NMAM INSTITUTE OF TECHNOLOGY, NITTE

M.TECH IN STRUCTURAL ENGINEERING

VISION

To uphold the Department as a leader in community development through innovation and excellence in diverse areas of Civil Engineering to meet the global challenges and market demands.

MISSION

- To provide the students a strong theoretical knowledge and practical skills to understand the basic concept and fundamentals of various Civil Engineering subjects.
- To be competent and skilled enough to take the challenges in Research, Consultancy and Entrepreneurship.
- To encourage the students in developing professional ethics through discipline and principles.

PROGRAM EDUCATIONAL OBJECTIVES – M.Tech. CST

PEO-01	Equipped to pursue professional career in the constantly changing field of Structural Engineering, and Construction Industry
PEO-02	Competent enough to contribute knowledge base through learning and research
PEO-03	Continue to practice and promote the needs and challenges of real world problems and come up with sustainable solutions for social needs.

PROGRAM OUTCOMES – M.Tech. CST

PO1: Become Proficient

Acquire in-depth knowledge of thediscipline or professional area including wider and global perspective with an ability to discriminate, evaluate, analyze and integrate for the enhancement of knowledge.

PO2: Logical Thinking

Analyze complex engineering problems logically, reaching substantiated conclusion for evaluating information to make intellectual and/or creative advances for carrying research.

PO3: Problem Solving

Think multi-dimensionally, conceptualize and solve engineering problemsfor public health and safety, cultural, societal and environmental factors in the core areas of expertise.

PO4: Pursue an Investigation

Compile information pertinent to real life problems through investigations and experiments, apply appropriate research methodologies, techniques and tools,design of experiments, analysis and interpretation of dataand synthesis of information to provide sustainable solutions.

PO5: Usage of modern Tools& Techniques

Create, select, learn and apply appropriate techniques, resources, and modern engineering tools, including forecasting and modelling, to complex engineering activities considering the limitations.

PO6: Synergetic and Multidisciplinary work

Apply knowledge in understanding the group dynamics, identify opportunities and contribute positively for collaborative-multidisciplinary scientific research, demonstrate a capacity for self-management and teamwork.

PO7: Environment and Sustainability

Understanding of environmental and social responsibility to contribute to the community for sustainable development of society.

PO8: Professional Ethics

Equip professional and intellectual integrity, professional code of conduct and ethics of research.

PO9: Individual and Team work

Observe and examine critically the outcomes of one's actions and as a member orleader in diverse team of multidisciplinary activities.

PO10: Communication

Communicate with the engineering and social community and with society at large, regarding complex engineering activities confidently and effectively.

PO11:Project Management and Finance

Illustrateskill in understanding of structural engineering and management principles and apply to multidisciplinary environments after consideration of economic and financial factors.

PO12: Life-long learning

Identify the need to engage in life-long learning independently with a high level of enthusiasm and commitment to improve knowledge and competence continuously.

PROGRAM SPECIFIC OUTCOMES – M.Tech. CST

PSO1

Apply knowledge of various domains of structural engineering; conduct experiments, analyze, interpret data and design.

PSO2

Competent with skills and knowledge forresearch and innovative practices

PSO3

Illustrateskill in understanding of structural engineering and management principles in sustainable development in line with social responsibilities.

SCHEME OF TEACHING AND EXAMINATION FOR
M.TECH.IN STRUCTURAL ENGINEERING
(2017-2018)

I SEMESTER

Sub-Code	Title	Teaching Dept	Contact hours/ week	Duration of SEE (Hrs)	Marks		Credits
			L-T-P-S		CIE	SEE	
17CST 101	Advanced Mechanics of Solids	CV	4-0-2-0	03	50	50	5
17CST 102	Advanced Design of RCC Structures	CV	4-0-2-0	03	50	50	5
17CST 103	Structural Dynamics	CV	4-0-2-0	03	50	50	5
17CST 11X	Elective I	CV	4-0-0-0	03	50	50	4
17CST 12X	Elective II	CV	4-0-0-0	03	50	50	4
17CST104	Research Experience through Practice-I	CV	0-0-4-0	03	100	-	2
		TOTAL	**30**		**350**	**250**	**25**

LIST OF ELECTIVES I & II

ELECTIVE-I	ELECTIVE-II
17CST111 Repair & Restoration of Structures	17CST121 Reliability Analysis of Structures
17CST112Cold Formed Light gage Steel Structures	17CST122 AI and Expert System in Structural Engineering
17CST113Optimization Techniques	17CST123 Design of Tall Structures
17CST114 Green Building Design	17CST124 Computational Structural Mechanics

SCHEME OF TEACHING AND EXAMINATION FOR

M.TECH.IN STRUCTURAL ENGINEERING

II SEMESTER

Sub-Code	Title	Teaching Dept	Contact hours/ week	Duration of SEE (Hrs)	Marks		Credits
			L-T-P-S		CIE	SEE	
17CST 201	Advanced Design of Steel Structures	CV	4-0-2-0	03	50	50	5
17CST 202	Design of Earthquake Resistant structures	CV	4-0-2-0	03	50	50	5
17CST 203	Finite Element Method of Analysis	CV	4-0-2-0	03	50	50	5
17CST 21X	Elective III	CV	4-0-0-0	03	50	50	4
17CST 22X	Elective IV	CV	4-0-0-0	03	50	50	4
17CST 204	Research Experience through Practice-II	CV	0-0-4-0	03	100	-	2
		TOTAL	**30**		**350**	**250**	**25**

LIST OF ELECTIVE III & IV

ELECTIVE-III	ELECTIVE-IV
17CST211 Design of Concrete Bridges	17CST221 Special Concretes
17CST212 Design of Industrial Structures (RCC & Steel)	17CST222 Stability Analysis of Structures
17CST213 Design concepts of Substructures	17CST223 Valuation techniques in Engineering
17CST214Advanced design of PSC Structur	

List of Audit Courses currently offered:

Sl. No.	NAME OF THE AUDIT COURSE	AUDIT COURSE CODE	PROGRAMME	DEPARTMENT
1	Disaster resistant building design & management	17AP004	1)CONSTRUCTION TECHNOLOGY 2)STRUCTURAL ENGINEERING	CIV

III SEMESTER

Sub. code	Name of the Subject	Teaching hours/week		Marks for		Total Credits
		Lecture	Practical/ Tutorials/ Field work	CIE	SEE	
17CST 301	Industrial Training / Mini Project	8 Weeks duration		50 (Report) 50(Presentation)		08
17CST 302	Seminar on Special Topics		-	100		02
17CST 303	Project Part– I		Full Time 10 Weeks	100 (Report) 100(Presentation)		10
Total				400		20

Note:

1. 17CST 301: Industrial training / Mini Project: Industrial training report and oral presentation are to be evaluated by the department for 50 marks each. If mini project is carried out it is evaluated for 100 marks by the Department Committee.
2. 17CST 302– Seminar marks are evaluated by the Department Committee.
3. 17CST 303– Project Part I: The student should give minimum of two progress seminars during the semester. The progress of the work is to be assessed by the Department Committee including the Guide, for 100 marks report and 100 marks presentation.

IV SEMESTER

Sub. code	Name of the Subject	Duration	Duration of Sem. End Exam in hours	Marks for			Total Credits
		Practical/ Field work		CIE	SEE	Total Marks	
17CST 401	Project Part-II	Full Time (30 Weeks)	-	200 [PPE*-I –100 PPE-II – 100]	200	400	30

* PPE – Project Progress Evaluation

Grand Total from 1st to 4th Semester: 100 credits

ADVANCED MECHANICS OF SOLIDS

SubjectCode	**: 17CSE101**	CIEMarks	:50
No.ofLectureHrs./Week	:04+02	ExamHrs	:03

TotalNo.ofLectureHrs. Hours:52+26 Exam :50

COURSE LEARNING OBJECTIVES:

1. To enlighten the students about the concepts of stress-strain-displacement relationships in cartesian and polar coordinates to solve simple elasticity problems
2. To understand the behaviour of laterally loaded plates under bending
3. To know about different types of shells and understand the stress-strain-displacement relationships

UNIT I

Theory of Elasticity : Cartesian co-ordinates; concepts of stress and strain at a point - generalized Hooke's law- homogeneity, Isotropy, Orthotropy, stress - strain relations - plane stress - plane strain. Equilibrium equations - boundary conditions, strain - displacement relations - compatibility equations in terms of strains and stresses. Analysis of stress and strain at a point in any direction - principal stresses and strains and their directions. **10hours**

UNIT II

Polar Coordinates : Equilibrium equations - strain displacement relations - compatibility equations (in terms of stresses). Stress function - solution of simple axi-symmetric problems - stress - concentration around a hole in a plate under the action of in - plane stresses.**10hours**

UNIT III

Theory of Plates : Slopes and curvatures of slightly bent plates - principal curvatures - moment - curvature relationships - small deflections of laterally loaded plates - boundary conditions - strain energy of bending of plates - bending of orthotropic plates. **10hours**

UNIT IV

Theory of Shells: Introduction, definition of terms, types of surfaces, classification of shell surfaces, structural action of a shell, Stress resultants, selection of shell type, methods of analysis of shells. Differential geometry of curves and surfaces , Membrane analysis of cylindrical, conical and spherical shells with examples -Equilibrium equations, strain-displacement relations, boundary conditions

12hours

UNIT V

Bending theory of cylindrical shells - Equilibrium equations, strain-displacement relations, stress-strain relations, force-displacement relations, differential equation in terms of displacements, solution to simply supported cylindrical shell **10hours**

Practical Component

Analysis of 2D problems using software, development of models for plate and shell structures.

