

INSTITUTE OF SCIENCE, TECHNOLOGY & ADVANCED STUDIES (VISTAS)
(Deemed to be University Estd. u/s 3 of the UGC Act, 1956)
PALLAVARAM, THALAMBUR, PERIYAPALAYAM-CHENNAI
ACCREDITED BY NAAC WITH 'A++' GRADE

M.Tech

STRUCTURAL ENGINEERING

Regulation - 2024

Curriculum and Syllabus

(Based on Choice based Credit System and

Outcome Based Education)

Effective from the Academic year 2025-2026

Department of Civil Engineering

School of Engineering

VISION OF THE CIVIL ENGINEERING DEPARTMENT

To achieve national and international recognition by becoming a collaborative centre for learning & innovation and preparing the engineers to be stewards of a sustainable society by enhancing their innovative spirit, developing their professional and leadership qualities to face the challenges of the society and provide sustainable solutions

MISSION OF THE CIVIL ENGINEERING DEPARTMENT

i. To train the students by disseminating the knowledge of engineering, science and technology through in plant trainings, internships, value added courses and industrial visits
ii. To assist the students in discovering their talents and skills to become experts/entrepreneurs in solving the contemporary issues of civil engineering
iii. To equip the students with relevant sustainable and engineering approaches to the built and natural environment by raising their professional and leadership qualities for creating a sustainable society
iv. To motivate the students to pursue higher education and compete at the global level
v. To collaborate with leading industrial organizations and educational institutions in India and abroad for creating centers of excellence in emerging areas of Civil engineering

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

The Program Eduactional Objectives (PEOs) of M.Tech Structural Engineering are

PEO 1 Equip students with contemporary knowledge on design and analysis of structures to succeed professionally in their careers and research

PEO 2 Develop deep understanding of mathematical, scientific and engineering fundamentals to define and solve structural engineering problems.

PEO 3 Provide socially and economically viable sustainable solutions to multidisciplinary problems with professional and ethical integrity

PEO 4 Foster active engagement with industry and R&D centres to engage in lifelong learning for career enhancement and to excel in research and development

PROGRAM OUTCOMES (PO):

At the end of the programme, M.Tech. Structural Engineering will be able to

PO 1 Identify and define problems, gather data related to the problem, generate and prioritize a set of alternative solutions, and select and implement the best alternative incorporating the recommendations of relevant codes of practice.

PO 2 Analyze, design, conduct numerical experiments, and interpret data of complex engineering problems

PO 3 Apply modern engineering tools, software and equipment to analyze critically, design, investigate and provide solutions to solve structural engineering problems

PO 4 Analyze the impact of engineering solutions on environment and the need for sustainable development

PO 5 Communicate and function effectively as an individual and as a team, within multi-disciplinary environment in executing and managing projects

PO 6 Demonstrate professional ethics and engage in lifelong learning to practice construction profession and develop ideas to amalgamate the existing and contemporary knowledge

PROGRAM SPECIFIC OUTCOMES (PSOs)

The Program Specific Objectives of the M.Tech. Structural Engineering are to produce engineers who:

PSO 1 Design, develop, analyze and execute structural systems by adhering to structural codes, management principles, ethics, economy, and safety

PSO 2	Apply technical competence, modern methods, tools and suitable materials to maintain and rehabilitate existing structures for societal betterment
PSO 3	Develop feasible solutions for a sustainable environment with emphasis on earthquake-resistant design through teamwork, communication, project execution, and continuous learning

BOARD OF STUDIES

SL.No.	Name & Designation	Category
1	Dr.T Ilango Associate Professor and Head Department of Civil Engineering, VISTAS	Chairman / BOS
2	Dr. P. R. Kalyana Chakravarthy Associate Professor Department of Civil Engineering, VISTAS	Internal stakeholder
3	Dr. S. Durgalakshmi Associate Professor Department of Civil Engineering, VISTAS	Internal stakeholder
4	Dr. M. K Soundarya Assistant Professor Department of Civil Engineering, VISTAS	Internal stakeholder
5	Dr. G. Sharmilaa Assistant Professor Department of Civil Engineering, VISTAS	Internal stakeholder
6	Dr. K. Saravanan Professor and Head Department of Civil Engineering, VIT, Chennai	External stakeholder (Subject Expert)
7	Mr J Rajesh Senior Engineer Upscale Engineering and Interior Design, Avadi, Chennai	External stakeholder (Industrial Expert)
8	Mr S Surendar Babu (Alumnus 2013-2017) Proprietor, Yekova Constructions, Chennai	External stakeholder (Alumni Member)

