KLE Technological University | Creating Value, Leveraging Knowledge

Curriculum Structure and Curriculum Content for the Academic Batch 2024-2026
School of Civil Engineering
Program: Structural Engineering

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Vision

KLE Technological University will be a national leader in Higher Education–recognised globally for innovative culture, outstanding student experience, research excellence and social impact.

Mission

KLE Technological University is dedicated to teaching that meets highest standards of excellence, generation and application of new knowledge through research and creative endeavors.

The three-fold mission of the University is:

- To offer undergraduate and post-graduate programs with engaged and experiential learning environment enriched by high quality instruction that prepares students to succeed in their lives and professional careers.

- To enable and grow disciplinary and inter-disciplinary areas of research that build on present strengths and future opportunities aligning with areas of national strategic importance and priority.

- To actively engage in the Socio-economic development of the region by contributing our expertise, experience and leadership, to enhance competitiveness and quality of life.

As a unified community of faculty, staff and students, we work together with the spirit of collaboration and partnership to accomplish our mission.

Vision

To be the most preferred branch of engineering through the highest order of excellence in teaching-learning and research with social commitment and responsibility.

Mission

Education Experience: To impart quality technical education to Civil Engineering students through innovative curricula, effective teaching and research experience that enable them to become highly competent to meet the challenging needs of industry and society.

Research: To explore and develop innovations that contributes to advancement of knowledge in both fundamental and applied domains of Civil Engineering.

Learning Environment: To provide scholarly and vibrant learning environment that enables staff and students to achieve personal and professional growth.

Service: To provide community services and involve in professional contributions leading to regional growth adding value through knowledge and expertise.

Program Educational Objectives/Program Outcomes and Program-Specific Objectives

Program Educational Objectives -PEO's
PEO-1: Conceive, realize and design structural engineering infrastructure that is the backbone of growth and prosperity of mankind.
PEO-2: Assess the impact of structural engineering activities on economy, environment and society at large.
PEO-3: Work in team with moral, ethical and professional responsibilities
PEO-4: Pursue higher education and/or engage in research and development through continuous learning
Program Outcomes-PO's
PO-1: An ability to independently carry out research /investigation and development work to solve practical problems.
PO-2: An ability to write and present a substantial technical report/document.
PO-3: To demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program.
PO-4: To use modern tools in modelling, analyzing, designing and performance evaluation of structures to adopt suitable retrofitting techniques and developing new structural martials with high mechanical properties.
PO-5: To work with integrity and ethics in their professional practice, having an understanding of responsibility towards society with sustainable development for lifetime.
Program Specific Objectives -PSO's
Nil

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Curriculum Structure-Overall

Semester				Total Program Credits: 178
Course with course code	**I**	**II**	**III**	**IV**
	Theory of Elasticity	Design of Tall Structures	Internship/Industrial Training[#]	MajorProject/ Project Work Phase II[*]
	Structural Dynamics	Finite Element Method	Minor Project/Project WorkPhaseI[*]	
	Advanced Design of RC Structures	Stability of Structures		
	Numerical Methods and Programming	Program Elective-I		
	Program Elective	Program Elective-II		
	CAAD Lab	Structural Simulation Laboratory		
	Recent Topics on Technology Trends	Design Project		
Credits	25	25	18	20

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Scheme Semester – I

AY: 2024-25

No	Code	Course	Category	L-T-P	Credits	Contact Hours	ISA	ESA	Total	Exam Duration (in hrs)
1.	20ESEC701	Theory of Elasticity	PC	4-0-0	4	04	50	50	100	3 hours
2.	20ESEC702	Structural Dynamics	PC	4-1-0	5	06	50	50	100	3 hours
3.	24ESEC701	Advanced Design of RC Structures	PC	4-1-0	5	06	50	50	100	3 hours
4.	19ESEC701	Numerical Methods and Programming	PC	4-0-0	4	04	50	50	100	3 hours
5.	-	Program Elective	PE	4-0-0	4	04	50	50	100	3 hours
6.	15ESEP701	CAAD Lab	PC	0-0-2	2	04	80	20	100	3 hours
7.	15ESET701	Recent Topics on Technology Trends	PC	1-0-0	1	01	100	-	100	-
TOTAL				21-2-2	25	29				

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List of Program Electives for Semester 1

Sr. No	Name of the Course	Course Code
1.	Design of Bridges	24ESEE701
2.	Advanced Concrete Technology	24ESEE702
3.	Fire Resistance of Structures	20ESEE701

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Semester – II

AY: 2024-25

No	Code	Course	Category	L-T-P	Credits	Contact Hours	ISA	ESA	Total	Exam Duration (in hrs)
1.	22ESEC701	Design of Tall Structures	PC	4-1-0	5	06	50	50	100	3 hours
2.	19ESEC702	Finite Element Method	PC	4-0-0	4	04	50	50	100	3 hours
3.	20ESEC706	Stability of Structures	PC	4-0-0	4	04	50	50	100	3 hours
4.	-	Program Elective-I	PE	4-0-0	4	04	50	50	100	3 hours
5.	-	Program Elective-II	PE	4-0-0	4	04	50	50	100	3 hours
6.	18ESEP701	Structural Simulation Laboratory	PC	0-0-1	1	02	80	20	100	3 hours
7.	19ESEP702	Design Project	PC	2-0-1	3	03	50	50	100	3 hours
TOTAL				**22-1-2**	**25**	**27**				

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List of Program Electives for Semester 2

Sr. No	Name of the Course	Course Code
	Program Elective-I	
1.	Design of Industrial Steel Structures	15ESEE703
2.	Structural Reliability	15ESEE704
3.	Theory of Plates and Shells	20ESEE702
	Program Elective-II	
1.	Design of Foundations	15ESEE706
2.	Structural Optimization	15ESEE707
3.	Structural Health Monitoring	20ESEE703

Semester- III

AY: 2025-26

No	Code	Course	Category	L-T-P	Credits	Contact Hours	ISA	ESA	Total	Exam Duration (in hrs)
1.	21ESEI801	Internship/Industrial Training[#]	PW	0-0-8	**8**	8	50	50	100	3 hours
2.	21ESEW801	Minor Project/Project WorkPhaseI[*]	PW	0-0-10	**10**	10	50	50	100	3 hours
		TOTAL		**0-0-18**	**18**	**18**				

Semester- IV

AY: 2025-26

No	Code	Course	Category	L-T-P	Credits	Contact Hours	ISA	ESA	Total	Exam Duration (in hrs)
1	19ESEW802	MajorProject/ Project Work Phase II[*]	PW	0-0-20	20	20	50	50	100	3 hours
			TOTAL	**0-0-20**	**20**	**20**				

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SEMESTER 1

Program: Master of Technology (Structural Engineering)		Semester: I
Course Title: Theory of Elasticity		**Course Code:20ESEC701**
L-T-P: 4-0-0	**Credits: 04**	**Contact Hours: 4 hrs/week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks: 100**
Teaching Hours: 50	**Examination Duration: 3Hrs**	