COURSE OUTCOME:

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

1. Explain the relationship between stress, strain and displacements for elasticity problems in two dimensions including axi-symmetric problems
2. Derive the equations for moment-curvature relationships for laterally loaded and orthogonal plates
3. Describe the membrane analysis of shell surfaces and to derive the relevant equations

REFERENCE BOOKS:

1. S.P. Timoshenko and J.N. Goodier, (1970), "Theory of Elasticity", III Edition, McGraw Hill Book Company, New York.
2. R.T. Fenner, (1986), "Engineering Elasticity", Ellis Horwood Limited, England.
3. L.S. Srinath, (1998), "Advanced Mechanics of Solids", Tata McGraw Hill, Delhi.
4. S.P. Timoshenko and S.W. Kriegar, (1959), "Theory of plates and shells", II Edition, McGraw Hill Book Company, New York.
5. A.C. Ugural, (1999), "Stresses in Plates and Shells", II Edition, McGraw Hill Book Company, New York
6. K. Chandrashekhara, (1995), "Analysis of Thin Concrete Shells", II Edition, New Age International Publishers, New Delhi
7. G.S. Ramaswamy, (2002), "Design and Construction of Concrete shell roofs", CBS Publications New Delhi.

ADVANCED DESIGN OF RCC STRUCTURES

SubjectCode	**: 17CST102**	CIEMarks	:50
No.ofLectureHrs./Week	:04+02	ExamHrs	:03
TotalNo.ofLectureHrs.	Hours:52+26	Exam	:50

COURSE LEARNING OBJECTIVES:

1. To provide basic knowledge of mathematics, science and engineering in the areas of advanced

RCC design using limit state design

2 To give procedural knowledge to design a system, component or process as per needs and specifications of advanced RCC structures like silos, bunkers chimneys, grid floor, flat slabs and continuous beams subjected to various loading combination with different end

3 To imbibe the culture of professional and ethical responsibilities by following codal provisions in the analysis, design and detailing of advanced structural elements for strength and durability.

UNIT I

Yieldline methodofdesignof slabs,flat slabs. **10hours**

UNIT II

Designof grid floors. **10hours**

UNIT III

Design of storage structures like silos, bunkers and chimneys **10hours**

UNIT IV

Designofcontinuousbeamswithredistributionof moments **12hours**

UNIT V

Design of curved beams. **10 hours**

Practical Component

Design of RC Structures using software and Structures Lab

COURSE OUTCOME:

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

1 Analyze and design the slabs by yield line method and also capable of designing flat slabs.

2 Design the grid floors for given practical condition

3 Effectively design the storage structures like silos, bunkers and chimneys.

4 Use the concept of redistribution of moments in design.

5 Reproduce the best building detailing in earthquake prone area and detailing of expansion & contraction joints.

TEXT BOOKS:

1 Raju N K “Advanced Reinforced Concrete Design”, CBS Publisher

2 Dr.B.C.Punmia et.al, “Reinforced Concrete Design”,Vol – II, Lakshmi Publications

REFERENCE BOOKS:

1 A Park and Paulay,**“Reinforced and PrestressedConcrete**”

2 LinTYandBurnsN H,“**ReinforcedConcreteDesign**".

3 Kong KFandEvans T H “**DesignofPrestressed ConcreteStructures**

4 P.C.Varghese,"**AdvancedReinforcedConcreteDesign**",Prentice-HallofIndia,NewDelhi,2005.
5 Dr.B.C.Punmia, Ashok Kumar Jain and Arun KumarJain,**"ComprehensiveRCCDesign"**

STRUCTURALDYNAMICS

SubjectCode	**: 17CST103**	CIEMarks	:50
No.ofLectureHrs./Week	:04+02	ExamHrs	:03
TotalNo.ofLectureHrs.	Hours:52+26	Exam	:50

COURSE LEARNING OBJECTIVES:

1. The objective of this course is tomakestudentstolearnprinciplesofStructuralDynamics and its importance in structural engineering field.
2. Toimplementstructural dynamicsprinciples throughdifferentmethodsandtoapplythesameforfreeandforcedvibrationofstructures.
3. To know the Importance of Natural frequency and mode shapes.
4. To understand and implement the various methods of modal analysis.
5. Toevaluatethedynamic characteristicsofthestructures for better structural design in view of earthquake.

UNIT I

Introduction: Introduction toDynamicalproblemsinCivilEngineering, Concept of degrees of freedom, D'Alembert'sprinciple, principle of virtualdisplacementandenergyprinciples

10 hours

UNIT II

DynamicsofSingle-degree-of-freedomsystems: Mathematicalmodels of SDOFsystem, Freevibrationresponse of dampedandundampedsystems,Responsetoharmonicloading,supportmotion,evaluationofdamping, vibration isolation, transmissibility, response to periodic forces. Numericalmethods appliedtoSDOF,Direct integration andDuhamel integral,principleofvibration-measuring instruments–seismometerand accelerometer. **12 hours**

UNIT III

DynamicsofMulti-degreefreedomsystems: Mathematicalmodelsof MDOF systems,freevibration ofundamped MDOF systems-Natural frequenciesandmodeshapes–orthogonalityconditions, freevibrationof dampedMDOFsystems. **10 hours**

UNIT IV

Modalanalysis& ApproximateMethods –freeand forcedvibrationwithandwithoutdamping.Rayleigh's method Dunkarley'smethod,Stodola'smethod,Rayleigh-Ritzmethod,Matrixmethod.

10 hours

UNIT V

DynamicsofContinuoussystems&Responseofstructurestoearthquakes: Freelongitudinalvibrationofbars, flexural vibration of beams with different end conditions, forced vibrations–responseofbeamsundermovingloads,wavepropagation in solids, CharacterizationOf earthquake groundmotion. **10 hours**

Practical Component

Dynamic Analysis of Structures Using Software's

COURSE OUTCOME:

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

1. Understand the importance of structural dynamics in civil engineering and basic principles.
2. Achieve knowledge on Single degree of freedom system in dynamics, mathematical equations and Vibration measuring instruments.
3. Achieve knowledge on Multi-degree of freedom system in dynamics and Mode shapes.
4. Know Modal analysis by various mathematical methods.
5. Understand DynamicsofContinuoussystems &Responseofstructurestoearthquakes.

TEXT BOOKS:

1. MarioPaz,"**Structuraldynamics–TheoryandComputation**", CBSPublishers
2. Mukyopadhyaya,"**VibrationandStructuralDynamics**",Oxford&IH

REFERENCE BOOKS:

1. MarioPaz,"**Structuraldynamics–TheoryandComputation**", CBSPublishers
2. Biggs,"**StructuralDynamics**",McGrawHill
3. R.W.Clough&J.Penzien,"**DynamicsofStructures**",McGrawHill
4. AnilK.Chopra,"**DynamicsofStructures**",PrenticeHallofIndia.
5. Timoshenko, S., "**Vibration Problems in Engineering**", VanNostrandCo.
6. Mukyopadhyaya,"**VibrationandStructuralDynamics**",Oxford&IH
7. WilliamThompson,"**TheoryofVibrationwithApplications**".
8. William Seto, "**Mechanical Vibrations**", McGraw Hill Pub., (SchaumSeries).

Research Experience through Practice-I

SubjectCode	**: 17CST104**	CIEMarks	:100
No.ofPracticalHrs./Week	:04	ExamHrs	:
TotalNo.ofLectureHrs.	Hours:39	Exam	:

COURSE LEARNING OBJECTIVES:

1. The objective of this course is to make students to learn and use industry standard softwares in a professional environment
2. To make students to learn to conduct various experimental investigation on concrete and to prepare design mixes
3. To make students to learn the procedure of static and dynamic analysis of structures using the standard specifications

Research Experience through Practice-I (In the First Semester)

Students may be offered inputs like how to conduct a literature survey, how to identify a research problem, how to write a research paper, research report, research proposal, and systematic way of conducting research etc. Department specific/PG Programme specific skill sets required for carrying out a research work may be offered to the students like software tools for system/device simulation and analysis, software/ hardware tools for signal acquisition, data processing, control simulation, Testing/measuring equipment used in research and Testing/measuring procedure. At the end of Research Experience through Practice-I in the first semester, PG students should be able to identify a research problem, with clear objectives and methodologies backed by extensive literature review. All the PG students may be asked to submit a research proposal and a presentation at the end of the first semester.

Individual PG Students are to be allotted to the individual faculty members based on student's area of research interest, specialization of faculty members in the beginning of the first semester.

COURSE OUTCOME:

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

1. Conduct various experimental investigation on concrete to check its suitability for the intended purpose.
2. Carry out mix design to develop design mixes.
3. Carryout nondestructive test.
4. Use of industry standard softwares like STAADPRO/SAAP to carry out static and dynamic analysis on structures.
5. Use of ETABS/STAADPRO to design RCC and steel structures.

TEXT BOOKS:

1. Shetty M.S, 'Concrete Technology ', S. Chand & Co. Ltd, New Delhi.
2. Mehta P.K, 'Properties of Concrete ', Tata McGraw Hill Publications, New Delhi.

REFERENCE BOOKS:

1. Neville AM, 'Properties of Concrete', ELBS Publications, London.
2. Relevant BIS codes.

REPAIR AND RESTORATION OF STRUCTURES

SubjectCode	**: 17CST111**	CIEMarks	:50
No.ofLectureHrs./Week	:04	ExamHrs	:03
TotalNo.ofLectureHrs.	Hours:52	Exam	:50

COURSE LEARNING OBJECTIVES:

1. Learn the failures of structure due to deterioration of concrete.
2. Gain the knowledge about difference between the repair and restoration of structures.
3. Study about the repair materials and compatibility with the parental structure.
4. Different types of retrofitting to strengthen the existing structures & Types of polymer concrete and epoxy grouting, shotcreting
5. Damage assessment of reinforced concrete structure methodology and approach

UNIT I

General: Introduction, Cause of deterioration of concrete structures, Diagnostic methods & analysis, preliminary investigations, experimental investigations using NDT, load testing, corrosion, core drilling and other instrumental methods. Quality assurance for concrete construction as built, concrete properties - strength, permeability, thermal properties and cracking.

10 hours

UNIT II

Influence on Serviceability and Durability: Effects due to climate, temperature, chemicals, wear and erosion, Design and construction errors, corrosion mechanism, Effects of cover thickness and cracking, methods of corrosion protection, corrosion inhibitors, corrosion resistant steels; cathodic protection.

