NANDHA ENGINEERING COLLEGE

(Autonomous)

Affiliated to Anna University Chennai ✤ Approved by AICTE ✤ Accredited by NBA-NewDelhi

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1.1.2 Details of Courses where syllabus revision was carried out in

M.E - Structural Engineering

Course Code	Course Name	% of Change
17STB02	Dynamics of Structures	30
17STB03	Applied Elasticity and Plasticity	20
17STB05	Experimental Stress Analysis and Techniques	40
17STB06	Behaviour and Design of Steel Structures	60
17STB08	Finite Element Analysis	40
17STX04	Design of Substructures	30
17STX06	Design of Plates, Shell and Spatial Structures	50
17STX10	Maintenance and Rehabilitation of Structures	20
	Average	**36.25 %**

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REGULATIONS 2017 (R17)

M.E. STRUCTURAL ENGINEERING

CHOICE BASED CREDIT SYSTEM

CURRICULUM AND SYLLABI

SEMESTER - I

SEMESTER: I

SL.NO.	COURSE CODE	COURSE TITLE	CATEGORY	PRE-REQUISITE	CONTACT PERIODS	L	T	P	C
THEORY									
1.	17STA01	Advanced Mathematics	FC	Nil	4	3	1	0	4
2.	17STB01	Advanced Reinforced Concrete Structures	PC	Nil	4	3	1	0	4
3.	17STB02	Dynamics of Structures	PC	Nil	4	3	1	0	4
4.	17STB03	Applied Elasticity and Plasticity	PC	Nil	4	3	1	0	4
5.	17STB04	Advanced Concrete Technology	PC	Nil	3	3	0	0	3
6.	E1	Elective I	PSE	Ref.PSE	3	3	0	0	3
PRACTICALS									
7.	17STC01	Advanced Structural Engineering Laboratory	PC	Nil	4	0	0	4	2
8.	17STE01	Technical Seminar - I	EEC	Nil	2	0	0	2	1
			TOTAL		28	18	4	6	25

SEMESTER: II

SL.NO.	COURSE CODE	COURSE TITLE	CATEGORY	PRE-REQUISITE	CONTACT PERIODS	L	T	P	C
THEORY									
1.	17STB05	Experimental Stress Analysis and Techniques	PC	Nil	3	3	0	0	3
2.	17STB06	Behaviour and Design of Steel Structures	PC	Nil	4	3	1	0	4
3.	17STB07	Aseismic Design of Structures	PC	Nil	3	3	0	0	3
4.	17STB08	Finite Element Analysis	PC	Nil	4	3	1	0	4
5.	E2	Elective II	PSE	Ref.PSE	3	3	0	0	3
6.	E3	Elective III	PSE/OE	Ref.PSE	3	3	0	0	3
PRACTICALS									
7.	17STC02	Structural Analysis and Design Laboratory	PC	Nil	4	0	0	4	2
8.	17STE02	Technical Seminar - II	EEC	Nil	2	0	0	2	1
				TOTAL	26	18	2	6	23

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SEMESTER III

SL.NO.	COURSE CODE	COURSE TITLE	CATEGORY	PRE-REQUISITE	CONTACT PERIODS	L	T	P	C
THEORY									
1.	E4	Elective IV	PSE	Ref.PSE	3	3	0	0	3
2.	E5	Elective V	PSE	Ref.PSE	3	3	0	0	3
3.	E6	Elective VI	PSE	Ref.PSE	3	3	0	0	3
PRACTICALS									
4.	17STE03	Project Work Phase - I	EEC	Nil	12	0	0	12	6
TOTAL					**21**	**9**	**0**	**12**	**15**

SEMESTER: IV

SL.NO	COURSE CODE	COURSE TITLE	CATEGORY	PRE-REQUISITE	CONTACT PERIODS	L	T	P	C
PRACTICAL									
1.	17STE04	Project Work Phase - II	EEC	17STE03	24	0	0	24	12
				TOTAL	**24**	**0**	0	**24**	**12**

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FOUNDATION COURSE (FC)

