PAAVAI ENGINEERING COLLEGE, NAMAKKAL (AUTONOMOUS)

M.E - STRUCTURAL ENGINEERING

REGULATIONS 2019

CURRICULUM

(CHOICE BASED CREDIT SYSTEM)

(For the candidates admitted during the Academic Year 2021-2022)

SEMESTER I

S. No	Course Code	Course Title	L	T	P	C
Theory						
1	PSE19101	Matrix Methods of Structural Analysis	3	1	0	4
2	PSE19102	Theory of Elasticity and Plasticity	3	1	0	4
3	PEN19101	Research Methodology and IPR	3	0	0	3
4	PSE1915*	Elective I	3	0	0	3
5	PSE1925*	Elective II	3	0	0	3
6	PEN19171	English for Research Paper Writing (Audit Course I)	2	0	0	0
Practical's						
7	PSE19103	Advanced Concrete Laboratory	0	0	2	1
Total			**17**	**2**	**2**	**18**

SEMESTER II

S. No	Course Code	Course Title	L	T	P	C
Theory						
1	PSE19201	Finite Element Methods	3	1	0	4
2	PSE19202	Structural Dynamics	3	1	0	4
3	PSE1935*	Elective III	3	0	0	3
4	PSE1945*	Elective IV	3	0	0	3
5	PEN19271	Pedagogy Studies (Audit Course II)	2	0	0	0
Practical's						
6	PSE19203	Structural Design Laboratory	0	0	4	2
7	PSE19204	Mini Project	0	0	4	2
		Total	**14**	**2**	**8**	**18**

LIST OF PROFESSIONAL ELECTIVES

ELECTIVE I

Catagory	Course Code	Course Title	L	T	P	C
PE	PSE19151	Theory of Plates	3	0	0	3
PE	PSE19152	Advanced Concrete Technology	3	0	0	3
PE	PSE19153	Theory of Structural Stability	3	0	0	3
PE	PMA19151	Advanced Mathematical Methods	3	0	0	3

ELECTIVE II

Category	Course Code	Course Title	L	T	P	C
PE	PSE19251	Structural Health Monitoring	3	0	0	3
PE	PSE19252	Smart Structures and Smart Materials	3	0	0	3
PE	PSE19253	Prefabricated Structures	3	0	0	3
PE	PSE19254	Earthquake Resistant Design	3	0	0	3

ELECTIVE III

Category	Course Code	Course Title	L	T	P	C
PE	PSE19351	Advanced Steel Design	3	0	0	3
PE	PSE19352	Design of Formwork	3	0	0	3
PE	PSE19353	Design of High Rise Structures	3	0	0	3
PE	PSE19354	Non Linear Analysis of Structures	3	0	0	3

ELECTIVE IV

Catagory	Course Code	Course Title	L	T	P	C
PE	PSE19451	Design of Advanced concrete Structures	3	0	0	3
PE	PSE19452	Design of Sub Structures	3	0	0	3
PE	PSE19453	Experimental Techniques and Model Analysis	3	0	0	3
PE	PSE19454	Design of Industrial Structures	3	0	0	3

SEMESTER I

PSE19101 MATRIX METHODS OF STRUCTURAL ANALYSIS 3 1 0 4

COURSE OBJECTIVES

To enable the students to,

- learn the basic concepts of structural analysis.
- know about the stiffness and flexibility methods from strain energy
- know about the determinate & indeterminate structures
- analyze the frames using flexibility matrix method.
- study the applications of matrix methods

Prerequisite: Nil

UNIT I INTRODUCTION 12

Generalised measurements - Degrees of freedom, Constrained Measurements, Behaviour of structures, Principle of superposition; Stiffness and flexibility matrices - Constrained measurements; Stiffness and flexibility coefficients from virtual work.

UNIT II MATRIX ANALYSIS OF STRAIN ENERGY 12

Strain energy - Stiffness and flexibility matrices from strain energy, Symmetry and other properties of stiffness and flexibility matrices; Betti's law and its applications - Strain energy in systems and in elements.

UNIT III DETERMINATE AND INDETERMINATE STRUCTURES 12

Determinate and indeterminate structures - Transformation of element matrices to system matrices, Transformation of system vectors to element vectors, Normal coordinates and orthogonal transformations.

UNIT IV FLEXIBILITY METHOD 12

Flexibility method applied to statically determinate and indeterminate structures - Choice of redundants, Transformation of redundants, internal forces due to thermal expansion and lack of fit.

UNIT V APPLICATIONS 12

Development of the method - Internal forces due to thermal expansion and lack of fit, Application to symmetrical structures, Comparison between stiffness and flexibility methods.

TOTAL PERIODS 60

COURSE OUTCOMES

Upon the completion of this course, the students will be able to

- understand the concepts of structural analysis.
- analyze the structures using stiffness & flexibility matrix concepts.
- analyze the truss elements using stiffness and flexibility matrix method.
- analyze the frame by flexibility matrix method.
- understand the applications of matrix methods

REFERENCES

1. Moshe, F., Rubenstein, Matrix Computer Analysis of Structures, Prentice Hall, NewYork, 1986.
2. Rajasekaran S, Computational Structural Mechanics, Prentice Hall of India, New Delhi,2001
3. Manickaselvam V.K., Elements of Matrix and Stability Analysis of Structures, KhannaPublishers, New Delhi, 1998.

CO PO MAPPING:

Mapping of course objectives with Programme Outcomes: **(1/2/3 indicates strength of correlation) 3- strong,2-Medium, 1-Weak**														
Cos	**Programme Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	-	-	-	2	2	-	-	-	-	-	-	2
CO2	3	2	-	-	-	2	2	-	-	-	-	-	-	2
CO3	3	2	-	-	-	2	2	-	-	-	-	-	-	2
CO4	3	2	-	-	-	2	2	-	-	-	-	-	-	2
CO5	3	2	-	-	-	2	2	-	-	-	-	-	-	2

PSE19102 THEORY OF ELASTICITY AND PLASTICITY 3 1 0 4

COURSE OBJECTIVES

To enable the students to,

- study the classical theory of linear elasticity for stress and strain
- obtain solutions for elasticity problems in Cartesian co-ordinates
- design equations of equilibrium in polar co-ordinates
- gain knowledge on torsion of rectangular sections and thin walled sections
- understand the plastic stress strain relations, criteria of yielding and elastic- plastic problems.

Prerequisite: Nil

UNIT I INTRODUCTION TO ELASTICITY 12

Basic concepts of deformation of deformable bodies - Displacement, Analysis of Stress and Strain, equilibrium equations, Compatibility equations, Stress strain relationship, Generalized Hooke's law, Lame's Constant

UNIT II TWO DIMENSIONAL PROBLEMS IN CARTESIAN CO-ORDINATES 12

Plane Stress and Plane Strain Problems - Airy's Stress Function, Polynomials, Direct method of determining Airy's Stress Function ; Two Dimensional Problems in Cartesian Coordinates - Bending of a Cantilever Loaded at Free End, Bending of a Beam under Uniform Loading-solution of Bi harmonic equation, St. Venant principle.

UNIT III TWO DIMENSIONAL PROBLEMS IN POLAR CO-ORDINATES 12

Equations of Equilibrium in Polar Coordinates - Two Dimensional Problems in Polar Coordinates; Bending of Curved Beam - Thick Cylinder under Uniform Pressure, Flat Plate subjected to in plane traction and Shear with Circular Hole

UNIT IV TORSION AND ENERGY THEORY 12

Torsion of Prismatic bars - Membrane Analogy of Torsion, Torsion of Rectangular Section, Torsion of Thin Tubes, Membrane analogy; Energy Methods - Principle of Virtual Work; Energy Theorems - Rayleigh's method, Rayleigh-Ritz method.

UNIT V INTRODUCTION TO PLASTICITY 12

Strain Hardening - Idealized Stress, Strain Curve; Yield Criteria - Von Misses Yield Criterion, Tresca Yield Criterion; Plastic Stress - Strain Relations (Flow Rule), Plastic Problems of beams in Bending and Torsion

TOTAL PERIODS 60

COURSE OUTCOMES

Upon the completion of this course, the students will be able to

- calculate the stress and strain parameters
- analyse the induced stress in the two dimensional problems in Cartesian coordinates
- interpret the induced stress in the two dimensional problems in polar coordinates

- apply the energy theorem and torsion to elastic problems
- determine the physical behaviour of yield criteria of materials

REFERENCES

1. Timeshenko.S.P and Goodier.J.N, "Theory of Elasticity", McGraw Hill International Edition,2013
2. Sadhu Singh, "Theory of Elasticity" &"Theory of Plasticity", Khanna Publishers, New Delhi, 2005
3. Chandramouli P.N., "Theory of Elasticity", 1st Edition, Yesdee Publishing Pvt. Ltd., Chennai, 2017
4. Jane Helena H., "Theory of Elasticity and Plasticity", Prentice Hall Publication, New Delhi, 2017.
5. Richard. G. Budynas, Advanced Strength and Applied Stress Analysis, McGraw-Hill, New Delhi, Second Edition, 2011

CO PO MAPPING:

Mapping of course objectives with Programme Outcomes: (1/2/3 indicates strength of correlation) 3- strong,2-Medium, 1-Weak														
Cos	**Programme Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	-	-	-	2	2	-	-	-	-	-	-	2
CO2	3	2	-	-	-	2	2	-	-	-	-	-	-	2
CO3	3	2	-	-	-	2	2	-	-	-	-	-	-	2
CO4	3	2	-	-	-	2	2	-	-	-	-	-	-	2
CO5	3	2	-	-	-	2	2	-	-	-	-	-	-	2

PEN19101 RESEARCH METHODOLOGY AND IPR 3 0 0 3

COURSE OBJECTIVES

To enable students to

- understand the formulation of Research problem
- be familiar with data collection and literature survey process
- know the statistical concepts in experimentation
- acquire knowledge in writing research proposal
- understand about patent rights and its importance

UNIT I RESEARCH PROBLEM FORMULATION **9**

Meaning of research, Objectives of Research, Types of research, Significance of Research, Research process, Selecting the problem, Necessity of defining the problem, Meaning of Research design, Need for research design, features of a good design, Different research designs.

UNIT II LITERATURE SURVEY **9**

Quantitative and Qualitative data, Scaling, Scaling Techniques, Experiments and Surveys, Collection of Primary and secondary data, Data preparation process. Research problems, Effective literature studies approaches, Survey for existing literature, Procedure for reviewing the literature, analysis and assessment

UNIT III DESIGN OF EXPERIMENTS **9**

Strategy of Experimentation - Typical applications of experimental design, Guidelines for designing experiments; Basic statistical concepts - Statistical concepts in experimentation, Regression approach to analysis of variance.

UNIT IV RESEARCH PROPOSAL AND WRITING **9**

Contents of a research proposal, Writing a research report - Research writing in general, Referencing, Writing a bibliography, Presentation and assessment by a review committee, Plagiarism, Research ethics.