10 hours

UNIT III

Maintenance and Repair Strategies: Definitions: Maintenance, repair and rehabilitation, Facets of Maintenance, importance of Maintenance, Preventive measures on various aspects Inspection, Assessment procedure for evaluating a damaged structure, causes of deterioration - testing techniques.

10 hours

UNIT IV

Condition Assessment of Reinforced Concrete Structure Approach and Methodology: Condition Survey, Visual Observation, Types of Damage and their Causes, In-situ testing, Durability tests for Corrosion of rebar Concrete, In-situ testing for Concrete, In-situ testing for steel Rebar, and specialized test. **10 hours**

UNIT V

Damages and Rehabilitations of Multistoried Buildings Subjected to Disasters: Introduction, Types of Damages and Failures, Damage assessment and Repair Methodology: Steps in Investigation, Investigation Procedure, Test to be conducted, Repair of Concrete elements, Steps in Repairing, Repair of steel structures, Poor foundation performance, Case studies of retrofitting of buildings, Repair material and techniques for retrofitting, Structural evaluation and repairs,

Examples of Repair to Structures: Repairs to overcome low member strength, Deflection, Cracking,

Chemical disruption, weathering wear, fire, leakage, marine exposure, engineered demolition techniques for dilapidated structures - case studies **12 hours**

COURSE OUTCOME:

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

1. Explain the failure and Experimental investigations to be carried out on structures.
2. Outline the difference between repair and restoration of structures.
3. Explain the Repair materials compatibility with the Parent structures
4. Suggest different retrofitting techniques for existing damaged structures.
5. Explain the damage assessment technique to be followed for RC structures

TEXT BOOKS:

1. Walter F. Silva-Araya, Oladis T. de Rinc¢n, Luis Pumarada-O'Neill. "Repair and Rehabilitation of Reinforced Concrete Structures:The State of the Art." ASCE Publications, 01-Jan-1998-Technology & Engineering

REFERENCE BOOKS:

1. Sidney., M. Johnson "**Deterioration Maintenance and Repair of Structures**"
2. R.N. Raikar "**Rehabilitation of Structures**"- Edited by, Vol. 1, 2 and 3, Proc., Int. Symposium, Maharashtra Indian Chapter of ACI, Bombay
3. Denison Campbell, Allen & Harold Roper, "**Concrete Structures – Materials, Maintenance and Repair**", Longman Scientific and Technical
4. R.T.Allen and S.C. Edwards, "**Repair of Concrete Structures**", Blakie and Sons
5. Raiker R.N. "**Learning for failure from Deficiencies in Design, Construction and Service**"-R&D Center (SDCPL)
6. Santhakumar A.R. "**Training Course notes on Damage Assessment and Repair in Low Cost Housing**", Anna University
7. Key, T. **"Assessment and renovation of concrete structures"**
8. B.S. Nayak **"Maintenance Engineering" PublishingCompanyPvt.Ltd.,NewDelhi**

COLD FORMED LIGHT GUAGE STEEL STRUCTURES

SubjectCode	**: 17CST112**	CIEMarks	:50
No.ofLectureHrs./Week	:04	ExamHrs	:03
TotalNo.ofLectureHrs.	Hours:52	Exam	:50

COURSE LEARNING OBJECTIVES:

1 To understand the concept of local buckling and limiting width to thickness ratio.
2 Design of structural elements in compression and tension using light gauge steel structures.
3 Design of light gauge steel structures in flexure.

UNIT I

Concept of local buckling of thin elements. Limiting width to thickness ratio. Post buckling strength **10 hours**

UNIT II

Formsoflightguagesections,Effectivewidthcomputation of unstiffened,stiffened,multiplestiffenedcompressionelements **10 hours**

UNIT III

Designofcompressionandtension members. **10 hours**

UNIT IV

Designofflexuralmembers(Laterallyrestrained/laterallyunrestrained). **12 hours**

UNIT V

Connectionsinstructurescomposedoflightgaugesections**10 hours**

COURSE OUTCOME:

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

1 Design light gauge steel structural elements in compression.
2 Design light gauge steel structural elements in tension.
3 Design light gauge steel structural elements in flexure.
4 Designing connections in structures composed of light gauge sections.

REFERENCE BOOKS:

1 RamchandraandVirendraGehlot"DesignofSteelStructures"Vol1and

Vol.2,ScientificPublishers,Jodhpur

2 IS-801-1975,IS-800-2007,IS-875

3 B.C.Punmia,A.K.Jain“DesignofSteelStructures”,LaxmiPublications, NewDelhi.

OPTIMIZATION TECHNIQUES

SubjectCode	**: 17CST113**	CIEMarks	:50
No.ofLectureHrs./Week	:04	ExamHrs	:03
TotalNo.ofLectureHrs.	Hours:52	Exam	:50

COURSE LEARNING OBJECTIVES:

1. Understand the need and concepts of design optimization.
2. To use conventional and modern optimization methods in structural applications.
3. To make students to learn the concepts of linear, non-linear, geometric and dynamic optimization techniques.

UNIT I

Introduction: Introduction to optimization, engineering applications of optimization, Formulation of structural optimization problems as programming problems. Optimization Techniques:Classical optimization techniques, single variable optimization, multivariable optimization with no constraints, unconstrained minimization techniques and algorithms constrained optimization solutions by penalty function techniques, Lagrange multipliers techniques and feasibility techniques

8 hours

UNIT II

Linear Programming: Linear programming, standard form of linear programming, geometry of linear programming problems, solution of a system of linear simultaneous equations, pivotal production of general systems of equations, simplex algorithms, revised simpler methods, duality in linear programming. **12 hours**

UNIT III

Non-linear programming: Non-linear programming, one dimensional minimization methods, elimination methods, Fibonacci method, golden section method, interpolation methods, quadratic and cubic methods, Unconstrained optimization methods, direct search methods, random search methods, descent methods. **12 hours**

UNIT IV

Constrained optimization techniques such as direct methods, the complex methods, cutting plane method, exterior penalty function methods for structural engineering problems. Formulation and solution of structural optimization problems by different techniques. **10 hours**

UNIT V

Geometric programming: Geometric programming, conversion of NLP as a sequence of LP/ geometric programming. **Dynamic programming:**Dynamic programming conversion of NLP as a sequence of LP/ Dynamic programming **10 hours**.

COURSE OUTCOME:

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

1. Achieve the knowledge of design and development of problem solving skills.
2. Understand the principles of optimization.
3. Summarize the linear, non-linear and geometric programming.
4. Implement the concept of dynamic programming.
5. Develop analytical ability to implement optimization techniques to structural problems.

REFERENCE BOOKS:

1. Spunt, "**Optimum Structural Design**"- Prentice Hall
2. S.S. Rao, "**Optimization – Theory and Practice**"- Wiley Eastern Ltd.
3. Uri Krisch, "**Optimum Structural Design**"- McGraw Hill
4. Richard Bronson, "**Operation Research**"- Schaum's Outline Series
5. Bhavikatti S.S.- "**Structural optimization using sequential linear programming"-** Vikas publishing house

GREEN BUILDING DESIGN

SubjectCode	**: 17CST114**	CIEMarks	:50
No.ofLectureHrs./Week	:04	ExamHrs	:03
TotalNo.ofLectureHrs.	Hours:52	Exam	:50

COURSE LEARNING OBJECTIVES:

1. To understand the concept of high performance green building and sustainability.
2. To study and understand the function of materials used for designing green buildings and generate substantial cost savings.
3. Learn about the selection of mechanical and electrical lighting systems.
4. Learn about green building water supply and waste water supply systems.

UNIT I

Introduction. Need for green building- Impact of building industry on energy resources, natural resources and environment. Green building-definition. Principles of green building. Concept of Embodied energy and calculation. Life cycle assessment. Consideration while selecting material and design for longevity **10 hours**.

UNIT II

Building envelope- Conventional materials and Use of low energy materials - Base materials for RCC and Steel systems. Alternatives to structural systems, masonry, mortar, plastering, roofing, ceiling, paving, flooring, doors, windows and wood work. Smart materials. Low energy construction- low energy material, locally sourcedmaterial and recycled material **12 hours**

UNIT III

Sustainable siting of building. Orientation of the building. Use of natural light, solar heat and ventilation. Fenestration and shading. Effective cooling and heating systems-solar passive techniques of heating and cooling in a building design. Methods of minimizing load on Conventional systems-Landscaping, water bodies. Building form-surface to volume ratio.

10 hours.

UNIT IV

Thermal Insulation for roof and walls. Glazing and shading systems. Building finishes. Effective electrical systems- photovoltaic systems. Efficient HVAC systems. Efficient lighting system- efficient bulbs, occupancy sensor systems and light sensors. Efficient motors. Energy auditing and Certification systems-GRIHA, LEED BREEAM and IGBC etc. **10 hours**.

UNIT V

Conserving water in building- Water efficient fixtures- flow restrictors, sensors, no water fixtures. Alternatives for secondary uses. Rain water harvesting, solar water heaters and solar cooking. Low flush toilets, grey water recycling. Onsite treatment. Eco-friendly toilets. Reducing irrigation water requirements. Vertical farming. Xeriscaping. **10 hours**

COURSE OUTCOME:

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

1	Apply the concepts of embodied energy and their calculations and design for longevity.
2	Application of alternative energy efficient materials for various building components.
3	Orient and plan the building environment to suit to effectively utilize the natural light, solar energy and other sources to ensure effective control on the inside environment of a building.
4	Understand the implementation of thermal insulation system, energy saving bulbs etc.,
5	Understand the criteria involved in energy auditing and certification systems-GRIHA, LEED BREEAM and IGBC etc.