Course Code	Course Title	CATEGORY	PRE-REQUISITE	CONTACT PERIODS	L	T	P	C	P.S
17STA01	Advanced Mathematics	BS	Nil	4	3	1	0	4	1

LIST OF PROFESSIONAL CORE (PC)

Course Code	Course Title	CATEGORY	PRE-REQUISITE	CONTACT PERIODS	L	T	P	C	P.S
17STB01	Advanced Reinforced Concrete Structures	PC	Nil	4	3	1	0	4	1
17STB02	Dynamics of Structures	PC	Nil	4	3	1	0	4	1
17STB03	Applied Elasticity and Plasticity	PC	Nil	4	3	1	0	4	1
17STB04	Advanced Concrete Technology	PC	Nil	3	3	0	0	3	1
17STC01	Advanced Structural Engineering Laboratory	PC	Nil	4	0	0	4	2	1
17STB05	Experimental Stress Analysis and Techniques	PC	Nil	3	3	0	0	3	2
17STB06	Behaviour and Design of Steel Structures	PC	Nil	4	3	1	0	4	2
17STB07	Aseismic Design of Structures	PC	Nil	3	3	0	0	3	2
17STB08	Finite Element Analysis	PC	Nil	4	3	1	0	4	2
17STC02	Structural Analysis and Design Laboratory	PC	Nil	4	0	0	4	2	2

LIST OF PROGRAM SPECIFIC ELECTIVES (PSE)

Course Code	Course Title	CATEGORY	PRE-REQUISITE	CONTACT PERIODS	L	T	P	C	P.S
17STX01	Soil - Structure Interaction	PSE	Nil	3	3	0	0	3	1
17STX02	Design of Structural Optimization	PSE	Nil	3	3	0	0	3	1
17STX03	Prefabricated Structures	PSE	Nil	3	3	0	0	3	1
17STX04	Design of Substructures	PSE	Nil	3	3	0	0	3	1
17STX05	Behaviour and Analysis of Tall Buildings	PSE	Nil	3	3	0	0	3	2
17STX06	Design of Plates, Shell and Spatial Structures	PSE	Nil	3	3	0	0	3	2
17STX07	Design of Steel - Concrete Composite Structures	PSE	Nil	3	3	0	0	3	2
17STX08	Structural Stability	PSE	Nil	3	3	0	0	3	2
17STX09	Design of Industrial Structures	PSE	Nil	3	3	0	0	3	2
17STX10	Maintenance and Rehabilitation of Structures	PSE	Nil	3	3	0	0	3	2

17STX11	Design of Off Shore Structures	PSE	Nil	3	3	0	0	3	2
17STX12	Wind and Cyclone Effects on Structures	PSE	Nil	3	3	0	0	3	2
17STX13	Design of Bridges	PSE	Nil	3	3	0	0	3	3
17STX14	Fracture Mechanics	PSE	Nil	3	3	0	0	3	3
17STX15	Mechanics of Composite Materials	PSE	Nil	3	3	0	0	3	3
17STX16	Non-Linear Analysis of Structures	PSE	Nil	3	3	0	0	3	3
17STX17	Advanced Structural Analysis	PSE	Nil	3	3	0	0	3	3
17STX18	Smart Structures	PSE	Nil	3	3	0	0	3	3
17STX19	Design of Prestressed concrete structures	PSE	Nil	3	3	0	0	3	3
17STX20	Solid and Hazardous Waste Management	PSE	Nil	3	3	0	0	3	3
17STX21	Energy Efficient Structures	PSE	Nil	3	3	0	0	3	3
17STX22	Structural Health Monitoring	PSE	Nil	3	3	0	0	3	3
EMPLOYMENT ENHANCEMENT COURSES (EEC)									
17STE01	Technical Seminar - I	EEC	Nil	2	0	0	2	1	1
17STE02	Technical Seminar - II	EEC	Nil	2	0	0	2	1	2
17STE03	Project Work Phase - I	EEC	Nil	12	0	0	12	6	3
17STE04	Project Work Phase - II	EEC	17STE03	24	0	0	24	12	4

