PAAVAI ENGINEERING COLLEGE, NAMAKKAL – 637 018
(AUTONOMOUS)
M.E. - STRUCTURAL ENGINEERING
REGULATIONS 2015
CURRICULUM

SEMESTER I

Course Code	Course Title	L	T	P	C
PMA15101	Advanced Mathematics	3	2	0	4
PSE15102	Structural Dynamics	3	2	0	4
PSE15103	Theory of Elasticity and Plasticity	3	2	0	4
PSE15104	Advanced Reinforced Concrete Structures	3	2	0	4
PSEE1*	Elective – I	3	0	0	3
PSEE2*	Elective – II	3	0	0	3

SEMESTER II

Course Code	Course Title	L	T	P	C
PSE15201	Advanced Structural Steel Design	3	2	0	4
PSE15202	Aseismic Analysis and Design of Structures	3	2	0	4
PSE15203	Design of Pre-stressed Concrete Structures	3	2	0	4
PSE15204	Finite Element Method	3	2	0	4
PSEE3*	Elective – III	3	0	0	3
PSEE4*	Elective – IV	3	0	0	3
PSE15205	Advanced Structural Engineering Laboratory	0	0	4	2

LIST OF ELECTIVE FOR I SEMESTER

Course Code	Course Title	L	T	P	C
PSEE15101	Matrix Methods of Structural Analysis	3	0	0	3
PSEE15102	Advanced Concrete Technology	3	0	0	3
PSEE15103	Maintenance and Rehabilitation of Structures	3	0	0	3
PSEE15104	Structural Optimization	3	0	0	3
PSEE15105	Design of Tall Buildings	3	0	0	3
PSEE15106	Non-linear Analysis of Structures	3	0	0	3
PSEE15107	Smart Structures	3	0	0	3

LIST OF ELECTIVE FOR II SEMESTER

Course Code	Course Title	L	T	P	C
PSEE15201	Design of Sub Structure	3	0	0	3
PSEE15202	Experimental Techniques and Instrumentation	3	0	0	3
PSEE15203	Computer Aided Analysis and Design of Structures	3	0	0	3
PSEE15204	Design of Bridges	3	0	0	3
PSEE15205	Mechanics of Composite Materials	3	0	0	3
PSEE15206	Energy Efficient Structures	3	0	0	3
PSEE15207	Structures in Disaster Prone Areas	3	0	0	3

SEMESTER I

PMA15101 ADVANCED MATHEMATICS 3 2 0 4

COURSE OBJECTIVES

- To familiarize the students in the field of differential equations to solve boundary value problems using Laplace Transform.
- To familiarize the students in the field of differential equations to solve boundary value problems using Fourier Transform associated with engineering applications.
- Have seen simple optimal control problems and can understand them as a special case of general variational problems
- To expose the students to conformal mapping and their applications to obtain solutions for buckling, dynamic response, heat and flow problems of one and two dimensional conditions.
- Introduce students to the fundamentals of vector and tensor algebra; and expose students to mathematical applications of Engineering.

UNIT 1 LAPLACE TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS 9 + 6

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 2 FOURIER TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS 9 + 6

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 3 CALCULUS OF VARIATIONS 9 + 6

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

UNIT 4 CONFORMAL MAPPING AND APPLICATIONS 9 + 6

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 5 TENSOR ANALYSIS 9 + 6

Summation convention – Contravariant and covaraiant vectors – Contraction of tensors – Innerproduct – Quotient law – Metric tensor – Chrirstoffel symbols – Covariant differentiation – Gradient, divergence and curl.

TOTAL : 45 + 30 = 75 PERIODS

COURSE OUTCOMES

On completion of the course the students will enable to

- solve boundary value problems usingLaplace
- solve boundary value problems using Fourier transform techniques.
- they will also solve Fluid flow and heat flow problems using conformal mapping.
- understand Vector and tensor algebra and its applications in applied sciences and engineering.
- formulate variational problems and analyse them to deduce key properties of system behaviour.

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. Ramaniah.G. "Tensor Analysis", S.Viswanathan Pvt. Ltd., 1990.
4. Sankara Rao, K., "Introduction to Partial Differential Equations", Prentice Hall of India Pvt. Ltd., New Delhi, 1997.
5. Spiegel, M.R., "Theory and Problems of Complex Variables and its Application (Schaum's Outline Series)", McGraw Hill Book Co., 1981.

WEB LINKS

1. http://www.nptel.ac.in/courses/111103021/
2. http://www.thefouriertransform.com/
3. http://www.lecture-notes.co.uk/susskind/classical-mechanics/lecture-2/calculus-of-variations/

PSE15102 STRUCTURAL DYNAMICS 3 2 0 4

COURSE OBJECTIVES

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

UNIT 1 PRINCIPLES OF DYNAMICS 9 + 6

Vibration and its importance to structural engineering problems - Elements of vibratory systems and simple harmonic motion - Generalized mass - D'Alembert's principle - Mathematical modelling 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 - Damped or undamped - Evaluation of damping - resonance - band width method to evaluate damping - Force transmitted to foundation - Vibration isolation.

UNIT 2 TWO DEGREE OF FREEDOM SYSTEMS ` 9 + 6

Equations of Motion of two degree of freedom systems - Damped and undamped free vibrations - Undamped forced vibration - Normal modes of vibration - Applications.

UNIT 3 DYNAMIC ANALYSIS OF MDOF 9 + 6

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

UNIT 4 DYNAMIC ANALYSIS OF CONTINUOUS SYSTEMS 9 + 6

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 5 PRACTICAL APPLICATIONS 9 + 6

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

TOTAL : 45 +30 = 75 PERIODS

COURSE OUTCOMES

At the end of this course the student will be able to

- understand the response of structural systems to dynamic loads and displacements.
- realize the behaviour and response of linear and non-linear SDOF and MDOF 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. Anil K.Chopra, “Dynamics of Structures”, Pearson Education, 2009.
2. Mario Paz, Structural Dynamics, “Theory and Computation”, Kluwer Academic Publication, 2004.
3. Craig.R.R, “Structural Dynamics - An Introduction to Computer methods”, John Wiley & Sons, 1989.
4. Manickaselvam ,V.K., “Elementary Structural Dynamics”, Dhanpat Rai & Sons, 2001.
5. Madhujit Mukhopadhyay - Structural Dynamics Vibrations and Systems, Ane Books India Publishers, 2010.

WEB LINKS

1. http://nptel.ac.in/courses/105101006/
2. http://freevideolectures.com/Course/3129/Structural-Dynamics#
3. http://onlinelibrary.wiley.com/journal/10.1002/%28ISSN%291096-9845/issues

PSE15103 THEORY OF ELASTICITY AND PLASTICITY 3 2 0 4

COURSE OBJECTIVES

- To study the classical theory of linear elasticity for two and three dimensional state of stress.
- To obtain solutions for elasticity problems in rectangular and polar coordinates as well as torsion of prismatic bars.
- To introduce the energy principles and energy method of solution of solid continuum mechanics.
- To gain knowledge on torsion of non-circular sections and thin walled sections.
- To understand the plastic stress strain relations, criteria of yielding and elasto- plastic problems.

UNIT 1 ELASTICITY 9 + 6

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

UNIT 2 FORMULATION AND SOLUTION OF ELASTICITY PROBLEMS 9 + 6

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

UNIT 3 ENERGY METHODS 9 + 6

Numerical and Energy methods - Castiglianos theorem - Principle of Virtual work - Principle of stationary potential energy - Principle of least work - Rayleigh's method - Rayleigh-Ritz method- Finite difference method - Simple applications.

UNIT 4 TORSION 9 + 6

Introduction, general solution of torsion problems, boundary conditions, stress function method - Torsion of non-circular sections, Prandtl's membrane analogy, Torsion of thin walled open and closed sections - Thin walled multiple cell closed sections.

