commands	**9 Hours** **3 Hours**
MODULE 3: IMAGE INTERPRETATION AND ANALYSIS Types of Data Products – types of image interpretation- basic elements of image interpretation- visual interpretation keys. Digital image processing – Pre-processing – image enhancement techniques – multispectral image classification – supervised and unsupervised. **Practical Component:** • Attribute data input and Measurement of Distance, Area • Supervised and Unsupervised Image Classification	**9 Hours** **3 Hours**
MODULE 4: GEOGRAPHIC INFORMATION SYSTEM	**9 Hours**

Introduction – Maps- Definitions – Map projections – types of map projections – map analysis GIS definition – basic components of GIS – standard GIS software.Data type – Spatial and non-spatial (attribute) data – measurement scales- Data base Management Systems (DBMS). **Practical Component:** • Generating Graphs, Charts and Diagrams from Tabular data	**3 Hours**
MODULE 5: DATA ANALYSIS Data type – Spatial and non-spatial (attribute) data – measurement scales- Data base Management Systems (DBMS). Application of GIS in highway- alignment studies, Environmental and water resources – land Information system. **Practical Component:** • Data Conversion – Vector to Raster and Raster to Vector. • Map Joining, Edge Matching and Layout Design.	**9 Hours** **3 Hours**

Theory	Tutorial	Practical	Project	Total
Hours: 45	**Hours: 0**	**Hours: 15**	**Hours: 0**	**Hours: 60**

Learning Resources
Textbooks:
1. Thomas. M.Lillesand and Ralph. W. Kiefer, "Remote Sensing and Image Interpretation", John Wiley and Sons, 7th Edition 2015.). 2. Basudeb Bhatta "Remote sensing and GIS" Oxford Publication, 2nd Edition 2011.
References:
3. Ian Heywood "An Introduction to GIS", Pearson Education, Asia, 4th Edition 2012 4. Lo.C.P and A.K.W.Yeung, "Concepts and Techniques of Geographic Information Systems", Prentice Hall of India Pvt. Ltd., New Delhi, 2nd Edition 2010 5. Burrough P.A. and Rachel A. McDonell, "Principles of Geographical Information Systems", Oxford Publication, 3rd Edition 2016.
Online Educational Resources:
4. https://elearn.nptel.ac.in/shop/nptel/remote-sensing-and-gis/?v=c86ee0d9d7ed 5. https://www.coursera.org/courses?query=remote%20sensing 6. https://www.udemy.com/course/google-earth-engine-gis-remote-sensing/?couponCode=ST8MT220425G3

Assessment (Embedded course)
CAT, Open Book Test, Learning Tasks (Concept Maps, Diagnostic Questions), End Semester Examination (ESE). Lab Workbook, Experimental Cycle tests, viva-voce.

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**	**Internal Expert(s)**	
Mr. **Saravanan Karuppasamy** Application Engineer at Autonomy & Positioning Division (Part Of Hexagon), Karnataka.	Dr. T Reshma Assistant Professor Department of Civil Engineering National Institute of Technology, Andhra Pradesh Tadepalligudam	3. Mr. S.Nishant /Civil 4. Mr.J.Viswanath	
Recommended by BoS on	05.12.2025		
Academic Council Approval		**Date**	

24CET208	Strength of Materials	L	T	P	J	C
		3	0	0	0	3
Professional Core		SDG		SDG No's. 04, 09 & 12		

Pre-requisite courses	24CEI202	Data Book / Code book (If any)	Nil

Course Objectives:	
The purpose of taking this course is to:	
1	**Acquire knowledge** of the fundamental concepts of stress, strain, deformation, and stability of materials.
2	**Develop skills** in analyzing various loading conditions on structural elements.
3	**Enhance competency** in solving engineering problems related to material behavior under different forces.
4	**Foster understanding** of the theoretical and practical aspects of indeterminate structures and energy principles.
5	**Prepare students** for real-world applications, aligning with industrial trends and sustainable development practices.

Course Outcomes		
After successful completion of this course, the students shall be able to		**Revised Bloom's Taxonomy Levels (RBT)**
CO 1	Explain the concepts of stress, strain, and energy principles.	U
CO 2	Apply principles of static equilibrium and energy methods to analyze indeterminate beams.	Ap
CO 3	Analyze the state of stress and strain in two-dimensional elements using mathematical models.	An
CO 4	Evaluate the critical loads for columns under various end conditions.	E
CO 5	Design structural elements considering advanced bending theories and sustainability aspects.	C

Co	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)											Program Specific Outcomes (PSO)
	1	2	3	4	5	6	7	8	9	10	11	

	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	PSO-1	PSO-2	PSO-3
1	CO1	3	3	2	1	2	1	1	1	1	2	1	3	2
2	CO2	3	3	3	2	2	2	1	2	1	1	2	3	2
3	CO3	3	3	3	3	3	2	1	2	1	2	1	3	3
4	CO4	3	3	2	2	2	2	1	2	1	1	2	3	3
5	CO5	3	3	3	3	3	2	3	2	2	3	2	3	3