LIST OF OPEN ELECTIVES (OE)

Course Code	Course Title	CATEGORY	PRE-REQUISIT	CONTACT PERIODS	L	T	P	C	P.S
17BAZ01	Research Methodology	OE	-	3	3	0	0	3	II

SL. No.	SUBJECT AREA	CREDITS AS PER SEMESTER				
		I	II	III	IV	TOTAL
1.	FC	4	0	0	0	4
2.	PC	17	16	0	0	33
3.	PSE	3	6	9	0	18
4.	EEC	1	1	6	12	20
TOTAL		25	23	15	12	75

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17STB02 DYNAMICS OF STRUCTURES

L	T	P	C
3	1	0	4

COURSE OBJECTIVES AND OUTCOMES:

	Course Objectives		Course Outcomes	Related Program outcomes
1.0	To expose the students the principles and methods of dynamic analysis	1.1	Understand the response of structural systems to dynamic loads and displacements.	a,b,c,d
2.0	Learn damped and Undamped techniques	2.1	Realize the behaviour and response of linear and non-linear SDOF and MDOF structures with Various dynamic loading.	a,e,j,k
3.0	Study the MDOF by approximate methods	3.1	Understand the behaviour and response of MDOF structures with various dynamic loading	a,e,j,k
4.0	Dynamic analysis using virtual work method	4.1	Find suitable solution for continuous system.	a,b,e,k
5.0	Analyse the various direct integration methods	5.1	Analyze dynamic response by direct integration method.	a,e,c,k

UNIT I PRINCIPLES OF VIBRATION ANALYSIS **(9+3)**

Vibration and its importance to structural engineering problems - Elements of vibratory systems and simple harmonic motion - generalized mass - D'Alembert's principle - Equations of motion by equilibrium and energy methods, free and forced vibration of single degree of freedom systems - Effect of damping - Transmissibility.

UNIT II TWO DEGREE OF FREEDOM SYSTEMS **(9+3)**

Formulation of Structure - Equations of Motion of Two degree of freedom systems - Damped and undamped free vibrations – Undamped forced vibration - normal modes of vibration – applications.

UNIT III DYNAMIC ANALYSIS OF MDOF **(9+3)**

Multi degree of freedom systems - Orthogonality of normal modes - approximate methods - Mode superposition technique - Numerical Integration procedure - Central Difference – Newmark's method.

UNIT IV DYNAMIC ANALYSIS CONTINUOUS SYSTEMS **(9+3)**

Free and forced vibration of continuous systems, Rayleigh-Ritz method - Formulation using Conservation of Energy – Formulation using Virtual Work.

UNIT V DIRECT INTEGRATION METHODS FOR DYNAMIC RESPONSE **(9+3)**

Introduction - Damping in MDOF systems - Nonlinear MDOF systems - Direct integration methods - Wilson 'φ' method - New 'β'method - measurement of damping and vibration techniques -Application of structural dynamics in the design of block and frame foundations.

TOTAL: L: 45 +T:15= 60 PERIODS

REFERENCES:

1. Roy R.Craig, Jr, Andrew J. Kurdila, "Fundamentals of Structural Dynamics", John Wiley& Sons. 2011.
2. Mario Paz, Structural Dynamics: "Theory and Computation", Kluwer Academic Publication, 2004.
3. Anil K.Chopra, "Dynamics of Structures", Pearson Education, 2007.
4. Leonard Meirovitch, "Elements of Vibration Analysis", McGraw Hill, 1986, IOS Press, 2006.
5. Ray W. Clough & Joseph Penzien, "Dynamics of Structures", Computers & Structures, USA 2003.
6. Jagmohan L. Humar, "Dynamics of Structures", A.A. Balkema Publishers, Rotterdam, 2002.