M.Tech. STRUCTURAL ENGINEERING DEGREE COURSE

COURSES OF STUDY AND SCHEME OF ASSESSMENT

(MINIMUM CREDITS TO BE EARNED: 80)

		Hours/Week				Maximum Marks		
Category	Course Title	Lecture	Tutorial	Practical	Credits	CA	SEE	Total
SEMESTER I								
Program Core	Mathematical Optimization	3	1	0	4	40	60	100
Program Core	Theory of Elasticity and Plasticity	3	1	0	4	40	60	100
Program Core	Advanced Concrete Structures	3	1	0	4	40	60	100
Program Elective	Program Elective-I	3	0	0	3	40	60	100
Program Elective	Program Elective-II	3	0	0	3	40	60	100
Program Core	Advanced Structural Engineering and Experimental Techniques Laboratory	0	0	4	2	40	60	100
Mandatory courses	Research Methodology and IPR	2	0	0	2	40	60	100
Audit Course	Personality Development	0	0	0	0	40	60	100
		17	**3**	**4**	**22**			

SEMESTER II

		Hours/Week				Maximum Marks		
Category	Course Title	Lecture	Tutorial	Practical	Credits	CA	SEE	Total
Program Core	Advanced Steel Structures	3	1	0	4	40	60	100
Program Core	Structural Dynamics	3	1	0	4	40	60	100
Program Core	Finite Element Analysis in Structural Engineering	3	1	0	4	40	60	100
Program Elective	Program Elective-III	3	0	0	3	40	60	100
Program Elective	Program Elective-IV	3	0	0	3	40	60	100
Program Core	Numerical and Finite Element Analysis Laboratory	0	0	4	2	40	60	100
Program Core	Mini Project	0	0	4	2	40	60	100
Audit Course	Pedagogy Studies	0	0	0	0	40	60	100
		15	**3**	**8**	**22**			

SEMESTER III

		Hours/Week				Maximum Marks		
Category	Course Title	Lecture	Tutorial	Practical	Credits	CA	SEE	Total
Program Elective	Program Elective V	3	0	0	3	40	60	100
Open Elective	Open Elective I	3	0	0	3	40	60	100
Program Core	Design & Simulation Laboratory	0	0	4	2	40	60	100
Internship	Internship	0	0	4	2	40	60	100
Project	Dissertation I	0	0	20	10	40	60	100
		6	**2**	**28**	**20**			

SEMESTER IV

		Hours/Week				Maximum Marks		
Category	Course Title	Lecture	Tutorial	Practical	Credits	CA	SEE	Total
Project	Dissertation II	0	0	32	16	40	60	100
		0	**0**	**32**	**16**			

LIST OF PROGRAM CORE COURSES

Code No.	Course	Hours / Week			Credits
		Lecture	**T**utorial	**P**ractical	
	Mathematical Optimization	3	1	0	4
	Theory of Elasticity and Plasticity	3	1	0	4
	Advanced Concrete Structures	3	1	0	4
	Advanced Structural Engineering and Experimental Techniques Laboratory	0	0	4	2
	Advanced Steel Structures	3	1	0	4
	Structural Dynamics	3	1	0	4
	Finite Element Analysis in Structural Engineering	3	1	0	4
	Numerical and Finite Element Analysis Laboratory	0	0	4	2
	Design & Simulation Laboratory	0	0	4	2

LIST OF PROGRAM ELECTIVE COURSES

Code No.	Course	Hours / Week			Credits
		Lecture	Tutorial	Practical	
	Advanced Concrete Technology	3	0	0	3
	Computational Method of Structural Analysis	3	0	0	3
	Structural Health Monitoring	3	0	0	3
	Repair and Rehabilitation of Structures	3	0	0	3
	Green Building Techniques	3	0	0	3
	Design of Energy Efficient Buildings	3	0	0	3
	Shoring, Scaffolding and Formwork	3	0	0	3
	Building Acoustics, Light and Ventilation engineering	3	0	0	3
	Building Services and maintenance	3	0	0	3
	Project Safety Management	3	0	0	3

