COIMBATORE INSTITUTE OF TECHNOLOGY

(Government Aided Autonomous Institution Affiliated to Anna University, Chennai)

COIMBATORE - 641 014, TAMILNADU, INDIA

DIAMOND JUBILEE

(1956 - 2016)

Department of Civil Engineering

M.E. Computer Methods and Applications in Structural Engineering

Curriculum and Syllabi

Under Choice Based Credit System

(For the students admitted during 2015 - 2016 and onwards)

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DEPARTMENT OF CIVIL ENGINEERING

COIMBATORE INSTITUTE OF TECHNOLOGY

VISION AND MISSION OF THE INSTITUTE

VISION

The Institute strives to inculcate a sound knowledge in engineering along with realized social responsibilities to enable its students to combat the current and impending challenges faced by our country and to extend their expertise to the global arena.

MISSION

The mission of CIT is to impart high quality education and training to its students to make them World-Class Engineers with a foresight to the changes and problems, and pioneers to offer innovative solutions to benefit the nation and the world at large.

DEPARTMENT OF CIVIL ENGINEERING

COIMBATORE INSTITUTE OF TECHNOLOGY

VISION AND MISSION OF THE DEPARTMENT OF CIVIL ENGINEERING

VISION

To provide quality education in Civil Engineering and to become a state-of-the-art source of world-class Civil Engineers and Researchers.

MISSION

To impart quality education with necessary skills to meet the requirements of the industry and to perform with professional ethics and an attitude for innovation in Civil Engineering through state-of-the-art technology.

DEPARTMENT OF CIVIL ENGINEERING

COIMBATORE INSTITUTE OF TECHNOLOGY

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

The following Programme Educational Objectives are designed based on the department mission.

PEO 1 : The graduates of this programme will have a strong base in analytical and technical knowledge to adapt them to work in interdisciplinary projects involving formulation, analysis, design and to meet challenges in real Civil Engineering projects.

PEO 2 : The graduates of this programme will have the skill to involve themselves in basic and applied research and development activities in core areas by effectively handling complex structural engineering and inter-disciplinary projects.

PEO 3 : The graduates of this programme will possess an attitude to update themselves in modern tools of structural analysis and design techniques in-line with global work environment.

DEPARTMENT OF CIVIL ENGINEERING

COIMBATORE INSTITUTE OF TECHNOLOGY

PROGRAMME OBJECTIVES (POs)

The structural engineering graduates after the completion of the programme will have the following capabilities :

PO1 : Demonstrate knowledge of analytical and applied Civil Engineering principles

PO2 : Apply knowledge in analysis and design of structures as per National and International Codes of practice

PO3 : Use and develope, computer methods and applications in analysis and design of structures

PO4 : Adapt to technical advancements and to acquire the required skill by life-long learning and continuing education

PO5 : Understand and solve the contemporary issues related to Structural Engineering.

PO6 : Carry out research by applying current knowledge and advances in construction industry culminating in a meaningful research work

PO7 : Conduct technical feasibility studies in infrastructure development in-line with global standards

PO8 : Function as an effective leader in a multidisciplinary team

PO9 : Effectively communicate complex issues to the field personnel

PO10 : Bring out sustainable inter-dependable structures in a professional ethical way

PO11 : Apprehend the advances in other specilization of engineering and providing solutions using recent technology

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(Government Aided Autonomous Institution Affiliated to Anna University, Chennai)

DEPARTMENT OF CIVIL ENGINEERING

COURSES OF STUDY

For the students admitted during 2015 - 2016 and onwards

Under Choice Based Credit System

Name of the degree : M.E. (Full-Time)

Specialization   : Computer Methods and Applications in Structural Engineering

Semester I

Course Code	Course	Hours / week			C	CY
		L	T	P		
15MCE11	Applied Mathematics	4	0	0	4	FC
15MCE12	Applied Elasticity and Plasticity	3	0	0	3	PC
15MCE13	Computer Analysis of Structures	3	0	0	3	PC
15MCE14	Computer Aided Design of Reinforced Concrete Structures	3	0	0	3	PC
15MCE15	Advanced Steel Structures	3	0	0	3	PC
	Elective - I	3	0	0	3	PE
15MCE16	Computer Applications Laboratory	0	0	2	1	PC
	TOTAL CREDITS				**20**	