UNIT 5 INTRODUCTION TO PLASTICITY 9 + 6

Physical assumptions - Criterion of yielding, plastic stress and strain relationship - Elastic plastic problems in bending - Torsion and thick cylinder.

TOTAL : 45 + 30 = 75 PERIODS

COURSE OUTCOMES

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

- understand the stresses and strains.
- determine the solution of elasticity problems.
- compute the beams and columns deformation using energy methods.
- analyse torsion of non-circular sections and thin walled sections.
- solve problems of plasticity.

REFERENCES

1. Timeshenko.S.P and Goodier.J.N, "Theory of Elasticity", McGraw Hill International Edition, 2010.
2. Sadhu Singh, "Theory of Plasticity", Khanna Publishers, 2005.
3. Hill.R, "Mathematical theory of Plasticity", Oxford Publishers 1998.
4. Sadhu Singh, "Theory of Elasticity and Metal Forming Processes", Khanna Publishers, 2005.
5. Chakrabarthy, "Theory of Plasticity", McGraw Hill Co., 2006.

WEB LINKS

1. https://www.vidyarthiplus.com/shop/theory-of-elasticity-and-plasticity-premium-lecture-notes-evangeline-edition.html
2. https://onderwijsaanbod.kuleuven.be/syllabi/v/e/H08W3AE.htm#activetab=doelstellingen_idp1232512
3. http://www.faadooengineers.com/threads/10108-Theory-of-elasticity-and-plasticity-full-notes-ebook-free-download-pdf

PSE15104 ADVANCED REINFORCED CONCRETE DESIGN 3 2 0 4

COURSE OBJECTIVES

- To simplify a standard reinforced concrete building into a number of manageable idealized substructures, structural elements and to construct their load paths.
- To interpret ultimate and serviceability limit state approaches in current structural design philosophy.
- To estimate primary design loads on structural elements such as beams and columns consulting appropriate standards and handbooks.
- To combine primary design load cases as per design standards to find critical load combination that governs design.
- To model building structure and analyze structural elements for design actions such as design bending moment, design shear force and deflections.

UNIT 1 DESIGN REGULATIONS 9 + 6

Review of limit state design of beams, slabs and columns according to IS code - Serviceability limit states - Deflection and cracking - Calculation of deflection and crack width according to IS Code.

UNIT 2 DESIGN OF SPECIAL RC ELEMENTS 9 + 6

Design of slender columns - Design of RC walls - Strut and tie method of analysis for corbels and deep beams - Design of corbels, deep-beams and grid floors.

UNIT 3 FLAT SLABS AND YIELD LINE THEORY 9 + 6

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 4 PLASTIC DESIGN 9 + 6

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

UNIT 5 DETAILING AND FIELD PRACTICE 9 + 6

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 -

shear walls - Fire resistance of structural members - Code requirements - Quality control of concrete.

TOTAL : 45 + 30 = 75 PERIODS

COURSE OUTCOMES

At the end 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. Unnikrishna Pillai and Devdas Menon "Reinforced concrete Design', Tata McGraw Hill Publishers Company Ltd., New Delhi, 2010.
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, 2005.
4. Dr.B.C.Punmia, Ashok kumar jain, Arun Kumar Jain, "Limit state design of Reinforced Concrete", Laxmi Publicatiions (P) Ltd, New Delhi, 2007.
5. Sinha.N.C. and Roy S.K., "Fundamentals of Reinforced Concrete", S.Chand and Company Limited, New Delhi, 2003.

CODE BOOKS

1. IS:13920-1993 - Ductile detailing of reinforced concrete structures subjected to seismic forces - Code of Practice.
2. IS:456-2000 - Indian Standard Code of Practice for Plain and Reinforced Concrete.
3. SP16-Design Aid for RC to IS 456-1978.

WEB LINKS

1. https://www.youtube.com/watch?v=pIdaC_I6H_M
2. https://en.wikipedia.org/wiki/Reinforced_concrete
3. http://searchworks.stanford.edu/view/317818

II SEMESTER

PSE15201 ADVANCED STRUCTURAL STEEL DESIGN 3 2 0 4

COURSE OBJECTIVES

- To study the concept of limit state design, working stress design and design philosophies of tension and compression members.
- To study various connections (welded and riveted), seated connections (Unstiffened and Stiffened connections) and to design them.
- To focus on the study and design of steel structures subjected to torsion.
- To study the plastic analysis of steel structures.
- To study the design concepts of light gauge steel structures.

UNIT 1 DESIGN METHODOLOGIES 9+6

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.

UNIT 2 DESIGN OF CONNECTIONS 9+6

Types of connections - Welded and riveted - Throat and root stresses in Fillet welds - Seated connections - Unstiffened and stiffened seated connections - Moment resistant connections - Clip angle connections - Split beam connections - Framed connections.

UNIT3 TORSION MEMBERS 9+6

Introduction – uniform torsion – non uniform torsion – torsion design – torsion and bending – distorsion.

UNIT 4 PLASTIC ANALYSIS OF STRUCTURES 9+6

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

UNIT 5 DESIGN OF LIGHT GAUGE STEEL STRUCTURES 9+6

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 :45+30 = 75PERIODS

COURSE OUTCOMES

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

- design various tension and compression members.
- design different types of steel connections and joints.
- have an exposure to design steel structures subjected to torsion.
- design for plasticity.
- perform design of light gauge steel structures.

REFERENCES

1. Subramanian .N, " Design of Steel Structures", Oxford University Press, 2008.
2. Dayarathnam.P, "Design of Steel Structures", A.H.Wheeler, India, 2007.
3. John E. Lothers, " Design in structural steel", Prentice Hall of India, New Delhi 1990.
4. Lynn S. Beedle, "Plastic Design of Steel Frames", John Wiley and Sons, New York 1990.
5. Wie Wen Yu, "Design of Cold Formed Steel Structures" , Mc GrawHIll Book Company, New York, 2010.

CODE BOOKS

1. IS:800-2007 - Indian Standard Code of Practice for general construction in steel (Limit State).
2. IS:875 (Part I to V) - Code of Practice for Design loads.
3. IS:801-1975 - Code of practice for use of cold formed light gauge steel structural members in general building construction.
4. IS:811 -1987 - Cold formed light gauge structural steel sections.
5. IS:6533-1989 (Part I & II) - Code of Practice for Design and Construction of Steel Chimney.
6. IS:802-1977 - Code of Practice for use of structural steel in Overhead Transmission Line Towers.
7. SP:6 - Handbook on Structural Steel Section.

WEB LINKS

1. https://engineering.purdue.edu/~ahvarma/CE%20470/
2. http://www.learnerstv.com/Free-engineering-Video-lectures-ltv323-Page1.html
3. http://peer.berkeley.edu/~yang/courses/ce248/CE248_LN_Floor_vibrations.pdf

PSE15202 ASEISMIC ANALYSIS AND DESIGN OF STRUCTURE 3 2 0 4

COURSE OBJECTIVES

- To make the students to understand the concepts of Engineering seismology
- To analyse building for earthquake forces and introduce design concepts
- To explain the design guidelines for earthquake resistant masonry and earthen buildings
- To analyse rigid frames and shear wall for earthquake loading
- To have knowledge on vibration control techniques

UNIT 1 EARTHQUAKE GROUND MOTION 9 + 6

Engineering Seismology - elastic rebound theory - plate tectonic theory - Seismic waves - earthquake size - measurement of earthquakes - strong ground motions - Tsunami - Seismic zoning map of India Information on some disastrous earthquakes.