LIST OF OPEN ELECTIVE COURSES

Code No.	Course	Hours / Week			**C**redits
		Lecture	**T**utorial	**P**ractical	
	Disaster Preparedness, Planning & Mitigation	3	0	0	3
	Total Quality System and Engineering	3	0	0	3

	Environmental Impact Assessment	3	0	0	3
	Fundamentals of Entrepreneurship	3	0	0	3
	E – Commerce	3	0	0	3
	Global Warming and Climate Change	3	0	0	3

LIST OF MANDATORY COURSES

Code No.	Course	Hours / Week			Credits
		Lecture	Tutorial	Practical	
	Research Methodology and IPR	2	0	0	2

LIST OF INTERNSHIP COURSES

Code No.	Course	Hours / Week			Credits
		Lecture	Tutorial	Practical	
	Internship	0	0	4	2

LIST OF PROJECT COURSES

Code No.	Course	Hours / Week			Credits
		Lecture	Tutorial	Practical	
	Dissertation - I	0	0	20	10
	Dissertation - II	0	0	32	16

LIST OF AUDIT COURSES

Code No.	Course	Hours / Week			Credits
		Lecture	Tutorial	Practical	
	Personality Development	0	0	0	0
	Pedagogy Studies	0	0	0	0

MATHEMATICAL OPTIMIZATION	L	T	P	Credits
	3	1	0	4

MATHEMATICAL OPTIMIZATION

COURSE OBJECTIVE:

1. To understand the optimization techniques used in compiler design.
2. To be aware of the various computer architectures that support parallelism.
3. To become familiar with the theoretical background needed for code optimization.
4. To understand the techniques used for identifying parallelism in a sequential program.
5. To learn the various optimization

UNIT I LINEAR PROGRAMMING 12

Formulation- Assumption of liner programming-linear programming model, terminology for solution of the model- Graphical and simplex methods-Big-M method-Two phase method-Dual simplex method-Primal Dual problems.

UNIT II UNCONSTRAINED ONE DIMENSIONAL OPTIMIZATION TECHNIQUES 12

Necessary and sufficient conditions –Unrestricted search methods-Fibonacci and golden section method-Quadratic Interpolation methods, cubic interpolation and direct root methods.

UNIT III UNCONSTRAINED N DIMENSIONAL OPTIMIZATION TECHNIQUES 12

Direct search methods –Random search –pattern search and Rosen brooch‟s hill claiming method Descent methods-Steepest descent, conjugate gradient, quasi -Newton method.

UNIT IV CONSTRAINED OPTIMIZATION TECHNIQUES 12

Necessary and sufficient conditions –Equality and inequality constraints-Kuhn-Tucker conditions Gradient projection method-cutting plane method- penalty function method.

UNIT V DYNAMIC PROGRAMMING 12

Principle of optimality- recursive equation approach-application to shortest route, Backward-Moving Solution Procedure, Forward-Moving Solution Procedure cargo-loading, allocation and production schedule problems.

TOTAL 60 Hours

COURSE OUTCOMES:

After successful completion of Optimization Techniques course, the student will be able to

CO 1. Understand the basic theoretical principles in optimization and formulation of optimization models

CO 2. Apply basic concepts of mathematics to formulate an optimization problem.

CO 3. Acquire an idea about the various direct and indirect search methods.

CO 4. Visualize advanced optimization applications in Mechanical engineering.

CO 5. Analyse and appreciate variety of performance measures for various optimization problems

REFERENCES

1. Grewal B.S, Higher Engineering Mathematics, Khanna publishers, 2017.
2. Venkataraman, M.K., Higher Mathematics for Engineers, National Publishing Co., 2019
3. Clark Robinson R, Introduction to Mathematical Optimization, Oxford Press, 2019
4. Xin-She Yang, Introduction to Mathematical Optimization: From Linear Programming to Metaheuristics, Cambridge International Science Publishing, 2018

THEORY OF ELASTICITY AND PLASTICITY

L	T	P	Credits
3	1	0	4

COURSE OBJECTIVE:

To develop the ability to use the principles of theory of elasticity in engineering problems and to introduce theoretical fundamentals of theory of plasticity

UNIT I ELASTICITY 12

Analysis of stress and strain, Equilibrium Equations - Compatibility Equations - Stress Strain Relationship. Generalized Hooke's law-Constitutive Equations

UNIT II 2D STRESS STRAIN PROBLEMS 12

Plane stress and plane strain - Simple two-dimensional problems in Cartesian and Polar Coordinates.