Semester II

Course Code	Course	Hours / week			C	CY
		L	T	P		
15MCE21	Structural Dynamics	3	0	0	3	PC
15MCE22	Finite Element Method	3	0	0	3	PC
15MCE23	Design of Foundation Structures	3	0	0	3	PC
	Elective - II	3	0	0	3	PE
	Elective - III	3	0	0	3	PE
	Elective - III	3	0	0	3	PE
15MCE24	Advanced Structural Engineering Laboratory	0	0	2	1	PC
	TOTAL CREDITS				**19**	

Semester III

Course Code	Course	Hours / week			C	CY
		L	T	P		
	Elective - V	3	0	0	3	PE
	Elective - VI	3	0	0	3	PE
	Elective - VII	3	0	0	3	PE
15MCE31	Practical Training				2	EEC
	TOTAL CREDITS				**11**	

Semester IV

Course Code	Course	Hours / week			C	CY
		L	T	P		
15MCE41	Project Work and Viva Voce				18	EEC
	TOTAL CREDITS				**18**	

Total number of credits : 68

LIST OF ELECTIVES

Sl. No.	Course Code	Course	Hours / week			C	CY
			L	T	P		
1	15MCEE1	Stability of Structures	3	0	0	3	PE
2	15MCEE2	Advanced Concrete Technology	3	0	0	3	PE
3	15MCEE3	Experimental Techniques and Instrumentation	3	0	0	3	PE
4	15MCEE4	Earthquake Resistant Design of Structures	3	0	0	3	PE
5	15MCEE5	Structural Optimization	3	0	0	3	PE
6	15MCEE6	Health Monitoring of Structures	3	0	0	3	PE
7	15MCEE7	Prestressed Concrete Structures	3	0	0	3	PE
8	15MCEE8	Corrosion and its Prevention	3	0	0	3	PE
9	15MCEE9	Theory of Plates	3	0	0	3	PE
10	15MCEE10	Design of Concrete Bridges	3	0	0	3	PE
11	15MCEE11	Design of Steel Concrete Composite Structures	3	0	0	3	PE
12	15MCEE12	Offshore Structures	3	0	0	3	PE
13	15MCEE13	Shell Structures	3	0	0	3	PE
14	15MCEE14	Computer Aided Analysis and Design of Tall Buildings	3	0	0	3	PE
15	15MCEE15	Wind and Cyclone Effects on Structures	3	0	0	3	PE
16	15MCEE16	Soil Structure Interaction	3	0	0	3	PE
17	15MCEE17	Mechanics of Composite Materials	3	0	0	3	PE

L - Lecture   T - Tutorial   P - Practical   C - Credits   CY - Category

FC - Foundation Course   PC - Professional Core

PE - Professional Elective   EEC - Employability Enhancement Course

15MCE11 - APPLIED MATHEMATICS

L	T	P	C
4	0	0	4

ASSESSMENT : THEORY

Category : *Foundation Course*

COURSE OBJECTIVE

- *To familiarize the students in the field of differential and elliptic equations to solve boundary value problems associated with engineering applications.*

- *To expose the students to variational formulation and numerical integration techniques and their applications to obtain solutions for buckling, dynamic response, heat and flow problems of one and two dimensional conditions.*

COURSE OUTCOME

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

CO1 : *Apprehend and apply the knowledge of Laplace and Fourier transformations in engineering*

CO2 : *Use Eigen value problems and Calculus of variations in structural engineering problems*

CO3 : *Apply Numerical Integration techniques for finite element analysis*

ONE DIMENSIONAL WAVE AND HEAT EQUATIONS

Laplace transform methods for one-dimensional wave equation - Displacements in a long string - longitudinal vibration of an elastic bar - Fourier transform methods for one-dimensional heat conduction problems in infinite and semi-infinite rods. **(13)**

ELLIPTIC EQUATION

Laplace equation - Properties of harmonic functions - Solution of Laplace's equation by means of Fourier transforms in a half plane, in an infinite strip and in a semi-infinite strip - Solution of Poisson equation by Fourier transforms method. **(12)**

CALCULUS OF VARIATIONS

Concept of variation and its properties - Euler's equation - Functional dependant on first and higher order derivatives - Functional dependant on functions of several independent variables - Variational problems with moving boundaries -Direct methods - Ritz and Kantorovich methods. **(12)**

EIGEN VALUE PROBLEMS

Methods of solutions: Faddeev - Leverrier Method, Power Method with deflation - Approximate Methods: Rayleigh - Ritz Method. **(12)**

NUMERICAL INTEGRATION

Gaussian Quadrature - One and Two Dimensions - Gauss Hermite Quadrature - Monte Carlo Method - Multiple Integration by using mapping function. **(11)**