UNIT 2 EARTHQUAKE ANALYSIS AND DESIGN CONCEPTS 9 + 6

Response spectra - introduction to methods of seismic analysis - Equivalent static analysis IS 1893 provisions - Response spectrum method - Time history method - Push over analysis - Mathematical modeling of multi-storey RC Building - Design methodology - Architectural consideration - geotechnical consideration - structural design consideration - Capacity design - Techniques of aseismic design.

UNIT 3 EARTHQUAKE DESIGN OF MASONRY BUILDINGS 9 + 6

Guidelines for earthquake resistant earthen buildings and masonry buildings - Design considerations.

UNIT 4 EARTHQUAKE DESIGN OF RC STRUCTURES 9 + 6

Earthquake resistant design of RCC. Buildings - Material properties - Lateral load analysis - Design and detailing - Rigid frames - Shear wall - Coupled shear wall.

UNIT 5 SPECIAL TOPICS 9 + 6

Liquefaction, vibration control - Tuned mass dampers - Principles and application, Basic concept of seismic base Isolation - Various systems- Case studies

TOTAL : 45 + 30 = 75 PERIODS

COURSE OUTCOMES

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

- describe ground motion and its relationship to seismic design of structures.
- calculate earthquake induced lateral force on the structure.
- include earthquake resistant features in masonry buildings.
- 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, 2007.
2. Pankaj Agarwal 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. Chen WF & Scawthorn, "Earthquake Engineering Hand book", CRC Press, 2003.
5. S.K.Duggal, "Earthquake Resistant Design of Structures", Oxford University Press, 2007

CODE BOOKS

1. IS:13920-1993 - Ductile detailing of reinforced concrete structures subjected to seismic forces - Code of Practice.
2. IS:1893 (Part I) - 2002 - Indian Standard Criteria for Earthquake Design of Structures - General Provisions and Buildings.
3. IS:4326 - 1993 - Earthquake Resistant Design and Construction of Buildings - Code of Practice.
4. IS:13827-1993 - Improving Earthquake Resistance of Earthen Buildings - Guidelines.
5. IS:13828 - 1993 - Improving Earthquake Resistance of Low Strength Masonry Buildings -- Guidelines.

WEB LINKS

1. http://www.tylin.com/en/services/seismic_analysis_retrofit_and_design
2. http://www.trb.org/Main/Blurbs/160387.aspx
3. http://www.sciencedirect.com/science/article/pii/S0886779801000517

PSE15203 DESIGN OF PRE-STRESSED CONCRETE STRUCTURES 3 2 0 4

COURSE OBJECTIVES

- To analyse various systems of prestressing using basic principles.
- To design flexural members for shear, bond and torsion and end blocks.
- To analyse and design continuous beams using the concept of linear transformation and cable profile.
- To design the tension and compression members and evaluate their application in design of pipes, water tanks, piles and flag mast.
- To analyse and design composite section and prestressed concrete bridges.

UNIT 1 PRINCIPLES AND BEHAVIOUR OF PRESTRESSING 9+6

Principles of Prestressing - Types and systems of prestressing, need forhigh strength materials - Analysis methods, losses, deflection (short-longterm), camber, cable layouts.

UNIT 2 DESIGN OF FLEXURAL MEMBERS 9+6

Behaviour of flexural members - Determination of ultimate flexural strength - Codal provisions - Design of flexural members - Design for shear - bond and torsion - Design of end blocks.

UNIT 3 DESIGN OF CONTINUOUS BEAMS 9+6

Analysis and design of continuous beams - Methods of achieving continuity - Concept of linear transformations, concordant cable profile and gap cables

UNIT 4 DESIGN OF TENSION AND COMPRESSIONMEMBERS 9+6

Design of tension members - Application in the design of prestressed pipes and prestressed concrete cylindrical water tanks - Design of compression members with and without flexure - application in the design of piles, flag masts and similar structures.

UNIT 5 DESIGN OF PRESTRESSED CONCRETE BRIDGES 9+6

Composite Beams - Analysis and design - Composite sections - Ultimate strength - Application in prestressed concrete bridges - Design of pre- tensioned and post tensioned girder bridges - Partial prestressing - advantages and applications.

TOTAL : 45+30 = 75 PERIODS

COURSE OUTCOMES

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

- explain the principle, types and systems of prestressing and analyse the deflections.
- determine the flexural strength and design the flexural members, end blocks.
- analyse the statically indeterminate structures and design the continuous beam.
- design the tension and compression members and apply it for design of piles.
- analyse the stress, deflections, flexural and shear strength and apply it for the design of bridges.

REFERENCES

1. Krishna Raju, “Prestressed Concrete”, Tata McGraw Hill Publishing Co, 2007.
2. Sinha.N.C.and.Roy.S.K, “Fundamentals of Prestressed Concrete”,S.Chand and Co., 2011.
3. Lin.T.Y., “Design of Prestressed Concrete Structures”, John Wiley and Sons Inc,1981.
4. Evans, R.H. and Bennett, E.W., “Prestressed Concrete”, Champman and Hall, London, 1998.
5. Rajagopalan.N, “Prestressed Concrete”, Narosa Publications, New Delhi, 2008.

CODE BOOKS

1. IS456 - 2000 - IS Code of Practice for Plain and Reinforced Concrete.
2. IS1343 - 1980 - IS Code of Practice for Prestressed Concrete.
3. IS1678-1998-Specification for Prestressed Concrete Pole for verhead Power Traction and Telecommunication lines.
4. IRC:6-2010 Standard Specifications and Code of Practice for Road Bridges, Section II - Loads and Stresses (Fifth Revision).
5. IRC:18-2000 Design Criteria for Prestressed Concrete Road Bridges(Post-Tensioned Concrete) (3rd Revision).
6. IRS - Indian Railway Standard Specifications.
7. BS8110 - 1985 - Code of Practice for Design and Construction.
8. IS784 - 2001 - IS Specification for Prestressed Concrete Pipes.
9. IS3370 - 1999 - Part III - IS Code of Practice for Concrete Structures for the storage of liquids.
10. IS875 - 1987 - Part I - IV - IS Code of Practice for Design loads.

WEB LINKS

1. http://www.assakkaf.com/ence_454_lecture_notes.htm
2. http://faculty.delhi.edu/hultendc/AECT480-Lecture%2024.pdf
3. http://www.colincaprani.com/structural-engineering/courses/lecture-notes/

PSE15204 FINITE ELEMENT METHOD 3 2 0 4

COURSE OBJECTIVES

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

UNIT 1 FORMULATION OF BOUNDARY VALUES 9 + 6

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 2 STRESS ANALYSIS 9 + 6

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 3 MESHING AND SOLUTION 9 + 6

Higher order elements – P and H methods of mesh refinement – Ill conditioned elements – Discretisation errors – Auto and adaptive mesh generation techniques - Error evaluation

UNIT 4 DYNAMIC ANALYSIS 9 + 6

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 5 PLATE AND SHELL ELEMENTS 9 + 6

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 : 45 + 30 = 75 PERIODS

COURSE OUTCOMES

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

- develop finite element formulations of 1 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.
- perform modal analysis to determine its natural frequencies, and analyze harmonically-forced vibrations.

REFERENCES

1. S. S. Bhavikatti, “Finite Element Analysis”, New Age Publishers,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, 2011.
5. Moaveni, S., “Finite Element Analysis Theory and Application with ANSYS”, Prentice Hall Inc., 2003.

WEB LINKS

1. http://www.colorado.edu/engineering/CAS/courses.d/IFEM.d/Home.html
2. http://nptel.ac.in/courses/112104115/
3. http://freevideolectures.com/Course/2357/Finite-Element-Method

PSE15205 ADVANCED STRUCTURAL ENGINEERING LABORATORY 0 0 4 2

COURSE OBJECTIVES

- At the end of this course, students will be able to design concrete mixes, perform advanced laboratory experiments that emphasize the structure-property relationship, statistical analysis, technical manuscript preparation and get a practical knowledge about the non destructive tests, measuring devices and their field applications.