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17STB03 APPLIED ELASTICITY & PLASTICITY

L	T	P	C
3	1	0	4

COURSE OBJECTIVES AND OUTCOMES:

	Course Objectives		Course Outcomes	Related Program outcomes
1.0	To understand the concept of elasticity	1.1	Understand the concept of stresses and strains.	a,b,c,k
2.0	To have knowledge about elasticity solution	2.1	To obtain solutions for elasticity problems in rectangular and polar coordinates	b,d,e,
3.0	To learn the Torsion of non circular	3.1	Analyze torsion of non-circular sections and thin walled sections.	a,b,,d
4.0	To study the energy by energy theorems	4.1	Analyze the beams and columns using energy methods	b,c,d,f
5.0	To learn the yield line criteria	5.1	Analyze using Plastic theories	c,d,f,k

UNIT I ELASTICITY **(9+3)**

Analysis of stress and strain, Equilibrium equations - Compatibility equations – stress strain relationship. Generalized Hooke's law.

UNIT II ELASTICITY SOLUTION **(9+3)**

Methods of formulation of elasticity problems, methods of solution of elasticity problems -- Plane stress and Plane strain problems - Simple two dimensional problems in Cartesian and polar co-ordinates.

UNIT III TORSION OF NON-CIRCULAR SECTION **(9+3)**

St.venant's approach - Prandtl's approach – Membrane analogy - Torsion of thin walled open and Closed sections.

UNIT IV ENERGY METHODS **(9+3)**

Strain energy – Principle of virtual work – Energy theorems – Rayleigh Ritz method – Finite difference method – Application to elasticity problems.

UNIT V PLASTICITY **(9+3)**

Physical Assumptions – Yield Criteria – Failure Theories – Applications of Thick Cylinder – Plastic Stress Strain Relationship. Elasto-Plastic Problems in Bending and Torsion.

TOTAL: L: 45 +T:15= 60 PERIODS

REFERENCES:

1. Timoshenko, S. and GoodierJ.N."Theory of Elasticity", McGraw Hill Book Co., Newyork, 2010.
2. Sadhu Singh, "Theory of Elasticity", Khanna Publishers, New Delhi 2005.
3. AC Ugural& SK Fenster, 'Advanced Strength and Applied Elasticity', Edward Arnold Publishers Ltd., UK, 2003.
4. Chou P.C. and Pagano, N.J. "Elasticity Tensor, Dyadic and Engineering Approaches", D.VanNostrand Co., Inc., London, 1992.
5. Irving H.Shames and James, M.Pitarresi, "Introduction to Solid Mechanics", Prentice Hall of India Pvt. Ltd., New Delhi 2000.

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17STB05 - EXPERIMENTAL STRESS ANALYSIS AND TECHNIQUES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	The course objective is to make students to know the concepts of measurements of static and dynamic response of Structures and to analyze the structure	1.1	Choose the methodology of measuring errors and strains and calibrate the machineries.	a,b,e,i
2.0	To measure the vibration by different techniques	2.1	Use various vibration measuring instruments and analyze the structures.	a,b,i,e.k
3.0	To learn the damage assessment	3.1	Measure distress in the structures using various electronic equipment	a,b,e,i
4.0	To study about the NDT methods	4.1	Perform advanced NDT methods in accessing the load testing of structures	a,b,f,k
5.0	To make the students to describe about the model analysis	5.1	To predict the behaviour of proto type structure by conducting model tests and analysis	a,b,c,i,l

UNIT I FORCES AND STRAIN MEASUREMENT (9)

Choice of Experimental stress analysis methods, Errors in measurements – Strain gauge, principle, types, performance and uses. Photo elasticity - principle and applications - Hydraulic jacks and pressure gauges – Electronic load cells – Proving Rings – Calibration of Testing Machines – Long-term monitoring – vibrating wire sensors – Fibre optic sensors.

UNIT II VIBRATION MEASUREMENTS (9)

Characteristics of Structural Vibrations – Linear Variable Differential Transformer (LVDT) – Transducers for velocity and acceleration measurements. Vibration meter – Seismographs – Vibration Analyzer – Display and recording of signals – Cathode Ray Oscilloscope – XY Plotter – Chart Plotters – Digital data Acquisition systems.

UNIT III DISTRESS MEASUREMENTS & CONTROL (9)

Diagnosis of distress in structures – crack observation and measurements – corrosion of reinforcement in concrete – Half cell, construction and use – damage assessment – controlled blasting for demolition – Techniques for residual stress measurements.