REFERENCE BOOKS:

1	Prof. Dr. Michael Bauer, Peter Mösle and Dr. Michael Schwarz (2010) "Green Building – Guidebook for Sustainable Architecture" Springer.
2	Tom Woolley, Sam Kimmins, Paul Harrison and Rob Harrison (2001) "Green Building Handbook" Volume 1-Spon Press. Editor:
3	MiliMajumdar, (2002) "Energy-efficient buildings in India" Tata Energy Research Institute.
4	TERI "Sustainable Building Design Manual- Volume I & II" Tata Energy Research Institute.
5	Indian Green Building Council: www.igbc.inIGBC Green Homes Abridged Reference Guide
6	IGBC Green Factory Building Abridged Reference Guide
7	LEED India NC Reference Guide / LEED India CS Reference Guide
8	Background material of green building training programme conducted by IGBC
9	Green Rating for Integrated Habitat Assessment: http://grihaindia.org/
10	United States Green Building Council: http://www.usgbc.org/
11	The Whole Building Design Guide: http://www.wbdg.org/Technical Manual
12	United States Department of Energy: http://energy.

RELIABILITYANALYSISOF STRUCTURES

SubjectCode	**: 17CST121**	CIEMarks	:50
No.ofLectureHrs./Week	:04	ExamHrs	:03
TotalNo.ofLectureHrs.	Hours:52	Exam	:50

COURSE LEARNING OBJECTIVES:

1. Understand the concepts and techniques of reliability and probability distributions.
2. Define safety format or failure surface for a given actions and responsealong with their statistics.
3. Arrive at mean value of a dominant design parameter for the targetreliability index.

UNIT I

PreliminaryDataAnalysis: Graphicalrepresentation-Histogram, frequency polygon, Measures of central tendency- grouped and ungroupeddata,measuresofdispersion,measuresofasymmetry.**Curve fitting and Correlation:** Fitting a straight line, curve of the form $y=ab^x$andparabola,Coefficientofcorrelation **10 hours**

UNIT II

ProbabilityConcepts: Randomevents-Samplespaceandevents,Venn diagram andeventspace,Measuresofprobability-interpretation, probability axioms,additionrule,multiplication rule,conditional probability,probabilitytreediagram,statisticalindependence, total probabilitytheoremandBaye'stheorem. **12 hours**

UNIT III

Randomvariables: Probabilitymassfunction,probabilitydensity function,Mathematicalexpectation,Chebyshev'stheorem.
Probabilitydistributions: Discretedistributions-Binomialandpoison distributions,Continuousdistributions-Normal,Lognormaldistributions.**10 hours**

UNIT IV

ReliabilityAnalysis: Measuresofreliability-factor ofsafety,safety margin,reliability index,performancefunctionandlimitingstate. ReliabilityMethods-First OrderSecondMomentMethod(FOSM),Point EstimateMethod (PEM), and AdvancedFirst Order Second Moment Method (Hasofer-Lind's method) **10 hours**

UNIT V

Systemreliability: Influenceofcorrelationcoefficient,redundantand non-redundant systems-series, paralleland combined systems, Uncertaintyinreliabilityassessments- Confidencelimits,Bayesian revisionofreliability.
Simulation Techniques: Monte Carlosimulation-Statistical experiments,samplesizeandaccuracy,Generation ofrandom numbers-randomnumberswithstandarduniform distribution, continuous random variables,discreterandomvariables **10 hours**

COURSE OUTCOME:

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

1. Apply the concepts of reliability and probability distribution.
2. Use simulation techniques to arrive at the statistics of design variables.
3. Compute reliability index, for the given design details.
4. Specify failure surface with given action and response.
5. Carryout reliability analysis.

TEXT BOOKS:

1. Raju N. K "Advanced Reinforced Concrete Design", CBS Publisher.
2. Dr.B.C.Punmia et.al, "Reinforced Concrete Design",Vol – II, Lakshmi Publications.

REFERENCE BOOKS:

1. Ranganathan, R.(1999)."**StructuralReliabilityAnalysisand design"**-Jaicopublishinghouse,Mumbai,India.
2. Ang,A.H.S.,andTang,W.H.(1984)."**Probabilityconceptsin engineering planninganddesign"**-Volume–I,JohnWiley and sons,Inc,NewYork.
3. Ang,A.H.S.,andTang,W.H.(1984)."**Probabilityconceptsin engineeringplanninganddesign"**-Volume–II,JohnWileyand Sons, Inc., New York.

AI&EXPERTSYSTEMINSTRUCTURALENGINEERING

SubjectCode	**: 17CST122**	CIEMarks	:50
No.ofLectureHrs./Week	:04	ExamHrs	:03
TotalNo.ofLectureHrs.	Hours:52	Exam	:50

COURSE LEARNING OBJECTIVES:

1. Use expert systems to achieve fairly high levels of performance in taskareas which require a good deal of specialized knowledge and training.
2. Develop expert systems to perform tasks which are physically difficult,tedious, or expensive to have a human perform.
3. To make students to learn the principles of software design process.

UNIT I

Software Engineering: Introduction of softwareengineering– Application areas– Softwaredesignprocess–variousdesign– representationtechniques.Top – downdesign,Bottom– updesign– modularprogramming– structuralprogramming –Conversionofnon-structuredprograms– Softwaretesting–Softwarereliabilityandavailability. **10 hours**

UNIT II

ObjectOrientedProgramming: Comparisonbetweenprocedure– orientedprogramming andobjectorientedprogramming,Advantagesof OOPobjects,Classes,Dataencapsulation,Inheritance,Polymorphismetc.Application of OOP in Analysis and design of RC, PSC and steel structuralelements.

ArtificialIntelligence: Artificial Intelligence,Introduction,AI –Applicationfields,definingtheproblems– statespacerepresentation – problemcharacteristics –production system–productionsystem characteristics. **12 hours**

UNIT III

Design of storage structures like silos, bunkers and chimneKnowledgerepresentation –Formallogic– predicatelogic–logic programming –forwardv/sbackwardreasoning–matchingcontrol knowledge.Searchandcontrol:Concepts–uniformedblindsearch:depth firstsearch: depthfirstsearch–breadth firstsearch–bi–directional search–informedsearch–heuristicgraphsearch–generateandtest–hill climbing – best first search AND Orgraph search. Non formal knowledge representation – semantic networks – frames – scripts – productionssystems.Programmingin LISP.**10 hours**.

UNIT IV

ExpertSystems: Theirsuperiorityoverconventionalsoftware– componentsof an expert system–expert systemlifecycle– expert systemdevelopmentsprocess–natureofexpertknowledge–techniques of solicitingand encoding expertknowledge. Inference: Forward chaining-backwardchaining– rulevalueapproach. **10 hours**

UNIT V

Uncertainty–symbolicreasoningunderuncertainty:logicfornon– monotonic reasoning. Statistical reasoning: Probability and Bayes theorem –certaintyfactorandrulebasedsystem–Bayesiannetwork– Dempster–Shafertheory.Fuzzy reasoning.Features ofrulebased, networksbased andframebasedexpert system– examplesof expertsystemsin ConstructionManagementandStructuralEngg.,Expertsystem shells.NeuralNetworks,Anintroduction –theirpossibleapplicationsin CivilEngg.**10 hours**

COURSE OUTCOME:

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

1. Achieve knowledge of design and development of problem solving skills.
2. Understand the principles of object oriented programming.
3. Design and develop analytical skills.
4. Summarize the artificial intelligence and expert system.
5. Understand the concept of knowledge representation.

REFERENCE BOOKS:

1. M.L.Shooman,"**SoftwareEngineering**"-McGrawHill.RichardFairly,"**SoftwareEngineeringConcepts**"-McGrawHill.
2. Timothy Budd, "**An Introduction to Object OrientedProgramminginTurboC++**"-Addison–WesleyPublications.
3. RoberLafore,"**ObjectOrientedProgramminginTurboC++**"- GelgotiaPublishers.
4. Balaguruswamy, "**Object Oriented Programming with C++**"TMHPublishingCompanyLtd.
5. Patterson DW, "**Artificial IntelligenceandExpertSystems"-**PrenticeHall,NewJersy.
6. Rich,E andKnightK."**ArtificialIntelligence**"-TMH,NewDelhi.
7. Rolston, D.W" **Artificial IntelligenceandExpertSystems"-**McGrawHill,NewYork.
8. Nilson,N.J.,"**PrincipalsofArtificialIntelligence"-**Narosa,NewDelhi.
9. Adeli, H., "**Expert SystemsinConstructionsandStructuralEngg"-**Chapman&Hall,NewYork.
10. Elaine RickandKeuinKnight, "**Artificial intelligence**"- TataMcGrawHillEdition.
11. H.Adeli**,"Expertsysteminstructuraldesignandconstruction**" ChapmanandHall,1988.
12. Kostem,"**ExpertsystemsinCivilEngineering**"-ASCE,1987.
13. C.S.KrishnamoorthyandSRajeev,**ComputerAidedDesign**,NarosaPublishingHouse.

DESIGNOFTALLSTRUCTURES

SubjectCode	**: 17CST123**	CIEMarks	:50
No.ofLectureHrs./Week	:04	ExamHrs	:03
TotalNo.ofLectureHrs.	Hours:52	Exam	:50

COURSE LEARNING OBJECTIVES:

1 The objectives of this course is to make students to learn principles of stability of tall buildings,
2 To design the tall buildings for earthquake and wind resistance.
3 To understand the behavior of various structural components in tall structures
4 To analyze and design the various complicated structural components of tall structures
5 To evaluate the performance of tall structures for strength and stability.