UNIT V INTELLECTUAL PROPERTY RIGHTS **9**

Intellectual Property - Definition, WTO, Fundamentals of Patent, Copyright - The rights of the owner, Term of copyright, Register of Trademark, Procedure for trade mark, Term of trademark, New Developments in IPR - Administration of patent system, IPR of Biological Systems, Computer Software.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon the completion of the course, students will be able to

- identify research problems
- collect and prepare suitable data for research
- design experiments for different statistical concepts.
- write research proposals and reports
- apply their research work for patent through IPR

REFERENCES

1. C.RKothari and Gaurav Garg, "Research Methodology Methods and Techniques" ,4th Edition, New Age International Publishers, 2019.
2. RanjitKumar, "Research Methodology": A step by Step Guide for beginners,2nd Edition, Pearson Education, 2010.
3. Douglas C. Montgomery, "Design and Analysis of Experiments", 9th edition, Wiley Publishers, 2017.
4. Neeraj Pandey and Khushdeep Dharni,"Intellectual Propertyrights",PHILearning,2014.
5. Dr.R.Radhakrishnan and Dr.S.Balasubramanian,"IntellectualPropertyRights,textandcases",Excel Books, New Delhi.

CO PO MAPPING:

Mapping of course objectives with Programme Outcomes:
(1/2/3 indicates strength of correlation) 3- strong, 2-Medium, 1-Weak

Cos	Programme Outcomes (POs)													
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	-	-	-	-	1	-	-	1	3	3	3
CO2	3	3	1	-	-	-	-	2	-	3	1	3	3	3
CO3	3	2	3	2	-	-	-	2	-	-	1	3	3	3
CO4	3	3	2	-	-	-	-	1	-	3	1	3	3	3
CO5	3	3	3	2	-	-	-	3	-	1	2	3	3	3

PSE19103 ADVANCED CONCRETE LABORATORY 0 0 2 1

COURSE OBJECTIVES

To enable the students to,

- gain knowledge about the design high grade concrete and study the parameters affecting its performance
- know about the fresh properties of self-compacting concrete
- conduct Non Destructive Tests on existing concrete structures.
- apply engineering principles to understand behavior of structural elements..

Prerequisite: Nil

LIST OF EXPERIMENTS

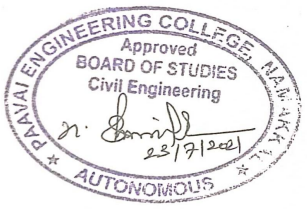
1. Concrete mix design and study of mechanical properties of concrete
2. Fresh properties of Self Compacting Concrete using slump flow, L Box and V Funnel Tests
3. Behavior of Beams under flexure, Shear and Torsion.
4. Study of stress-strain curve of high strength concrete
5. Correlation between cube strength, cylinder strength, split tensile strength and modulus of rupture.
6. Non-Destructive testing of existing concrete members.
   I. Rebound hammer.
   II. Ultrasonic Pulse Velocity Tester.

TOTAL PERIODS 30

COURSE OUTCOMES

Upon the completion of this course, the students will be able to

- design high grade concrete and study the parameters affecting its performance
- test the fresh properties of self-compacting concrete.
- test the existing concrete structures by Non Destructive Tests.
- apply engineering principles to behavior of structural elements..



REFERENCES

1. Properties of Concrete, Neville A. M., 5th Edition, Prentice Hall, 2012.
2. Concrete Technology, Shetty M. S., S. Chand and Co., 2006.
3. L.S Srinath, "Experimental Stress Analysis", Tata McGraw-Hill Publishing Company Limited, New Delhi, 1992.

CO PO MAPPING:

Mapping of course objectives with Programme Outcomes: (1/2/3 indicates strength of correlation) 3- strong,2-Medium, 1-Weak														
Cos	**Programme Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	-	-	-	1	2	-	3	-	-	2	-	2
CO2	3	-	-	-	-	1	2	-	3	-	-	2	-	2
CO3	3	-	-	-	-	1	2	-	3	-	-	2	-	2
CO4	3	-	-	-	-	1	2	-	3	-	-	2	-	2

ELECTIVE I

PSE19151 THEORY OF PLATES 3 0 0 3

COURSE OBJECTIVES

To enable the students to,

- understand the various boundary conditions for laterally loaded plates.
- know about the rectangular plate method.
- make the students to be familiar with circular plates.
- understand the concepts of energy methods
- design the Orthotropic plates

Prerequisite: Nil

UNIT I INTRODUCTION TO PLATES THEORY 9

Thin Plates with small deflection - Laterally loaded thin plates, governing differential equation, various boundary conditions.

UNIT II RECATANGULAR PLATES 9

Rectangular plates - Simply supported rectangular plates; Navier solution and Levy's method; Rectangular plates with various edge conditions - plates on elastic foundation.

UNIT III CIRCULAR PLATES 9

Symmetrical bending of circular plates - plates on elastic foundation.

UNIT IV SPECIAL AND APPROXIMATE METHODS 9

Energy methods - Finite difference and Finite element methods

UNIT V ANISOTROPIC PLATES AND THICK PLATES 9

Orthotropic plates and grids - moderately thick plates.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon the completion of this course, the students will be able to

- design the laterally loaded plates with various boundary conditions.
- design the rectangular plates using various methods.
- understand the bending of circular plates.
- understand the Finite difference and Finite element methods
- designthe thick plates

REFERENCES

1. AnselC.Ugural, ”Stresses in plate and shells”, McGraw Hill International Edition, 1999.
2. Reddy J N, “Theory and Analysis of Elastic Plates and Shells”, McGraw Hill Book Company, 2006.
3. Chandrashekahara,K. “Theory of Plates”, University Press (India) Ltd., Hyderabad, 2001.
4. Bairagi, “Plate Analysis”, Khanna Publishers, 1996.

CO PO MAPPING:

Mapping of course objectives with Programme Outcomes: (1/2/3 indicates strength of correlation) 3- strong,2-Medium, 1-Weak														
Cos	**Programme Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	-	-	-	-	2	-	-	-	-	1	-	2
CO2	3	2	-	-	-	-	2	-	-	-	-	1	-	2
CO3	3	2	-	-	-	-	2	-	-	-	-	1	-	2
CO4	3	2	-	-	-	-	2	-	-	-	-	1	-	2
CO5	3	2	-	-	-	-	2	-	-	-	-	1	-	2

PSE19152 ADVANCED CONCRETE TECHNOLOGY 3 0 0 3

COURSE OBJECTIVES

To enable the students to,

- summarize the properties of concrete making materials such as cement, aggregates and admixtures.
- categories the properties and tests on fresh and hardened concrete.
- acquire the practical knowledge on mix design principles, concepts and methods.
- get an adequate knowledge about the special concretes and their applications in the diverse Construction field.
- study the concrete manufacturing processes, concreting methods and different special formworks.

Prerequisite: Nil

UNIT I MATERIALS FOR CONCRETE 9

Cement - Manufacturing, Types and grades of cement, Chemical composition, Hydration of cement, Micro structure of hydrated cement, Testing of cement, Special cements; Aggregates – classification, IS Specifications, properties, Grading and specified grading, Methods of combining aggregates, Testing of Aggregates; Water - Physical and chemical properties; Admixtures - Chemical & mineral Admixtures, Mineral additives.

UNIT II PROPERTIES OF CONCRETE 9

Properties of fresh concrete - Workability, Segregation, Bleeding, Latiance; Tests on fresh concrete; Properties and tests on hardened concrete - Structural properties, Strength, factors affecting the strength of Concrete; Maturity of concrete - modulus of elasticity, creep, shrinkage, factors affecting creep and shrinkage concrete; Micro structure of concrete - Micro cracking, Testing of existing and aged structures using NDT, Variability of strength in concrete; Durability of concrete - Chemical attack on concrete.

UNIT III CONCRETE MIX DESIGNS 9

Principles of mix design - Methods of concrete mix design, Factors influencing mix proportions; IS, ACI and British methods of mix design; Statistical quality control - Sampling and acceptance criteria.

UNIT IV SPECIAL CONCRETES 9

Light weight concrete and types; Fly ash concrete; Fibre reinforced concrete types & applications; Sulphur concrete; Sulphur impregnated concrete; Polymer concrete & its types; Super plasticized and hyper Plasticized concretes; Epoxy resins and screeds - properties, Their applications in rehabilitation works; High Performance concrete; high performance fibre reinforced concrete; Roller compacted concrete; Self - Concrete and its applications; Bacterial concrete; Recycled aggregate concrete; Smart concrete; Ferro cement and its applications.

UNIT V CONCRETING METHODS 9

Concrete manufacturing process - Stages of manufacturing - Transportation, placing and curing methods, Extreme weather concreting; Special concreting methods - Vacuum dewatering, Underwater concreting; Special form work types.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon the completion of the course, the students will be able to

- execute and test the concrete made with cement, aggregates and admixtures.
- describe the properties and durability of hardened concrete.
- execute mix proportioning of concrete and describe how the strength of concrete can be modified by changing the proportions..
- use suitable concrete for different structures considering the prevailing weathering conditions.
- decide the correct concreting methods in the field depending upon the requirement and site conditions.

REFERENCES

1. Shetty.M.S., "Concrete Technology: Theory and Practice" ,S. Chand and Co. Pvt Ltd, Delhi, 2005
2. Santhakumar A.R., "Concrete Technology", Oxford University Press India, 2006.
3. Neville A.M., "Properties of Concrete ", Prentice Hall,5th Edition 2012.
4. Piett-Claude Aitcin, "High Performance Concrete", Talyor& Francis, 2011.
5. IS: 10262-2009, Indian Standard " Concrete Mix Proprotioning- Guide Lines" (First Revision)
6. Charts from ACI211.1-91-1991-American Standard Practice for normal, heavy weight and mass concrete, ACI Committee211.

CO PO MAPPING:

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Cos	**Programme Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	-	-	-	2	2	-	-	-	-	2	-	2
CO2	3	-	-	-	-	2	2	-	-	-	-	2	-	2
CO3	3	-	-	-	-	2	2	-	-	-	-	2	-	2
CO4	3	-	-	-	-	2	2	-	-	-	-	2	-	2
CO5	3	-	-	-	-	2	2	-	-	-	-	2	-	2

PSE19153 THEORY OF STRUCTURAL STABILITY 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the basic concepts and approximate methods of stability.
- study the stability of columns using theoretical and numerical methods.
- enumerate the lateral buckling, lateral torsional buckling and flexural torsional buckling of beams.
- study various numerical techniques and energy methods for buckling of thin plates.
- get accustomed to beam column joint behaviour and that of frames.

Prerequisite: Nil

UNIT I BUCKLING OF COLUMNS 9

States of equilibrium - Classification of buckling problems, concept of equilibrium, energy, imperfection and vibration approaches to stability analysis; Eigen value problem - Governing equation for columns; Analysis for various boundary conditions - using Equilibrium; Energy methods; Approximate methods - Rayleigh Ritz, Galerkins approach; Numerical Techniques - Finite difference Method, Effect of shear on buckling.