UNIT IV NON DESTRUCTIVE TESTING METHODS (9)

Load testing on structures, buildings, bridges and towers – Rebound Hammer – acoustic emission – ultrasonic testing principles and application – Holography – use of laser for structural testing – Brittle coating, Advanced NDT methods – Ultrasonic pulse echo, Impact echo, impulse radar techniques, GECOR & GPR.

UNIT V MODEL ANALYSIS (9)

Model Laws – Laws of similitude – Model materials – Necessity for Model analysis – Advantages – Applications – Types of similitude – Scale effect in models – Indirect model study – Direct model study - Limitations of models – investigations – structural problems –Usage of influence lines in model studies.

TOTAL: L: 45 = 45 PERIODS

REFERENCES:

1. Sadhu Singh, "Experimental Stress Analysis", Khanna Publishers, 4th Edition, New Delhi, 2006.
2. Ganesan.T.P, "Model Analysis of Structures", University Press, India, 2000.
3. Dalley .J.W and Riley.W.F, "Experimental Stress Analysis", McGraw Hill Book Company, N.Y. 1991.
4. Srinath.L.S, Raghavan.M.R, ingaiah.K, Gargesha.G, Pant.B and Ramachandra.K, "Experimental Stress Analysis", Tata McGraw Hill Company, New Delhi, 1984.
5. C. S. Rangan, Instrumentation – Devices and Systems, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, 1983.

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17STB06 BEHAVIOUR AND DESIGN OF STEEL STRUCTURES

(IS 800:2007, IS 801:1975, IS805:1995, IS811:1987, IS875:1987 PART I, II, III)

L	T	P	C
3	1	0	4

COURSE OBJECTIVES AND OUTCOMES:

	Course Objectives		Course Outcomes	Related Program outcomes
1.0	To study the load on structures with lateral loads and design of connections	1.1	Familiarize on behaviour of members and connections	a,c,d,f
2.0	To design the Multistoreyed builds	2.1	To know about the Design of industrial structures	a,b,d,e,f
3.0	To learn and design the Light gauge sections	3.1	To learn about the design of light gauge steel Sections	a,b,c,
4.0	To make the students to design the special structures	4.1	Practice on analysis and design of steel towers & chimneys	a,b,c,
5.0	To study about the plastic analysis	5.1	To know about the design philosophy for plastic analysis	a,b,e,f

UNIT I DESIGN OF CONNECTIONS (9+3)

Bracket connections - Shear connections – fin plate, end plate and cleat connections – moment connection – direct welded, strap plate and plate connections – semi rigid connections.

UNIT II INDUSTRIAL BUILDING (9+3)

Industrial building frames - wind load analysis-Calculation of wind load and its combination- Framing – Roof Bracing - Crane girders and columns - Analysis of Trussed bents – Design example - Design of rigid joints knee for gable frames. Structure of Multistoreyed Buildings - Bracing systems of Multistorey frames.

UNIT III LIGHT GAUGE SECTIONS (9+3)

Concepts -Design of cold formed sections - effective width - stiffened sections - multiple stiffened sections - design of light gauge beams and columns – Torsional – Flexural buckling – composite decks.

UNIT IV DESIGN OF SPECIAL STRUCTURES (9+3)

Design of Chimneys – Self-supporting and guyed chimneys – Design of Silos – Bunker design – Design of towers.

UNIT V PLASTIC ANALYSIS AND DESIGN (9+3)

Concept of plastic analysis-Theory of plastic bending - Plastic hinge - redistribution of moments - failure mechanisms - plastic analysis and design of fixed beams, continuous beams and portal frames by mechanism method.