UNIT III TORSION OF NON-CIRCULAR SECTION 12

St. Venant's approach - Prandtl's approach – Membrane analogy - Torsion of Thin Walled- Open and Closed sections-Design approach to open web section subjected to torsion - Finite Difference Method

UNIT IV BEAMS ON ELASTIC FOUNDATIONS 12

Beams on Elastic foundation – Methods of analysis – Elastic line method – Idealization of soil medium – Winkler model – Infinite beams – Semi-infinite and finite beams – Rigid and flexible – Uniform Cross Section – Point load and UDL – Solution by Finite Differences.

UNIT V PLASTICITY 12

Physical Assumptions – Yield Criteria – Failure Theories –Thick Cylinder – Plastic Stress Strain Relationship - Bending and Torsion in Elasto-Plastic Materials -Strain hardening Materials

TOTAL: 60 Hours

OUTCOMES:

On completion of this course, the student is expected to be able to

CO1 Derive and write the fundamental equations of elasticity describing the linear behavior of elements and develop constitutive models based on material behavior

CO2 Demonstrate the application of plane stress and plane strain in a given situation in both cartesian and polar coordinate systems

CO3 Solve torsion problems in circular and non-circular cross-sections

CO4 Analyse beams resting on elastic foundations

CO5 Solve analytically the simple boundary value problems with elasto-plastic and strain hardening properties

REFERENCES:

1. Ansel.C.Ugural and Saul.K.Fenster, “Advanced Strength and Applied Elasticity,” Fourth Edition, Prentice Hall Professional Technical Reference, New Jersey, 2019.
2. Chakrabarty. J, “Theory of Plasticity”, Third Edition, Elsevier Butterworth – Heinmann – UK, 2023.
3. Jane Helena H, "Theory of Elasticity and Plasticity", PHI, New Delhi 2017.
4. Timoshenko, S. and GoodierJ.N " Theory of Elasticity", Third Edition, McGraw Hill Book Co., New York, 2017.

ADVANCED CONCRETE STRUCTURES

L	T	P	Credits
3	1	0	4

COURSE OBJECTIVE:

To make the students familiar with the behaviour of RCC beams and columns and to design special structural members with proper detailing

UNIT I BEHAVIOUR AND DESIGN OF R.C. BEAMS 12

Properties and behaviour of concrete and steel – Behaviour and design of R.C. beams in flexure, shear and torsion - modes of failure - calculations of deflections and crack width as per IS 456.

UNIT II BEHAVIOUR AND DESIGN OF R.C. COLUMNS 12

Behaviour of short and long columns - behaviour of short column under axial load with uniaxial and bi-axial moments - construction of Pu - Mu interaction curves - Design of slender columns.

UNIT III DESIGN OF SPECIAL R.C. ELEMENTS 12

Design of RC walls - design of corbels - strut and tie method - design of simply supported and continuous deep beams - analysis and design of grid floors.

UNIT IV FLAT SLABS AND YIELD LINE BASED DESIGN 12

Design of flat slabs according to IS method – Check for shear - Design of spandrel beams - Yield line theory and design of slabs - virtual work method - equilibrium method.

UNIT V INELASTIC BEHAVIOUR OF CONCRETE STRUCTURES 12

Inelastic behaviour of concrete beams - Moment-curvature curves - moment redistribution - Concept of Ductility – Detailing for ductility – Design of beams, columns for ductility - Design of cast-in-situ joints in frames.