Course Content	
ENERGY PRINCIPLES Concepts of strain energy, resilience, and work-energy principles - Applications of Castigliano's theorem and Maxwell's reciprocal theorem - Energy methods for deformation analysis.	**09 Hours**
INDETERMINATE BEAMS Analysis of propped cantilever, fixed beam - Clapeyron's theorem of three moments for continuous beams.	**09 Hours**
GENERALIZED STATE OF STRESS AND STRAIN States of stress and strain – Differential equations of equilibrium of stress and strain - principal stresses and principal planes (3D) – Theories of elastic failure	**09 Hours**
COLUMNS Euler's theory of buckling - Members with eccentric loading - Rankine Gordon formula for eccentrically loaded columns - Practical design considerations for columns with different end conditions.	**09 Hours**
ADVANCED TOPICS IN BENDING OF BEAMS Non-linear bending behaviour and shear stresses in beams - Unsymmetrical bending and curved beams - Winkler Bach formula - Application of bending theories to engineering design - shear flow - shear centre - channel section - stress concentration	**09 Hours**

Theory Hours:45	Tutorial Hours: 15	Practical Hours: 0	Project Hours: 0	Total Hours:60

Learning Resources

Textbooks:

1. Gere, J.M., *Mechanics of Materials*, Cengage Learning, Stamford (2020).
2. Beer, F.P., Johnston, E.R., *Mechanics of Materials*, McGraw Hill, New York (2019).
3. R.K. Rajput, *Strength of Materials (Mechanics of Solids)*, S. Chand Publishing, 2022.

References:

4. Timoshenko, S.P., Goodier, J.N., Theory of Elasticity, McGraw Hill, New York (2021).
5. Boresi, A.P., Schmidt, R.J., Advanced Mechanics of Materials, Wiley, Hoboken (2019).

Online Educational Resources:

1. https://nptel.ac.in/courses/112103108
2. https://ocw.mit.edu/courses/mechanical-engineering/
3. https://www.khanacademy.org/
4. https://www.civilengineeringacademy.com
5. https://www.youtube.com/LearnEngineering
6. https://nptel.ac.in/courses/112107147
7. https://www.coursera.org/
8. https://swayam.gov.in/
9. https://www.engineeringtoolbox.com/column-buckling
10. https://www.edx.org/
11. https://ocw.tudelft.nl
12. https://civilengineeringhub.com

Assessment (Theory course)

CAT, Activity and Learning Task(s)*, Mini project, MCQ, End Semester Examination (ESE)

Course Curated by

Expert(s) from Industry	Expert(s) from Higher Education Institution	Internal Expert(s)
Mr. Kannan Sagadevan Manager Structural Engineer Sobha Glazing and Metal Works Private Limited Bengaluru, Karnataka, India	**Dr. D. Rajkumar** Assistant Professor Civil Engineering Thiagarajar College Of Engineering Madurai, Tamilnadu, India	**G. Karthikeyan** Assistant Professor-II Civil Engineering Kumaraguru College of Technology Coimbatore, Tamilnadu, India
Recommended by BoS on	05.12.2025	
Academic Council Approval		**Date**

24CEI209	Highway Engineering	L	T	P	J	C
		3	0	2	0	4
Professional Core		SDG	SDG No's.-9			

Pre-requisite courses	Nil	Code book	IRC 37, IRC 58

Course Objectives:	
The purpose of taking this course is to:	
1	Understand the principles of highway classification, alignment, and geometric design to establish the foundation for efficient and safe roadway planning.
2	Learn the characteristics of traffic flow, including road user behavior, vehicle interactions, and traffic control measures, to support effective traffic management.
3	Develop proficiency in testing and evaluating highway materials, such as aggregates, bitumen, and soil, to ensure their suitability for different pavement designs.
4	Gain practical experience in pavement construction techniques and maintenance strategies to enhance the durability and performance of road infrastructure.
5	Build the ability to integrate modern technologies, such as Intelligent Transportation Systems (ITS), into transportation planning and operations to address contemporary urban mobility challenges.

Course Outcomes		
After successful completion of this course, the students shall be able to		Revised Bloom's Taxonomy Levels (RBT)
CO 1	Explain the fundamentals of transportation systems, highway planning	U
CO 2	Apply geometric design principles for horizontal and vertical curves	Ap
CO 3	Apply traffic engineering methods for data collection, analysis and level-of-service evaluation.	Ap
CO 4	Analyze pavement materials using standard tests and design of pavements.	An
CO 5	Analyze the pavement construction techniques and maintenance practices to select appropriate methods for road longevity.	An
CO6	Explain the fundamentals of intelligent transportation systems to enhance traffic operations and improve urban mobility.	U

Co	Program Outcomes (PO) (Strong-3, Medium – 2, Weak-1)											Program Specific Outcomes (PSO)
	1	2	3	4	5	6	7	8	9	10	11	