UNIT II BUCKLING OF BEAM-COLUMNS AND FRAMES 9

Theory of beam column - Stability analysis of beam column with single and several concentrated loads, distributed load and end couples; Analysis of rigid jointed frames with and without sway; Use of stability function to determine the critical load.

UNIT III TORSIONAL AND LATERAL BUCKLING 9

Torsional buckling - Combined Torsional and flexural buckling, Local buckling; Buckling of Open Sections; Numerical solutions - Lateral buckling of beams, pure bending of simply supported and cantilever beams.

UNIT IV BUCKLING OF PLATES 9

Governing differential equation - Buckling of thin plates, various edge conditions; Analysis by equilibrium and energy approach - Finite difference method.

UNIT V INELASTIC BUCKLING 9

Double modulus theory - Tangent modulus theory, Shanley's model; Eccentrically loaded inelastic Column; Inelastic buckling of plates - Post buckling behaviour of plates.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon the completion of this course the students will be able to

- analyze both static and dynamic instabilities by both theoretical and numerical methods.
- execute and work out the stability of columns and its buckling variations.
- be well versed in the lateral buckling, torsional buckling, flexural torsional buckling of various beams and non - circular sections.

- evaluate buckling of thin plates using energy methods and various numerical techniques.
- examine the behaviour of beam columns and frames with and without side sway using classical and stiffness methods.

REFERENCES

1. Timoshenko, S., and Gere., "Theory of Elastic Stability", McGraw Hill Book Company, 2012.
2. Gambhir, "Stability Analysis and Design of Structures", Springer, New York , 2004.
3. Ashwini Kumar, "Stability of Structures", Allied Publishers LTD, New Delhi, 2003
4. Iyenger.N.G.R., "Structural Stability of Columns and Plates", Affiliated East West Press,1988.

CO PO MAPPING:

Mapping of course objectives with Programme Outcomes: (1/2/3 indicates strength of correlation) 3- strong,2-Medium, 1-Weak														
Cos	**Programme Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	-	-	-	2	2	-	-	-	-	-	-	2
CO2	3	2	-	-	-	2	2	-	-	-	-	-	-	2
CO3	3	2	-	-	-	2	2	-	-	-	-	-	-	2
CO4	3	2	-	-	-	2	2	-	-	-	-	-	-	2
CO5	3	2	-	-	-	2	2	-	-	-	-	-	-	2

PMA19151 ADVANCED MATHEMATICAL METHODS 3 0 0 3

COURSE OBJECTIVES

To enable the students to,

- analyze the treatment involved in solving differential equations by means of Laplace transformation.
- study the significance of the distribution of heat, signals and frequency.
- familiarize with single and multi-dimensional problems of variation calculus
- discuss about the suitable transformation of a function in a particular plane to another plane.
- expose the mathematical applications of vectors and tensor analysis to handle diverse problems.

Prerequisite: Nil

UNIT I LAPLACE TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS 9

Laplace transform, Definitions, properties - Transform of some simple function, Transform of error function, Dirac Delta function, Unit Step functions - Convolution theorem, Inverse Laplace Transform, Complex inversion formula, Solutions to partial differential equations; Heat equation - Wave equation.

UNIT II FOURIER TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS 9

Fourier transform: Definitions, properties - Transform of elementary functions, Dirac Delta function; Convolution theorem - Parseval's identity; Solutions to partial differential equations - Heat equation, Wave equation, Laplace and Poisson equations.

UNIT III CALCULUS OF VARIATIONS 9

Concept of variation and its properties - Euler's equation, Functional dependent on first and higher order derivatives, Functional's dependent on functions of several independent variables; Variational problems with moving boundaries - Problems with constraints; Direct methods - Ritz and Galerkin methods.

UNIT IV CONFORMAL MAPPING AND APPLICATIONS 9

Introduction to analytic functions - conformal mappings and bilinear transformations; Schwarz Christoffel transformation; Transformation of boundaries in parametric form - Physical applications , Fluid flow and heat flow problems.

UNIT V TENSOR ANALYSIS 9

Summation convention - Contravariant and covaraiant vectors, Contraction of tensors, Inner product - Quotient law, Metric tensor; Chrirstoffel symbols - Covariant differentiation, Gradient, divergence and curl.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon the completion of this course the students will be able to

- solve the differential equations using Laplace Transform by applying its boundary conditions

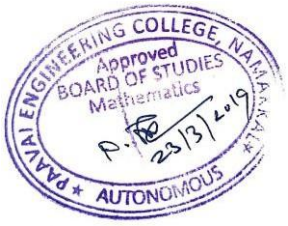
- gain knowledge in fourier transform techniques in distribution of heat and signal processing.
- understand the concepts of solving a variational problem using the Euler equation.
- solve fluid flow and heat flow problems using conformal mapping.
- apply the physical applications and simplifications of tensors.

REFERENCES

1. Larry C. Andrews, Bhimsen K. Shivamoggi, "Integral Transforms for Engineers", SPIE Optical Engineering press, Washington USA (1999).
2. Gupta, A.S., "Calculus of Variations with Applications", Prentice Hall of India Pvt. Ltd., New Delhi, 1997.
3. James, G., "Advanced Modern Engineering Mathematics", 3rd Edition, Pearson Education, 2004.
4. Ramaniah.G. "Tensor Analysis", S.Viswanathan Pvt. Ltd., 1990.
5. SankaraRao, K., "Introduction to Partial Differential Equations", Prentice Hall of India Pvt. Ltd., New Delhi, 1997.
6. Spiegel, M.R., "Theory and Problems of Complex Variables and its Application (Schaum"s Outline Series)", McGraw Hill Book Co., 1981.
7. Lev D. Elsgolc., "Calculus of Variations" , Courier Corporation, 2012.
8. E. B. Saff, Arthur David Snider., "Fundamentals of Complex Analysis with Applications to Engineering and Science" , Prentice Hall, 2003.

CO PO MAPPING:

Mapping of course objectives with Programme Outcomes: (1/2/3 indicates strength of correlation) 3- strong,2-Medium, 1-Weak														
Cos	**Programme Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	3	2	2	-	-	-	-	-	-	-	1	3	2
CO2	3	3	2	1	-	-	-	-	-	-	-	1	3	2
CO3	3	2	3	2	-	-	-	-	-	-	-	1	3	2
CO4	3	2	2	2	-	-	-	-	-	-	-	1	3	2
CO5	3	3	2	2	-	-	-	-	-	-	-	1	3	2



ELECTIVE II

PSE19251 STRUCTURAL HEALTH MONITORING 3 0 0 3

COURSE OBJECTIVES

To enable the students to,

- learn the fundamentals of structural health monitoring
- study the various vibration-based techniques for structural health monitoring
- make the students to be familiar with static field testing
- understand the classification of dynamic field testing
- know the materials and techniques used for repair of structures.

Prerequisite: Nil

UNIT I INTRODUCTION TO STRUCTURAL HEALTH MONITORING 9

Definition of structural health monitoring (SHM) - Motivation for SHM, SHM as a way of making materials and structures smart, factors affecting health of structures, causes of distress; Regular maintenance - concepts ,various measures, structural safety in alteration.

UNIT II VIBRATION-BASED TECHNIQUES 9

Basic vibration concepts for SHM - Local and global methods, Damage diagnosis as an inverse problem; model - based damage assessment; mathematical description of structural systems with damage - assessment of health of structures, collapse and investigation, investigation management, SHM procedures.

UNIT III STATIC FIELD TESTING 9

Types of static tests - simulation and loading methods, sensor systems and hardware requirements, static response measurement.

UNIT IV DYNAMIC FIELD TESTING 9

Types of dynamic field test - stress history data, dynamic response methods, hardware for remote data Acquisition systems; remote structural health monitoring.

UNIT V REPAIRS AND REHABILITATIONS OF STRUCTURES 9

Case studies (Site visit) - piezo-electric materials and other smart materials; electro- mechanical impedance (EMI) technique - adaptations of EMI technique.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon the completion of this course, the students will be able to

- understood the fundamentals of maintenance and repair strategies.
- decide the basic concepts of structural health monitoring.
- assess the health of structure using static field methods.
- use an appropriate remote health monitoring technique.
- suggest repairs and rehabilitation measures of the structures.

REFERENCES

1. Daniel Balageas, Claus-Peter Fritzen, Alfredo Güemes, Structural Health Monitoring, Wiley ISTE, 2006.
2. Douglas E Adams, Health Monitoring of Structural Materials and Components-Methods with Applications, John Wiley and Sons, 2007.
3. J.P. Ou, H.Li and Z.D. Duan, Structural Health Monitoring and Intelligent Infrastructure, Vol-1, Taylor and Francis Group, London, U.K, 2006.
4. Victor Giurglutiu, Structural Health Monitoring with Wafer Active Sensors, Academic Press Inc, 2007.

CO PO MAPPING:

Mapping of course objectives with Programme Outcomes: (1/2/3 indicates strength of correlation) 3- strong,2-Medium, 1-Weak														
Cos	**Programme Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	-	-	-	2	2	-	-	-	-	1	-	2
CO2	3	2	-	-	-	2	2	-	-	-	-	1	-	2
CO3	3	2	-	-	-	2	2	-	-	-	-	1	-	2
CO4	3	2	-	-	-	2	2	-	-	-	-	1	-	2
CO5	3	2	-	-	-	2	2	-	-	-	-	1	-	2

PSE19252 SMART STRUCTURES AND SMART MATERIALS 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- know about the smart materials
- understand the measuring techniques
- know about the different sensors
- understand the actuator techniques
- know various signal processing & control system

Prerequisite: Nil

UNIT I INTRODUCTION 9

Introduction to Smart materials and Structures - Instrumented structures functions and response; Sensing systems - Self-diagnosis; Signal processing consideration - Actuation systems and effectors.

UNIT II MEASURING TECHNIQUES 9

Strain Measuring Techniques using Electrical strain gauges - Types, Resistance, Capacitance, Inductance; Wheatstone bridges - Pressure transducers, Load cells, Temperature Compensation, Strain Rosettes.

UNIT III SENSORS 9

Sensing Technology - Types of Sensors, Physical Measurement using Piezo Electric Strain measurement, Inductively Read Transducers; The LVOT - Fiber optic Techniques; Chemical and Bio-Chemical sensing in structural Assessment - Absorptive chemical sensors, Spectroscopes, Fibre Optic Chemical Sensing Systems and Distributed measurement.

UNIT IV ACTUATORS 9

Actuator Techniques - Actuator and actuator materials, Piezoelectric and Electrostrictive Material; Magneto structure Material - Shape Memory Alloys, Electro orheological Fluids, Electro magnetic actuation, Role of actuators and Actuator Materials.