Unit I

1.Stress

Introduction, Continuum, Stress at a point, Stress components in rectangular and cylindrical coordinates; Equilibrium equations; Stress on an oblique plane; Stress transformation; Stress invariants, Principal stresses and principal planes; Deviatoric stresses; Maximum shear stresses; Octahedral stresses **10 hrs**

2. Strain

Strain at a point, notations, geometrical interpretation of strain; Strain- deformation relations; Strain compatibility equations; Strain transformation; Strain invariants, Principal strains and Principal planes; Deviatoric strains; Octahedral strains **06 hrs**

3. Stress Strain Relations

Linearity and nonlinearity – material, geometric, contact, Stress strain relations for an isotropic material; Plane stress and Plane strain problems; Stresses in terms of displacements; Equilibrium equations in terms of displacements; Compatibility equations in terms of stresses; St. Venant's principle **04 hrs**

Unit II

4. Two Dimensional Problems in Rectangular Coordinates

Airy's stress function; Bi harmonic equation for plane stress and plane strain; Polynomial stress functions; Cantilever beam subjected to load at the free end – stresses and displacements; Simply supported beam subjected to uniformly distributed load – stresses and displacements **06 hrs**

5. Two Dimensional Problems in Polar Coordinates

General equations in polar coordinates; Transformation from rectangular o polar coordinates; Bi harmonic equation; Axisymmetric problems – Thick cylinder subjected to radial pressure, Rotating disk; Non-axisymmetric problems – Platewith a circular hole, Concentrated force at a point of a straight boundary. **08 hrs**

6. Torsion of Prismatic Bars

Assumptions, St. Venant's solution; Torsion of bars with different sections – elliptic, equilateral sections; Membrane analogy method; Torsion of narrow rectangular sections; Torsion of thin walled sections **07 hrs**

Unit III

7. Theories of Failure

Mechanism of plastic deformation; Theories of failure – Maximum principal stress, Maximum shearing stress, Maximum elastic strain, Octahedral shearing strain, Maximum elastic energy, Energy of distortion; Significance of the theories of failure; Use of factor of safety in design; Mohr's theory of failure;Stress space and strain space. **09 hrs**

Text Books

1 Timoshenko, S.P. and Goodier, J.N., Theory of Elasticity, 3ed. McGraw- Hill Book Co.,

New York, 2017.

2 Valliappan, S., Continuum Mechanics Fundamentals, Oxford & IBHPublishing Co., New Delhi, 1981.

3 Srinath, L.S., Advanced Mechanics of Solids, 3ed., Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2017.

Reference Books:

1. Boresi, A.P., Sidebottom, O.M., Seely, F.B. and Smith, J.O., Advanced Mechanics of Materials, 4ed. John Wiley & Sons,, New York, 1985.
2. Sadd, M.H., Elasticity – Theory, Applications and Numeric, Academic Press, 2014.

Back

Program: Master of Technology (Structural Engineering)		Semester: I
Course Title: Structural Dynamics		Course Code:20ESEC702
L-T-P: 4-1-0	Credits: 5	Contact Hours:6 hrs/week
ISA Marks: 50	ESA Marks: 50	Total Marks:100
Teaching Hours: 50	Examination Duration: 3hrs	

Unit I

1. Introduction

Nature of dynamic forces, Sources of vibration; Mathematical modelling; Elements of vibrating systems and their characteristics, Equivalent properties of combination of elements; Equation of motion by D'Alembert's principle, Principle of virtual displacements, Rayleigh's energy method; Classification of vibration **05 hrs**

2.Free Vibration of SDOF Systems

Equation of motion; Response of undamped and damped SDOF systems; Critical damping; Logarithmic decrement – single and multiple cycles; Energy dissipation **06 hrs**

3.**Harmonically Excited Vibration of SDOF Systems**

Equation of motion; Response of damped SDOF systems to harmonic excitation, Steady-state response; Dynamic amplification factor; Quality factor and bandwidth, Half-power bandwidth method for estimation of damping; Response to harmonic displacement of support; Response of a system under rotating unbalance. **08 hrs**

Unit II

4. Vibration of SDOF Systems under Arbitrary Excitation

Impulse, Unit impulse, Response of a SDOF systems subjected to unit impulse; Response to arbitrary excitation – Duhamel integral; Response and response spectrum of undamped SDOF systems for selected forces – Step force, Time delayed step force, Rectangular pulse, Linear force, Blast load, Triangular pulse; Direct integration methods – Constant average acceleration and Linear acceleration methods; Newmark method **09 hrs**

5. Multi Degree of Freedom Systems

Undamped free vibration of two degree of freedom systems – equations of motion, characteristic equation, natural frequencies and mode shapes; Matrix form of equations of motion, Eigenvalue problem; Orthogonality of normal modes; Ortho normalization of normal modes; Free vibration of MDOF systems for given initial conditions; Forced vibration of MDOF systems; Modal analysis equation; Material and modal damping **09 hrs**

Unit III

6.Continuous Systems

Equation of motion; Undamped free vibration of beams with different support conditions – Simply supported, Cantilever, Propped cantilever and Fixed beams. **05 hrs**

7. Engineering Seismology and Supplemental Devices

Introduction to engineering seismology, Internal structure of earth, Elastic rebound theory, Theory of plate tectonics, Seismic waves, Classification of earthquakes, Nature of earthquake force, Seismicity of India, Supplemental devices – passive, semi-active, active & hybrid systems. **08 hrs**

Text Books

1.Rao, S.S., Mechanical Vibrations, 5ed., Addison-Wesley Publishing Co., Reading, Massachusetts, 2010.
2.Paz, M., Structural Dynamics, 4ed., CBS Publishers & Distributors, New Delhi, 1997
3.Chopra, A.K., Dynamics of Structures, 4ed., Prentice-Hall of India Pvt. Ltd., New Delhi, 2011.
4.Craig, R.R., Structural Dynamics – An Introduction to Computer Methods, John Wiley & Sons, New York, 1983.
5.Thomson, W.T. and Dahleh, M..D., Theory of Vibration, with applications, 5ed., Pearson Education Inc., 2008.

Reference Books:

1. IS:1893-2002 (Part 1), Criteria for Earthquake Resistant Design of Structures, Bureau of Indian Standards, New Delhi, 2002.
2. IS:13920-1993, Ductile Detailing of Reinforced Concrete Structures Subjected to Seismic Forces, Bureau of Indian Standards, New Delhi, 1993.
3. IS:4326-1993, Earthquake Resistant Design and Construction of Buildings – Codeof Practice, Bureau of Indian Standards, New Delhi, 1993

Back

Program: Master of Technology (Structural Engineering)		Semester: I
Course Title: Advanced Design of RC Structures		Course Code: 24ESEC701
L-T-P: 4-1-0	Credits: 5	Contact Hours:6 hrs/week
ISA Marks: 50	ESA Marks: 50	Total Marks:100
Teaching Hours: 50	Examination Duration: 3hrs	

Unit I

Design of Non-conventional Slabs.