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. Fabrication, casting and testing of simply supported reinforced concrete beam for strength and deflection behaviour.
4. Testing of simply supported steel beam for strength and deflection behaviour.
5. Fabrication, casting and testing of reinforced concrete column subjected to concentric and eccentric loading.
6. Dynamic testing of cantilever steel beam
    a. To determine the damping coefficients from free vibrations.
    b. To evaluate the mode shapes.
7. Static cyclic testing of single bay two storied steel frames and evaluate
    a. Drift of the frame.
    b. Stiffness of the frame.
    c. Energy dissipation capacity of the frame.
8. Determination of in-situ strength and quality of concrete using
    a. Rebound hammer.
    b. Ultrasonic Pulse Velocity Tester.
9. Study of Measuring devices such as
    a. Beggs Deformeter
    b. Mechanical Strain Gauge
    c. Optical strain gauge
    d. Electrical Strain Gauges

TOTAL : 60 PERIODS

COURSE OUTCOMES

- At the end of this course, the students will be able to describe the behaviour of reinforced concrete and steel beam for strength and deflection and the dynamic behaviour of cantilever steel beam and also able to understand the strength and quality of concrete

REFERENCES

1. Dally J W, and Riley W F, "Experimental Stress Analysis", McGraw- Hill Inc. New York, 1991.
2. L.S Srinath, „Experimental Stress Analysis", Tata McGraw-Hill Publishing Company Limited, New Delhi, 1992.

LIST OF ELECTIVES FOR I SEMESTER

PSEE15101 MATRIX METHODS OF STRUCTURAL ANALYSIS 3 0 0 3

COURSE OBJECTIVES

- To develop flexibility and stiffness matrices for the single and two coordinate system.
- To transform stiffness and flexibility matrices from system coordinate to element coordinate
- To expose flexibility method and its application to pin jointed plane truss, continuous beams, frames and grids.
- To develop stiffness matrix and their application to two and three dimensional pin- jointed trusses.
- To analyse substructures by iteration methods.

UNIT 1 FUNDAMENTAL CONCEPTS- STIFFNESS AND FLEXIBILITY 9

Introduction-Force and displacement measurement - Generalized or Independent measurement - Constrained or Dependent measurements- Behaviour of structures - Principle of superposition - Methods of Structural analysis - Introduction structure with single coordinate - Two coordinates - Flexibility and stiffness matrices in N coordinates- Examples, symmetric nature of matrices - Stiffness and flexibility matrices in constrained measurements - Stiffness and flexibility of systems and elements - Computing displacements and forces from virtual work- Computing stiffness and flexibility coefficients.

UNIT 2 ENERGY CONCEPTS & TRANSFORMATION IN STRUCTURES 9

Strain energy in terms of stiffness & flexibility matrices - Properties of stiffness and flexibility matrices - Interpretation of coefficients - Betti’s law (forces not at the coordinates) - Other energy theorems - Using matrix notations - Determinate, indeterminate structures - Transformation of system forces to element forces - Element flexibility to system flexibility -System displacement to element displacement - Element stiffness to system stiffness - Transformation of forces and displacements in general - Stiffness and flexibility in general - Normal coordinates and orthogonal transformation - Principle of contragradience.

UNIT 3 FLEXIBILITY METHOD 9

Statically determinate structures - Indeterminate structures - Choice of redundant leading to ill and well-conditioned matrices - Automatic choice of redundant- Rank technique - Transformation to one set of redundant to another - Internal forces due to thermal expansion and lack of fit - Reducing the size of flexibility matrix - Application to pin jointed plane truss - continuous beams - Frames -Grids.

UNIT 4 STIFFNESS METHOD 9

Introduction - Development of the stiffness method - Stiffness matrix for structures with zero force at some coordinates- Analogy between flexibility and stiffness - lack of fit - Stiffness matrix with rigid motions - Application of stiffness approach to pin jointed plane & space trusses - Continuous beams - Frames - Grids - Space frames introduction only - Static condensation technique- Choice of method - Stiffness or flexibility - Direct stiffness approach - Application to two & three dimensional pin- Jointed trusses.

UNIT 5 ANALYSIS BY SUBSTRUCTURES &ITERATION 9

Analysis by substructures using the stiffness & the flexibility method with tridiagonalisation - Iteration method for frames with non-prismatic members - Iteration method applied to rigidly connected members - Computer program for the analysis of rigidly connected beams - Efficiency of the iteration method.

TOTAL :45 PERIODS

COURSE OUTCOMES

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

- understand the basic concept of flexibility and stiffness, principle of superposition and methods of structural analysis.
- transform the flexibility and stiffness matrices from system coordinates to element coordinates.
- identify the degree of freedom and ability to formulate flexibility matrix of components of structure.
- formulate the stiffness matrix and apply to 2D and 3D structure.
- analyse the frame through the iteration methods.

REFERENCES

1. Rubinstein F.M., "Matrix Computer methods of Structural Analysis", Prentice Hall, 1966.
2. William Weaver JR. and James M. Gere, "Matrix Analysis of framed Structures", CBS Publishers and Distributers,1990.
3. ManickaSelvam V.K, "Elements of Matrix Stability Analysis of Structures", Khanna Publishers, 2006.
4. Pandit G.S, Gupta S.P, "Structural Analysis-A matrix Approch", Tata McGraw Hill Publishing Company Ltd, 2008.
5. C. Natarajan and P.Revathy, "Matrix methods of structural analysis, (Theory and Practice)", PHI Publications, 2011

WEB LINKS

1. https://www.youtube.com/watch?v=O1LwyvdZdCc
2. https://en.wikipedia.org/wiki/Direct_stiffness_method
3. http://www.pucmmsti.edu.do/websise/estudiante/materias/201220131/ST-IC%20-424-T-

01/Analisis%20Matricial,%201de%203.pdf

PSEE15102 ADVANCED CONCRETE TECHNOLOGY 3 0 0 3

COURSE OBJECTIVES

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

UNIT 1 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 - classifications - 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 2 PROPERTIES OF CONCRETE 9

Properties of fresh concrete - Workability - Segregation – Bleeding - Laitance - Tests on fresh concrete - Properties & 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 of concrete - Microstructure 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 3 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 4 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-compacting concrete and its applications - Bacterial concrete - Recycled aggregate concrete - Smart concrete - Ferro cement and its applications.

UNIT 5 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 : 45 PERIODS

COURSE OUTCOMES

At the end 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 fresh and 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. Santhakumar A.R., "Concrete Technology", Oxford University Press India, 2006.
2. Neville A.M., "Properties of Concrete", Prentice Hall,5th Edition 2012.
3. Shetty, M.S., "Concrete Technology: Theory and Practice", S.Chand and Co. Pvt. Ltd., Delhi, 2005.
4. Pierre-Claude Aitcin, "High Performance Concrete", Taylor & Francis, 2011.
5. Mary Krumboltz Hurd, "Formwork for Concrete", American Concrete Institute, 2005.

CODE BOOKS

1. IS:10262-2009, Indian Standard "Concrete Mix Proportioning - Guide Lines" (First Revision).
2. IS:456-2000, Plain and Reinforced Concrete - code of practice (4^{th} Edition).
3. Charts from ACI 211.1-91 - 1991 - American Standard Practice for selecting proportions for normal, heavy weight and mass concrete, ACI Committee 211.
4. Charts from DOE 1988 Teychenne, D C, Franklin, R E and Erntroy, H C. British Code of Practice for Design of normal concrete mixes, Department of the Environment (DOE),UK, HMSO, 1975 (1988).