UNIT V SIGNAL PROCESSING AND CONTROL SYSTEMS 9

Data Acquisition and Processing - Signal Processing and Control for Smart Structures; Sensors as Geometrical Processors; Signal Processing - Control System, Linear and Non – Linear.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon the completion of this course, the students will be able to

- gain knowledge on the basics of smart materials
- know the applications of strain gauges
- know the applications of LVOT
- know the applications of actuators
- understand the various signal processing & control system

REFERENCES

1. Brain Culshaw – Smart Structure and Materials Artech House – Borton. London-1996.
2. L. S. Srinath – Experimental Stress Analysis – Tata McGraw-Hill, 1998.
3. J. W. Dally & W. F. Riley – Experimental Stress Analysis – Tata McGraw-Hill, 1998.

CO PO MAPPING:

Mapping of course objectives with Programme Outcomes: (1/2/3 indicates strength of correlation) 3- strong,2-Medium, 1-Weak														
Cos	**Programme Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	-	-	1	2	2	-	-	-	-	2	-	2
CO2	3	-	-	-	1	2	2	-	-	-	-	2	-	2
CO3	3	-	-	-	1	2	2	-	-	-	-	2	-	2
CO4	3	-	-	-	1	2	2	-	-	-	-	2	-	2
CO5	3	-	-	-	1	2	2	-	-	-	-	2	-	2

PSE19253 PREFABRICATED STRUCTURES 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- impart the basic knowledge about prefabrication
- familiar with prefabricated components
- acquire the basic concepts design principles of prefabrication
- update their knowledge about joints in structural members
- design the prefabricated components for abnormal loads.

Prerequisite: Nil

UNIT I INTRODUCTION 9

Types of prefabrication, prefabrication systems and structural schemes, Need for prefabrication, Principles, Materials; Disuniting of structures; Handling and erection - Elimination of erection stresses

UNIT II PREFABRICATED COMPONENTS 9

Production - Transportation and erection, Shuttering and mould design, Dimensional tolerances; Erection of R.C. Structures; Total prefabricated buildings - Structural behaviour of precast structures; Large panel constructions - Construction of roof and floor slabs; Wall panels; Columns; Shear walls.

UNIT III DESIGN PRINCIPLES 9

Design of cross section based on efficiency of material used - Problems in design; joint flexibility - Allowance for joint deformation; Design of construction and expansion joints.

UNIT IV STRUCTURAL MEMBERS 9

Designing and detailing of prefabricated units - industrial structures, Multi-storey buildings; Water tanks - Dimensioning and detailing of joints for different structural connections.

UNIT V DESIGN FOR ABNORMAL LOADS 9

Progressive collapse - Codal provisions, Equivalent design loads for considering abnormal effects such as earthquakes, cyclones - Importance of avoidance of progressive collapse.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon the completion of this course, the students will be able to

- have the basic knowledge about prefabrication
- familiarity with prefabricated components
- get the basic concepts design principles of prefabrication
- update their knowledge about joints in structural members
- design the prefabricated components for abnormal loads.

REFERENCES

1. Precast Concrete Structures, Precast Concrete Structures, Second Edition by Kim S. Elliott, CRS Publishers, 2016
2. Gerostiza C.Z., Hendrikson C. and Rehat D.R., "Knowledge based process planning forconstruction and manufacturing", Academic Press Inc., 2012.
3. Donald Watson and Michael J.Crosbie, "Time Saver Standards for Architectural Design",8th Edition, Tata McGraw Hill Edition, 2011
4. Walter Martin Hosack, "Land Development Calculations", McGraw Hill 2nd Edition, USA 2010.
5. Development Control Rules for Chennai Metropolitan Area, CMA, Chennai, 2004.
6. IS 15916:2011 - Building Design And Erection Using prefabricated Concrete.
7. IS 11447: 1985 - Code of practice for construction with large panel prefabricates.
8. IS 1893: 2002 (Part - I)- Criteria for Earthquake Resistant Design of Structures - General.
9. IS 13920: 1993 - Ductile detailing of Reinforced Concrete Structures.

CO PO MAPPING:

Mapping of course objectives with Programme Outcomes: (1/2/3 indicates strength of correlation) 3- strong,2-Medium, 1-Weak														
Cos	**Programme Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	-	-	2	2	2	-	-	-	-	2	-	2
CO2	3	-	-	-	2	2	2	-	-	-	-	2	-	2
CO3	3	-	-	-	-	2	2	-	-	-	-	2	-	2
CO4	3	-	-	-	-	2	2	-	-	-	-	2	-	2
CO5	3	-	-	-	-	2	2	-	-	-	-	2	-	2

PSE19254 EARTHQUAKE RESISTANT DESIGN 3 0 0 3

COURSE OBJECTIVES

To enable the students to,

- know the concepts of single degree freedom
- analyse building for earthquake forces
- explain the design guidelines for earthquake resistant masonry and earthen buildings
- analyse the ductility detailing
- gain knowledge on base isolation techniques

Prerequisite: Nil

UNIT I SINGLE DEGREE OF FREEDOM SYSTEM (SDOF) 9

Introduction to Systems with single degree of freedom - Equation of motion of SDOF and its solution; Analysis of free vibrations damped and undamped; Response to harmonic, impulsive, periodic and general dynamic loading; Analysis SDOF systems with ground motion (earth quake loads)

UNIT II MULTI-DEGREE OF FREEDOM SYSTEM (MDOF) 9

Modeling of shear frames up to two degree of freedom system - Modal analysis for free vibration, Modal analysis for forced vibration with harmonic loading and determination of nodal forces from first principles

UNIT III DESIGN SEISMIC FORCES 9

Codal provisions for design as per IS 1893-2002 - Concept of response spectrum and procedure for constructing the response spectrum, Determination of lateral forces; base shear - by response spectrum method for 2 storey moment resistant frames, Calculation of drift and top storey lateral deflection, Aspects in planning and layout for regular and irregular buildings in plan and elevation; Mass and stiffness irregularity - Calculation of centre of mass and centre of rigidity for simple layouts, Computation of eccentricity and torsion in irregular buildings

UNIT IV DETAILING FOR DUCTILITY 9

Definition of Ductility - General Codal provisions for ductility detailing as per IS :13920-1993, Codal provisions for ductility detailing as per IS :13920-1993 for columns, Codal provisions for ductility detailing as per IS :13920- 1993 for beams, Codal provisions for ductility detailing as per IS :13920-1993 for foundation, Shear wall design and detailing as per IS :13920-1993

UNIT V SPECIAL TOPICS 9

Concept of seismic damage ratings - Repair and Rehabilitation techniques and seismic strengthening, Case studies in repair and rehabilitation; Passive control of vibration using base isolation techniques - Properties of base isolators and modeling procedure of base isolators using SAP and ETABS; Active control of vibration - New and favorable materials to resist seismic forces

TOTAL PERIODS 45

COURSE OUTCOMES

Upon the completion of this course the students will be able to

- describe ground motion and its relationship to seismic design of structures.
- Understand the concept of nodal forces
- calculate earthquake induced lateral force on the structure.
- apply the basic principles of conceptual design for earthquake resistant RC buildings and carry out the detailed design of earthquake resistant RC buildings.
- adopt vibration control methods for buildings located in earthquake zone.

REFERENCES

1. Chopra A K, "Dynamics of Structures - Theory and Applications to Earthquake Engineering", Prentice- Hall of India Pvt. Ltd., New Delhi, 2017.
2. PankajAgarwal and Manish Shrikhande, "Earthquake Resistant Design of Structures, Prentice", Hall of India Pvt. Ltd., New Delhi, 2006.
3. Taranath B S, "Wind and Earthquake Resistant Buildings - Structural Analysis & Design", Marcell Decker, NewYork, 2005.
4. S.K.Duggal, "Earthquake Resistant Design of Structures", Prentice Hall of India, New Delhi, 2013.
5. Chen WF &Scawthorn, "Earthquake Engineering Hand book", CRC Press, 2003.
6. IS:1893 (Part I) - 2002 - Indian Standard Criteria for Earthquake Design of Structures - General Provisions and Buildings.
7. IS:4326 - 1993 - Earthquake Resistant Design and Construction of Buildings - Code of Practice.
8. IS:13920-1993 - Ductile detailing of reinforced concrete structures subjected to seismic forces - Code of Practice.
9. IS:13827-1993 - Improving Earthquake Resistance of Earthen Buildings - Guidelines.
10. IS:13828 - 1993 - Improving Earthquake Resistance of Low Strength Masonry Buildings - Guidelines.

CO PO MAPPING:

Mapping of course objectives with Programme Outcomes: (1/2/3 indicates strength of correlation) 3- strong,2-Medium, 1-Weak														
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	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	-	-	-	-	2	-	-	-	-	2	2	-
CO2	3	2	-	-	-	-	2	-	-	-	-	2	2	-
CO3	3	2	-	-	-	-	2	-	-	-	-	2	2	-
CO4	3	2	-	-	-	-	2	-	-	-	-	2	2	-
CO5	3	2	-	-	2	-	2	-	-	-	-	2	2	-

PEN19171 ENGLISH FOR RESEARCH PAPER WRITING 2 0 0 0

COURSE OBJECTIVES

To enable students to

- To understand how to improve the writing skills and level of readability.
- To learn about what to write in each section and to understand the skills needed to write a title.
- To choose and focus on a topic of interest and to learn how to paraphrase, summarize, using correct attribution and following documentation guidelines.
- To craft a research paper in their discipline.
- To ensure the good quality of paper at first-time submission.

UNIT I PLANNING AND PREPARATION 6

Precision of Words, Breaking up long sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness. Expressing independent thought with grace, clarity and force.

UNIT II STRUCTURE OF A PAPER 6

Details of all the parts - Clarifying Who Did What, Highlighting the Findings, Hedging and Criticizing, Skills to identify something we really need to know some ways to find a topic, to venture out across the swamp of research without losing our bearings; Paraphrasing - Sections of a Paper, Abstract, Introduction. Introduction to Free writing.

UNIT III LITERATURE REVIEWS AND CITATIONS 6

Key skills required to - write a title, an abstract, write an introduction, write the review of the literature, conduct a literature review of all current research in their field. Review of the Literature, Methods, Results, Discussion and Conclusions - citing references correctly and avoiding plagiarism.

UNIT IV EDITING AND ORGANISING SKILLS 6

Skills required to - write the Methods, write the Discussion, write the Results, write Conclusions; write about what we've learned truthfully so the reader really gets it in thought and expression, demonstrating a clear understanding and execution of the research.

UNIT V WRITING STANDARDS 6

Useful phrases, to ensure paper is as good as it could possibly be the first - time submission, first draft, second draft, final draft of research report, journal article, literature review, dissertation chapter, grant proposal, or other relevant document. Avoid -inadequate support of generalizations, slipshod or hurried style, poor attention to detail, straying from directions, mechanical errors, underwritten and/or marred by confused purpose, lack of organization, repetition of ideas, improper use of words, and frequent grammatical, spelling and punctuation errors.