Introduction to design of waffle slab, grid floor, Flat slab and the difference in structural behavior among them. Advantages of grid floors over conventional slab designs. Design of grid floor by approximate methods as per IS 456-2000 code provisions. **10 hrs.**

Design of Flat Slabs:

Design of flat slabs with and without drop panel & column head (any two). **10 hrs.**

Unit II

Design of Continuous Beams:

Introduction to RCC Continuous beam, Design of continuous beams by Is 456-2000 code provisions, Using SP 16 Charts and considering redistribution moments, Introduction to Strut-Tie Models, Strut-Tie Models for Deep Beams, Beam-Column. **10 hrs.**

Design of Curved Beams:

Introduction to curved beams, Analysis of bending and torsional moments in circular beams, Moments in, Design of RCC circular beams, Design of RCC semicircular beam supported on three columns equally spaced. **10 hrs.**

Unit III

Ductile Detailing of RC Members:

Ductile detailing, Ductile Detailing of Frames for Seismic Forces: Introduction, General principles, Factors that increase ductility, ductile detailing of beams – Requirements. **5 hrs.**

Design of Shear Wall:

Design of Shear Walls, bond and development length, curtailment of reinforcing steel. Introduction to the Yield line theory of analysis Numerical. **5 hrs.**

Text Books:

1. Bhavikatti, S. S., Advance R.C.C. Design (R.C.C. Volume-II), Vikas Publishing House PVT., Ltd., New Delhi, 2008.
2. Dr. Krishna Raju, N., Advanced Reinforced Concrete Design (IS: 456-2000), 2ed., CBS Publishers and Distributors, New Delhi, 2011.

Reference Books:

1. Jain, A.K., Reinforced Concrete, New Chand and Bros, Roorkee, 1993.
2. Pillai, U and Menon, D., Design of Concrete Structures, Tata McGraw Hill Publishing
3. Company Limited, New Delhi, 2011.
4. Purushottaman, Behaviour of Reinforced concrete structural elements, Tata- McGraw-Hill.
5. Varghese, P.C., Advanced Reinforced Concrete Design, Prentice Hall of India, New Delhi 2001.
6. IS 456:2000 Plain and Reinforced Concrete- Code of Practice.
7. IS 4995(Part I)-1974Criteria sor Design of Reinforced Concrete Bins for Storage of Granular and Powdery Materials- Part I General Requirements and Assessment of Bin

Loads.
8. IS 4995(Part II)-1974Criteria for Design of Reinforced Concrete Bins for Storage of Granular and Powdery Materials- Part II Design Criteria.
9. IS 4998 (Part I) :1992 Criteria for Design of Reinforced Concrete Chimneys Part 1 Assessment of Loads.

Back

Program: Master of Technology (Structural Engineering)		Semester: I
Course Title: Numerical Methods and Programming		Course Code: 15ESEC703
L-T-P: 4-0-1	Credits: 5	Contact Hours: 6hrs/week
ISA Marks: 50	ESA Marks: 50	Total Marks:100
Teaching Hours: 50	Examination Duration: 3hrs	

Unit I

1.Modelling, Computers and Error Analysis

Mathematical modelling, Analytical and numerical solutions, Computer programs, Algorithms, flow charts, Approximations, Round-off errors, Accuracy and precision, Machine epsilon. **04 hrs**

2.Linear Algebra

Systems of linear algebraic equations, Uniqueness of solution, Ill conditioned systems, Direct methods – Gauss elimination method, Gauss-Jordan method, LU decomposition by Crout method and Cholesky method; Iterative methods – Gauss Seidel method; Determinants and matrix inversion. **10 hrs**

3.Numerical Integration

Trapezoidal rule; Simpson's rules; Gaussian quadrature **06 hrs**

Unit II

4.Solution of Nonlinear Equations

Bracketing methods – Bisection method, False position method; Secant method; Newton's method. **08 hrs**

5.Eigenvalue Problems

Eigenvalue problems, Eigenvectors, Jacobi method, Power method, Power method with scaling, Power method with spectral shift, Inverse Power method. **06 hrs**

6. Interpolation and Curve Fitting

Interpolation, Lagrange's method, Newton's method, Polynomial method Curve fitting, Least squares fit, Cubic splines. **06 hrs**

Unit III

7.Solution of Ordinary Differential Equations

Euler's method; Second and fourth order Runge-Kutta methods; Systems of equations using Euler's and Runge-Kutta methods. **10 hrs**

Text Books

Reference Books:

1. Kiusalaas, J., Applied Numerical Methods in Engineers with Python, Cambridge University Press, 2005.

2. Gerald, C.F. and Wheatley, P.O., Applied Numerical Analysis, 6ed., Pearson Education, 1999.

3. Chapra, S.C. and Canale, R.P., Numerical Methods for Engineers with Programming and Software Applications, 3ed., Tata McGraw Hill, New Delhi, 1998.

Back

Program: MasterofTechnology(StructuralEngineering)		Semester: I
Course Title: Design of Bridges		**Course Code: 24ESEE701**
L-T-P: 4-0-0	**Credits: 4**	**Contact Hours:4 hrs/week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks:100**
Teaching Hours: 50	**Examination Duration: 3hrs**	

Unit – I

1.Introduction

Historical development of Bridges, site investigations, types of bridges and their suitability. **03 hrs**

2.Bridge Loadings

Loads and stresses- various loads to be considered while designing bridges. IRC Loading standards. Impact factor., International bridge standards.

ILD for SF and BM under moving loads **03 hrs**

3.Design of Solid Deck slab bridges

Design of Solid deck slab bridge, MOST standard drawings **08 hrs**

4.Culverts

Types of culverts, Design of box culvert for IRC class loading. **06 hrs**

Unit II

1. Design of T - beam bridge

Design of T -beam bridge for class AA tracked vehicle Design of interior deck slab panel by Piegaude' s theory.Design of longitudinal girder by Courbon's theory, approximate design of cross girder. Drawing of T -Beam bridge for given site particulars. **14hrs**

2. Prestressed Concrete Bridges

Concept of Prestressing, Advantages of PSC bridges, Design of PSC bridges (Rectangular and I –sections), Cable profiles, Stress calculations, Design of End blocks **05 hrs**

Unit III

1. Prestressed Concrete Bridges (Continued)

Numerical Problems on PSC Girder bridges **05 hrs**

2. Design of Sub-Structures

Bearings, Abutmnets, types of Piers, Foundations, Protection works, Numerical problem on stability of abutment. **05 hrs**

Text Books

1. Victor, D.J. Essentials of Bridge Engineering, Oxford - IBH Publishers, New Delhi, 2006.
2. Krishna Raju, N., Design of Bridges, Oxford - IBH Publishers, New Delhi, 2017.

Reference Books:

1. Praveen Nagarajan, Design of Concrete Bridges, Wiley Publishers, 2020.
2. Rajagopalan, N., Bridge Superstructure, Narosa Publishers, New Delhi, 2006.