WEB LINKS

1. https://en.wikipedia.org/wiki/Advance_Concrete
2. http://www.concretematerialscompany.com/concrete/

3. http://www.engineeringcivil.com/concrete-mix-design-calculations.html

PSEE15103 MAINTENANCE AND REHABILITATION OF STRUCTURES 3 0 0 3

COURSE OBJECTIVES

- To expertise the students to procure the accurate idea about the maintenance of repair strategies of building.
- To identify and apply appropriate structural and construction technologies to rectify maintenance problems.
- To formulate the students comprehend the basic concepts related to materials available for repair.
- To articulate the students to deal in practice with the recent repair and demolition.
- To create an ability to prepare repair and rehabilitation method for various deteriorated structure.

UNIT 1 MAINTENANCE AND REPAIR STRATEGIES 9

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 2 SERVICEABILITY AND DURABILITY OF CONCRETE 9

Quality assurance for concrete - 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 3 MATERIALS FOR REPAIR 9

Special concretes and mortar - concrete chemicals - special elements for accelerated strength gain - Expansive cement - Polymer concrete - sulphur infiltrated concrete - Ferro cement - Fibre reinforced concrete.

UNIT 4 TECHNIQUES FOR REPAIR AND DEMOLITION 9

Rust eliminators and polymers coating for rebars during repair - foamed concrete, mortar and dry pack - vacuum concrete - Gunite and Shotcrete - Epoxy injection - Mortar repair for cracks - shoring and underpinning. Methods of corrosion protection - corrosion inhibitors - corrosion resistant steels - coatings and cathodic protection - Engineered demolition techniques for dilapidated structures - Case studies.

UNIT 5 REPAIRS, REHABILITATION AND RETROFITTING OF STRUCTURES 9

Repairs to overcome low member strength - Deflection, cracking, chemical disruption - weathering corrosion, wear, fire, leakage and marine exposure.

TOTAL : 45 PERIODS

COURSE OUTCOMES

At the end 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 fresh and 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 Company, New Delhi, 2005.
2. Santhakumar, A.R., Training Course notes on Damage Assessment and repair in Low Cost Housing , “RHDC-NBO” Anna University, July 1992.
3. Raikar, R.N., Learning from failures - Deficiencies in Design, Construction and Service - R&D Centre (SDCPL), RaikarBhavan, Bombay, 1987.
4. Dension Campbell, Allen and Harold Roper, ”Concrete Structures, materials, maintenance and repair”, Longman Scientific and Technical, UK, 1991.
5. Dr. B. Vidivelli, “Rehabilitation Of Concrete Structures”, Standard Publishers Distributors, 2007.

WEB LINKS

1. http://theconstructor.org/concrete/design-of-concrete-structures-for-durability/7268/
2. http://www.sustainableconcrete.org/?q= node/171
3. http://www.concreteconstruction.net/rep air/demolition-the-easy-way.aspx

PSEE15104 STRUCTURAL OPTIMIZATION 3 0 0 3

COURSE OBJECTIVES

- To describe the fundamentals of optimization concepts and their applications in the structural engineering field.
- To categorize the linear programming methods of the optimization.
- To discriminate the constrained and unconstrained variables of the various structural engineering problems.
- To prepare the various methods of optimality involving geometric and dynamic programming.
- To summarize on the various advanced techniques in the structural optimization.

UNIT 1 OPTIMIZATION FUNDAMENTALS 9

Optimization methods - Introduction, Problem formulation, Introduction to mathematical principles in optimization -Mathematical models - Activity - Design methodology- Civil engineering case study- Unconstrained functions - single variable- several variable- equality constraints - inequality constraints- optimization- design space- Feasible and Infeasible- Convex and concave - Active constraints- Local and Global optima - differential Calculus- Optimality criteria- Lagrange multiplier method- Kuhn- tucker Criteria.

UNIT 2 LINEAR PROGRAMMING 9

Formulation of problems - Graphical solution -Analytical methods - Standard form - Slack, surplus and artificial variables -Canonical form - Basic feasible solution - Simplex method - Two phase method -Penalty method - Duality theory - Primal - Dual algorithm.

UNIT 3 NON-LINEAR PROGRAMMING 9

Introduction to non-linear problems - One dimensional minimization methods - unimodal function - Exhaustive and unrestricted search - Dichotomous search - Fibonacci method- Golden section method - Interpolation methods. Unconstrained multivariable function - Univariate method- Cauchy's steepest descent method- conjugate gradient method (Fletcher Reeves) - Variable metric methods (Davison-Fletcher-Powell) - Direct and indirect methods - Interior Penality function - External Penalty function method.

UNIT 4 GEOMETRIC PROGRAMMING AND DYNAMIC PROGRAMMING 9

Geometric Programming- Polynomial - Degree of difficulty- Reducing G.P.P. to a set of simultaneous equations - Concepts of solving problems with zero difficulty and one degree of difficulty - Dynamic

Programming - Bellman's principle of optimality -Representation of a multi stage decision problem - Concept of sub -optimisation problems - Truss optimization.

UNIT 5 NON-TRADITIONAL METHODS 9

Genetic Algorithm - Terminology - Natural Law of Evolutions - Genetic operators - steps for solution of problems - Simulated Annealing - Algorithm - Boltzman's equation - ANT Colony optimization – Algorithm Pheromone trail - Travelling salesman problem- Introduction to TABU search - sample problem- Artificial Neural Network - Application characteristics.

TOTAL : 45 PERIODS

COURSE OUTCOMES

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

- apply the basic ideas in optimization to make the structures as lightly as possible.
- classify the linear programming techniques in engineering optimization.
- formulate the unconstrained and constrained optimization problems in structural design.
- identify the methods in solving the problems related to geometric and dynamic Programming.
- standardize in advanced techniques of optimization such as genetic algorithm and Artificial Neural Networks.

REFERENCES

1. Rao. S.S., "Optimisation Theory and Applications", New Age International Private Limited Publisher, New Delhi, 2002.
2. Belegundu, A.D.and Chandrapatla,T.R., "Optimisation Concepts and Applications in Engineering", Pearson Education, 2011.
3. Deb K., "Optimisation for Engineering Design", Algorithms and examples, Prentice Hall, New Delhi, 2012.
4. Arora J.S., "Introduction to Optimum Design", McGraw -Hill Book Company, 2011.
5. Taha, H.A., "Operations Research - An Introduction", Prentice Hall of India, 2004.

WEB LINKS

1. http://www.structures.ethz.ch/education/master/optimization
2. http://web.mit.edu/16.810/www/16.810_L8_Optimization
3. http://nptel.ac.in/courses/105108127

PSEE15105 DESIGN OF TALL BUILDINGS 3 0 0 3

COURSE OBJECTIVES

- To paraphrase various aspects of planning of tall buildings and know about different types of loads
- To establish various structural systems for high rise buildings with their behaviour and analysis.
- To illustrate knowledge about analysis involved in tall structures.
- To formulate about sectional shapes and design for differential movement, creep and shrinkage effects.
- To impart knowledge about stability analysis of various systems and to know about advanced topics.

UNIT 1 DESIGN PRINCIPLES AND LOADING 9

General - Factors affecting growth, height and structural form - Design philosophy - Loading - Gravity loading - Wind loading - Earthquake loading - Combinations of loading - Strength and Stability - Stiffness and drift limitations - Human comfort criteria- Creep effects - Shrinkage effects - Temperature effects - Fire - Foundation settlement - Soil- structure interaction, Material.

UNIT 2 BEHAVIOUR OF VARIOUS STRUCTURAL SYSTEMS 9

High rise behaviour - Rigid frames, braced frames, Infilled frames, shear walls, coupled shear walls, wall-frames, tubulars, cores, futrigger - braced and hybrid mega systems.