TOTAL PERIODS 30

COURSE OUTCOMES

Upon the completion of the course, students will be able to

- prepare and write a research paper in their discipline.
- be initially organized and well-versed as a researcher, reviewing in detail general versus specific and problem-solution structures.
- understand the basics of citations, avoiding plagiarism and literature reviews.

- culminate the actual crafting and revising of a research paper.
- use suitable vocabulary, grammar and punctuation to write flawless piece of writing.

REFERENCES

1. Goldbort R (2006) Writing for Science, Yale University Press
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book .
4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

CO PO MAPPING:

Mapping of course objectives with Programme Outcomes: (1/2/3 indicates strength of correlation) 3- strong,2-Medium, 1-Weak														
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CO1	-	-	-	-	-	-	2	-	3	2	2	1	-	2
CO2	-	-	-	2	-	-	2	-	3	2	2	1	2	2
CO3	-	-	-	2	-	-	2	-	3	2	2	1	2	2
CO4	-	-	-	-	-	-	2	-	3	2	2	1	1	1
CO5	-	-	-	2	2	-	1	-	3	2	2	2	-	-

SEMESTER II

PSE19201 FINITE ELEMENT METHODS 3 1 0 4

COURSE OBJECTIVES

To enable the students to,

- equip with the finite element analysis fundamentals.
- formulate the boundary value problems into FEA.
- perform engineering simulations using finite element analysis software (ANSYS).
- understand the ethical issues related to the utilization of FEA in the industry. .
- execute the CAD interfaces, joints and connections, non-linear behavior, optimization and analysis to code.

Prerequisite: Nil

UNIT I FORMULATION OF BOUNDARY VALUES 12

Basic steps in finite element anlaysis - Boundary value problems, Approximate solutions, Variational and weighed residual methods, Ritz and Galerkin formulations; Concept of piecewise approximation and finite element; Displacement and shape functions - Weak formulation, Minimum potential Energy, Generation of stiffness matrix and load vector.

UNIT II STRESS ANALYSIS 12

Two dimensional problems - Plane stress, plane strain and axisymmetric problems, Triangular and rectangular elements, Natural coordinates, Computation of stiffness matrix for isoparametric elements; Numerical integration (Gauss quadrature) - Brick elements, Elements for fracture analysis; Introduction to plate bending and shell elements

UNIT III MESHING AND SOLUTION 12

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 DYNAMIC ANALYSIS 12

Introduction - Vibrational problems, Equations of motion based on weak form , Longitudinal vibration of bars, Transverse vibration of beams; Consistent mass matrices - Element equations, Solution of eigenvalue problems; Vector iteration methods - Normal modes, Transient vibrations, Modeling of damping, Direct integration methods

UNIT V PLATE AND SHELL ELEMENTS 12

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 PERIODS 60

COURSE OUTCOMES

Upon the completion of this course, the students will be able to

- develop finite element formulations of single degree of freedom problems and solve them
- use finite element analysis programs based upon either "p-method" or "h-method" finite element mathematical formulations
- use ansys software to perform stress, thermal and modal analysis
- compute the stiffness values of noded elements
- determine its natural frequencies, and analyze harmonically-forced vibrations

REFERENCES

1. S. S. Bhavikatti, "Finite Element Analysis", New Age International Pvt. Ltd., New Delhi,2007.
2. C. S. Krishnamoorthy, "Finite Element Analysis: Theory and Programming", Tata McGraw-Hill, 2008.
3. Zienkiewicz, O.C. and Taylor, R.L., "The Finite Element Method", McGraw - Hill, 2005.
4. Chandrupatla, R.T. and Belegundu, A.D., "Introduction to Finite Elements in Engineering", Prentice Hall of India, 2012.
5. Moaveni, S., "Finite Element Analysis Theory and Application with ANSYS", Prentice Hall Inc., 2003.

CO PO MAPPING:

Mapping of course objectives with Programme Outcomes: (1/2/3 indicates strength of correlation) 3- strong,2-Medium, 1-Weak														
Cos	**Programme Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	-	-	-	2	2	-	-	-	-	-	-	2
CO2	3	2	-	2	-	2	2	-	-	-	-	-	-	2
CO3	3	2	-	-	-	2	2	-	-	-	-	-	-	2
CO4	3	2	-	2	-	2	2	-	-	-	-	-	-	2
CO5	3	2	-	-	-	2	2	-	-	-	-	-	-	2

PSE19202 STRUCTURAL DYNAMICS 3 1 0 4

COURSE OBJECTIVES

To enable the students to,

- understand the response of structural systems to time-varying dynamic loads and displacements.
- apply the behaviour and response of linear and nonlinear two degree of freedom structures with various dynamic loading, analysis with viscous dampers.
- study the behaviour and response of MDOF structures with various dynamic loading.
- determine the behaviour of structures subjected to dynamic loads such as wind, earthquake and blast.
- compute the different dynamic analysis procedures for calculating the response of structures.

Prerequisite: Nil

UNITI PRINCIPLES OF DYNAMICS 12

Vibration and its importance to structural engineering problems - Elements of vibratory systems and simple harmonic motion, Generalized mass, D'Alemberts principle; Mathematical modeling of dynamic systems - Degree of freedom, Equation of motion for S.D.O.F, Damped and undamped free vibrations, Undamped forced vibration, Critical damping; Response to harmonic excitation -Evaluation of damping , resonance, band width method to evaluate damping - Force transmitted to foundation, Vibration isolation.

UNIT II TWO DEGREE OF FREEDOM SYSTEMS 12

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 12

Multidegree of freedom system - undamped free vibrations, Orthogonality relationship; Approximate methods - Holzer, Rayleigh, Rayleigh - Ritz methods; mode superposition technique; Numerical integration procedure - Central Difference, Newmark's method.

UNIT IV DYNAMIC ANALYSIS OF CONTINUOUS SYSTEMS 12

Free and forced vibration of continuous systems - axial vibration of a beam, Flexural vibration of a beam; Rayleigh-Ritz method - Formulation using Conservation of Energy, Formulation using Virtual Work.

UNIT V PRACTICAL APPLICATIONS 12

Idealisation and formulation of mathematical models for wind, earthquake, blast and impact loading; Base Isolation - Principles of analysis, Linear and Non-linear.

TOTAL PERIODS 60

COURSE OUTCOMES

Upon the completion of this course, the students will be able to

- understand the response of structural systems to dynamic loads and displacements.
- realize the response of linear and non-linear TDOF structures with various dynamic loading.
- determine the behaviour and response of MDOF structures with various dynamic loading.
- find suitable solution for continuous system.
- understand the behaviour of structures subjected to dynamic loads such as wind, earthquake and blast

REFERENCES

1. A.K. Chopra, Dynamics of Structures - Theory and Applications of Earthquake Engineering, Pearson Education., 2014.
2. Paz Mario., Structural Dynamics - Theory and Computation, CBS Publication., 5th edition,2006.
3. Manickaselvam ,V.K., "Elementary Structural Dynamics", DhanpatRai& Sons, 2001.
4. MadhujitMukhopadhyay - Structural Dynamics Vibrations and Systems, Ane Books India Publishers, 2010.
5. Shashikant K. Duggal., Earthquake Resistant Design of Structures, Oxford University Press, 2013.

CO PO MAPPING:

Mapping of course objectives with Programme Outcomes: (1/2/3 indicates strength of correlation) 3- strong,2-Medium, 1-Weak														
Cos	**Programme Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	-	-	-	2	2	-	-	-	-	-	-	2
CO2	3	2	-	2	-	2	2	-	-	-	-	-	-	2
CO3	3	2	-	-	-	2	2	-	-	-	-	-	-	2
CO4	3	2	-	2	-	2	2	-	-	-	-	-	-	2
CO5	3	2	-	-	-	2	2	-	-	-	-	-	-	2

PSE19203 STRUCTURAL DESIGN LABORATORY 0 0 4 2

COURSE OBJECTIVES

To enable the students to,

- gain knowledge on fabrication, casting and testing of concrete structures
- know the in-situ strength of structures
- conduct static and dynamic test on frame and beam
- conduct Non Destructive Tests on existing concrete structures.

Prerequisite: Advanced Structural Analysis

LIST OF EXPERIMENTS

1. Fabrication, casting and testing of simply supported reinforced concrete beam for strength and deflection behaviour.
2. Testing of simply supported steel beam for strength and deflection behaviour.
3. Fabrication, casting and testing of reinforced concrete column subjected to concentric and eccentric loading
4. Dynamic testing of cantilever steel beam
    A. To determine the damping coefficients from free vibrations.
    B. To evaluate the mode shapes.
5. Static cyclic testing of single bay two storied steel frames and evaluate
    A. Drift of the frame.
    B. Stiffness of the frame
6. Determination of in-situ strength and quality of concrete using
    A. rebound hammer
    B. Ultrasonic Pulse Velocity Tester

TOTAL PERIODS 60

COURSE OUTCOMES

Upon the completion of this course, the students will be able to

- understand the fabrication, casting and testing of concrete structures
- gain knowledge on finding the in-situ strength of structures
- understand the static and dynamic testing of frame and beam
- test the existing concrete structures by Non Destructive Tests.

CO PO MAPPING:

Mapping of course objectives with Programme Outcomes: (1/2/3 indicates strength of correlation) 3- strong,2-Medium, 1-Weak														
Cos	**Programme Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	-	-	-	2	2	-	3	-	-	2	-	2
CO2	3	-	-	-	-	2	2	-	3	-	-	2	-	2
CO3	3	-	-	-	-	2	2	-	3	-	-	2	-	2
CO4	3	-	-	-	-	2	2	-	3	-	-	2	-	2
CO5	3	-	-	-	-	2	2	-	3	-	-	2	-	2

PSE19204 **MINI PROJECT** **0 0 4 2**

COURSE OBJECTIVES

To enable the students to,

- work on a specific technical topic in Structural Engineering & to acquire writing abilities for seminars and conferences
- identify structural Engineering problems by reviewing literature

Prerequisite: Nil

SYLLABUS CONTENT

Mini project will have mid & end semester presentation. Mid semester presentation willinclude identification of the problem based on literature review on the topic referring to latest literature available. End semester presentation should be done along with the report on identification of the topic for the work & the methodology adopted involving scientific research, collection & analysis of data determining solutions highlighting individual's contribution. Continuous assessment of mini project at mid semester& end semester will be monitored by the departmental committee.

Similarly, the students will have to present a mini project presentation of not less than fifteen minutes and not more than thirty minutes on their respective topic. A brief copy of their presentation also should be submitted. They will defend their presentation. Evaluation will be based on the technical presentation with the report.

TOTAL PERIODS 60

COURSE OUTCOMES

Upon the completion of this course, the students will be able to

- trained to face an audience and to tackle any problem during group discussion in the Interviews.
- study different techniques to analyze the problem & present solution by using his/her technique applying Engineering principles.