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Program: Master of Technology (Structural Engineering)		Semester: I
Course Title:Advanced Concrete Technology		**Course Code: 24ESEE702**
L-T-P: 4-0-0	**Credits: 4**	**Contact Hours: 4hrs/week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks:100**
Teaching Hours: 50	**Examination Duration: 3hrs**	

Unit – I

Essentials of Concrete: Composition of OPC – Manufacture – Modified Portland Cements – Mineral Admixtures – Slags – Pozzolanas and Fillers – Chemical Admixtures – Retarders – Air Entraining Agents – Water Proofing Compounds –Plasticizers and Super Plasticizers, Aggregates – Properties and testing of fine and course aggregates – combining of aggregates – Substitute material for aggregates – recent advancements. **12 Hrs**

Concrete as a Composite Material: Materials science aspects of the properties and behaviour of Cement Concrete: physical and chemical aspects of cement hydration, type and morphology of hydrates. **8 Hrs**

Unit II

Concrete mix design for sustainable materials: Mix proportioning – Mixes incorporating Fly ash, Silica fume, GGBS – Mixes for High Performance Concrete – High strength concrete – variations in concrete strength. Methods of transportation, placing and curing-extreme whether concreting. **10 Hrs**

Innovative concretes: Fibre Reinforced Concrete – Self Compacting Concrete – Polymer Concrete – High performance concrete – Sulphur concrete – pervious Concrete. Vacuum dewatering of concrete-Under water concreting, Heavy weight and mass concrete, Heat resisting concrete, Reactive Powder Concrete, Roller Compacted Concrete. **10 Hrs**

Unit III

Durability of concrete: Factors affecting durability – Chemical Attack – Permeability – chloride penetration –water absorption – creep – Shrinkage, Freeze-Thaw Effect. **6 Hrs**

Microstructure of concrete: Microstructure of hydrated cement paste, Interfacial Transition Zone. **4 Hrs**

Text Books

1. Santhakumar.A.R., Concrete Technology, Oxford University press, New Delhi. 2007.
2. Gambhir.M.L., Concrete Technology – Tata McGraw Hill Book Co. Ltd.,Delhi, 2004.
3. MethaP.K.andMontreio P.J.M., Concrete Structure Properties and Materials, Prentice Hall, 1998.
4. Gupta.B.L. and Amit Gupta, Concrete Technology, Standard Publishers Distributer, New Delhi, 2004.

Reference Books:

1. Neville, A. M., Properties of Concrete, 4ed., Longman, 1995.

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Program: Master of Technology (Structural Engineering)		Semester: I
Course Title: Fire Resistance of Structures		**Course Code: 20ESEE701**
L-T-P: 4-0-0	**Credits: 4**	**Contact Hours:4 hrs/week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks:100**
Teaching Hours: 40	**Examination Duration: 3hrs**	

1.Introduction

Overview, Fire Safety in Buildings, Fire Safety Objectives, Process of Fire Development, Fire Resistance, Controlling Fire Spread, Building Construction for Fire Safety **3hrs**

2.Fire and Heat transfer

Fuels, Combustion, Fire Initiation, t-squared fires, Heat Transfer. **4hrs**

3.Room Fires and Fire Severity **4hrs**

Pre flashover, Flashover and Post flashover fires, Fire Severity and Fire Resistance, Equivalent Fire Severity.

4.Fire Resistance **3hrs**

Introduction, Fire Resistance Tests, Listings, Fire Resistance by Calculation, Fire Resistance of Assemblies.

Unit II

5. Design of Structures Exposed to Fire

Overview of design of structures at normal temperature, Structural Design in Fire Condition, Material properties in fire, Design of individual members exposed to fire, Design of structural assemblies exposed to fire. **10 hrs**

6. Design of Concrete Structures Exposed to Fire

Behaviour of concrete structures exposed to fire, Concrete and Reinforcing temperatures, Mechanical properties of concrete at elevated temperatures, Design of concrete members exposed to fire. **8 hrs**

Unit III

3.Design of Steel Structures Exposed to Fire

Behavior of steel structures exposed to fire, Steel temperatures, Pr c votection systems, Mechanical properties of steel at elevated temperatures, Design of steel members exposed to fire. **8 hrs**

Text Books

1. Andrew H. Buchanan, Structural Design for Fire Safety, John Wiley and Sons, LTD, 2006.
2. John A. Purkiss, Long-Yuan Li, Fire Safety Engineering Design of Structures, CRC Press Taylor and Francis group Boca Raton, 2014.

Reference Books:

1. Yong Wang, Ian Burgess, Frantisek Wald, Martin Gillie, Performance Based Fire Engineering of Structures, CRC Press Taylor and Francis Group Boca Raton, 2013.
2. Naotake Noda, Richard B. Hetnarski, Yoshinobu Tanigawa, Thermal Stresses, Taylor and Francis group, New York, 2003.
3. EN 1992-1-1 Eurocode 2: Design of concrete structures - Part 1-2

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Program: Master of Technology (Structural Engineering)		Semester: I
Course Title:Computer Aided Analysis and Design Lab		**Course Code: 15ESEP701**
L-T-P: 0-0-2	**Credits: 2**	**Contact Hours: 4hrs/week**
ISA Marks: 80	**ESA Marks: 20**	**Total Marks:100**
Teaching Hours: 48	**Examination Duration: 3hrs**	

1.Structural Analysis using SAP software **12hrs**

a.Introduction to SAP 2000 user interface.

b. Modelling and analysis of RC framed building including interpretation of results using SAP2000

c.Modelling and analysis of steel industrial frame including interpretation of results using SAP2000

d.Modelling and analysis of structures using OpeSees

2. RC Design using MS Excel **36 hrs**

a. Design of singly reinforced rectangular beam section.

b. Design of doubly reinforced rectangular beam section.

c. Design of singly reinforced T- beam section.

d. Design of column subjected to axial compression and uniaxial bending.

e. Design of isolated footing.

f. Design of Cantilever retaining wall.

g. Design of Counterfort retaining wall.

h. Design of Intz water tank.

Reference Books:

1. Computers and Structures Inc., Getting Stated with SAP 2000
2. Computers and Structures Inc., CSI Analysis Reference Manual for SAP 2000, ETABS and SAFE
3. Computers and Structures Inc., Introductory Tutorial for SAP 2000
4. Jain, A.K. Reinforced Concrete Limit State Design, 7ed., Nemi Chand & Bros., Roorkee, 2012

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SEMESTER 2

Program: M.Tech (Structural Engineering)		Semester: II
Course Title: Design of Tall Structures		**Course Code:22ESEC701**
L-T-P: 4-1-0	**Credits: 05**	**Contact Hours: 6 hrs/week**
ISA Marks:50	**ESA Marks:50**	**Total Marks:100**
Teaching Hours: 50	**Examination Duration: 3Hrs**	

Unit I

1. Introduction **10 Hrs**

Design philosophy, loading, sequential loading, materials and design mixes. Loading and Movement: Gravity loading: Dead and live load, methods of live load reduction, Impact, Gravity loading, Construction loads.