TOTAL : 60

TEXT BOOKS

1. *Sankara Rao.K, "Introduction to Partial Differential Equations", Prentice Hallof India Pvt. Ltd., New Delhi, 2011.*

2. *Rajasekaran.S, "Numerical Methods in Science and Engineering A Practical Approach", S.Chand & Company Ltd.,2003.*

REFERENCES

1. *Gupta.A.S, "Calculus of Variations with Applications", Prentice Hall of India Pvt. Ltd., New Delhi, 2008.*

2. *Andrews.L.C and Shivamoggi.B.K, "Integral Transforms for Engineers", Prentice Hall of India Pvt. Ltd., New Delhi, 2003.*

15MCE12 - APPLIED ELASTICITY AND PLASTICITY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

Category : *Professional Core*

COURSE OBJECTIVE

To understand the concept of 3D stress, strain analysis and its applications to simple problems.

COURSE OUTCOME

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

CO1 : *Apprehend the principles of elasticity, plasticity and fracture mechanics*

CO2 : *Solve engineering problems related to thick cylinders, shafts and curved bars*

CO3 : *Use computer programming in solving problems related to plasticity and elasticity*

ANALYSIS OF STRESS AND STRAIN

Elasticity approach - Definition and notation of stress - components of stress and strain - generalized Hooke's Law - Principal stresses and strains for three dimensional element Equations of equilibrium and compatibility conditions for 3-D problems in Cartesian and cylindrical co-ordinates - Transformation of stresses and strains - Boundary conditions. Use of Programming Languages/ Software Packages for Stress/ Strain Analysis **(8)**

TWO DIMENSIONAL PROBLEMS IN CARTESIAN COORDINATES

Plane stress and plane strain problems with practical examples. Equations of equilibrium and compatibility conditions in Cartesian coordinates - Airy's stress function, bending of a cantilever of narrow rectangular cross-section under the action of couples, knife edge and varying distributed loads, bending of simply supported beams by uniform and uniformly varying loads. Use of Computer Programming/ Software Packages. **(8)**

TWO DIMENSIONAL PROBLEMS IN POLAR COORDINATES

Equations of equilibrium and compatibility conditions in polar coordinates - axisymmetrical problems; thick cylinder under uniform pressure, shrink and force fits, circular arc beams subjected to pure bending - bending of curved bar - Stress concentrations due to circular hole in plate - effect of concentrated and uniformly distributed load on straight boundary of semi-infinite plates, stresses in circular disc subjected to diametrically opposite concentrated loads. Use of Computer Programming/ Software Packages **(8)**

TORSION

Torsion of various shaped bars, pure torsion of prismatic bars, prandtle's membrane analogy, strain energy and finite difference method, torsion of rolled profiles, stress concentrations at re-entrant corners, torsion of thin walled tubes and hollow shafts. Plastic torsion - Elastic - plastic torsion analysis - circular section - sand heap analogy. Numerical Methods Using Software Packages **(8)**

THEORY OF PLASTICITY

Stress - strain diagram - Ideal plastic body - Illustration of plastic Analysis - Yield criteria - Rankine's theory - St.Venant's theory - Tresca Criterion - Beltramis theory - Von Mises criterion - Mohr's theory of yielding - Yield surface - Flow rule (stress - strain relation for perfectly plastic flow)- Prandtl Reuss equality - plastic work - stress - strain relation based on Tresca - plastic potential - uniqueness of a stress distribution - strain hardening - sand heap analogy. **(8)**

INTRODUCTION TO FRACTURE MECHANICS

Failure criteria and fracture toughness - stress intensity factor. **(5)**

TOTAL : 45

TEXT BOOKS

1. *Ernest E.Sechler, "Elasticity Engineering", Dover Publications, New York, 1968.*

2. *Chen.W.F. and Henry.D.J, "Plasticity for Structural Engineers", Cengage Learning India Pvt. Ltd., , New Delhi, 2008.*

REFERENCES

1. *Timoshenko and Goodier.J.N, "Theory of Elasticity", Mc Graw Hill book co, New York, 1988.*

2. *Sadhu Singh, "Theory of Plasticity", Khanna Publications, New Delhi, 2000.*

3. *A.C.Ugural and S.K.Fenster, "Advanced Strength and Applied Elasticity", Edward Arnold Publishers Ltd., UK, 2003.*

15MCE13 - COMPUTER ANALYSIS OF STRUCTURES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

Category : *Professional Core*

COURSE OBJECTIVE

To study the energy concepts, analysis of structures by stiffness and flexibility approaches.