UNIT 3 ANALYSIS OF TALL 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 & 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.

UNIT 4 STRUCTURAL ELEMENTS 9

Sectional shapes, properties and resisting capacity, design, deflection, cracking, prestressing, shear flow -

Design for differential movement - creep and shrinkage effects - temperature effects and fire resistance.

UNIT 5 STABILITY 9

Overall buckling analysis of frames - wall-frames - Approximate methods second order effects of gravity of loading - P-Delta analysis - simultaneous first-order and P Delta analysis - Translational - Torsional instability - out of plumb effects - stiffness of member in stability - effect of foundation rotation.

TOTAL : 45 PERIODS

COURSE OUTCOMES

At the end of this course the student will be able to

- know design principles and different types of loading
- describe the various structural systems used in the construction of tall structures.
- capable of analysing the tall structures
- design of structural elements for secondary effects
- execute stability analysis, overall buckling analysis of frames, analysis for various secondary effects such as creep, shrinkage and temperature.

REFERENCES

1. Bryan Stafford Smith and Alexcoull, “Tall Building Structures -
2. Analysis and Design”, John Wiley and Sons, Inc., 1991.
3. Taranath B.S., “Structural Analysis and Design of Tall Buildings”, McGrawHill, 2011.’
4. 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,1995.
5. Lin T.Y and Stotes Burry D, “Structural Concepts and systems for Architects and Engineers”, John Wiley, 1988.

WEB LINKS

1. http://www.sciencedirect.com/science/article/pii/S0307904X09003813
2. http://www.sciencedirect.com/science/article/pii/S016761050700089X
3. http://www.crcnetbase.com/isbn/9781439850893

PSEE15106 NON - LINEAR ANALYSIS OF STRUCTURES 3 0 0 3

COURSE OBJECTIVES

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

UNIT 1 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 2 ELASTIC ANALYSIS OF FLEXURAL MEMBERS 9

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

UNIT 3 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 4 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 shells - Forced nonlinear vibration of shells - Post buckling of shells.

UNIT 5 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 : 45 PERIODS

COURSE OUTCOMES

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

- describe the 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.

WEB LINKS

1. http://ocw.mit.edu/resources/res-2-002-finite-element-procedures-for-solids-and-structures-spring-2010/nonlinear
2. https://www.andrew.cmu.edu/course/24-688/handouts/Week%2010%20-%20Nonlinear%20Structural%20Analysis/Lecture%20Material/Week%2010%20-%20Nonlinear%20Structural%20Analysis%20-%20Lecture%20Presentation.pdf
3. http://mostreal.sk/html/guide_55/g-str/gstr8.html

PSEE15107 SMART STRUCTURES 3 0 0 3

COURSE OBJECTIVES

- To describe the basic principles and mechanisms of smart materials and devices.
- To demonstrate knowledge and understanding of the physicalprinciples underlying the behavior of smart materials.
- To outline the basic principles and mechanisms of measuring techniques.
- To practice knowledge and understanding of the engineering principles in smart sensors, actuators and transducer technology.
- To propose improvement on the design, analysis, manufacturing and application issues involved in integrating smart materials and devices.

UNIT 1 PROPERTIES OF MATERIALS AND ER AND MR FLUIDS 9

Piezoelectric Materials and properties - Actuation of structural components - Shape Memory Alloys - Constitutive modeling of the shape memory effect, vibration control - Embedded actuators - Electro rheological and magnetorheological fluids - Mechanisms and Properties - Fiber Optics - Fibre characteristics - Fiber optic strain sensors

UNIT 2 VIBRATION ABSORBERS 9

Parallel damped vibration absorber - Gyroscopic vibration absorber - Active vibration, absorber - Applications - Vibration Characteristics of mistuned systems - Analytical approach

UNIT 3 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 4 CONTROL OF STRUCTURES 9

Control modeling of structures - Control strategies and limitations - Classification of control systems - Classical control, Modern control, Optimal control and Digital control - Active structures in practice.

UNIT 5 APPLICATIONS IN CIVIL ENGINEERING 9

Application of shape memory - Alloys in bridges - Concept of smart bridges - Application of ER fluids - Application of MR dampers in different structures - Application of MR dampers in bridges and high rise structures - Structural health monitoring - Application of optical fibres - Concept of smart concrete.

TOTAL : 45 PERIODS

COURSE OUTCOMES

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

- select various smart materials and devices.
- set up analytical approach on vibration absorbers.
- Propose various strain measurement using smart materials.
- manipulate control strategies of smart structures.
- apply principles of smart structures to civil engineering field.

REFERENCES

1. Gandhi, M.V and Thompson, B.S., "Smart Materials and Structures", Chapman and Hall,1992.
2. Yoseph Bar Cohen, "Smart Structures and Materials", The International Society for Optical Engineering, 2003.
3. Srinivasan, A.V., and Michael McFarland. D., "Smart Structures - Analysis and Design",Cambridge University Press, 2001.
4. Brian Culshaw, "Smart Structures and Materials", Artech House, Boston, 1996.
5. P. Gaudenzi, "Smart Structures: Physical Behavior, Mathematical Modeling and Applications", Macmillan India Ltd ,2007.

WEB LINKS

1. http://www.me.metu.edu.tr/courses/me493
2. http://nptel.ac.in/courses/112104173
3. http://theconstructor.org/structural-engg/smart-structures-and-materials/6/

LIST OF ELECTIVES FOR II SEMESTER

PSEE15201 DESIGN OF SUB STRUCTURES 3 0 0 3

COURSE OBJECTIVES

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

UNIT 1 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 2 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 3 PILE FOUNDATION 9

Pile foundations - Types - General principles of design - Estimation of load capacity of piles by static and 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 4 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 5 FOUNDATIONS OF TRANSMISSION LINE TOWERS 9

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

TOTAL : 45 PERIODS

COURSE OUTCOMES

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

- attain the perception of site investigation to select suitable type of foundation based on soil category.
- be capable of ensuring design concepts of shallow foundation.
- be efficient in selecting suitable type of pile for different soil stratum and in evaluation of group capacity by formulation
- design different types of well foundation.
- deliver the design concepts for transmission line tower foundation

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. "Dynamics of Bases and Foundations" by Barken.McGraw Hill Company.

CODE BOOKS

1. IS 2911 : Part 1 : Sec 1 : 1979 Code of practice for design and construction of pile foundations: Part 1 Concrete piles, Section 1 Driven cast in-situ concrete piles
2. 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
3. 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.
4. 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.
5. IS 2911 : Part 2 : 1980 Code of practice for designing and construction of pile foundations: Part 2 Timber piles.
6. IS 2911 : Part 3 : 1980 Code of practice for design and construction of pile foundations: Part 3 Under reamed piles
7. IS 2911 : Part 4 : 1985 Code of practice for design and construction of pile foundations: Part 4 Load test on piles
8. IS 6403 : 1981 Code of practice for determination of bearing capacity of shallow foundations

WEB LINKS

1. http://theconstructor.org/geotechnical/site-investigation-or-soil-exploration/312/
2. http://www.gic-edu.com/908/Distance--Shallow-Foundation-Design-Settlement-Analysis-Workshop-12-PDHs
3. http://www.nptel.ac.in/downloads/105104137/

PSEE15202 EXPERIMENTAL TECHNIQUES AND INSTRUMENTATION 3 0 0 3

COURSE OBJECTIVES

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

UNIT 1 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 2 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 3 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 4 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 5 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 : 45 PERIODS

COURSE OUTCOMES

At the end of the 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.

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1. Sadhu Singh, “Experimental Stress Analysis”, Khanna Publishers, New Delhi,1996.
2. Ganesan T.P., “Model Analysis of Structures”, Universities Press (India) Ltd 2005.
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. Sirohi.R.S., Radhakrishna.H.C, “Mechanical Measurements”, New Age International (P) Ltd. 1997.