TOTAL: L: 45 +T:15= 60 PERIODS

REFERENCES:

1. N.Subramanian, "Design of Steel Structures", Oxford University Press, 2008.
2. S. K. Duggal, Limit State Design of Steel Structures, McGraw Hill, 2014.
3. P.Dayaratnam, "Design of Steel Structures", A.H.Wheeler, India, 2008.
4. Ramchandra (Vol I and II), Design of Steel Structures-1, Scientific Publishers, 2009.
5. Linton E. Grinter, "Design of Modern Steel Structures", Eurasia Publishing House, New Delhi, 1996.
6. FrdericoM.Mazzolani& Robert Tremblay,"Behaviour of steel structures in seismic areas" A. A. Balkema Publishers, Brookfield, USA, 2000.
7. Bungale. S. Taranath, "Structural Analysis and design of Tall Buildings – Steel and composite construction", CRC Press Taylor and Francis Group, BacoRatan, US, 2012.

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17STB08 FINITE ELEMENT ANALYSIS

L	T	P	C
3	1	0	4

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	To develop the skills in finite element method	1.1	Develop finite element formulations of one degree of freedom problems and solve them	a,b,f,i
2.0	To acquire knowledge about Plane Stress and strain problems	2.1	Perform modal analysis to determine its natural frequencies, and analyze harmonically-forced vibrations.	a,c,f,j
3.0	To gain the knowledge about the Meshing problems	3.1	Use finite element analysis programs based upon either "p-method" or "h-method" finite element mathematical formulations	a,f,k
4.0	To learn about various vibration problems	4.1	Analysis the plane stress, plain strain and axis symmetric problems related to Triangular and Quadrilateral elements.	a,b,c,l
5.0	To analyse the plate and shell elements	5.1	Analysis on application of beams, columns using finite element analysis.	b,c,d,f

UNIT I INTRODUCTION **(9+3)**

Approximate solutions of boundary value problems - Methods of weighted residuals, approximate solution using variational method, Modified Galerkin method, Boundary conditions and general comments. Basic finite element concepts - Basic ideas in a finite element solution, General finite element solution procedure, Finite element equations using modified Galerkin method.

UNIT II STRESS ANALYSIS **(9+3)**

Two Dimensional problems – Plane Stress, Plane Strain and Axisymmetric Problems - Triangular and Quadrilateral Elements Natural Coordinates – Isoparametric Formulation - Numerical Integration -Plate Bending and Shell Elements — Brick Elements –Elements for Fracture Analysis

UNIT III MESHING AND SOLUTION PROBLEMS **(9+3)**

Higher Order Elements - P and H Methods of Mesh Refinement - ill conditioned Elements -Discretisation Errors – Auto and Adaptive Mesh Generation Techniques - Error Evaluation

UNIT IV NONLINEAR, VIBRATION AND THERMAL PROBLEMS **(9+3)**

Material and Geometric Nonlinearity – Methods of Treatment – Consistent System Matrices – Dynamic Condensation – Eigen Value Extraction - thermal analysis.

UNIT V PLATE AND SHELL ELEMENTS **(9+3)**

Formation of stiffness matrix for plate bending elements of triangular and quadrilateral elements - Concept of four node and eight node isoparametric elements - Cylindrical thin shell elements.

TOTAL: L: 45 +T:15= 60 PERIODS

REFERENCES:

1. S. S. Bhavikatti, "Finite Element Analysis", New Age Publishers, 2010.
2. Chandrupatla, R.T. and Belegundu, A.D., "Introduction to Finite Elements in Engineering", Prentice Hall of India, 2007
3. C. S. Krishnamoorthy, "Finite Element Analysis: Theory and Programming", Tata McGraw-Hill, 1994.
4. David Hutton, "Fundamentals of Finite Element Analysis", Tata McGraw Hill Publishing Company Limited, New Delhi, 2005.
5. Bathe, K.J., "Finite Element Procedures in Engineering Analysis", Prentice Hall Inc., 2009.
6. Tirupathi R. Chandrupatla and Ashok D. Belegundu, "Introduction to Finite Elements in Engineering" Prentice Hall of India Pvt. Ltd., New Delhi, 2011.