UNIT I

DesignCriteria, LoadingandMovement: Designphilosophy,loading,sequentialloading,and materials– highperformance concrete,fiberreinforcedconcrete, lightweightconcrete,designmixes. GravityloadingDeadandliveload,methods ofliveloadreduction,Impact,Gravityloading,Constructionloads. **10 hours**

UNIT II

Windloading&Earthquake loading staticanddynamic approach,Analyticalandwindtunnel experimentationmethod.Equivalent lateralforce, modalanalysis, combinationsofloading, workingstressdesign, Limitstatedesign,Plastic design. **10 hours**

UNIT III

Behavior ofVariousStructuralSystems: Factorsaffectinggrowth, Heightand structuralform; Highrise behavior,Rigidframes,braced frames, in-filled frames, shearwalls,coupledshearwalls,wall-frames, tubular,cores,Futigger– bracedandhybridmegasystem. **10 hours**

UNIT IV

Analysis and Design: Modeling for approximate analysis, accurate analysisandreduction techniques, analysisofbuildingastotalstructural systemconsideringoverall integrityand major subsysteminteraction, analysisformemberforces;driftandtwist,computerized generalthree dimensionalanalyses. Sectionalshapes,propertiesand resistingcapacities,design,deflection,cracking,pre-stressing, shearflow.Designfor differentialmovement,creepandshrinkageeffects,temperatureeffects and fire.
12 hours

UNIT V

StabilityofTallBuildings: Overallbucklinganalysisofframes,wall frames,approximatemethods,secondordereffectsofgravity ofloading, P-Deltaanalysis,simultaneous firstorderandP-Deltaanalysis, Transnational, Torsionalinstability,outofplumbeffects,stiffnessof memberinstability,effectoffoundationrotation. **10 hours**

COURSE OUTCOME:

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

1 AchieveKnowledgeofdesignanddevelopmentofproblemsolvingskills.
2 Understandthe effect of earthquake and wind load on structures.
3 Understand the behavior ofvarious structural system
4 Understand theprinciplesof strengthandstabilityDesignanddevelopanalyticalskills.
5 SummarizethebehaviorofvariousstructuralsystemsUnderstandtheconceptsofP-Deltaanalysis.

REFERENCE BOOKS:

1 TaranathB.S, "**StructuralAnalysisandDesignof TallBuildings**",McGrawHill
2 WilfgangSchuller,"**Highrisebuildingstructures**"-JohnWiley
3 BryanStaffordSmith&Alexcoull,"**TallbuildingstructuresAnalysisandDesign**"-JohnWiley
4 T.Y Lin&D.StotesBurry, "**StructuralconceptsandsystemforArchitectsand Engineers"-**JohnWiley
5 LynnS.Beedle,"**AdvancesinTallBuildings**"-CBSPublishersandDistributors.
6 Dr.Y.P.Gupta– Editor,"**ProceedingsNationalSeminaronHighRise Structures-DesignandConstruction practicesfor middlelevelcities"-**NewAgeInternationalLimited.

COMPUTATIONALSTRUCTURALMECHANICS

SubjectCode	**: 17CST124**	CIEMarks	:50
No.ofLectureHrs./Week	:04	ExamHrs	:03
TotalNo.ofLectureHrs.	Hours:52	Exam	:50

COURSE LEARNING OBJECTIVES:

1. To provide basic knowledge of mathematics and numerical techniques to solve problems in structural analysis.
2. To highlight the various steps involved in analyzing problems related to plane trusses, plane frames and continuous beams using matrix methods, viz., flexibility and stiffness methods.
3. To enlighten the concept of temperature effects and lack of fit in solving problems of structural analysis

UNIT I

Brief history of Theory of structures: Static and Kinematic indeterminacy,Conceptsof stiffnessand flexibility.Energyconcepts. Principleof minimumpotentialenergyand minimumcomplementary energy.
Introduction to flexibilityandstiffnessmethods: Development of elementflexibilityandelementstiffnessmatrices fortruss,beam andgrid elements.
12 hours

UNIT II

Flexibility method: Force-transformation matrix– Developmentofglobalflexibilitymatrixforcontinuous beams,planetrussesandrigid planeframes(havingnotmorethansixco-ordinates –6x6flexibility matrix), **Analysis**ofcontinuousbeams**,**planetrussesandrigidplaneframes(havingnotmorethan3coordinates).
10 hours

UNIT III

StiffnessMethod: Displacement-transformationmatrix–Development ofglobalstiffnessmatrixforcontinuous beams,planetrusses andrigid plane frames (having not more than six co-ordinates– 6x6 stiffness matrix), Analysisofcontinuousbeams, planetrussesandrigidplaneframesby stiffnessmethod(havingnot morethan3coordinates). **10 hours**

UNIT IV

Direct Stiffness Method: Analysis of continuous beams, plane trusses and rigid plane frames (having not more than 3 coordinates). **10 hours**

UNIT V

Effects of temperature change andlack of fit. Related numerical problems by flexibility and stiffness method as in Units 2and 4. Solution techniques including numerical problems for simultaneous equations - Gauss elimination and Choleskymethods.Bandwidth consideration.
10 hours

COURSE OUTCOME:

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

1. Develop flexibility and stiffness matrix for truss, beam and grid elements.
2. Analyze beams, frames and trusses by flexibility method.
3. Solve problems on beams, frames and trusses by stiffness method using element approach.
4. Apply the knowledge of direct stiffness method to analyze problems on beams, frames and trusses.
5. Use numerical techniques for solving simultaneous equations with the understanding of band width.

TEXT BOOKS:

1. S.Rajasekaran,"**ComputationalStructuralMechanics**",PHI, New Delhi2001
2. C.S.Reddy,"**BasicStructuralAnalysis**",TMH,NewDelhi2001

REFERENCE BOOKS:

1. F.W.Beaufaitetal, "**ComputermethodsofStructuralAnalysis"**, PrenticeHall,1970.
2. W.Weaver and J.H.Gere, "**Matrix Analysis ofFramed Structures"**,VanNastran,1980
3. H.KardeStuncer,"**ElementaryMatrixAnalysisofStructures"**, McGrawHill, 1974.
4. A.K.Jain , "**Advanced Structural AnalysiswithComputer Application" ,** NemichandandBrothers,Roorkee,India

ADVANCED DESIGN OF STEEL STRUCTURES

SubjectCode	**: 17CST201**	CIEMarks	:50
No.ofLectureHrs./Week	:04+02	ExamHrs	:03
TotalNo.ofLectureHrs.	Hours:52+26	Exam	:50

COURSE LEARNING OBJECTIVES:

1. The objectives are to provide students with advanced knowledge of steel structural design and confidence to apply the underlying principles to solve a wide range of structural steel problems.
2. Tounderstand the importance of plastic analysis in structural steel design.
3. To have expertise in designing various components of structures using steel
4. To understand design complexities with respect to members subjecting to various forces in case of steel design
5. Understand the advanced principles of the design of hot-rolled and cold-formed steel structural members.

UNIT I

Plastic Analysis: Introduction, Ductility of steel, fully plastic moment of mild steel sections, plastic hinges and shape functions, basic theorems of plastic analysis, plastic analysis of continuous beams and portal frames (Single bay and Single storey only) **10 hours**

UNIT II

Laterally Unrestrained Beams: Lateral buckling of beams, factors affecting lateral stability, IS 800 code provisions, design approach. Lateral buckling strength of cantilever beams, continuous beams, beams with continuous and discrete lateral restraints, mono- symmetric and non-uniform beams – Design Examples. **12 hours**

UNIT III

Members Subjected to Combined Forces:

Beam Columns in Frames: Behaviour of short and long beam-columns, effects of slenderness ratio and axial force on modes of failure, biaxial bending, strength of beam columns, effective length of columns, methods in IS 800 – Examples.

Beams subjected to Torsion and Bending: Shear center and warping**,** methods of evaluating the torsional effects, IS 800 Code provisions, and Design examples: Rolled and hollow sections.

10 hours

UNIT IV

Steel Beams with Web Openings: Shape of the web openings, practical guide lines, and force distribution and failure patterns, analysis of beams with perforated thin and thick webs, design of castellated beams, Vierendeel girders. **10 hours**

UNIT V

Cold formed steel sections and Tubular sections: Techniques and properties, advantages, typical profiles, Stiffened and un-stiffened elements, Local buckling effects, effective section properties, IS 811 code provisions- numerical examples, beam design, column design.Design principles of rounded tubular structures, permissible stresses, design of tensionmembers, compression members and beams, connections. **10 hours**

Practical Component

Design of Steel Structures Using Software's and Structures Lab

COURSE OUTCOME:

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

1. Understand the importance of steel design in structural engineering field.
2. Achieve knowledge of plastic analysis and its importance in steel structures design.
3. Achieve knowledge on design of structural members subjected to combined forces
4. To know the expected failure patterns and various methods of design of beams with web openings
5. To know the methods of design and design principles of cold formed and tubular sections design.

TEXT BOOKS:

1. N. Subramanian, "Design of Steel Structures", Oxford,IBH.
2. Duggal.S.K.,"Design of Steel structures". Tata McGraw-Hill Education, 2000.

REFERENCE BOOKS:

1. IS 1641, 1642,1643
2. IS 800: 2007, IS 811
3. INSDAG Teaching Resource Chapter 11 to 20

DESIGN OF EARHQUAKE RESISTANT STRUCTURES

SubjectCode	**: 17CST202**	CIEMarks	:50
No.ofLectureHrs./Week	:04+02	ExamHrs	:03
TotalNo.ofLectureHrs.	Hours:52+26	Exam	:50

COURSE LEARNING OBJECTIVES:

1 To give preliminary exposure to design of earthquake engineering
2 To outline Seismic response of building and response history behaviors for different timeperiod.
3 Improve analytical skill and problem solving abilities
4 Design some earthquake resistant structures
5 Explain the earthquake resistant of masonry structures

UNIT I

Introduction to engineering seismology, Seismic Waves, Characteristics of Earthquake and its quantification, Magnitude and Intensity, Seismic Instruments, Strong Ground Motions, Characteristics of Earthquakes, Attenuation of the Ground motion, History of Major Earthquakes in India. **10 hours**

UNIT II

Seismic response of buildings,Study of response of buildings and structures due to past earthquakes, Complexity of Earthquake Ground Motion.