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PSEE15203 COMPUTER AIDED ANALYSIS AND DESIGN OF STRUCTURES 3 0 0 3

COURSE OBJECTIVES

- To familiarise with graphic primitives, transformations and 2-D drafting of computer graphics.
- To get practiced with computer methods of structural analysis.
- To understand the structural design concepts.
- To be familiar with linear programming and CPM and PERT.
- To inculcate the students with Artificial Intelligence.

UNIT 1 COMPUTER GRAPHICS 9

Graphic primitives - Transformations - Basics of 2-D drafting - Modeling of curves and surfaces – Wire frame modeling - Solid modeling - Graphic standards - Drafting software packages and usage

UNIT 2 STRUCTURAL ANALYSIS 9

Computer aided analysis of steel and RC Structural elements – Application of software.

UNIT 3 STRUCTURAL DESIGN 9

Computer aided design of steel and RC Structural elements - Detailed drawing – Bill of materials

UNIT 4 OPTIMIZATION 9

Application of linear programming - Simplex algorithm - Post-optimality analysis - Project scheduling - CPM and PERT applications

UNIT 5 ARTIFICIAL INTELLIGENCE 9

Introduction - Heuristic search - knowledge based expert systems – Rules and decision tables – Inference mechanisms- Simple applications - Genetic algorithm and applications - Principles of Neural network - Architecture and applications of KBES - Expert system shells.

TOTAL :45 PERIODS

COURSE OUTCOMES

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

- be familiar with 2 D drafting and can use drafting software.
- perform structural analysis using analysis package
- design the structures with computer methodologies.
- optimize the structural design with various computer packages and graphics.

- apply artificial intelligence to real life applications.

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1. Krishnamoorthy C.S and Rajeev S., “Computer Aided Design”, Narosa Publishing House, New Delhi, 2005.
2. Groover M.P. and Zimmers E.W. Jr.," CAD/CAM, Computer Aided Design and Manufacturing ", Prentice Hall of India Ltd, New Delhi, 2006.
3. Harrison H.B., “Structural Analysis and Design Vol.I and II”, Pergamon Press, 1991
4. Rao. S.S., " Optimisation Theory and Applications ", Wiley Eastern Limited, New Delhi, 2009.
5. Richard Forsyth (Ed.), “Expert System Principles and Case Studies”, Chapman and Hall, 1996.

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2. http://link.springer.com/article/10.1007%2Fs40069-012-0027-7#page-1
3. http://www.civil.northwestern.edu/people/bazant/PDFs/Papers/S12.pdf

PSEE15204 DESIGN OF BRIDGES 3 0 0 3

COURSE OBJECTIVES:

- To study the various bridge forms and typical loadings on the bridges.
- To get familiarized with the design of short span bridges.
- To possess knowledge on the design concepts of long span bridges.
- To design the prestressed concrete bridges.
- To understand the concept of designing the substructure for bridges, plate girder to IRC loadings, foundation for bridges and bearings

UNIT 1 DESIGN PRINCIPLES 9

General basic bridge forms - Beam, arch, suspension, various types of bridges, selection of type of bridge and economic span length, drainage, road, kerb, classification, investigation and planning. design loads for bridges - Dead load, live load, IRC loading, IRS loading, Aashto loading, wind load, longitudinal forces, centrifugal forces, buoyancy, water current forces, thermal forces deformation and horizontal forces

UNIT 2 SHORT SPAN BRIDGES 9

Design of culvert, Deck slab bridge - T - Beam girder bridge - Pigeaud's Theory - Courbon's Method

UNIT 3 LONG SPAN BRIDGES 9

Design principles of continuous bridges - box girder bridges and balanced cantilever bridges.

UNIT 4 DESIGN OF PRESTRESSED CONCRETE BRIDGES 9

Flexural and Torsional parameters - Courbon's Theory - Distribution Coefficient by exact analysis - Design of girder section - maximum and minimum prestressing forces - Eccentricity - Live load and dead load shear forces - Cable Zone in Girder - Check for stresses at various sections - Check for diagonal tension - Diaphragms - End Block - Short term deflections.

UNIT 5 DESIGN OF PLATE GIRDER BRIDGES , BEARINGS AND SUBSTRUCTURES 9

Design of riveted and welded plate girder bridges - Wind effects - Main section, splicing, curtailment, stiffeners - Different types of bearings - design of bearings - Design of masonry and concrete piers and abutments - Types of bridge foundations - Design of foundations - Footings - Pile foundations.

TOTAL : 45 PERIODS

COURSE OUTCOMES

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

- understand the design theories for super structure and sub structure of bridges
- design short span bridges.
- understand the behaviour of continuous bridges, box girder bridges.
- design prestressed concrete bridges.
- design railway bridges, plate girder bridges, different types of bearings , abutments, piers and various types of foundations for Bridges

REFERENCES

1. Ponnuswamy.S "Bridge Engineering", Tata McGrawHill, 2008.
2. Johnson Victor.D, "Essentials of Bridge Engineering", Oxford & IBH, 2007.
3. Jagadeesh T.R. and Jayaram .M.A., "Design of Bridge Structures", Prentice Hall of India Pvt Ltd., 2004.
4. Raina V.K., "Concrete Bridge Practice", Tata McGraw Hill Publishing Company, New Delhi, 1994.
5. Bakht.B and Jaegar.L.G., "Bridge Analysis Simplified", McGraw Hill, 1985.

CODE BOOKS

1. IRC:6-2010 Standard Specifications and Code of Practice for Road Bridges, Section II - Loads and Stresses (Fifth Revision).
2. IRC:18-2000 Design Criteria for Prestressed Concrete Road Bridges (Post-Tensioned Concrete) (Third Revision).
3. IRC:21-2000 Standard Specifications and Code of Practice for Road Bridges, Section III - Cement Concrete (Plain and Reinforced) (Third Revision).
4. IRC:22-2008 Standard Specifications and Code of Practice for Road Bridges, Section VI - Composite Construction (Limit States Design) (Second Revision).
5. IRC:24-2010 Standard Specifications and Code of Practice for Road Bridges, Steel Road Bridges (Limit State Method)Third Revision).
6. IRC:83-1999 (Part-I) Standard Specifications and Code of Practice for Road Bridges, Section IX - Bearings, Part I : Metallic Bearings (First Revision).
7. IRC:83-1987 (Part II) Standard Specifications and Code of Practice for Road Bridges, Section IX - Bearings, Part II: Elastomeric Bearings.
8. IRC:83-2002 (Part III) Standard Specifications and Code of Practice for Road Bridges, Section IX - Bearings, Part III: POT, POT-CUMPTFE,PIN and Metallic Guide Bearings.

9. Pigeaud's curves

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2. http://handbook.uts.edu.au/subjects/49131.html
3. http://www.britannica.com/technology/bridge-engineering

PSEE15205 MECHANICS OF COMPOSITE MATERIALS 3 0 0 3

COURSE OBJECTIVES

- To describe the composite materials and properties of composite fiber and matrix constituents.
- To state stress strain relation of orthotropic and anisotropic materials
- To recall the static, dynamic and stability analysis for simpler cases of composite plates.
- To elucidate the failure criterion and fracture mechanism of composites.
- To identify the metal and ceramic composite & design with composites

UNIT 1 INTRODUCTION 9

Introduction to Composites - Classifying composite materials and their properties - Commonly used fiber and matrix constituents - Composite Construction - Properties of Unidirectional Long Fiber Composites - Short Fiber Composites.

UNIT 2 STRESS STRAIN RELATIONS 9

Concepts in solid mechanics - Hooke's law for orthotropic and anisotropic materials - Linear Elasticity for Anisotropic materials - rotations of stresses, strains, residual stresses.