CO PO MAPPING:

Mapping of course objectives with Programme Outcomes: (1/2/3 indicates strength of correlation) 3- strong,2-Medium, 1-Weak														
Cos	**Programme Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	-	-	-	-	2	2	-	3	-	-	2	-	2
CO2	3	-	-	-	-	2	2	-	3	-	-	2	-	2

ELECTIVE III

PSE19351 ADVANCED STEEL DESIGN 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- understand the concepts of limit state design, working stress design and design philosophies of tension and compression members.
- study the various connections (welded and riveted), seated connections (Unstiffened and Stiffened connections) and to design them.
- design the components of industrial building elements
- study the plastic analysis of steel structures.
- design concepts of light gauge steel structures.

Prerequisite: Nil

UNIT I DESIGN METHODOLOGIES 9

Concept of design methodologies - Philosophies of Limit State Design, Working stress design, LRFD; Tension members - Introduction, net sectional area for concentrically and eccentrically loaded members, tension splices, bending of tension members, stress concentrations; Compression members - Introduction, practical end conditions and effective length factors, elastic compression members, restrained compression members, torsional buckling, built up compression members with lacings and battens, column splices.

UNIT II STRUCTURAL CONNECTIONS 9

Design of high strength function grip bolts - Design of riveted and bolted connections at the junctions of beams and columns in frames, Design of un-stiffened and stiffened seat connections; Welded connections - eccentric connections, Beam end connections, Direct web fillet welded connections, Direct web Butt welded connection, Double plate web connection, Double angle web connection, Un-stiffened and stiffened seat connection; Moment resistant connection - Behaviour of welded connections, problems

UNIT III INDUSTRIAL BUILDINGS 9

Loads on structures - Roof trusses, Roof and side coverings; Design of truss elements - Design of purlins, louver Rails, gable column, gable wind girder and end bracings of industrial buildings; Analysis and Design of gable frame.

UNIT IV PLASTIC ANALYSIS OF STRUCTURES 9

Introduction - shape factor; Moment redistribution - combined mechanisms; Analysis of portal frames - Effect of axial force, Effect of shear force on plastic moment; Connections – requirement, Moment resisting connections, Design of straight corner connections, Haunched connections; Design of continuous beams.

UNIT V DESIGN OF LIGHT GAUGE STEEL STRUCTURES 9

Cold formed light gauge section - Type of cross sections; stiffened - multiple stiffened and unstiffened element, flat width ratio, effective design width; Design of light gauge compression member - Effective width for load and deflection determination; Design of tension members; Design of flexural members - Shear lag, Flange curling.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon the completion of this course, the students will be able to

- design various tension and compression members.
- learn different types of steel connections and joints.
- understand the design of purlin, gable column and gable wind girder
- apply the knowledge of plastic analysis in steel design
- applicationof design of light gauge steel structures in Civil Engineering field.

REFERENCES

1. Subramanian N., "Design of Steel Structures", Oxford University Press, New Delhi, 2011.
2. Dayaratnam P., "Design of Steel Structures", 3rd Edition, S. Chand & Company, New Delhi, 2013.
3. L.S.Jayagopal, D.Tensing, "Design of Steel Structures", Vikas Publishing, 2015.
4. Bhavikatti.S.S "Design of Steel Structures by Limit State Method", International Publishing House Pvt. Ltd, 2012
5. Wie Wen Yu, "Design of Cold Formed Steel Structures" ,McGraw-Hill Book Company, New York, 2010.
6. IS: 800-2007 - Indian Standard Code of Practice for general construction in steel (Limit State).
7. IS:801-1975 - Code of practice for use of cold formed light gauge steel structural members in general building construction
8. IS: 811 -1987 - Cold formed light gauge structural steel sections.

CO PO MAPPING:

Mapping of course objectives with Programme Outcomes: (1/2/3 indicates strength of correlation) 3- strong,2-Medium, 1-Weak														
Cos	**Programme Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	-	-	-	2	2	-	-	-	-	-	-	2
CO2	3	2	-	2	-	2	2	-	-	-	-	-	-	2
CO3	3	2	-	2	-	2	2	-	-	-	-	-	-	2
CO4	3	2	-	-	-	2	2	-	-	-	-	-	-	2
CO5	3	2	-	-	-	2	2	-	-	-	-	-	-	2

PSE19352 **DESIGN OF FORMWORK** **3 0 0 3**

COURSE OBJECTIVES

To enable students to,

- select proper formwork, accessories and material.
- analyze the formwork for beams, slabs, columns, walls and foundations
- understandthe formwork design for special structures.
- manage the working of flying formwork.
- judge the formwork failures through case studies.

Prerequisite: Nil

UNIT I INTRODUCTION **9**

Requirements and Selection, Formwork materials - Timber, Plywood, Steel, Aluminum, Plastic and Accessories; Horizontal and Vertical Formwork supports.

UNIT II FORMWORK DESIGN **9**

Design Concepts - Formwork Systems and Design for Foundations, Walls, Columns, Slab and Beams.

UNIT III FORMWORK DESIGN FOR SPECIAL STRUCTURES **9**

Design and Details of Special Structures - Shells, Domes, Folded Plates, Overhead Water Tanks, Natural Draft Cooling Tower, Bridges.

UNIT IV FLYING FORMWORK **9**

Table Form, Tunnel Form, Slip Form - Formwork for Precast Concrete, Formwork Management Issues - Pre and Post Award.

UNIT V FORMWORK FAILURES **9**

Causes - Case studies in Formwork Failure, Formwork Issues in Single and Multi - Story Building Construction.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon the completion of the course, students will be able to

- evauate proper formwork, accessories and material.
- design the formwork for beams, slabs, columns, walls and foundations
- understoodthe formwork for special structures.
- rectify the formwork management issues.
- solve the formwork failures through case studies.

REFERENCES

1. Robert I. PeurifoyGarold D. Oberlender “Formwork for Concrete structures”Mc Graw Hill India, 2010.
2. Formwork for Concrete Structurs, Kumar Neerajha, Tata McGraw Hill Education, 2012.

3. IS 14687:1999, False work for Concrete Structures - Guidelines, BIS.
4. IRC 87 - 2011- Guidelines on formwork, false work and temporary structures

CO PO MAPPING:

Mapping of course objectives with Programme Outcomes: (1/2/3 indicates strength of correlation) 3- strong,2-Medium, 1-Weak														
Cos	**Programme Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	-	-	-	2	2	-	-	-	-	2	-	2
CO2	3	2	-	-	-	2	2	-	-	-	-	2	-	2
CO3	3	2	-	-	-	2	2	-	-	-	-	2	-	2
CO4	3	2	-	-	-	2	2	-	-	-	-	2	-	2
CO5	3	2	-	-	-	2	2	-	-	-	-	2	-	2

PSE19353 DESIGN OF HIGH RISE STRUCTURES 3 0 0 3

COURSE OBJECTIVES

To enable the students to,

- introduce the loading condition on high rise buildings
- gain knowledge on power transmission structures
- gain on power plant structures
- explain the design of foundation for towers
- familiar with analysis and design of high rise buildings

Prerequisite: Nil

UNIT I LOADING OF HIGH RISE BUILDINGS 9

Loading- sequential loading, Gravity loading, Wind loading, Earthquake loading, - Equivalent lateral force, modal analysis, combination of loading; Static and Dynamic approach - Analytical and wind tunnel experimental methods; Design philosophy - working stress method, limit state method and plastic design.

UNIT II POWER TRANSMISSION STRUCTURES 9

Cables -Transmission line towers, Substation Structures; Tower foundations - Testing towers.

UNIT III POWER PLANT STRUCTURES 9

Chimneys and Cooling Towers - High pressure boilers and piping design; Nuclear containment structures

UNIT IV FOUNDATION 9

Design of foundation for Towers, Chimneys and Cooling Towers; Machine Foundation - Design of Turbo Generator Foundation.

UNIT V ANALYSIS AND DESIGN OF HIGH RISE BUILDINGS 9

Modeling for analysis – Assumptions, Modeling for approximate analyses, Modeling for accurate analysis; Reduction techniques - Dynamic analysis, Response to wind loading, Along - wind response; Across - wind response, Estimation of natural frequencies and damping, Types of excitation; Design to minimise dynamic response - Response to earthquake motions, Response to ground accelerations, Response spectrum analysis, Estimation of natural frequencies and damping, Human response to building motions.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon the completion of the course, the students will be able to

- utilize the design concept for various structures subjected to wind
- be efficient in design of transmission line towers.
- analyse and design chimneys as per codal provisions.
- be familiar with all types of machine foundations.
- describe the various structural systems used in the construction of tall structures

REFERENCES

1. Rolf Katzenbach, Steffen Leppla, et al.., "Foundation systems for High rise structures", CRC Press, 2016.
2. Gupta.Y.P.,(Editor), Proceedings of National Seminar on High Rise Structures- Design and Construction Practices for Middle Level Cities, New Age International Limited, New Delhi,2015.
3. Taranath B.S., "Structural Analysis and Design of Tall Buildings", McGrawHill, 2011.
4. Santhakumar, A.R. and Murthy, S.S., "Transmission Line Structures", Tata McGraw Hill 2011.
5. IS 6060 -1971 - Code of practice for Day lighting of factory buildings
6. IS 3103 -1975- Code of practice for industrial ventilation
7. IS 3483 -1965 - Code of practice for Noise reduction in industrial buildings
8. IS 6533 (Part 1 & Part 2) -1989 - Code of practice for design and construction of steel chimneys
9. IS:875 (Part 1 to 5) - Code of Practice for Design loads
10. IS:802-1977(Part 2) - Code of practice for use of structural steel in Over Head transmission line towers
11. IS:4091-1979 - Code of Practice for Design and Construction of Foundations for Transmission Line Towers and Poles

CO PO MAPPING:

Mapping of course objectives with Programme Outcomes: (1/2/3 indicates strength of correlation) 3- strong,2-Medium, 1-Weak														
Cos	**Programme Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	-	-	-	2	2	-	-	-	-	2	-	2
CO2	3	2	-	-	-	2	2	-	-	-	-	2	-	2
CO3	3	2	-	-	-	2	2	-	-	-	-	2	-	2
CO4	3	2	-	-	-	2	2	-	-	-	-	2	-	2
CO5	3	2	-	-	-	2	2	-	-	-	-	2	-	2

PSE19354 NON LINEAR ANALYSIS OF STRUCTURES 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- read the concept of nonlinear behaviour of beams and vibrations of beams.
- understand the elastic analysis of statically determinate and indeterminate flexural members.
- differentiate the inelastic analysis of statically determinate and indeterminate flexural members.
- evaluate the nonlinear analysis of plates and its governing equation.
- know the governing equation of circular and non-circular shells.

Prerequisite: Nil

UNIT I NONLINEAR BENDING AND VIBRATION OF BEAMS 9

Introduction - Types of nonlinearities, Nonlinear governing equation for beams, Geometrically nonlinear beam problems; Vibrations of beams with various boundary conditions - Forced vibration of beams; Post buckling cantilever column - Behaviour of beams with material nonlinearity; Nonlinear vibration and instabilities of elastically supported beams.