	Engineering Knowledge	Problem Analysis	Design/Development of Solutions	Conduct Investigations of Complex Problems	Engineering Tool Usage	The Engineer and The World	Ethics	Individual and Collaborative Team work	Communication	Project Management and Finance	Life-Long Learning	PSO-1	PSO-2	PSO-3
1	3	3	3	2	3	2	2				2	3	3	
2	3	3	3	3	3	2	2	2			2	3	3	
3	3	3	3	3	3	2	2	3			2	2	3	
4	3	2	3	3	2	2	2	2			2	3	3	
5	3	1	2	2	2	2	2	3	3		2	2	3	
6	3	3	3	3	3	2	3	3	3		2	3	3	

Course Content	
MODULE 1: HIGHWAY ALIGNMENT AND GEOMETRIC DESIGN Introduction - Highway development in India - Classification of roads - Requirements and factors controlling alignment of roads -Modern Techniques- Engineering surveys for highway location - cross sectional elements - Sight distances - Design of horizontal alignment - Design of vertical alignment - worked out problems in geometric design.	**10 Hours**
MODULE 2: TRAFFIC ENGINEERING Introduction - Road user, vehicle and traffic characteristics – traffic studies - Speed, volume, Origin Destination, parking studies, accident study - traffic signs, markings, signal design concepts. **Practical Component:** • Traffic Volume Study • Traffic Speed study	**10 Hours** **2 Hours**
MODULE 3: PAVEMENT OF MATERIALS AND DESIGN Desirable properties and testing of highway materials: aggregates, bitumen and subgrade soil – Bituminous mix design – pavement types and layer composition - Factors influencing the design of pavements - Design of flexible pavement (worked out problems) and rigid pavements- IRC guidelines. **Practical Component:** Highway Materials Testing: • Tests on Aggregate (Impact, Shape, Abrasion, specific gravity, water absorption tests) • Tests on Bitumen (Specific gravity, penetration, ductility, flash and fire point, softening point test, viscosity) • Test on soil (CBR) Design of Bituminous Mixes:	**10 Hours** **10 Hours**

• Marshall Stability Test	
MODULE 4: PAVEMENT CONSTRUCTION AND MAINTENANCE Construction of flexible pavements, construction of rigid pavements - Pavement Failures - Pavement Maintenance - evaluation methods - overlay. **Practical Component:** Pavement Evaluation Tests: • Benkleman Beam test (Demonstration) • Roughness Test (MERLIN) • Skid Resistance Test	**10 Hours** **3 Hours**
MODULE 5: SUSTAINABLE AND SMART TRANSPORTATION Basics of sustainability - Smart mobility, Introduction to Intelligent Transportation Systems (ITS), Green pavements.	**5 Hours**

Theory Hours:	**45**	**Tutorial Hours:**	**0**	**Practical Hours:**	**15**	**Project Hours:**	**0**	**Total Hours:**	60

Learning Resources

Textbooks:

1. Khanna, S.K.,Justo, C.E.G., Veeraragavan. A. Highway Engineering, Nemchandand Bros, 2015, Roorkee.
2. Kadiyali, L.R.,andLal, N.B., Principles and Practices of Highway Engineering, Khanna Publishers, 2013.

References:

3. IRC: 37, Guidelines for the Design of Flexible Pavements.
4. IRC: 58, Guidelines for the Design of Rigid Pavements.
5. IRC:15, Standard Specifications and Code of Practice for Construction of Concrete Roads
6. Ministry of Road Transport and Highways Specifications for Roads and Bridges
7. Mashrur A. Chowdhury, and Adel Sadek, Fundamentals of Intelligent Transportation Systems Planning, Artech House, Inc., 2013
8. Sharma, S.K., Principles, Practice and Design of Highway Engineering, S. Chand & Co., New Delhi, 2017.

Online Educational Resources:

1. https://onlinecourses.nptel.ac.in/noc22_ce94/preview (Geometric Design of Highways By Prof. Rajat Rastogi IIT Roorkee)
2. https://archive.nptel.ac.in/courses/105/105/105105107/ (Transportation Engineering and Road development Process by IIT Kharagpur)
3. https://www.coursera.org/specializations/infrastructure-for-transportation-systems (L&T Edutech)
4. Mastering bitumen for better roads and innovative applications | Coursera

Assessment (Embedded course)
CAT 1, CAT 2, Activity and Learning Task(s), MCQ, End Semester Examination (ESE) Lab Workbook, Experimental Cycle tests, viva-voce

Course Curated by			
Expert(s) from Industry	**Expert(s) from Higher Education Institution**		**Internal Expert(s)**
Mr. K. Sankar, Highway Design Engineer, AS Systems Chennai	Dr. Arjun Siva, Assistant Professor Amritha University		Mrs. Anita . S AP/ CE KCT
Recommended by BoS on	05.12.2025		
Academic Council Approval	No.	**Date**	