TOTAL: 60 Hours

OUTCOMES:

On completion of the course, the student is expected to be able to

CO1 Explain the structural behaviour of flexural members and columns

CO2 Design the compression members and construct interaction diagrams

CO3 Design the special elements like corbels, deep beams and grid floors

CO4 Design flat slab and spandrel beams

CO5 Predict the moment curvature behavior and design and detail concrete elements based on ductility

REFERENCES:

1. Gambhir.M. L., “Design of Reinforced Concrete Structures”, Prentice Hall of India, 2021.
2. Purushothaman, P, “Reinforced Concrete Structural Elements: Behaviour Analysis and Design”,

Tata McGraw Hill, 2021

3. Unnikrishna Pillai and Devdas Menon “Reinforced Concrete Design’, Third Edition, Tata McGraw Hill Publishers Company Ltd., New Delhi, 2022.
4. Varghese, P.C, “Advanced Reinforced Concrete Design”, Prentice Hall of India, 2020.
5. Sinha.S.N., Reinforced Concrete Design", Tata McGraw Hill publishing company Ltd.2017

ADVANCED STRUCTURAL ENGINEERING AND	L	T	P	Credits
EXPERIMENTAL TECHNIQUES LABORATORY	0	0	4	2

A) ADVANCED STRUCTURAL ENGINEERING LABORATORY

COURSE OBJECTIVE:

1. To provide a thorough knowledge of material selection through the material testing based on specification
2. To provide a detailed account of modern experimental techniques in construction Engineering research.
3. To introduce the basic working principles, the operational know-how, and the strength and limitations of the techniques

LIST OF EXPERIMENTS

1. Mix design of concrete as per IS, ACI & BS methods for high performance concrete.
2. Flow Characteristics of Self Compacting concrete.
3. Effect of minerals and chemical admixtures in concrete at fresh and hardened state with relevance to workability, strength and durability.
4. NDT on hardened concrete - UPV, Rebound hammer and core test.
5. Permeability test on hardened concrete (RCPT) – Demonstration

B) EXPERIMENTAL TECHNIQUES LABORATORY

. **LIST OF EXPERIMENTS**

1. Determination of elastic constants – Hyperbolic fringes
2. Determination of elastic constants – Elliptical fringes
3. Strain gauge meter – Determination of Young's modulus of a metallic wire
4. Ultrasonic interferometer – ultrasonic velocity in liquids
5. Electrical conductivity of metals and alloys with temperature-four probe method
6. Resistivity measurements
7. NDT – Ultrasonic flaw detector
8. Calibration of Proving Ring and LVDT **TOTAL: 60 Hours**

COURSE OUTCOMES:

On completion of the course, the student is expected to be able to

CO1 : Do the mix proportion using IS and ACI codal provisions.

CO2 : Test the concrete in a non-destructive manner using a rebound hammer.

CO3: Apply the analytical techniques and graphical analysis to interpret the experimental data

CO4 : Study the flow characteristics of self-compacting concrete

CO5 : Learn to calibrate and use proving rings and LVDTs

REFERENCES:

1. Beaufit F.W et al. "Computer Methods of Structural Analysis", Prentice Hall, 2021.
2. Bathe K.J, and Wilson. E.L, "Numerical Methods in Finite Element Analysis";,Prentice Hall, Engle Wood Cliffs, New Jersey, USA, 2018
3. Rubinstien. M.F, “Matrix Computer Analysis of Structures”, Prentice Hall, 2019.

RESEARCH METHODOLOGY AND IPR

L	T	P	Credits
2	0	0	2

COURSE OBJECTIVE:

To impart scientific, statistical and analytical knowledge for carrying out research work effectively.

UNIT I INTRODUCTION TO RESEARCH 6

The hallmarks of scientific research – Building blocks of science in research – Concept of Applied and Basic research – Quantitative and Qualitative Research Techniques – Need for theoretical frame work – Hypothesis development – Hypothesis testing with quantitative data. Research design – Purpose of the study: Exploratory, Descriptive, Hypothesis Testing.

UNIT II EXPERIMENTAL DESIGN 6

Laboratory and the Field Experiment – Internal and External Validity – Factors affecting Internal validity. Measurement of variables – Scales and measurements of variables. Developing scales – Rating scale and attitudinal scales – Validity testing of scales – Reliability concept in scales being developed – Stability Measures.