Response Spectrum- elastic and elasto-plastic spectra, tripartite plot, use of response spectrum in earthquake resistant design. **12 hours**

UNIT III

Earthquake analysis of multi-storied RC structure, discussion of IS code provisions of Earthquake resistant design of buildings. Analysis and design of RCC multistoried buildings by limit state method using static and dynamic method. **10 hours**

UNIT IV

Structural configuration for earthquake resistant design frames, shear walls and dual systems, Seismic Resistant Structural Systems

Ductility and energy absorption in buildings, details of providing ductility in structures, lessons from structural damage during past earthquakes. Artofdetailingearthquakeresistantstructures, expansionandcontractionjoints in buildings. **10 hours**

UNIT V

Concepts for Earthquake resistant masonry: lateral load analysis of masonry building, basis of flexibility of diaphragm, strength and material properties of masonry, Causes to failure of masonry structures and remedial measures taken to retrofit the structures, causes of damage in masonry building, poor performance of masonry building, Behavior of unreinforced and reinforced masonry wall, preparation of earthquake resistance of earthen building, in plane stiffness of wall with openings, Seismic behavior of masonry buildings during past earthquake, earthquake resistant design of masonry building- IS codal provisions. **10 hours**

Practical Component

Earthquake Engineering Lab

COURSE OUTCOME:

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

1. Explain the basic principles and history of earthquake engineering
2. Analyze Seismic response of building and response history behaviors for different earthquake data for different time period
3. Ability to deal with practical problems in earthquake engineering in static and dynamic loading
4. Suggest earthquake resistant design methods of shear wall, dual system and important of ductility in structures
5. Understand the concept of earthquake resistant of masonry structures.

TEXT BOOKS:

1. Minoru Wakabayashi, "**Design of Earthquake Resistant Buildings**", McGraw Hill Pub
2. Anil K Chopra, "**Dynamics of Structures – Theory and Application to Earthquake Engineering**", 2nd ed., Pearson Education pub.
3. Anderson, R .A., "**Fundamentals of Vibrations**", Mc Millan
4. IS – 1893 (Part I): 2002, IS – 13920: 1993, IS – 4326: 1993, IS-13828: 1993
5. Timoshenkeo, S., "**Vibration and Structural Dynamics**", Van Nostrand Co.
6. Clough and Penzien, "**Dynamics of Structures"**. McGraw Hill
7. Mukyopadhyaya, "**Vibration and Structural Dynamics**", Oxford & IBH
8. James Ambrose and Dimitry Vergun, **"Design for Earthquakes".**
9. David Key, "**Earthquake Design Practice for Buildings**", Thomas Telford

REFERENCE BOOKS:

1. Dowrick D.J., "Earthquake Resistant Design" John Wiley & Sons, London, 2009.
2. Shrikande M. & Agarwal P. "Earthquake Resistant Design of Structures" Prentice Hall (India) Ltd, New Delhi, 2006.
3. Dr. Vinod Hosur , "Earthquake Resistant Design of Building Structures" John Wiley & Sons, London
4. Manuals/guidelines/reading materials to be downloaded from http://www.nicee.org
5. S.K.Duggal, (2007), "Earthquake Resistant Design of Structures", Oxford University Press, New Delhi 2007.

FINITE ELEMENT METHOD OF ANALYSIS

SubjectCode	**: 17CST203**	CIEMarks	:50
No.ofLectureHrs./Week	:04+02	ExamHrs	:03
TotalNo.ofLectureHrs.	Hours:52+26	Exam	:50

COURSE LEARNING OBJECTIVES:

1. To provide basic knowledge of finite element analysis to solve problems in structural mechanics
2. To highlight the various steps involved in analyzing problems related to plane trusses, beams, plane stress, plane strain, axisymmetric, plates and shells using finite element method.
3. To enlighten the concept of isoparametric elements and variation method.

UNIT I

Basicconceptsofelasticity –KinematicandStaticvariablesforvarious typesofstructuralproblems– approximatemethodof structuralanalysis– Rayleigh– Ritz method , Finitedifferencemethod– Finiteelement method. Principles of finite element method – advantages &disadvantages– Finiteelementprocedure. Finite elements used for one, two &three dimensional problems.
12 hours

UNIT II

Element aspect ratio–meshrefinement vs. Higherorderelements– Numberingofnodestominimizeband width.
Nodaldisplacement parameters–Convergence criterion–Compatibility requirements– Geometricinvariance–Shape function–Polynomialform ofdisplacementfunction.
GeneralizedandNaturalcoordinates–Lagrangianinterpolation function – shapefunctionsforone,two&threedimensional elements.**10 hours**

UNIT III

Isoparametricelements - Internal nodes and higher order elements– Serendipity andLagrangianfamily ofFiniteElements–Subparametric andSuperparametricelements–Condensation ofinternalnodes– Jacobiantransformation Matrix.Developmentofstrain–displacement matrixand stiffnessmatrix,consistentload vector,numericalintegration.
10 hours

UNIT IV

Variationmethodandminimization ofEnergyapproachofelement formulation.
ApplicationofFiniteElementMethodfortheanalysisofone&two dimensional problems-Analysis ofsimplebeamsandplanetrusses. **10 hours**

UNIT V

Application toplanestress/strain/axisymmetricproblemsusingCST& QuadrilateralElements.
ApplicationtoPlates&Shells-Choiceofdisplacementfunction **10 hours**

Practical Component

Finite Element Analysis Using Software's

COURSE OUTCOME:

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

1. Explain the concepts of finite element analysis and the steps involved.
2. Develop shape functions and displacement functions for one, two and threedimensional elements.
3. Derive strain-displacement matrix, Jacobian matrix and to justify the significance ofisoparametric elements.
4. Analyze one and two dimensional problems using finite element method.
5. Apply the knowledge of finite element analysis to plane stress, plane strain,axisymmetric, plates and shells problems.

TEXT BOOKS:

1. KrishnamoorthyCS,"**FiniteElementAnalysis"-**TataMcGraw Hill.
2. Desai C and Abel J F, "**Introduction to the Finite Element Method**"-EastWestPressPvt. Ltd.,1972.

REFERENCE BOOKS:

1. BatheK J, "Finite Element Procedures in Engineering Analysis"- PrenticeHall.
2. Rajasekaran.S, "Finite Element Analysis in Engineering Design"-Wheeler Publishing.
3. CookRD, MalkanDS& Plesta M.E, "Concepts and Application of Finite Element Analysis" - 3rd Edition, John WileyandSons Inc., 1989.
4. ShamesIHand DymC J,"Energy and Finite Element Methods in Structural Mechanics"- McGraw Hill,NewYork, 1985

Research Experience through Practice-II

SubjectCode	**: 17CST204**	CIEMarks	:100
No.ofPracticalHrs./Week	:04		
TotalNo.ofLectureHrs.	Hours:39		

COURSE LEARNING OBJECTIVES:

1. The objective of this course is to make students to learn and use industry standard softwares in a professional environment.
2. To make students to learn to conduct various experimental investigation on concrete and to prepare design mixes.
3. To make students to learn the procedure of static and dynamic analysis of structures using the standard specifications.

Research Experience through Practice-II (In the Second Semester)
In the second semester, the students are expected to carry out Mathematical modelling/Design calculations/computer simulations/Preliminary experimentation/testing of the research problems identified during Research Experience through Practice-I carried out in the first semester. At the end of the second semester, students are expected to write a full research paper based on the Mathematical modelling/ Design calculations/computer simulations/Preliminary experimentation/testing carried out during second semester.

COURSE OUTCOME:

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

1. Conduct various experimental investigation on concrete to check its suitability for the intended purpose.
2. Carry out mix design to develop design mixes.
3. Carryout nondestructive test.
4. Use of industry standard softwares like STAADPRO/SAAP to carry out static and dynamic analysis on structures.
5. Use of ETABS/STAADPRO to design RCC and steel structures.

TEXT BOOKS:

1. Shetty M.S, 'Concrete Technology ', S. Chand & Co. Ltd, New Delhi.
2. Mehta P.K, 'Properties of Concrete ', Tata McGraw Hill Publications, New Delhi.

REFERENCE BOOKS:

1. Neville AM, 'Properties of Concrete', ELBS Publications, London.

2 Relevant BIS codes.

SubjectCode	**: 17CST211**	CIEMarks	:50
No.ofLectureHrs./Week	:04	ExamHrs	:03
TotalNo.ofLectureHrs.	Hours:52	Exam	:50

COURSE LEARNING OBJECTIVES:

1	The objectives of this course is to make students to learn principles and design of Concrete Bridges
2	To design the Concrete Bridges for various loading conditions as per IRC Standards.
3	To understand the various design procedures and feasibility for concrete bridges.
4	To understand the design complications of various types of bridges for various classes of vehicle loading
5	To learn the structural detailing of Concrete bridges.

UNIT I

IntroductionBridges and Bridgesubstructures: HistoricalDevelopments,SiteSelectionforBridges, ClassificationofBridgesForcesonBridges**.** Abutments,piersandwingwalls.**8 hours**

UNIT II

BoxCulvert: DifferentLoadingCasesIRCClassAATracked, Wheeled andClassALoading,workingouttheworstcombination ofloading, Moment Distribution,CalculationofBM&SF,StructuralDesign ofSlab Culvert,withReinforcementDetails. **10 hours**

UNIT III

T Beam Bridge Slab Design: Proportioning of ComponentsAnalysis of interiorSlab& CantileverSlabUsing IRC ClassAA Tracked, Wheeled ClassA Loading,Structural Design of Slab, with ReinforcementDetail.

T Beam Bridge Cross Girder Design: Analysis of CrossGirder for Dead Load& Live LoadUsing IRC ClassAA Tracked, Wheeled ClassA LoadingA Loads,StructuralDesign of Beam, with ReinforcementDetail.

T Beam Bridge Main Girder Design: Analysis of Main Girder forDead Load&Live LoadUsing IRC ClassAA Tracked, Wheeled ClassA LoadingUsing COURBON'S Method,Analysis of MainGirderUsing HENDRY-JAEGER and MORICE-LITTLE Method for IRC ClassAA Tracked vehicle only, BM&SF for differentloads,Structural Design of MainGirder With ReinforcementDetails

14 hours

UNIT IV

PSCBridges: IntroductiontoPreandPostTensioning,Proportioning of Components, Analysis andStructuralDesign ofSlab,Analysis ofMain GirderusingCOURBON's MethodforIRCClassAAtrackedvehicle, Calculation of pre-stressing force, cable profile and calculation of stresses,DesignofEndblockanddetailingof maingirder **10 hours**.