2. Structural Systems **10 Hrs**

Factors affecting growth, Height and structural form; High rise behavior, Rigid frames, braced frames, in-filled frames, shear walls, coupled shear walls, wall frames, tubular, cores, Outrigger –braced and hybrid mega system.

Unit II

3. Lateral Load Estimation **09 Hrs**

Static and dynamic approach, Analytical and wind tunnel experimentation method for wind. Earthquake loading: Equivalent lateral force, modal analysis, combinations of loading.

4. Analysis and Design **11 Hrs**

Modeling for approximate analysis, accurate analysis and reduction techniques, analysis of building as total structural system considering overall integrity and major subsystem interaction, analysis for member forces; drift and twist, computerized general three dimensional analyses.

Unit III

5. Stability of Tall Buildings **07 Hrs**

Overall buckling analysis of frames, wall frames, approximate methods, second order effects of gravity of loading, P-Delta analysis, simultaneous first order and P-Delta analysis, Translational, Torsional instability, out of plumb effects, stiffness of member in stability, effect of foundation rotation. Structural elements: sectional shapes, properties and resisting capacities, design, deflection, cracking, pre-stressing, shear flow. Design for differential movement, creep and shrinkage effects, temperature effects and fire.

6. Disaster Management **03 Hrs**

Techno legal aspect, techno-legal and techno-financial work; Model town and country planning legislation, land use zoning regulations, development control regulations and building bye-laws; Registration, qualification and duties of professionals, disaster response policy, effects of building services.

Text Books:

1 B. S. Taranath, *Structural Analysis and Design of Tall Buildings*, 2nd ed. New York, NY, USA: McGraw Hill, 2016.

2 W. Schueller, *High Rise Building Structures*, 2nd ed. New York, NY, USA: John Wiley,

2020.
3 B. S. Smith and A. Coll, *Tall Building Structures: Analysis and Design*, 2nd ed. New York, NY, USA: John Wiley, 2010.
4 T. Y. Lin and D. Stotesbury, *Structural Concepts and Systems for Architects and Engineers*, 3rd ed. New York, NY, USA: John Wiley, 2014.
5 L. S. Beedle, *Advances in Tall Buildings*, 2nd ed. New Delhi, India: CBS Publishers and Distributors, 2018.
6 Y. P. Gupta, *Proceedings of the National Seminar on High Rise Structures: Design and Construction Practice for Middle Level Cities*, 2nd ed. New Delhi, India: New Age International Limited, 2015.

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Program: M.Tech (Structural Engineering)		Semester: II
Course Title: Finite Element Method		**Course Code:19ESEC702**
L-T-P: 4-0-0	**Credits: 04**	**Contact Hours: 4hrs/week**
ISA Marks:50	**ESA Marks:50**	**Total Marks:100**
Teaching Hours: 50	**Examination Duration: 3Hrs**	

Unit I

1. Overview of Matrix Method of Structural Analysis **08 Hrs**

Development of stiffness matrices with reference to system and element coordinates for different types of elements. Analysis of continuous beams.

2. Introduction to Finite Element Method **04 Hrs**

Introduction, Basic concepts on finite element analysis, Introduction to nodes, elements, and shape functions, Steps in Finite Element Analysis, Key concepts and Terminologies.

3. Finite Element Formulation Technique **08 Hrs**

Virtual work, and variational principle (Rayleigh-Ritz Method), different types of weighted integral methods such as Galerkin Method, Collocation Method, and Method of Least-squares , Application of FEM techniques to solve Second order boundary value problem - Simply supported beam and cantilever beam subjected UDL, Point Loads.

Unit II

4. 1D Dimensional Elements 10Hrs

Application of FEM to Solve various 1-D problems of Bars and Truss: Co-ordinates system, shape Functions for 1-D Elements, Properties of Shape Functions, Lagrange Interpolating Polynomials, Development of stiffness matrix, strain displacement matrix, stress strain matrix, Numerical.

5. 2D Dimensional Elements 10Hrs

Application of FEM to Solve various 2-D problems of Triangular Elements, Rectangular Elements - Coordinates system, shape Functions, Properties of Shape functions, Lagrange Interpolating Polynomials for CST elements, Development of stiffness matrix, strain displacement matrix, stress strain matrix for CST element, Numerical.

Unit III

6. 3D Dimensional Elements **05Hrs**

Application of FEM to Solve various 3D problems – Bending of thin Plate, Displacement model for frame, Shell Element, strain -displacement model for shell

7. Computer Implementation **05Hrs**

Structure of FEM program for FEM analysis, Description of different modulus in FEM software (ABAQUS), Introduction to different types of analysis, Pre- and post-processing. Comparison of manually solved problems with software results.

Text Books:

1 Reddy J.N., An Introduction to Finite Element Method, 3ed., McGraw- Hill Publishing Company Inc, New York, 2017.

2 Krishnamoorthy C. S., Finite Element Analysis, Tata McGraw-Hill Education Pvt. Ltd, New Delhi, 2004.

3 Bhavikatti, S.S., Structural Analysis Volume-I and II, Vikas Publishing House Pvt. Ltd.,

Bangalore, 2003.

References:

1. Rajasekaran, S., *Finite Element Analysis in Engineering Design*, S. Chand Group, 2006.
2. Pandit G.S. and Gupta S.P., *Structural Analysis, A Matrix Approach*, 2ed., Tata McGraw- Hill EducationPvt. Ltd, New Delhi, 2008.
3. Cook R.D., Malkus D.S., Plesha M.E. and Witt R.J. *Concepts And Applications Of Finite Element Analysis*, 4ed., John Wiley and Jous, Inc., 2013.
4. Bathe K.J., *Finite Element Procedures*, Klaus-Jürgen Bathe; 2ed., 2014.
5. Daryl L. Logan., *A first course in the Finite Element Method*, 5ed, Cengage Learning, 2010.
6. Tirupathi R. Chandrupatla and Ashok D. Belegundu, *Introduction to Finite Elements in Engineering*, 4ed, Pearson, 2011.

Program: M.Tech (Structural Engineering)		Semester: II
Course Title:Stability of Structures		**Course Code:20ESEC706**
L-T-P: 4-0-0	**Credits: 04**	**Contact Hours: 4hrs/week**
ISA Marks:50	**ESA Marks:50**	**Total Marks:100**
Teaching Hours: 50	**Examination Duration: 3Hrs**	

Unit I

1. Introduction to Stability of Structures **04 Hrs**

Basic definitions of stability, Methods of solution, Rigid body assemblages with one and two degrees of freedom.

2. Buckling of axially loaded members **06 Hrs**

Buckling loads for members with different end conditions: hinged-hinged, fixed-free, fixed-hinged, fixed-fixed; Struts with elastic supports, Framed columns, Portal frames: columns hinged at the base, columns fixed at the base.

3. Stability of Beam Columns **10 Hrs**

Basic equation of equilibrium, Beam-column with concentrated loads, Beam column with an interior moment, Beam-column subjected to distributed loads.