UNIT III DATA COLLECTION METHODS 6

Interviewing, Questionnaires, etc. Secondary sources of data collection. Guidelines for Questionnaire Design – Electronic Questionnaire Design and Surveys. Special Data Sources: Focus Groups, Static and Dynamic panels. Review of Advantages and Disadvantages of various Data-Collection Methods and their utility. Sampling Techniques – Probabilistic and nonprobabilistic samples. Issues of Precision and Confidence in determining Sample Size. Hypothesis testing, Determination of Optimal sample size.

UNIT IV RESEARCH REPORT 6

Purpose of the written report – Concept of audience – Basics of written reports. Integral parts of a report – Title of a report, Table of contents, Abstract, Synopsis, Introduction, Body of a report – Experimental, Results and Discussion – Recommendations and Implementation section – Conclusions and Scope for future work.

UNIT V PRINCIPLES OF IPR, COPYRIGHT LAW AND PRACTICES 6

Introduction to Intellectual Property Rights, Concept and Theories Kinds of Intellectual Property Rights, Economic analysis of Intellectual Property Rights, Advantages and Disadvantages of IPR, Copyright and Neighboring Rights, Concept and Principles, Historical background and Development of Copyright Law, Leading International Instruments, Berne Convention, Universal Copyright Convention

TOTAL: 30 Hours

COURSE OUTCOME:

CO-1: Propose research problem

CO-2: Select to carry out research analysis

CO-3: Classify to follow data collection methods

CO-4: Implement to understand multivariate statistical techniques

CO-5: Represent to understand about research report.

REFERENCE BOOKS:

1. C.R.Kothari, Research Methodology, Wishva Prakashan, New Delhi, 2021
2. Donald H.McBurney, Research Methods, Thomson Asia Pvt. Ltd. Singapore, 2020
3. N.S. Gopalakrishnan & T.G. Agitha, Principles of Intellectual Property Eastern Book Company, Lucknow, 2019

TECHNICAL SEMINAR - I **0 0 0 0**

The students are presenting 10 topics of contemporary techniques, methods and ideas of the construction industry for a period of 2 ½ months or 40 hours (Minimum).

There shall be 10 presentations made by each student during the semester and the presentation will be monitored by the review committee. The student will be making their presentation on the techniques, ideas, methodologies learnt by him / her before the committee.

The report shall carry a maximum of 20 marks, technical content and ideas in the presentation will carry 20 marks, presentation by the student will carry 20 marks and the viva-voce examination shall carry 40 marks. (Marks are awarded to each student based on the individual performance during the presentation and in the viva-voce examination). This is an audit course for the students of M.E Construction Engineering and Management

ADVANCED STEEL STRUCTURES

L	T	P	Credits
3	1	0	4

COURSE OBJECTIVE:

1. To impart sufficient knowledge to students on various codal provisions for steel structural design.
2. To offer knowledge to analyse and design different types of bolted and welded connections; industrial structural members; cold formed structural elements; and special structures such as chimney etc.
3. To give exposure to students on plastic analysis of structures.

UNIT I BEHAVIOUR AND DESIGN OF CONNECTIONS 12

Types of connection - importance - codal provisions as per IS: 800 - behaviour and design of bracket connection - unsiffened and stiffened seated connections – framed connections - connections for force and moment transmission – tee stub and end plate connections - stiffeners and other reinforcement.

UNIT II ANALYSIS AND DESIGN OF INDUSTRIAL BUILDINGS 12

Review of loads on structures - dead, live wind and seismic loads as per standards - requirements of industrial buildings - structural framing - braced frames & unbraced frames - analysis and design of Industrial building components such as roof truss, rafter bracing, purlin, eave girder, stanchions, gable column and bents - analysis and design of gable frames - design of moment resisting base plates.

UNIT III ANALYSIS AND DESIGN OF COLD–FORMED STEEL STRUCTURES

12 Types of cross sections – concepts of local buckling and effective width – codal provisions as per IS : 801 - analysis and design of unstiffened and stiffened compression elements - design of webs of beams - design of flexural members - economic design for beam strength - concept of lateral buckling of beams - concept of lateral bucking and bracing requirement – concept of shear lag and flange curling - design of compression members - design of wall studs and connection details.