COURSE OUTCOME

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

CO1 *: Apprehend the knowledge of analysis of structures using matrix methods*

CO2 *: Solve problems in beams, frames & trusses*

CO3 *: Develop computer programs for matrix methods*

BASIC CONCEPTS

Indeterminacy - Static, Kinematic - Generalized measurements - Degrees of Freedom - Constrained measurements - Behavior of Structures - Principle of Superposition - Equilibrium, Compatibility and Force displacement relations. **(5)**

STIFFNESS AND FLEXIBILITY

Stiffness and Flexibility matrices in Single, two and n-coordinates; Structures with Constrained measurements; Stiffness and flexibility coefficients - Basic Stiffness and basic Flexibility method applied to spring models. **(6)**

ENERGY CONCEPTS AND TRANSFORMATION OF INFORMATION

Strain energy; Stiffness and flexibility matrices for strain energy - Betti's law and its applications - Properties of stiffness and flexibility matrices - Contra gradient law- Co-ordinate transformations - Transformation of element matrices to structure matrices - orthogonal transformations. **(9)**

STIFFNESS METHOD

Development of the method - Structure stiffness matrix for beams, frames and trusses using displacement transformation matrix and coordinate transformation matrix - Internal forces due to thermal expansion and lack of fit - Direct stiffness methods- Static condensation - transfer matrix method - symmetry and anti-symmetry of structures - reanalysis technique -Analysis by substructures using the stiffness method. **(9)**

FLEXIBILITY METHOD

Flexibility Method applied to statically determinate and indeterminate structures; Choice of redundant; Primary structure- General formulation- Structures flexibility matrix using force transformation matrix - Internal forces due to thermal expansion and lack of fit. **(9)**

COMPUTER PROGRAMS

Development of Computer programs for simple problems (beams, frames and trusses). Computer application and use of computer packages. **(7)**

TOTAL : 45

TEXT BOOKS

1. *Devdas Menon, "Advanced Structural Analysis", Narosa Publishing House, Daryagang, New Delhi,2009.*

2. *Moshe.F.Rubinstein, "Matrix Computer Analysis of Structures", Prentice Hall, 1986*

REFERENCES

1. *Rajasekaran.S and Sankarasubramanian.G, "Computational Structural Mechanics", Prentice Hall of India, New Delhi, 2001.*

2. *Pandit.G.S and Gupta.S.P, "Structural Analysis - a Matrix Approach", Tata Mc Graw Hill Publishing Company, 2004.*

3. *Weaver.J.R and Gere.J.M, "Matrix Analysis of Framed Structures", CBS Publishers, New Delhi, 1986.*

4. *Fleming.J.F, "Computer analysis of Structural Systems", Mcgraw Hill Book Co., 1989.*

15MCE14 - COMPUTER AIDED DESIGN OF REINFORCED CONCRETE STRUCTURES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

Category : *Professional Core*

COURSE OBJECTIVE

To study the behavior, analysis and design of RC Structures.

COURSE OUTCOME

On completion of the course the students will be able to

CO1 : *Acquire knowledge on strength and serviceability of reinforced concrete elements.*

CO2 : *Design special Reinforced Concrete elements such as deep beams, corbels, shear wall and grid floors.*

CO3 : *Analyse and design the RC structures using software packages.*

DESIGN OF RC ELEMENTS AND SERVICEABILITY CRITERIA

Review of limit state design of slabs, beams and columns according to IS codes. Calculation of Deflection and crack width for beams and slabs as per IS codes. **(8)**

DESIGN OF SPECIAL RC ELEMENTS

Design of RC walls - Ordinary and shear walls - Design of corbels - Design of deep beams - Detailing. **(10)**

FLAT SLABS AND GRID FLOOR

Design of flat slabs and flat plates - Limitations - Design of voided slabs - Analysis and design of Grid floors - Detailing. **(10)**

INELASTIC BEHAVIOUR OF CONCRETE BEAMS

Moment - Curvature (M - θ) relation of Reinforced Concrete Sections - Moment redistribution - Baker's method of plastic design - Advantages and Disadvantages of Moment Redistribution - Application of software packages and computer programming. **(9)**

DESIGN LOADS OTHER THAN EARTHQUAKE LOADS

Dead Loads - Imposed Loads (IS 875 Part 2) - Loads due to Imposed Deformations - General Theory of Wind Effects on Structures. Application of software packages and computer programming. **(8)**

TOTAL : 45

TEXT BOOKS

1. P.C.Vargheese, "Advanced Reinforced Concrete Design", 2nd Edition, Prentice hall of India,New Delhi, 2009.

2. Park.R and Paulay.T, "Reinforced Concrete Structures", John Wiley and Sons, New Delhi, 1988.

3. Unnikrishnan Pillai and Devdos Menon, "Reinforced Concrete design", Tata McGraw Hill Publishers Company Ltd., NewDelhi, 2009.