UNIT II ELASTIC ANALYSIS OF FLEXURAL MEMBERS 9

Flexural behaviour - Statically determinate and statically, Indeterminate bars, Uniform and varying thickness.

UNIT III INELASTIC ANALYSIS OF FLEXURAL MEMBERS 9

Inelastic analysis of uniform and variable thickness members subjected to small deformations - Inelastic analysis of flexible bars of uniform and variable stiffness, Members with and without axial restraints.

UNIT IV NONLINEAR STATIC AND DYNAMIC ANALYSIS OF PLATES 9

Introduction - Governing nonlinear equations for plates, Boundary conditions and methods of solutions; Large deflection analysis of rectangular and non-rectangular plates - Free and forced vibrations of rectangular and non-rectangular plates; Post buckling behaviour of plates - Effects of transverse shear deformations and material nonlinearity; Introduction - Derivations of governing equations, Circular and noncircular cylindrical shells, Shallow cylindrical shell, Forced nonlinear vibration of shells, Post buckling of shells.

UNIT V NONLINEAR ANALYSIS OF SHELLS 9

Introduction - Derivations of governing equations, Circular and noncircular cylindrical shells, Shallow cylindrical shells, Forced nonlinear vibration of shells, Post buckling of shells.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon the completion of this course, the students will be able to

- basic concepts of nonlinearity and its governing equation for various boundary conditions.
- categorize the elastic analysis with various boundary conditionsof thin walled structural members

- compare the inelastic analysis with various boundary conditions of thin walled structural members
- justify static and dynamic analysis of plates.
- express nonlinear analysis of shells.

REFERENCES

1. Reddy.J.N, "Non linear Finite Element Analysis", Oxford University Press,2008.
2. Sathyamoorthy, M.,"Nonlinear Analysis of Structures", CRC Press, Boca Raton, Florida, 1997
3. Fertis, D. G.,"Nonlinear Mechanics", CRC Press, Boca Raton, Florida, 1998.
4. Majid K.I., "Non Linear Structures", Butter worth Publishers, London, 1972.
5. Iyengar N G R, "Elastic Stability of Structural elements", Macmillan India Ltd ,2007.
6. IS 1905 -1987-Code of Practice for Structural Use of Unreinforced Masonry.

CO PO MAPPING:

Mapping of course objectives with Programme Outcomes: (1/2/3 indicates strength of correlation) 3- strong,2-Medium, 1-Weak														
Cos	**Programme Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	-	-	-	2	2	-	-	-	-	2	-	2
CO2	3	2	-	-	-	2	2	-	-	-	-	2	-	2
CO3	3	2	-	-	-	2	2	-	-	-	-	2	-	2
CO4	3	2	-	-	-	2	2	-	-	-	-	2	-	2
CO5	3	2	-	-	-	2	2	-	-	-	-	2	-	2

ELECTIVE IV

PSE19451 DESIGN OF ADVANCED CONCRETE STRUCTURES 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- interpret ultimate and serviceability limit state approaches in current structural design philosophy.
- design deep beams corbels and shear walls.
- estimate design loads on structural elements such as flat slabs and spandrel beams consulting appropriate standards.
- gain knowledge on plastic design of reinforced concrete structures.
- design and prepare detail structural drawings for execution citing relevant IS codes.

Prerequisite: Nil

UNIT I DESIGN PHILOSOPHY 9

Review of limit state design of beams, slabs and columns as per IS Code - Modeling of Loads, Material Characteristics.

UNIT II DESIGN OF RC DEEP BEAMS CORBELS AND SHEAR WALLS 9

Strut and tie method of analysis for corbels and deep beams - Design of corbels, deep beams; Design of Shear Walls - Compression Field Theory for Shear Design; Design against Torsion as per IS Code.

UNIT III DESIGN OF FLAT SLABS AND YIELD LINE THEORY 9

Design of Column Supported Slabs (with/without Beams) under Gravity Loads - Direct design method, Equivalent frame method, Shear in Column, Supported two- way slabs; Design of spandrel beams; Yield line theory and Hillerborg's strip method of design of slabs.

UNIT IV PLASTIC DESIGN OF RC STRUCTURES 9

Limit analysis - Moment redistribution, Codal recommendations for Moment redistribution; Baker's method of plastic design - Design of cast - in-situ joints in frames.

UNIT V DETAILING AND FIELD PRACTICE 9

Detailing for ductility - Measures of ductility, Flexural yielding in frames and walls, Flexural members in ductile frames, Columns and frame members subject to bending and axial load; Joints in ductile frames - Fire resistance of structural members, Code requirements, Quality control of concrete.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon the completion of this course the students will be able to

- understand and analyze the behaviour of reinforced concrete subjected to flexure, shear and axial loading.
- identify underlying plastic concepts in modern concrete design methods
- design reinforced concrete beams, slabs and columns in accordance to IS Code.

- enumerate the concept of reinforced concrete, using moment redistribution and Baker's method.
- produce design calculations and drawings in appropriate professional formats.

REFERENCES

1. Unni Krishna Pillai and DevdasMenon "Reinforced concrete Design", Tata McGraw Hill Publishing co Ltd, 2016
2. Varghese, P.C., "Limit State Design of Reinforced Concrete", Prentice Hall of India, 2007
3. Varghese, P.C, "Advanced Reinforced Concrete Design", Prentice Hall of India, 2009
4. B.C.Punmia, Ashok kumarjain, Arun Kumar Jain, "Limit state design of Reinforced Concrete", LaxmiPublicatiions (P) Ltd, New Delhi, 2007
5. Krishnaraju, N. 'Advanced Reinforced Concrete Design', CBS Publishers and Distributors, Delhi,2013

CO PO MAPPING:

Mapping of course objectives with Programme Outcomes: (1/2/3 indicates strength of correlation) 3- strong,2-Medium, 1-Weak														
Cos	**Programme Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	-	2	-	2	2	-	-	-	-	-	-	2
CO2	3	2	-	2	-	2	2	-	-	-	-	-	-	2
CO3	3	2	-	2	-	2	2	-	-	-	-	-	-	2
CO4	3	2	-	2	-	2	2	-	-	-	-	-	-	2
CO5	3	2	-	2	-	2	2	-	-	-	-	-	-	2

PSE19452 DESIGN OF SUB STRUCTURES 3 0 0 3

COURSE OBJECTIVES

To enable the students to

- assess the soil condition at a given location in order to suggest suitable foundation based upon bearing capacity.
- compose the design of different type of shallow foundations like isolated, raft and combined footing
- familiarise with the design of pile foundation and pile caps.
- outline the design of well and caissons foundations.
- categorize various types of design of tower foundations

Prerequisite: Nil

UNIT I SITE INVESTIGATION, SELECTION OF FOUNDATION AND BEARING CAPACITY 9

Objectives - Methods of exploration, Depth of exploration, Sample disturbance, Factors governing location and depth of foundation, In situ testing of Soils, Plate load test; Geophysical methods - Selection of foundation Bearing capacity of shallow foundations by Terzaghi's theory, Meyerhof's theory, and codal provisions, Bearing capacity of footing subjected to inclined and eccentric loading, Problems; Types of shear failure - General principles of foundation design, Foundations on expansive soil.

UNIT II DESIGN OF SHALLOW FOUNDATIONS 9

Types of shallow foundations - General principles of design of reinforced concrete shallow foundations; Structural design of isolated and combined footing - Structural design of rafts by conventional method, Principles of design of buoyancy raft and basement (no design problems).

UNIT III PILE FOUNDATION 9

Pile foundations – Types, General principles of design, Estimation of load capacity of piles by staticand dynamic formulae; Detailing of reinforcement as per IS 2911; Design of Piles and Pile caps , Settlement analysis of pile groups, Negative skin friction, Pile load tests.

UNIT IV 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 V FOUNDATIONS OF TRANSMISSION LINE TOWERS 9

Introduction - Necessary information, Forces on tower foundations, General design criteria, Choiceand type of foundation, Design procedure, Types of Foundations; Design of foundation for transmission towers.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon the completion of this course, the students will be able to

- decide the suitability of soil exploration methods for different projects.
- design shallow foundation & calculate settlement for different soil strata.
- analyze and design pile foundation.
- understand the construction procedure& design of coffer dams and well foundation.
- perceive knowledge on sheet pile design.

REFERENCES

1. Winterkorn. H. F., and Fang, H. Y., "Foundation Engineering Hand Book - Van Nostrard - Reinhold - 1990.
2. Tomlinson. M.J. and Boorman, R., "Foundation design and construction", VI edition, ELBS Longman, 2001.
3. Nayak. N.V., "Foundation design manual for practicing engineers", DhanpatRai and Sons, 1985.
4. Arora. K.R, "Soil Mechanics & Foundation Engineering", Standard Publishers & Distributors, 2005.
5. IS 2911 : Part 1 : Sec 1 : 1979 Code of practice for design and construction of pile foundations: Part 1Concrete piles, Section 1 Driven cast in-situ concrete piles
6. IS 2911 : Part 1 : Sec 2 : 1979 Code of practice for design and construction of pile foundations: Part 1 Concrete piles, Section 2 Bored cast-in-situ piles
7. IS 2911 : Part 1 : Sec 3 : 1979 Code of practice for design and construction of pile foundations: Part 1 Concrete piles, Section 3 Driven precast concrete piles.
8. IS 2911 : Part 1 : Sec 4 : 1984 Code of practice for design and construction of pile foundations: Part 1 concrete piles, Section 4 Bored precast concrete piles
9. IS 2911 : Part 2 : 1980 Code of practice for designing and construction of pile foundations: Part 2 Timber piles.
10. IS 2911 : Part 3 : 1980 Code of practice for design and construction of pile foundations: Part 3 Under reamed piles
11. IS 2911 : Part 4 : 1985 Code of practice for design and construction of pile foundations: Part 4 Load test on piles
12. IS 6403 : 1981 Code of practice for determination of bearing capacity of shallow foundations

CO PO MAPPING:

Mapping of course objectives with Programme Outcomes: (1/2/3 indicates strength of correlation) 3- strong,2-Medium, 1-Weak														
Cos	**Programme Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	-	-	-	2	2	-	-	-	-	2	-	2
CO2	3	2	-	-	-	2	2	-	-	-	-	2	-	2
CO3	3	2	-	-	-	2	2	-	-	-	-	2	-	2
CO4	3	2	-	-	-	2	2	-	-	-	-	2	-	2
CO5	3	2	-	-	-	2	2	-	-	-	-	2	-	2

PSE19453 EXPERIMENTAL TECHNIQUES AND MODEL ANALYSIS 3 0 0 3

COURSE OBJECTIVES

To enable the students to,

- define the errors in measurement and the principles of measurement using various electronic and physical testing machines.
- dramatize with vibrating measuring instruments and digital and electronic display using different sensors.
- understand the wind flow measurement and pressure measurement and scale different models using direct model study and indirect model study.
- measure the distress in concrete structures using various electrical and electronic machineries.
- test various civil engineering structures using Non Destructive Testing methodologies.