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17STX04 DESIGN OF SUB STRUCTURES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES AND OUTCOMES:

	Course Objectives		Course Outcomes	Related Program outcomes
1.0	To gain familiarity with different types of foundation.	1.1	Be capable of ensuring investigation & design concepts of shallow foundation	a,d,i,k
2.0	To explore the students to the design of shallow foundations and deep foundations.	2.1	Be efficient in selecting suitable type of pile for different soil stratum	a,b,f,k
3.0	To understand the concept of designing well	3.1	Enumerate the Design & construction of well foundation	a,b,c,i
4.0	To understand the concept of machine foundations.	4.1	Understand the basic principles of design of machine foundation & vibration analysis.	a,b,f,k
5.0	To gain the knowledge about Miscellaneous structures foundations	5.1	Deliver the design concepts for transmission line tower foundation	a,c,f,j

UNIT I SHALLOW FOUNDATIONS (9)

Soil investigation – Basic requirements of foundation – Types and selection of foundations. Bearing capacity of soil - plate load test – Design of reinforced concrete isolated, strip, combined and strap footings – mat foundation.

UNIT II PILE FOUNDATIONS (9)

Introduction – Types of pile foundations – load carrying capacity - pile load test – structural design of straight piles – different shapes of piles cap – structural design of pile cap.

UNIT III WELL AND CAISSON FOUNDATIONS (9)

Well and caisson foundations – Structural elements of Caisson and Well foundations – Elements of well foundation – Forces acting on Caisson and well foundations – Design of individual components of Caisson and well foundation (only forces acting and design principles) – Sinking of well – Shifts and tilts in Well foundations – Preventive measures.

UNIT IV MACHINE FOUNDATIONS (9)

Types of machine foundation - General requirements and design criteria - General analysis of machine foundations - Dynamic properties of soil - soil system - Stiffness and damping parameters - Tests for design parameters - Reinforcement and construction details – Vibration isolation.

UNIT V FOUNDATIONS FOR MISCELLANEOUS STRUCTURES (9)

Foundations for towers, Chimneys, Silos – Structural Design of supports for foundation excavations - Case studies – Design of Anchors - Foundation in Expansive Soils - Introduction - Identification of expansive soils Swell potential and swelling pressure - Methods of foundation in expansive soils.

TOTAL: L: 45 = 45 PERIODS

REFERENCES:

1. Das, B.M. Principles of Foundation Engineering, 8th Edition, Cengage Learning, 2015
2. Swami Saran, 'Analysis and Design of Substructures', Oxford & IBH Publishing Company Private Limited, 2009.
3. Tomlinson.M.J, "Foundation Design and Construction", Longman, Sixth Edition, New Delhi, 1995.
4. Varghese.P.C, "Design of Reinforced Concrete Foundations" – PHI learning private limited, New Delhi, 2009.

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17STX06 DESIGN OF PLATES, SHELL AND SPATIAL STRUCTURES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES AND OUTCOMES:

Course Objectives		Course Outcomes		Related Program outcomes
1.0	This course objective is to develop the skills of students in the areas of design of shell, folded plate, space frames &.	1.1	Analyse various shapes of plates using various methods	a,b,c,e,i
2.0	To design the folded plates by numerical methods	2.1	Understand the behavior folded plates	a,c,f,k
3.0	To design and analyse the shell	3.1	Know the structural behaviour and philosophy of shells	a,e,f,i,k
4.0	To learn the nodes and behaviour	4.1	Analysis & design the space frame	a,c,d,j
5.0	To design the space frames	5.1	Application of Formex	a,d,j,k

UNIT I SYMMETRICAL BENDING OF PLATES (9)

Equation of equilibrium and deformation of plates – Bending of rectangular plates and circular plates.