Unit II

3. Stability of Frames **12 Hrs**

Stability functions – distinct and auxiliary stability functions; Stability stiffness influence coefficients, Stiffness matrix including axial force effects, Critical load for frames without sidesway; Critical load for frames with sidesway.

4. Energy Criteria and Energy Based Methods **08 Hrs**

Energy criterion; Timoshenko's method; Rayleigh-Ritz method; Galerkin method.

Unit III

5. Buckling of Members having Open Sections **10 Hrs**

Shear centre; Torsional buckling – members subjected to torsion, members subjected to axial force; Lateral buckling of beams – torsional buckling due to flexure, torsional buckling due to flexure and axial force; Lateral buckling of beams subjected to lateral loads – cantilever beam, simply supported beam.

Text Books:

1. Timoshenko, S.P. and Gere, J.M., Theory of Elastic Stability, 2ed., McGraw Hill Book Co., New York, 1961.
2. Simitses, G.J. and Hodges, D.H., Fundamentals of Structural Stability, Butterworth & Heinemann, 2006.
3. Gambhir, M.L., Stability Analysis and Design of Structures, Springer, 2009.
4. ManickaSelvam, V.K., Elements of Matrix and Stability Analysis of Structures, 6ed., Khanna Publishers, New Delhi, 2004.
5. Srinath, L.S., Advanced Mechanics of Solids, 3ed., Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 2017.

Program: M.Tech (Structural Engineering)		Semester: II
Course Title:Design of Industrial Steel Structures		**Course Code:15ESEE703**
L-T-P: 4-0-0	**Credits: 04**	**Contact Hours:4 hrs/week**
ISA Marks:50	**ESA Marks:50**	**Total Marks:100**
Teaching Hours: 50	**Examination Duration: 3Hrs**	

Unit I

1. Plastic Methods of Analysis **12 Hrs**

Stress strain relation for steel, Formation of plastic hinges, redistribution of moments; Section modulus, Fully plastic moment for selected shapes of cross section; Theorems of plastic collapse; Collapse load for beams & frames; Factors affecting fully plastic moment of a section.

2. Plastic Methods of Design **10 Hrs**

Plastic design of continuous beams; Trial and error method; Method of combining mechanisms; Plastic moment distribution for design of portal frames and pitched roof frames; Design of continuous beams.

Unit II

3. Minimum weight design **08 Hrs**

Minimum weight design; Design for strong column-weak beam and strong beam-weak column; Theorems of minimum weight design.

4. Design of Bunkers, Silos and Chimneys **12 Hrs**

Design of bunkers, silos and chimneys.

Unit III

5. Design of Frames for Industrial Structures **04 Hrs**

Design of frames for gravity and wind loads.

6.Design of Light Gauge Structural Steel Sections **04 Hrs**

Design of light gauge structural steel sections for axial, flexural and combined axial compression and flexure.

Text Books:

1. Ramchandra, Design of Steel Structures, Vol. II, 7ed., Standard Book House, New Delhi, 1991,
2. Limit state design of steel structures, vol II, Dr B C Punmia, Laxmi Publications, New Delhi
3. Neal, B.G., The Plastic Methods of Structural Analysis, 2ed., Chapman & Hall, London, 1963.
4. Baker, J.F., Horne, M.R. and Heyman, J., The Steel Skeleton, Vol. II - Plastic Behaviour and Design, ELBS & Cambridge University Press, London, 1961.
5. Duggal, S.K., Limit State Design of Steel Structures, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2010.

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Program: M.Tech (Structural Engineering)		Semester: II
Course Title:Structural Reliability		**Course Code:15ESEE704**
L-T-P: 4-0-0	**Credits: 04**	**Contact Hours: 4hrs/week**
ISA Marks:50	**ESA Marks:50**	**Total Marks:100**
Teaching Hours: 50	**Examination Duration: 3Hrs**	

Unit I

1. Concepts of structural safety.
Introduction to safety, Safety concepts in Different Design Philosophies, Introduction to probability based design concepts **03 hrs**

2. Basics statistics
Introduction, Data reduction, Histograms, Sample correlation. **03 hrs**

3. Probability Theory
Introduction, Random events, Random variables, Functions of random variables, Moments and expectation, Common probability distributions, External distributions **05 hrs**

4. Resistance distribution and parameters
Introduction, statistics of properties of concrete and steel, Statistics of strength of Bricks and Mortar, Dimensional variations, Characterization of variables of compressive strength of concrete in structures and yield strength of steel, allowable stresses based on specified reliability. **05 hrs**

5.Probabilistic Analysis of loads
Gravity load, Introduction, load as a stochastic process. Wind load- Introduction, wind speed, return period, estimation of life time design wind speed, probability model of wind load. **05 hrs**

Unit II

6.Basic Structural Reliability
Introduction, Computation of structural reliability. **07 hrs**

7.Monte Carlo study of Structural Safety
Monte Carlo methods and Applications **04 hrs**

8.Level - 2 Reliability methods
Introduction, Basic variables and failure surface, First order second moment methods like Hasofer and linds method, Non- normal distributions, Determination of B for present designs, correlated variables. **08 hrs**

Unit III

9.Reliability Based Design
Introduction, Determination of partial safety factors, safety checking, Formats Development of reliability. Based design criteria. Optional safety factors, Summary of results of study for Indian standards. - R. C. C. Designs. **10 hrs**

Text Books:

1. Ranganathan, R., Structural Reliability Analysis and Design, 1ed. Jaico Book House, 2006.

References

2. Aggarwal, K.K., Reliability Engineering, Apress Springer (India) Pvt. Ltd., 2007.
3. Andrzej, S. N and Kevin, R. C., Reliability of Structures, 2ed., McGraw Hill Company, KOGA, 2012.
4. Srinath, L.S., Reliability Engineering, 4ed., East West Books (Madras) Pvt. Ltd., 2005.

Program: Master of Technology (Structural Engineering)		Semester: I
Course Title:Theory of Plates & Shell Structures		**Course Code: 20ESEE702**
L-T-P: 4-0-0	**Credits: 4**	**Contact Hours: 4 hrs/week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks:100**
Teaching Hours: 50	**Examination Duration: 3hrs**	

Unit – I

1.Theory of plates. Small deflection of laterally loaded thin rectangular plates- Navier's and Levy's solution - Solutions of plates for various loading and boundary conditions. Symmetric loading of circular plates with various edge conditions for both solid and annular plates. Energy methods and Finite Difference methods for rectangular plates.