UNIT IV ANALYSIS AND DESIGN OF SPECIAL STRUCTURES 12

Design of self supporting chimney (lined and unlined) - codal provisions of IS 6533 - stresses due to wind and earthquake forces – design of base plate, anchor bolts and foundation - check for deflection - design for dynamic effects - wind effects on chimney - gust factor Method - design of guyed chimneys.

UNIT V PLASTIC ANALYSIS OF STRUCTURES 12

Introduction - concepts of plastic design - shape factor - redistribution of moments - plastic collapse load - conditions of plastic analysis - methods of plastic analysis - plastic design of portal frames – problems. Connections - requirement - design of straight and haunched connections.

Total :60 Hours

COURSE OUTCOMES:

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

CO 1 Design connections for the expected shear force and bending moment

CO 2 Design components of industrial building such as roof truss, purlins, columns, bracing based on application requirement.

CO 3 Analyse and design cold formed flexural members, compression members and wall studs.

CO 4 Design self supporting and guyed chimney for the various loading conditions.

CO 5 Describe the concepts of plastic design, methods of plastic analysis and plastic collapse mechanism

REFERENCES:

1. Dayaratnam, P., Design of Steel Structures, Wheeler Publishing, 2021.
2. Teaching Resource for Structural Steel Design, INSDAG, Kolkatta, 2021.
3. Rhodes, J, Design of Cold-Formed Steel Members, Elsevier Science Publishers, 2019.
4. Ramchandra, S., Design of Steel Structures, Vol.-II, Standard Publications, New Delhi, 2019.
5. Salmon, C.G., and Johnson, J.E., Steel Structures-Design and Behaviour, Harper and Row, 2017
6. Subramanian N, Steel Structures - Design and practice, Oxford University Press, 2019.

STRUCTURAL DYNAMICS

L	T	P	Credits
3	1	0	4

COURSE OBJECTIVES:

1. To impart knowledge about theory of vibrations and vibration parameters to analyse the dynamic forces caused by an earthquake.
2. To introduce the design of buildings for blast and impact forces as per BIS codes of practice.

UNIT I SINGLE DEGREE OF FREEDOM SYSTEMS 12

Formulation of equations of motion by different methods - free and forced vibrations, effect of damping.

UNIT II MULTI DEGREE OF FREEDOM SYSTEMS 12

Formulation of structure property matrices, eigen value problems, mode shapes and orthonormality of modes, approximate methods of extraction of eigen values.

UNIT III CONTINUOUS SYSTEMS

12 Modeling - free and forced vibration of bars and beams. Rayleigh –Ritz method –formulation using conservation of energy –formulation using virtual work

UNIT IV DIRECT INTEGRATION METHODS FOR DYNAMIC RESPONSE 12

Damping in MDOF systems - Nonlinear MDOF systems - Wilson Theta method, Newmark's beta method - step-by-step numerical integration techniques.

UNIT V DESIGN AGAINST BLAST AND IMPACT 12

Characteristics of internal and external blast - Impact and impulse loads - pressure distribution on buildings above ground due to external blast - underground explosion - design of buildings for blast and impact as per BIS codes of practice.

Total : 60 Hours

COURSE OUTCOMES:

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

CO 1 Develop the equation of motion for single degree of freedom

CO 2 Analyze the dynamic response of multi degree of freedom systems

CO 3 Analyze the free and forced vibration of bars and beams

CO 4 Determine the dynamic response of structures using numerical integration procedure

CO 5 Design the buildings for blast and impact forces using BIS codes of practice.

REFERENCES:

1. Clough R.W, and Penzien J, Dynamics of Structures, Second Edition, McGraw-Hill International Edition, 2020.
2. Mario Paz, Structural Dynamics – Theory and Computations, Third Edition, CBS Publishers, 2019.
3. Roy R Craig, Structural Dynamics – An Introduction to Computer Methods, John Wiley and Sons, 2018.
4. Humar J. L., Dynamics of Structures, Prentice Hall, 2019.