UNIT II NUMERICAL METHODS (9)

Energy method, finite difference and finite element methods for solution of plate bending problems. Principles of design of folded plates

UNIT III SHELLS (9)

Geometry of shells – Classification of Shells – membrane theory of circular and cylindrical shells – Detailed Analysis and design of cylindrical shells – Detailing of Reinforcement in shells, edge beams and transfer beam

UNIT IV INTRODUCTION TO SPACE FRAMES (9)

Space frames – configuration – types of nodes – general principles of design Philosophy – Behaviour

UNIT V ANALYSIS OF SPACE FRAMES (9)

Analysis of space frames – Formex Algebra, FORMIAN – detailed design of space frames

TOTAL: L: 45 = 45 PERIODS

REFERENCES:

1. Billington.D.P, "Thin Shell Concrete Structures", McGraw Hill Book Co., New York, 1982.
2. G.S. Ramasamy, Design and Construction of Concrete Shell Roofs, CBS Publishers and Distributors, New Delhi, 2003.
3. Santhakumar.A.R and Senthil.R, "Proceedings of International Conference on Space Structures", Anna University, Chennai, 1997.
4. Pietraszkiewicz.W and Szymmczak.C "Shell Structures" Taylor Francis Group, UK, 2005.
5. Bangesh.M.Y.H and Bangesh.T "Elements of Spatial Structures" Thomas Telford publishing, US, 2003.
6. Varghese.P.C., Design of Reinforced Concrete Shells and Folded Plates, PHI Learning Pvt. Ltd., 2010

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17STX10 MAINTENANCE AND REHABILITATION OF STRUCTURES

L	T	P	C
3	0	0	3

COURSE OBJECTIVES AND OUTCOMES:

	Course Objectives		Course Outcomes	Related Program outcomes
1.0	To develop the ability of students to assess the strength, durability of structures materials	1.1	Recognize the mechanisms of degradation of concrete structures	a,b,d,g
2.0	To understand the Quality control in concrete construction	2.1	Plan towards the strength and durability of existing concrete structures	a,c,e,k
3.0	To learn the materials and techniques for repair	3.1	Realize the basic concepts and materials& techniques available for repair works.	b,d,f,l
4.0	To gain the knowledge about the demolition of structures	4.1	Knowledge on strengthening and stabilization on existing concrete structures	a,b,i,l
5.0	To learn the composite construction	5.1	Posses the ability to find out suitable techniques for repair and demolition process	a,b,d,e,l

UNIT I MAINTENANCE AND REPAIR STRATEGIES (8)

Maintenance, repair and rehabilitation, Facets of Maintenance, importance of Maintenance various aspects of Inspection, Assessment procedure for evaluating a damaged structure, causes of deterioration.

UNIT II SERVICEABILITY AND DURABILITY OF CONCRETE (8)

Quality assurance for concrete construction concrete properties- strength, permeability, thermal properties and cracking. - Effects due to climate, temperature, chemicals, corrosion - design and construction errors - Effects of cover thickness and cracking.

UNIT III MATERIALS AND TECHNIQUES FOR REPAIR (12)

Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, sulphur infiltrated concrete, Ferro cement and polymers coating for rebars loadings from concrete, mortar and dry pack, vacuum concrete, Gunite and Concrete, Epoxy injection, Mortar repair for cracks, shoring and underpinning. Methods of corrosion protection, corrosion inhibitors, corrosion resistant steels and cathodic protection

UNIT IV REPAIRS TO STRUCTURES (10)

Repair of structures distressed due to earthquake – Strengthening using FRP - Strengthening and stabilization techniques for repair - Types of demolition techniques - Engineered demolition techniques for structures - Case Studies

UNIT V STRENGTHENING OF STRUCTURES (7)

General principle – relieving loads – Strengthening super structures – plating – Conversation to composite construction – post stressing – Jacketing – bonded overlays – Reinforcement addition – strengthening substructures – under pinning – Enhancing the load capacity of footing – Design for rehabilitation

TOTAL: L: 45 = 45 PERIODS

REFERENCES:

1. Dodge Woodson.R,"Concrete Structures – protection, repair and rehabilitation", ElsevierUK, 2009.
2. Denison Campbell, Allen and Harold Roper, "Concrete Structures, Materials, Maintenance and Repair", Longman Scientific and Technical, UK, 1991.
3. Santhakumar A.R., "Concrete Technology" Oxford University Press, Printed in India by Radha Press, New Delhi, 2007.
4. Peter H.Emmons, "Concrete Repair and Maintenance Illustrated", Galgotia Publications pvt. Ltd., 2001.

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