20 hrs

Unit II

2.Theory of Shells: Introduction to differential geometry of curves and surfaces – classification of shells- beam theory.Membrane theory- bending theory for symmetric shells. Membrane theory for shells of revolutions - domes - hyperboloid of revolution. Design of domes, hyperbolic paraboloid. **20 hrs**

Unit III

3.Analysis and design of folded plates by Whitney's and Simpson's methods. Membrane theory for hyperbolic paraboloid, elliptic paraboloid and conoids**.** **10 hrs**

Reference Books:

1. Bhavikatti S.S., *Theory of Plates and Shells*, 2ed., New Age International, New Delhi, 2014.
2. Bairagi, N.K., *A Text Book of Plates Analysis*, Khanna Pub. New Delhi, 1986.
3. Bairagi, N.K., *Shells Analysis*, Khanna Pub. New Delhi, 1990.
4. Chandrashekhar, K., *Theory of Plates*, Universities Press Ltd, 2001.
5. Ramaswamy, G.S., *Design and Construction of Concrete Shell Roofs*, CBS Publisher & Distributors, New Delhi – 1986.
6. Szilard, R., *Theory and analysis of plates - classical and numerical methods*, Prentice Hall,1994
7. Timoshenko, S.P. and Woinoisky-Krieger, *Theory of Plates and Shells*, McGraw- Hill Book Co., New York, 1959.

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Program: Master of Technology (Structural Engineering)		Semester: I
Course Title: Design of Foundations		**Course Code: 15ESEE706**
L-T-P: 4-0-0	**Credits: 4**	**Contact Hours: 4 hrs/week**
ISA Marks: 50	**ESA Marks: 50**	**Total Marks:100**
Teaching Hours: 50	**Examination Duration: 3hrs**	

Unit – I

1. Soil Exploration

Subsurface exploration programme for industrial structures, Interpretation of soil parameters. Tests on disturbed and undisturbed soil samples, Soil exploration report. **07 hrs**

Shallow Foundation

Design Criteria. Types of shallow foundations. Bearing capacity theories. Bearing capacity from field tests. Use of different foundation models. Design of individual and combined footings. Design of raft foundations for industrial structures Conventional methods. Modulus of subgrade reaction. Beams on elastic foundations. Analysis of footings by – finite difference. **12 hrs**

Unit II

4.Pile Foundations

Load carrying capacity of the pile. Design of pile and pile groups. Batter piles and under-reamed piles. Design of pile cap. Design of axially and laterally loaded piles. **10 hrs**

5.Well Foundations

Shapes of wells. Components of well, lateral Stability of well foundation. Design aspects of components of well foundation. **04 hrs**

6.Machine Foundations

Design criteria for machine foundations. Basic terminologies. Vibration analysis. Methods of analysis. Determination of soil parameters. Foundations for reciprocating machines. Foundations for impact type of machines. Vibration isolation. **07 hrs**

Unit III

7.Foundations for Special Structures

Foundations for tall structures - Water tanks, Chimneys, Antenna towers and Radar units.**06 hrs**

8.Special types of Foundations

Shells in foundations - Hyperbolic - Paraboloid shells. **04 hrs**

Reference Books:

1. Bowles, J. E., Foundation Analysis and Design, 5ed., Mc Graw Hill company New York, 1996.
2. Brahma, S. P., Foundation Engineering, Tata McGraw Hill Company New Dehli, 1985.
3. Murthy, V.N.S., Advanced Foundation Engineering, CBS Pub. New Delhi.,2007.
4. Nainan Kurian., Modern Foundations Introduction to Advanced Techniques, Tata McGraw Hill Company, New Dehli, 1982.
5. Swami Saran, Analysis and Design of Substructures: Limit State Design, 2ed, oxford and IBH publishing co. Pvt. Ltd., 2006.
6. Srinivasulu, P. and Vaidyanathan, C.V., Hand Book of Machine Foundations, Tata McGraw Hill Company New Dehli , 2002.
7. Tomlinson, M.J., Pile Design and Construction Practice, 6ed, CRC Press, 2014

8. Varghese. P.C., Foundation Engineering, PHI Pub. New Delhi. 2005.
9. Winterkorn, H. F. and Fang H. Y., Foundation Engineering Hand Book, 2ed, Van Nostrand Reinhold Company, 1991.
10. N.H. Som, and Das S.C., Theory and Practice of Foundation Design, PHI, Learning Pvt Ltd., New Delhi, 2009Ramaswamy, G.S., *Design and Construction of Concrete Shell Roofs*, CBS Publisher & Distributors, New Delhi – 1986.

IS Codes:

1. IS 2911 (Part 1/Sec 3): 2010 - Design And Construction of Pile Foundations
2. IS: 2950 (Part I) -1981 (Reaffirmed 2008) - Code of Practice for Design and Construction of Raft Foundations

Program: M.Tech Structural Engineering		Semester: II
Course Title: Structural Optimization		Course Code:15ESEE707
L-T-P: 4-0-0	Credits: 04	Contact Hours: 4 hrs/week
ISA Marks:50	ESA Marks:50	Total Marks:100
Teaching Hours: 40	Examination Duration: 3Hrs	

Unit I

1.Introduction

Engineering applications, optimum design methods, Mathematical statement –Terminology and basic concepts, Classification of optimization problems, Optimization Techniques **03 hrs**

2.Classical Optimization Techniques

Single variable optimization, Multivariable optimization, Lagrange multiplier method and constrained variation method – Kuhn tucker conditions **04 hrs**

3.Linear Programming

Standard form, Simplex method, two phase simplex method, revised simplex method

4.Non-Linear Unconstrained Optimization Search Techniques **06 hrs**

One dimensional problems - elimination and Interpolation methods, Hooke and Jeeve's method, Descent methods, Newton's method, Davidon Powell Flether method. **06 hrs**

Unit II

5.Non-Linear Constrained Optimization Search Techniques

Feasible Direction method, Interior and Exterior penalty function method – sequential linear programming techniques **10 hrs**

6.Dynamic and Geometric Programming

Multistage decision concert, principles of optimality, calculus and tabular method of Dynamic Programming, solution of a constrained geometric programming problem. **07 hrs**

Unit III

7.Non-Traditional Search Techniques

Genetic Algorithm, Neural Network based Optimization and Optimization of Fuzzy system. **07 hrs**

8.Application to Structural Optimization

R.C. Structures, Steel Structures and stress concentration minimization problems. **07 hrs**

Reference Books:

1 Rao, S.S., Engineering Optimization Theory and Application, New Age International (P) Ltd. Publishers, 2008.
2 Fox, R.L., Optimization Methods for Engineering Design, Addison – Wesley Publishing Company, 1971.
3 Bhavikatti, S.S., Fundamentals of Optimum Designs in Engineering, New Age Publishers, 2010.
4 Ravindran, A, Ragsdel, K.M., Reklaitis, G.V., Engineering Optimization Methods and Applications, 2ed., Wiley India Pvt. Ltd., 2006.
5 Bishma Rao GSS., Optimization Techniques, Scitech Pub., 2003.
6 Mohan C. and Kusum Deep, Optimization Techniques, New Age International (P) Ltd., 2009.

Back

Program: M.Tech (Structural Engineering)		Semester: II
Course Title: Structural Health Monitoring		Course Code:20ESEE703
L-T-P: 4-0-0	Credits: 04	Contact Hours:40
ISA Marks: 50	ESA Marks:50	Total Marks:100
Teaching Hours: 04	Examination Duration: 3Hrs	

Unit I

1. Introduction **08 Hrs**

Factors affecting Health of Structures, Causes of Distress, Regular Maintenance. Concepts, Various Measures, Structural Safety in Alteration.