UNIT 3 ANALYSIS OF LAMINATED COMPOSITES 9

Governing equations for anisotropic and orthotropic plates - Angle-ply and cross ply laminates. Static, dynamic and stability analysis for simpler cases of composite plates. Inter laminar stresses.

UNIT 4 FAILURE AND FRACTURE OF COMPOSITES 9

Netting analysis - Failure criterion - maximum stress - maximum strain, fracture mechanics of composites - Sandwich construction.

UNIT 5 APPLICATIONS AND DESIGN 9

Metal and ceramic matrix composites - Applications of composites, composite joints - Design with composites- Review, Environmental issues

TOTAL : 45 PERIODS

COURSE OUTCOMES

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

- categorize the fibre types and classify the composite material.
- tell the stress –strain properties, longitudinal and transverseproperties of composites lamina.
- analyse the laminated composites and compute the lamina strength.
- locate the failure criterion and fracture mechanics of composites.
- relate the load deformation relation, residual stresses for the design of composites.

REFERENCES

1. Daniel and Ishai, "Engineering Mechanics of Composite Materials", Oxford University Press, 2006.
2. Jones R.M., "Mechanics of composite materials", McGraw-Hill, Kogakusha Ltd., Tokyo, 1998.
3. Agarwal.B.D. and Broutman.L.J., "Analysis and Performance of fiber composites", John-Wiley and Sons, 2006.
4. Michael W.Hyer, "Stress Analysis of Fiber-Reinforced Composite Materials", McGraw Hill, 2009.
5. Mukhopadhyay.M, "Mechanics of Composite Materials and Structures",University Press, India, 2005.

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2. http://www.nptel.ac.in/courses/101104010
3. http://naca.central.cranfield.ac.uk/reports/arc/rm/3677.pdf

PSEE15206 ENERGY EFFICIENT STRUCTURES 3 0 0 3

COURSE OBJECTIVES:

- To create awareness of the necessity of energy needed for structures.
- To study the different climate types and their influence in building design.
- To focus on the thermal environment of structures
- To equip the knowledge of appliances and their utilisation in buildings.
- To elucidate the energy audit systems in buildings.

UNIT 1 ENERGY EFFICIENT CONCEPTS 9

Need of energy in buildings - assessment - Energy consumption pattern of various types of buildings - Factors influencing the energy use in building - Concepts of energy efficient building.

UNIT 2 CLIMATE 9

Study of Climate types - their influence in building design - Environmental factors affecting building design - Analysis of thermal and visual environment.

UNIT 3 HEAT AND LIGHT 9

Heat gain and loss phenomenon in buildings - Thermal performance parameters - Role of building enclosures, openings and materials in thermal environment - Basic principles of light and daylight - Energy efficient light design of buildings - Daylight design of buildings.

UNIT 4 APPLIANCES IN BUILDINGS 9

Major appliances in building and their energy consumptions - Principles of solar heating, cooling and power (PV) systems - Integration of energy efficient appliances with the buildings.

UNIT 5 ENERGY AUDIT 9

Energy survey and energy audit of buildings - Calculation of energy inputs and utilization in buildings - Energy audit reports of buildings - Concepts of Green Buildings - energy rating of buildings.

TOTAL :45 PERIODS

COURSE OUTCOMES

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

- get introduced to various energy consumptions
- master the climate and environmental factors affecting building design.
- gain knowledge of design of buildings according to thermal environment.
- acquire the skills of utilisation of appliances and the principles behind them.
- obtain the knowledge of energy audit in buildings

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1. Chand, I. and Bhargava,P.K., "The Climatic Data Handbook", Tata McGraw Hill Publishing Company Limited, New Delhi 1999.
2. Threlkeld, J.L,"Thermal Environmental Engineering", Printice-Hall, Englewood Cliffs, NJ, 1998.
3. Lal Jayamaha, "Energy-Efficient Building Systems: Green Strategies for Operation and Maintenance", McGraw Hill, 2007.
4. Krishnan, A., Baker, N., Yannas, S. and Szokolay, S.V., "Climate Responsive Architecture - A Design Hand Book for Energy Efficient Buildings", Tata McGraw Hill Publishing Company Ltd, New Delhi, 2001.
5. Shahin Vassigh, Jason R. Chandler, "Building Systems Integration for Enhanced Environmental Performance" J. Ross Publishing, 2011.

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1. 'Handbook on functional requirements of buildings', Parts 1-4, SP: 41 (S&T), Bureau of Indian Standards - 1995.

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2. https://www.wbdg.org/resources/efficientlighting.php
3. http://www.institutebe.com/Green-Net-Zero-Buildings/renewable-energy-advantages.aspx

PSEE15207 STRUCTURES IN DISASTER PRONE AREAS 3 0 0 3

COURSE OBJECTIVES

The main objective of this course is

- to know the various types of disaster caused by the nature and disaster prone areas in India.
- to have a knowledge about the response of the structure for various disaster.
- to obtain a brief knowledge about the planning and preparedness for a disaster.
- to know about the various modern materials and tools used in disaster reduction.
- to have knowledge about the various organisations involved in disaster management.

UNIT 1 DISASTER 9

Introduction - Types of disasters - Disaster mitigating agencies and their organization structure at different levels - Overview of disaster situations in India - Vulnerability profile of India and vulnerability mapping including disaster prone areas, communities and places.

UNIT 2 RESPONSE OF THE STRUCTURE 9

Philosophy for design to resist Earthquake, Cyclone and flood -By-laws of urban and Semi-Urban areas- Traditional and modern structures. Response of dams, bridges, buildings - Testing and evaluation - Classification of structures from safety point of view - Methods of strengthening for different disasters - Qualification test.

UNIT 3 SEISMIC VULNERABILITY OF URBAN AREAS 9

Seismic response of R.C frames buildings with soft first storey - Preparedness and planning for an urban earthquake disaster - Tsunami and its impact - Urban settlements.

UNIT 4 MODERN MATERIALS AND TECHNIQUES 9

Use of modern materials their impact on disaster reduction - Use of modern analysis, design and construction techniques - Optimization for performance - Damage surveys - Maintenance and modifications to improve hazard resistance - Different types of foundation and its impact on safety.

UNIT 5 DISASTER MANAGEMENT 9

Landslide hazards zonation mapping - Geo-environmental problems associates with the occurrence of landslides - Role of remote sensing, science and technology - Rehabilitation programmes - Management of Relief Camp - information systems and decision making tools, voluntary agencies and community participation - various stages of disaster Management.

TOTAL :45 PERIODS

COURSE OUTCOMES

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

- know the various disasters, their characteristics, causes and impacts.
- know about the strengthening of structures by various methods which was affected by the disaster.
- understand the response of building with soft first storey.
- use of various modern methodology and tools to reduce destructions.
- have a brief knowledge about disaster mitigating agencies.

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1. Allen, R.T. and Edwards, S.C., “Repair of Concrete Structures”, Blakie and Sons, 2005.
2. Moskvin V, “Concrete and Reinforced Structures - Deterioration and Protection”, MirPublishers, Moscow, 1983.
3. Singh R.B, “Disaster Management”, Rawat Publications, 2000.
4. Sachindra Narayan, “Anthropology of Disaster management”, Gyan Publishing house, 2000.
5. Harsh K Gupta, “Disaster Management”, Orient Blackswan Pvt. Ltd., 2003

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1. IS 1893 : 2002 (Part 1) - Criteria for Earthquake Resistant Design of Structures - General.
2. IS 4326 : 1993 - Code of Practice for Earthquake Resistant Design and Construction of Buildings .

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3. http://www.slideshare.net/chaitanyakorra/disaster-resistant-architecture