Prerequisite: Nil

UNIT I FORCES AND STRAIN MEASUREMENT 9

Choice of Experimental stress analysis methods, errors in measurements - Strain gauge, principle, types, performance and uses; 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 ACOUSTICS AND WIND FLOW MEASURES 9

Principles of Pressure and flow measurements - Pressure transducers, sound level meter, Venturimeter and flow meters; Wind tunnel and its use in structural analysis - structural modeling, Direct Model Study and Indirect Model study.

UNIT IV DISTRESS MEASUREMENTS AND 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 V 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 - Ground penetrating radar (GPR).

TOTAL PERIODS 45

COURSE OUTCOMES

Upon the completion of this course, the students will be able to

- choose the methodology of measuring errors and strains and calibrate the machineries and equipment used in the laboratory.
- operate various vibration measuring instruments and analyse the structures using digital display unit.
- indicate the model using direct and indirect model analysis (Using Buckingham PI Theorem).
- measure distress in the structures using various electronic equipment.
- employ advanced NDT methods in accessing the load testing of structures.

REFERENCES

1. Sadhu Singh, 'Experimental Stress Analysis', Khanna Publishers, New Delhi, 2009.
2. Rangan C S et al., 'Instrumentation - Devices and Systems', Tata McGraw-Hill Publishing Co., Ltd., New Delhi, 2017.
3. Ganesan T.P., "Model Analysis of Structures", Universities Press (India) Ltd 2005.
4. Dally J W and Riley W.F, 'Experimental stress Analysis', McGraw-Hill Inc. New York, 1991.

CO PO MAPPING:

Mapping of course objectives with Programme Outcomes: (1/2/3 indicates strength of correlation) 3- strong,2-Medium, 1-Weak														
Cos	**Programme Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	-	-	-	2	2	-	-	-	-	2	-	2
CO2	3	2	-	-	-	2	2	-	-	-	-	2	-	2
CO3	3	2	-	-	-	2	2	-	-	-	-	2	-	2
CO4	3	2	-	-	-	2	2	-	-	-	-	2	-	2
CO5	3	2	-	-	-	2	2	-	-	-	-	2	-	2

PSE19454 DESIGN OF INDUSTRIAL STRUCTURES 3 0 0 3

COURSE OBJECTIVES

To enable the students to,

- impart a broad knowledge in the area of Planning and functionalrequirements for industrial structures
- understand the concepts of gantry girders, steel bunkers of industrial building
- understand the basic design concepts of machine foundation
- know the design concepts of power plant structures
- realise the design concepts of power transmission structures

Prerequisite: Nil

UNIT I PLANNING AND FUNCTIONAL REQUIREMENTS 9

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.

UNIT II INDUSTRIAL BUILDINGS - STEEL 9

Roofs for industrial buildings - gantry girders, components of the crane system, forces, impact factor, forms of gantry girder, design of gantry girders; steel bunkers and silos - components of bunkers, IS code specifications, design of silos.

UNIT III INDUSTRIAL BUILDINGS-CONCRETE 9

Loads on the corbel - bearing stress, evaluation of internal forces; design of corbels and nibs; design limits of machine foundation for empirical methods, classifications of machine foundations, various types of machine foundations - analysis and design of machine foundations.

UNIT IV POWER PLANT STRUCTURES 9

Components of concrete bunkers - theories, IS code specifications, procedure for design of concrete bunkers; design of concrete silo - types of chimneys, loads on chimneys shell, design aspects, design procedure for concrete chimney.

UNIT V POWER TRANSMISSIONSTRUCTURES 9

Transmission line towers - configuration, determination of tower height, clearances, critical parameters of tower, types of towers, analysis, tower design; substation structures - procedure for design of tower foundations.

TOTAL PERIODS 45

COURSE OUTCOMES

Upon the completion of this course, the students will be able to

- know the planning and functional requirements of various industries.
- get an idea about the components of steel bunkers and silos
- possess the ability to understand the design limits of machine foundation.
- realize the basic concepts and design of power plant structures
- design power transmission structures.

REFERENCES

1. Subramanian N., "Design of Steel Structures", 3rd Edition, Oxford University Press, 2011.
2. Dayaratnam, P., "Design of Steel Structures", A.H. Wheeler & Co., Ltd., Allahabad, 2008.
3. Srinivasulu P and Vaidyanathan.C, "Handbook of Machine Foundations", Tata McGraw Hill, 2004
4. Jurgen Axel Adam, KatharriaHausmann, Frank Juttner, Klauss Daniel, "Industrial Buildings: A Design Manual", Birkhauser Publishers, 2004.
5. Santhakumar, A.R. and Murthy, S.S., "Transmission Line Structures", Tata Mc Graw Hill 1992
6. IS 4995 (Part I& II) -1974 - Criteria for design of reinforced concrete bins for the storage of granular and powder materials.
7. IS 6060 -1971 - Code of practice for Day lighting of factory buildings
8. IS 3103 -1975- Code of practice for industrial ventilation
9. IS 3483 -1965 - Code of practice for Noise reduction in industrial buildings
10. IS 6533 (Part 1 &Part 2) -1989 - Code of practice for design and construction of steel chimneys
11. IS:875 (Part 1 to 5) - Code of Practice for Design loads
12. IS:802-1977(Part 2) - Code of practice for use of structural steel in Over Head transmission line towers
13. IS: 3370-1967 - Part 2 to 4 - Code of Practice for Concrete Structures for the storage of liquids - Reinforced Concrete Structures.
14. IS:4091-1979 - Code of Practice for Design and Construction of Foundations for Transmission Line Towers and Poles
15. IS:9178-1980 - Criteria for Design of Steel Bins for Storage of Bulk Materials

CO PO MAPPING:

Mapping of course objectives with Programme Outcomes: (1/2/3 indicates strength of correlation) 3- strong,2-Medium, 1-Weak														
Cos	**Programme Outcomes (POs)**													
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**
CO1	3	2	-	-	-	2	2	-	-	-	-	2	-	2
CO2	3	2	-	-	-	2	2	-	-	-	-	2	-	2
CO3	3	2	-	-	-	2	2	-	-	-	-	2	-	2
CO4	3	2	-	-	-	2	2	-	-	-	-	2	-	2
CO5	3	2	-	-	-	2	2	-	-	-	-	2	-	2

PEN19271 PEDAGOGY STUDIES 2 0 0 0

COURSE OBJECTIVES

The students will be able to

- understand the aims, objectives and educational philosophies of Education
- acquire the knowledge of Instructional objectives of teaching and teaching skills
- apply the knowledge of methods and strategies of teaching in real classroom situation
- utilize the instructional aids and tools for effective classroom teaching
- acquaint with the knowledge of professional development of teachers

Prerequisite: Nil

UNIT I EDUCATION AND ITS PHILOSOPHY 6

Education - Definition, Aims, Objectives, Scope, Educational philosophy of Swami Vivekananda, Mahatma Gandhi, Rabindranath Tagore, Sri Aurobindo and J.Krishnamoorthy, Montessori,Jean-Jacques Rousseau, Friedrich Froebel and John Dewey. Current trends and issues in Education - Educational reforms and National policy on Education-1968 and 1986-its objectives and features

UNIT II INSTRUCTIONAL OBJECTIVES AND DESIGN 6

Instructional Objectives - Taxonomy of Educational objectives, Writing of general and specific objectives; Instructional design - Planning and designing the lesson, Writing of lesson plan - meaning, its need and importance, format of lesson plan and Types of lesson plan Skills of teaching - various ways of introducing lessons, explaining skills, problem solving skills, illustrative skills, scaffolding skills, integrating ICT skills, questioning skills, Reinforcement skills, skill of probing questions, skill of stimulus variation and computation skills.

UNIT III INSTRUCTIONAL METHODS AND STRATEGIES 6

Instruction strategies - Lecture, demonstration, laboratory, Inductive method, Deductive method, Inquiry method, seminar, panel discussion, symposium, problem solving, project based learning (PBL), Learning by doing, workshop, role - play(socio-drama), Recent trends - Constructivist learning, Problem - based learning - Brain-based learning - Collaborative learning - Flipped learning, Blended learning, e-Learning trends, Video conferencing

UNIT IV INSTRUCTIONAL MEDIA 6

Key concepts in the selection and use of media in education, Developing learning resource material using different media, Instructional aids - types, uses, selection, preparation, utilization. Dale cone of Experience, Teacher's role in procuring and managing instructional Aids- Projected and non-projected aids, multimedia, video-teleconferencing etc.

UNIT V TEACHER PREPARATION 6

Teacher - roles and responsibilities, functions, characteristics, competencies, qualities, Preparation of professional teacher, Organizing professional aspects of teacher preparation programs, Professional development of teachers-In-service training, Refresher programmes, workshop and higher studies.

TOTAL PERIODS 30

Practicum:

Writing of three lesson plans

Practice teaching for 15 days

Preparation of one teaching aid

A seminar on one educational philosophy

Assignment on any of these five units

COURSE OUTCOMES

Upon the completion of this course, the students will be able to

- explain the educational philosophies of Education
- write instructional and specific objectives in lesson plan
- utilize the teaching skills and methods effectively
- use instructional media efficiently
- update themselves in the area of professional development

REFERENCES

1. T.V. Somashekar, G Viswanathappa and Anice James (2014), Methods of Teaching Mathematics, Hyderabad, Neelkamal publications Pvt Ltd
2. National Policy on Education 1968 and 1986- National Policy on Education 1986-Programme of Action 1992.
3. Batra, P. (2010). Social science learning in schools: Perspectives and challenges. New Delhi: Sage publications India.
4. Benjamin S., Bloom et al. (1987). Taxonomy of educational objectives. Longman Group.
5.
6. Encyclopaedia of Modern Methods of Teaching and Learning (Vol. 1-5).
7.
8. Karthikeyan, C. (2004). A Text book on instructional technology, RBSA
9.
10. Siddiqui, MujibulHasan (2005). Techniques of classroom teaching A.P.H
11.
12. Dhamija, N. (1993). Multimedia approaches in teaching social studies. New Delhi: Harman Publishing House
13. Jeffrey Bennett (2014). On Teaching Science: Principles and Strategies That Every Educator Should Know. Big Kid Science: Boulder,CO
14. Kulbir Singh. (2010). Teaching of mathematics. New Delhi: Sterling Publishers.
15.
16. Bawa, M.S. &Nagpal, B.M. (2010). Developing teaching competencies. New Delhi: Viva Book House
17. Sharma, R.A. (2008). Technological foundation of education. Meerut: Lall Books Depot.
18.

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CO1	-	-	2	-	-	-	2	-	3	2	2	2	-	2
CO2	-	-	-	2	2	2	2	-	3	2	2	2	2	2
CO3	-	-	-	2	3	2	2	-	3	2	2	2	2	2
CO4	-	-	-	-	3	2	2	-	3	2	2	2	1	1
CO5	-	-	-	-	2	-	1	-	3	2	1	2	-	-