2. Structural Audit **08 Hrs**

Assessment of Health of Structure, Collapse and Investigation, Investigation Management, Assessment by NDT techniques, SHM Procedures.

Unit II

3. Static Field Testing **08 Hrs**

Types of Static Tests, Simulation and Loading Methods, Behavioral / Diagnostic tests - Proof tests, Sensor systems and hardware requirements, Static Response Measurement- strain gauges, LVDTs, dial gauges - case study.

4. Dynamic Field Test **08 Hrs**

Types of Dynamic Field Test, Stress History Data, Dynamic Response Methods, Forced vibration method, Impact hammer and shaker testing, Hardware for Data Acquisition Systems, Network of sensors, Data compression techniques, Remote Structural Health Monitoring.

Unit III

5. Introduction To Retrofitting and Repairs of Structures **08 Hrs**

Introduction to retrofitting of structures, Retrofitting of structural elements, Techniques, Material used for retrofitting, Case Studies, piezo–electric materials and other smart materials, electro–mechanical impedance (EMI) technique, adaptations of EMI technique

Text Books:

1 Structural Health Monitoring Daniel Balageas, Claus-Peter Fritzen and Alfredo Güemes, John Wiley-ISTE, London, 2006.

2 Health Monitoring of Structural Materials and Components - Methods with Applications, Douglas E Adams, John Wiley & Sons, New York, 2007.

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Program: M.Tech (Structural Engineering)		Semester: II
Course Title: Structural Simulation Lab		**Course Code:18ESEP701**
L-T-P: 0-0-2	**Credits: 02**	**Contact Hours: 4hrs/week**
ISA Marks:80	**ESA Marks:20**	**Total Marks:100**
Teaching Hours:30	**Examination Duration: 3Hrs**	

Demonstrations

1. Introduction to Ansys modeling, material properties, meshing and element types.
2. Introduction to Loading, Boundary conditions and post processing.

Experiments

1. Compute the Shear force and bending moment diagrams for the beam loaded centrally with concentrated load and find the maximum deflection. Assume rectangular c/s area of 100 mm * 100mm, Young's modulus of 210 MPa, Poisson's ratio 0.27.
2. Compute the Shear force and bending moment diagrams for the 3D beams, with concentrated loads, UDL, Direct Moment and UVL and find the maximum deflection. Assume rectangular c/s area of 100 mm * 100mm, Young's modulus of 210 MPa, Poisson's ratio 0.27.
3. Analysis of Reinforced Concrete beam subjected to concentrated loading at center with different boundary conditions.
4. Determine the nodal deflections, reaction forces, and stress for the truss system shown below(E = 200GPa, A = 3250mm^2).
5. Analyse the plate of 20mm thick with circular hole at the centre of the plate with 3D element, the dimensions of the plate are 150mmX100mm and circular hole is of the diameter 10mm. Determine the stress concentration at preferred points.
6. Analyze a 2D portal frame subjected to mechanical loading as shown in the lab session and arrive at stress resultants and deflections at preferred points.
7. A pipe of 100mm external dia. And 20mm thickness carries water at a pressure of 20MPa. Determine the maximum and minimum intensities of hoop stresses in the section of pipe. Also plot the variation of hoop and radial stresses across the thickness of pipe. Case a) Solid rotating disc Case b) Hollow rotating disc
8. Obtain the first ten natural frequencies of the Fixed-Fixed beam shown in figure and compare them with theoretical values. Also plot their mode shapes, Modulus of elasticity, E = 2.068 x 10^{11} N/m^2, Poisson's ratio = 0.3, Density = 7830 Kg/m^3

Text Books:

1 Introduction to Finite Element Analysis Using ANSYS by S. Moaveni, 3rd ed., Pearson, 2014.
2 Finite Element Analysis: Theory and Application with ANSYS by S. M. Moaveni, 4th ed., Pearson, 2015.
3 The Finite Element Method and Applications in Engineering Using ANSYS by E. Madenci and I. Guven, 2nd ed., Springer, 2015.
4 Practical Finite Element Analysis by N. S. Gokhale, S. S. Deshpande, S. V. Bedekar, and A. N. Thite, 1st ed., Finite to Infinite, 2008.
5 ANSYS Workbench 2021: A Tutorial Approach by S. Tickoo, 1st ed., CADCIM Technologies, 2021.

Back

Program: M.Tech (Structural Engineering)		Semester: II
Course Title: Design Project		Course Code:19ESEP702
L-T-P: 0-0-3	Credits:3	Contact Hours: 3 hrs/week
ISA Marks: 50	ESA Marks: 50	Total Marks:100
Teaching Hours: 40	Examination Duration: 3hrs	

Collection of information: Geotechnical details such as strata, depth of foundation etc. Approved architectural drawings showing different floor plans, elevations, section at critical locations and working drawings of stairs. Materials to be used in construction, such as floor finish, weather proof course, partition walls, false ceiling etc. The type of loads, gravity loads, wind and earth quake loads etc. Types of Lifts and capacity of lifts. Loads due to water tanks. Building services such as a/c ducting.

Analysis of Buildings: Modelling of a single storey building; Modelling of a multi-storeyed building (Assigning of member properties, Sizes, Supports, and Orientation etc.) Creating of various loads/load Combinations and assigning. Analysis of building models. Printing support reactions, forces on various members. Printing deflected shapes of buildings and Building model etc.

Design of Building Components: Preparation of Excel sheets for the design of beam; :(i)Singly reinforced rectangular beam (ii) Doubly reinforced beam(iii) T-Beam(iv) L-Beam, Column; (i) Design of Short Columns(ii) Design of Long Columns, Design of footings; (i) Isolated footings(ii)Combined footings and Design of slabs. Preparation of sketches showing the reinforcement details of the above components.

Functional and architectural design of a building from, but not restricted to one of the following category: Educational institutions, Administration buildings, Industrial buildings, Commercial buildings, Public facilities such as bus terminus, rail station, hospitals, cinema halls, auditorium etc.

Expected Deliverables: Identify project details, structural design drawings and calculations.

Reference Books:

1. Jain, A.K., *Reinforced Concrete Limit State Design*, Nem Chand and Brothers, Roorkee,
2. Swami Saran, *Analysis and Design of Substructures – Limit State Design*, 2ed., Oxford & IBH Publishing Co., 2006.
3. Varghese, P.C., *Design of Reinforced Concrete Foundations*, PHI Learning, 2009.
4. IS 875(Part 1):1987 Code of practice for design loads (other than earthquake) for buildings and structures – Dead loads, Bureau of Indian Standards, New Delhi
5. IS 875(Part 2):1987 Code of practice for design loads (other than earthquake) for buildings and structures – Imposed loads, Bureau of Indian Standards, New Delhi
6. IS 456:2000 Plain and reinforced concrete – Code of practice, Bureau of Indian Standards, New Delhi
7. IS 1893 (Part 1):2016, Criteria for earthquake resistant design of structures – General provisions and buildings, Bureau of Indian Standards, New Delhi

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