FINITE ELEMENT ANALYSIS IN STRUCTURAL ENGINEERING	L	T	P	Credits
	3	1	0	4

COURSE OBJECTIVE:

1. To introduce the fundamental concepts of finite element method, specifically the conception of an idea that is involved in the finite element analysis of a structure.
2. To incorporate overview of matrix techniques and plane stress and plane strain concepts.
3. To expose the finite element software to analyse the structural members

UNIT I CONCEPTS OF FINITE ELEMENT METHOD 12

General description of the finite element method – overview of matrix techniques - basic equations from solid mechanics - variational formulation - approximate methods – Rayleigh Ritz, Weighted residual (Galerkin) and finite difference methods.

UNIT II PLANE STRESS AND PLANE STRAIN 12

The concept of an element - derivation of Elemental Equations – assembly - imposition of boundary Conditions - solution of the equations – basic functions and shape functions – one dimensional elements - two dimensional problems in plane stress and plain strain.

UNIT III AXISYMMETRIC STRESS ANALYSIS AND 3D STRESS ANALYSIS 12

Axisymmetric problems - triangular and quadrilateral Elements - natural coordinates - isoparametric formulation - numerical Integration - plate bending and shell elements - brick elements - Higher Order Elements.

UNIT IV MESHING AND SOLUTION PROBLEMS 12

Pre and post processor interpretations - p and h methods of refinement - conditioned elements - discretisation errors – patch test - auto and adaptive mesh generation techniques - error evaluation - finite element programming and FEA Software – ANSYS.

UNIT V NONLINEAR AND VIBRATION PROBLEMS 12

Material and geometric non-linearity - consistent system matrices – dynamic condensation - eigen value extraction - modal methods – integration methods - application to thermal analysis.

Total : 60 Hours

COURSE OUTCOMES:

On the successful completion of these modules, students will be able to

CO 1 Solve the boundary value problems using approximate methods.

CO 2 Derive and elemental equations and shape function for one and two dimensional elements.

CO 3 Form the isoparametric functions for various elements.

CO 4 Determine the mesh refinement and error evaluation for various elements.

CO 5 Model and analyse 2D and 3D systems using finite element software.

REFERENCES:

1. Seshu, P., Text Book of Finite Element Analysis, Prentice-Hall of India Pvt. Ltd., New Delhi, 2019.
2. Reddy, J.N., An Introduction to the Finite Element Method, McGraw-Hill International Editions (Engineering Mechanics Series), 2021.
3. Chandrupatla & Belagundu, Introduction to Finite Elements in Engineering, 3rd Edition, Prentice-Hall of India, Eastern Economy Editions, 2020.
4. David V. Hutton Fundamentals of Finite Element Analysis, Tata McGrawHill Edition, 2018.
5. Cook Robert. D., Plesha, Michael. E & Witt, Robert.J. Concepts and Applications of Finite Element Analysis, Wiley Students Edition, 2021.

NUMERICAL AND FINITE ELEMENT ANALYSIS	L	T	P	Credits
LABORATORY	0	0	4	2

COURSE OBJECTIVE:

1. To solve the mathematical equations and finite element analysis with computational methods like MATLAB and Finite element software using software like ANSYS, ABAQUS etc

LIST OF EXPERIMENTS/ EXERCISES

1. Dynamic analysis of frame using mathematical computational software
2. Finite Element Analysis of 2D truss and 3D space trusses
3. Finite Element Analysis of 3D space trusses
4. Modelling and Finite Element Analysis of RC beams
5. Modelling and Finite Element Analysis of RC slabs
6. Finite Element Analysis of thin and thick plates
7. Stability analysis using FEM
8. Analyze the bending moment of simply supported beam
9. Frame analysis of beams under various load conditions
10. Analysis of shells using ANSYS

TOTAL: 60 Hours

COURSE OUTCOMES:

At the end of the course, the student will be able to carry out

CO1 Thorough knowledge to handle FE software

CO2 Dynamic analysis of frames

CO3 Analysis of thin and thick plates

CO4 Perform Stability Analysis of Structures

CO5 Learn to use MATLAB and import MATLAB codes for FE modelling

REFERENCES

1. Seshu P, "Finite Element Analysis", Prentice Hall Private Learning Ltd, 2021
2. Reddy J N, "Introduction to Finite Element Method", Mc-Graw Hill Education, 2019
3. Tirupathi R. Chandrupatla and Ashok D. Belugundu," Introdution to Finite Elements in Engineering", Prentice Hall Private Learning Ltd, 2021