UNIT V

Balanced CantileverBridge: Introductionand proportioningof components,Designofsimplysupportedportionanddesignofcantileverportion,designofarticulation. **10 hours**

COURSE OUTCOME:

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

1	AchieveKnowledge on history of bridges and various components of bridges
2	Learn thedesign of Box and Slab culvert and its structural detailing.
3	Learn thedesign of T-Beam bridge Slab, cross girder and main girder and its structural detailing
4	Understand theprinciplesPSC Bridge design and structural detailing
5	AchieveKnowledge on design of Balance cantilever Bridge.

REFERENCE BOOKS:

1	**"EssentialsofBridgeEngineering**"- DJohnsonVictor,Oxford&IBHPublishingCo NewDelhi
2	**"DesignofBridges"-**NKrishnaRaju,Oxford&IBHPublishing Co NewDelhi
3	**"PrinciplesandPracticeof BridgeEngineering"-**SP BindraDhanpatRai &SonsNewDelhi
4	IRC6–1966"**StandardSpecificationsAndCodeOfPractice ForRoadBridges"-** SectionII LoadsandStresses,TheIndian RoadCongressNewDelhi
5	IRC21–1966"**StandardSpecificationsAndCodeOfPractice ForRoadBridges"-** Section IIICementConcrete(Plainand reinforced)TheIndianRoadCongressNewDelhi
6	IS456–2000"**IndianStandardPlainandReinforcedConcreteCodeofPractice"-** (FourthRevision)BISNewDelhi
7	IS 1343 – "**Indian Standard Prestressed Concrete Code ofPractice"-**BISNewDelhi
8	RainaV.K.,"**ConcreteBridgePractice**"-TataMcGrawHill
9	BakhtB&Jaeggar,"**BridgeAnalysisSimplified**"-McGrawHill
10	Ponnuswamy. S,"**BridgeEngineering**"-TataMcGrawHill.
11	Derrick Beckett, "**An Introduction to Structural Design ofConcrete**

DESIGNOFINDUSTRIAL STRUCTURES

SubjectCode	**: 16CST212**	CIEMarks	:50
No.ofLectureHrs./Week	:04	ExamHrs	:03
TotalNo.ofLectureHrs.	Hours:52	Exam	:50

COURSE LEARNING OBJECTIVES:

1. Gain knowledge about classification and planning of Industrial Structures along with analysis of industrial Building
2. Explain Tower configurations, Factor of safety and loads of Transmission tower
   Improve analytical skill and problem solving abilities for industrial structures
3. Design tall chimneys & Transmission line Tower
4. Design foundation of towers

UNIT I

Planning and functional requirements : Classification of Industries and Industrial structures - planning for Layout Requirements regarding Lighting, Ventilation and Fire Safety - Protection against noise and vibration - Guidelines of Factories Act **8 hours**.

UNIT II

Analysis of industrial building: Introduction to Industrial Building, Loads, Industrial Floors, Roof Systems, Plastic Analysis, Portal Frames, Crane Gantry girder, Design for Wind and Eartquake Action, Beam Column Connections **12 hours**.

UNIT III

Analysis of transmission line towers: Introduction to Transmission Towers, Material Properties, Clearences, and Tower Configurations, Factors of Safety and load, Tower Design

10 hours

UNIT IV

Steel Chimneys: Analysis and design of tall chimneys **12 hours**

UNIT V

Foundation of Towers: Introduction of Foundation of Towers, Types of Loads, Basic Design Requirement, Soil Parameters, Structural Arrangement of Foundations, Soil Resistance for designing Foundations, Design Procedure for Foundation **10 hours**

COURSE OUTCOME:

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

1. Plan industrial structures for functional requirements.
2. Analyze and Design for Industrial Building for Wind and EQ loads
3. Design Transmission Towers
4. Design Chimneys,
5. Design Foundation of Towers

TEXT BOOKS:

1. B.C.Punmia,A.K.Jain“DesignofSteelStructures”,LaxmiPublications, NewDelhi**.**
2. N Subramanian-“DesignofSteelStructure”oxfordUniversityPress

REFERENCE BOOKS:

1. Jurgen Axel Adam, Katharria Hausmann, Frank Juttner, Klauss Daniel, Industrial Buildings: A Design Manual, Birkhauser Publishers, 2004.
2. Manohar S.N, Tall Chimneys - Design and Construction, Tata McGraw Hill, 1985
3. Santhakumar A.R. and Murthy S.S., Transmission Line Structures, Tata McGraw Hill, 1992.
4. Srinivasulu P and Vaidyanathan.C, Handbook of Machine Foundations, Tata McGraw Hill, 1976.
5. RamchandraandVirendraGehlot“DesignofSteelStructures“Vol1and Vol.2,ScientificPublishers,Jodhpur.
6. IS-800-2007,IS-875

DESIGNCONCEPTSOFSUBSTRUCTURES

SubjectCode	**: 17CST213**	CIEMarks	:50
No.ofLectureHrs./Week	:04	ExamHrs	:03
TotalNo.ofLectureHrs.	Hours:52	Exam	:50

COURSE LEARNING OBJECTIVES:

1. Study the preliminary exposure to soil exploration and fundamental requirements of foundation design and requirement.
2. Design and analysis of various foundations.
3. Study of deep foundation, design, analysis and the stability check.
4. Design and analysis of well foundations
5. Stabilityand design considerations for tall structures and ring foundations.

UNIT I

Introduction, Site investigation, In-situ testing of soils,Subsoil exploration,Classificationoffoundationssystems. Generalrequirement offoundations, Selectionoffoundations, ComputationsofLoads,Designconcepts. Shallowfoundationsinclay,Shallowfoundationinsand&C-Φ soils.Footingsonlayeredsoilsandslopingground. **10 hours**

UNIT II

Typesofrafts,bearingcapacity &settlements ofraftfoundation,rigidmethods,Flexiblemethods,soil-structureinteraction,differentmethodsof modelingthesoil.Combinedfootings(rectangular&trapezoidal), strap footings &wall footings, Raft –superstructure interactioneffects &generalconceptsofstructuraldesign,Basementslabs **12 hours**

UNIT III

DeepFoundations: Load Transfer inDeepFoundations, Types ofDeep Foundations, Ultimate bearingcapacity of different types of pilesin different soilconditions, Laterallyloaded piles,tension piles& batter piles, Pile groups: Bearingcapacity, settlement, uplift capacity, load distribution between piles, Proportioning and designconcepts of piles **10 hours**

UNIT IV

Types of caissons, Analysis of well foundations, Design principles, Well construction and sinking **10 hours**.

UNIT V

Foundationsfor tower structures:Introduction,Forces on towerfoundations,Selectionoffoundation type,Stabilityanddesign considerations,Ringfoundations–generalconcepts.

10 hours

COURSE OUTCOME:

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

1. Understand and Explain the basic requirements for foundations and design foundations
2. Design and Analyze foundations using rigid and flexible methods and also check the stability
3. Ability to Design and analyses of deep foundations.
4. Understand various types of Caissons and capable to design well foundation.
5. Ability to Design and analyses foundation for tall structures and check the stability.

REFERENCE BOOKS:

1. Swami Saran – "Analysis & Design of Substructures"- Oxford & IBH Pub. Co. Pvt. Ltd., 1998.
2. Nainan P Kurian – "Design of Foundation Systems"- Narosa Publishing House, 1992.
3. R.B. Peck, W.E. Hanson & T.H. Thornburn – "Foundation Engineering"- Wiley Eastern Ltd.,Second Edition, 1984
4. J.E. Bowles – "Foundation Analysis and Design"- McGraw-Hill Int. Editions, Fifth Ed., 1996
5. W.C. Teng – "Foundation Design"- Prentice Hall of India Pvt. Ltd., 1983.
6. Bureau of Indian Standards:IS-1498, IS-1892, IS-1904, IS-6403, IS-8009, IS-2950, IS-11089, IS-11233, IS-2911 and all other relevant codes.

ADVANCED DESIGN OF PRE-STRESSD CONCRETE STRUCTURES

SubjectCode	**: 17CST214**	CIEMarks	:50
No.ofLectureHrs./Week	:04	ExamHrs	:03
TotalNo.ofLectureHrs.	Hours:52	Exam	:50

COURSE LEARNING OBJECTIVES:

1 Understand various types of prestressed structural elements.
2 Analyzeand determineloads and stresses in PSC Members
3 Applyknowledgeofanalytical solution in problem solving
4 Designand detailingof Prestressed structural elements.
5 Designing statically indeterminate structures

UNIT I

DesignofSectionforFlexure: Allowablestresses -Elasticdesignofsimplebeamshaving rectangularandI-sectionforflexure-kernlines-cableprofileandcablelayout.Designof SectionsforShear:ShearandPrincipalstresses-Improvingshearresistanceby different prestressingTechniques-horizontal,slopingandverticalprestressing-Analysisofrectangular and l-beam-Designof shear reinforcement-Indian code provisions,Importance of modulusof elasticityof Prestressing tendons, failures of prestressed concrete. **09 hours**

UNIT II

Shear and Torsional resistance- ultimate shear resistance- Design of shear reinforcement in torsion.
10 hours

UNIT III

CompositesectionsofprestressedconcretebeamandcastinsituRCslabanalysisofstresses differentialshrinkagedeflectionsFlexuralandshearstrengthofcompositesectionsDesignof compositesections.**09 hours**

UNIT IV

TransferofPrestressin PretensionedMembers:Transmissionofprestressingforcebybond Transmission length ,Flexural bond stresses-lScodeprovisions-Anchorage zonestresses in post tensionedmembers-stressdistributioninEndblock-Analysisbyapproximate,Guyonand Magnel methods-Anchoragezonereinforcement. **12 hours**.

UNIT V

Statically indeterminateStructures:Advantages&disadvantagesofcontinuousPrestressedbeams-Primary andsecondary moments-PandClines-Lineartransformationconcordantandnon- concordantcableprofiles-Analysisofcontinuousbeamsandsimpleportalframes (singlebay and single story). **12 hours**

COURSE OUTCOME:

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

1 Identifyvarious prestressed structural elements.
2 Applyanalytical skills to evaluateperformanceof prestressed structural elements
3 Analyzeprestressed structural elements with various considerations.
4 Design and detail prestressed structuralelementsforvarious loadingconditions.
5 Designvarious statically indeterminate prestressed structural elements.

REFERENCE BOOKS:

1 N Krishnaraju "Prestressed Concrete", Tata McGraw- Hill Education, 2008.

2 Lin T. Y and H. Burns "Prestressed Concrete structures", Wiley Publication, 2009.

3 N. Rajagopalan, "Prestressed Concrete", Narosa Publishing House.2nd edition 2005.

4 A. Nilson, "Design of Prestressed Concrete", John Willey&Sons.2nd edition, ISBN 1765 1997.

SPECIAL CONCRETE

SubjectCode	**: 17CST221**	CIEMarks	:50
No.ofLectureHrs./Week	:04	ExamHrs	:03
TotalNo.ofLectureHrs.	Hours:52	Exam	:50

COURSE LEARNING OBJECTIVES:

1 Learn the principles of concrete mix design.

2 To differentiate between the different types of concrete.

3 To characterize the high performance concrete.

UNIT I

Componentsofmodernconcreteanddevelopmentsintheprocessand constituentmaterials:Roleofconstituents,Developmentincements andcementreplacementmaterials, pozzolona, flyash,silicafume,rice huskash,recycledaggregates,chemicaladmixtures.MixproportioningofConcrete:Principlesandmethods.

10 hours

UNIT II

LightWeightconcrete:Introduction,classification, properties,strength anddurability,mixproportioningandproblems.Highdensity concrete:Radiationshieldingabilityofconcrete,materials for highdensityconcrete, mix proportioning,propertiesin freshandhardenedstate,placementmethods.

12 hours

UNIT III

Ferrocement:Ferrocementmaterials,mechanicalproperties,cracking offerrocement,strengthandbehaviourintension,compression and flexure,Designofferrocement intension,ferrocement constructions, durability,andapplications. **10 hours**

UNIT IV

Fibre reinforced concrete:Fibre materials, mix proportioning, distributionandorientation,interfacialbond,propertiesinfreshstate,strengthandbehaviorintension,compressio n andflexureofsteelfibre reinforcedconcrete,mechanical properties,crackarrestandtoughening mechanism,applications.**10 hours**

UNIT V

HighPerformanceconcrete:constituents,mixproportioning,properties infreshand hardenedstates,applicationsandlimitations.Ready Mixed Concrete, Self-CompactingConcrete, Reactive powder concrete, bacterialconcrete **10 hours**

COURSE OUTCOME:

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

1. Achieve knowledge of design and development of problem solving skills.
2. Understand the principles of concrete mix design.
3. Design and develop analytical skills.
4. Summarize the light weight concrete, ferro cement material and fibre reinforced concrete.
5. Understand the concept of high performance concrete.

TEXT BOOKS:

1 NevilleA.M,“**PropertiesofConcrete”**PearsonEducationAsis, 2000
2 P. Kumar Mehta,PaulJ.N.Monterio,CONCRETE, “**Microstructure,PropertiesandMaterials”**-TataMcGrawHill

REFERENCE BOOKS:

1 A.R.Santhakumar, (2007) “Concrete Technology”-Oxford University Press,NewDelhi, 2007.
2 Short AandKinniburgh.W, “Light Weight Concrete”- Asia PublishingHouse, 1963
3 Aitcin P.C. “High performance concrete”-EandFN,Spon London 1998
4 Rixom.R. and Mailvaganam.N., “Chemical admixtures in concrete”-E andFN,Spon London 1999
5 Rudnai.G., “Light Wiehgt concrete”-Akademiaikiado, Budapest, 1963.

STABILITYANALYSISOFSTRUCTURES

SubjectCode	**: 17CST222**	CIEMarks	:50
No.ofLectureHrs./Week	:04	ExamHrs	:03
TotalNo.ofLectureHrs.	Hours:52	Exam	:50

COURSE LEARNING OBJECTIVES:

1 Learn the principles of stability of structures.

2 To analyze the structural elements for stability.

3 To evaluate the use of strain energy in the plate bending and stability.

UNIT I

Beam–column–Differentialequation.Beamcolumnsubjectedto(i) lateralconcentrated load,(ii)severalconcentrated loads,(iii)continuous lateralload.Applicationoftrigonometricseries,Euler'sformulationusing fourthorderdifferential equationforpined–pined,fixed–fixed,fixed– freeand fixed– pinnedcolumn **8 hours**.

UNIT II

Bucklingoframesandcontinuousbeams.Elastica. Energymethod– Approximate calculation ofcriticalloadsforacantilever.Exactcritical load for hinged–hingedcolumnusingenergyapproach.Bucklingofbaronelasticfoundation.Bucklingofcantilevercolumn under distributedloads. Determinationof criticalloads bysuccessive approximation.Bars withvaryingcrosssectionEffectofshear force on critical load.Column subjected to non – conservativefollowerandpulsatingforces **12 hours**.

UNIT III

Stability analysis by finite element approach– deviationof shape functionforatwonoddedBernoulli – Eulerbeamelement (lateraland translation of) – element stiffness and element geometric stiffness matrices– assembledstiffnessand geometricstiffnessmatricesfor a discretisedcolumnwithdifferentboundarycondition– calculationof criticalloadsforadiscretised(twoelements)column (bothendsbuiltin). Bucklingofpinjointedframes(maximum oftwoactivedof)– symmetricalsinglebayportalframe**12 hours**.

UNIT IV

Lateralbucklingof beams– differentialequation– purebending– cantileverbeamwith tip load – simplysupportedbeamof I section subjectedto centralconcentratedload.PureTorsionofthin–walledbarsofopencrosssection.Non–uniformTorsionofthin–walledbarsofopencrosssection **10 hours**.

UNIT V

Expressionforstrainenergyinplatebendingwithinplateforces (linearandnon–linear).Bucklingofsimplysupported rectangular plate–uniaxialloadandbiaxialload.Bucklingofuniformlycompressed rectangularplate simplysupportedalongtwo oppositesides perpendicular tothedirectionofcompression andhavingvariousedgeconditionalong theothertwo sides. **10 hours**

COURSE OUTCOME:

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

1. Achieve knowledge of design and development of problem solving skills.
2. Understand the principles of strength and stability.
3. Design and develop analytical skills.
4. Appraise the stability analysis by finite element approach.
5. Understand the concept of lateral buckling of beams.

REFERENCE BOOKS:

1. Stephen P.Timoshenko, James M Gere, "Theory of Elastic Stability"-2nd Edition, McGraw–Hill,NewDelhi.
2. Robert D Cook et.al, "Concepts and Applications of Finite Element Analysis"-3rd Edition, John Wiley andSons,New York.
3. S.Rajashekar, "Computations and Structural Mechanics"- Prentice–Hall, India
4. RayW CloughandJ Penzien, "Dynamics of Structures"- 2nd Edition, McGrawHill,New Delhi
5. H.Zeiglar, "Principles of Structural Stability"-BlaisdallPublications.

VALUATION TECHNIQUES IN ENGINEERING

SubjectCode	**: 17CST223**	CIEMarks	:50
No.ofLectureHrs./Week	:04	ExamHrs	:03
TotalNo.ofLectureHrs.	Hours:52	Exam	:50

COURSE LEARNING OBJECTIVES:

1. Understanding the concepts of values, obsolescence, amortization and depreciation.
2. Valuation of open urban land, factors affecting intrinsic values of land.
3. Valuation of land with buildings, Valuation of licensed premises.

UNIT I

Purpose of valuation, different forms of values, obsolescence, amortization, depreciation and its methods of determination using straight line, constant percentage, declining balance, sinking fund and sum of years method. Problems on valuation using Year's Purchase, Capitalized value.

9 hours

UNIT II

Methods of valuation of open urban land, factors affecting intrinsic values of land, Comparative method, Abstractive method, Belting method. Problems on above methods **10 hours**.

UNIT III

Outgoings- Municipal & Government Taxes, insurance, Loss of rent, collection charges, annual repairs & maintenance. Problems on outgoings. Rent: definition, types of rent, problems on standard rent of buildings. Cost of structure-BIS rules for measuring plinth area and cubical contents

10 hours

UNIT IV

Valuation of land with buildings-Rental method, Valuation by reference to profit, Direct comparisons of capital value, Residual or developmental method, valuation based on cost or contractor's method. Leasehold properties and freehold Properties. Rights and Liabilities of Lessor & Lessee. Valuation of licensed premises. Problems on valuation of cinema and hotel.

11 hours

UNIT V

Easements- self-imposed, legally created, Dominant and servient heritage- effect of easements on valuation. Market- Real Estate market and market value-fair market value, open market value- parameters affecting Investments- Bonds, debentures, capital gains, wealth Tax and Income Tax. Valuation on land acquisition. **12 hours**

COURSE OUTCOME:

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

1. Understand different forms of values, obsolescence, amortization, depreciation and its methods of determination.
2. Apply methods of valuation of open urban land, factors affecting intrinsic values of land, Comparative method, Abstractive method, Belting method.
3. Valuate land with building.

4 Understand real estate market and market values.

5 Understand the parameters affecting Investments- Bonds, debentures, capital gains, wealth Tax and Income Tax. Valuation on land acquisition.

REFERENCE BOOKS:

1 Banerjee “Principles and Practice of valuation”.

2 Rao Gopinath C.H., “Valuation Practice of Immovable Properties”.

3 Mitra A.K., “Theory and Practice of valuation”.

4 Shah N.A., “Quality surveying and valuation”.

5 Rangwala “Valuation of Real Properties” (2011) Charotarpublishing private limited, Anand India.