REFERENCES

1. Baker.A.L.L, "The Ultimate Load Theory Applied to the Design of Reinforced Concrete Frames", Concrete Publications, London, 1956.

2. Sinha.N.C and Roy.S.K, "Fundamentals of Reinforced Concrete", S.Chand and Company, New Delhi, 2003.

3. Dayaratnam.P, "Design of Reinforced Concrete Structures", Oxford & OBH Publishing Co. Pvt. Ltd., Calcutta, 2005.

4. P.Purushothaman, "Reinforced Concrete Structural Elements - Behaviour Analysis and Design", Tata McGraw Hill Publishing Company Limited, New Delhi, 1986.

5. Gambhir, "Design of Reinforced Concrete Structures", PHI Learning Ltd., New Delhi, 2008.

6. IS 456-2000 : Plain and Reinforced Concrete - Code of Practice.

7. IS 875 : Part 1 : Part 1 Dead loads - Unit weights of building material and stored materials (Incorporating IS:1911-1967).

15MCE15 - ADVANCED STEEL STRUCTURES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

Category : *Professional Core*

COURSE OBJECTIVE

To study the concept of limit state design and analysis and design of Industrial buildings, steel towers, Trusses and Chimneys.

COURSE OUTCOME

On completion of the course the students will be able to:

CO1 : *Acquire knowledge in the structural steel analysis and design*

CO2 : *Familiarize in the design of various steel structures and their connections*

CO3 : *Use software packages in the design of steel structures*

LIMIT STATE DESIGN

Introduction to Limit state design -Ultimate and serviceability limit states - Design of tension, compression members - Design of beams. **(9)**

BEHAVIOUR AND DESIGN OF CONNECTIONS

Behavior of connections - Design requirements of bolted and welded connections -unstiffened and stiffened seated connections - framed connection - moment resistant connection - Tee stub and end plate connections **(9)**

ANALYSIS AND DESIGN OF INDUSTRIAL BUILDING

Types of loads on structures - Analysis and design of Industrial buildings and bents - sway and non sway frames - Analysis and design of gable frames -Design of Purlins , louver rails, gable column and wind girder. **(9)**

ANALYSIS AND DESIGN OF STEEL TOWERS

Transmission line towers - Micro Wave Towers - Loads on towers - Shape, Sag and Tension in Uniformly loaded conductors - Analysis of towers - Design of member in towers - Design of tower foundations. Design and Analysis of Steel Towers using Software packages. **(9)**

ANALYSIS AND DESIGN OF SPECIAL STRUCTURES

Analysis and design of trusses - forces in members - Design of self supporting chimney and guyed steel chimney- Stress due to wind and earthquake forces - Gust factor method - Design of foundation. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Subramanian.N, "Design of Steel Structures", Oxford University press, 2014.*

2. *Duggal, "Limit state design of Steel structures", Tata McGraw Hill, New Delhi, 2014.*

3. *Jayagopal L.S and D. Tensing "Design of Steel Structures" Vikas Publishing House Private Limited, New Delhi, 2015.*

REFERENCES

1. *Dayaratnam, 'Design of steel structure', S.Chand & Co., New Delhi, 2010.*

2. *Ramachandra, "Design of Steel Structures" Vol.2, Standard Publishing House, New Delhi. 2010.*

3. *IS 800 -2007,Indian Standard Code of practice for General Construction in Steel.*

4. *IS: 6533 Code of Practice for Design and Construction of steel chimney.*

5. *SP 6 : Part 1 : 1964 Handbook for structural engineers - Structural steel sections.*

6. *IS 802 : Part 1 : Sec 1 : 1995 Code of practice for use of structural steel in overhead transmission line towers, Part 1 Materials and Loads and permissible stresses Section 1 Materials and Loads*

7. *IS 6533: Part 2 : 1989 Code of practice for design and construction of steel chimneys Part 2 Structural aspects.*

15MCE16 - COMPUTER APPLICATIONS LABORATORY

	L	T	P	C
	0	0	2	1

ASSESSMENT : PRACTICAL

Category : *Professional Core*

COURSE OBJECTIVE

To impart training for application to advanced problems in analysis and design of civil engineering structures which expose the students to understand structural engineering softwares and also to address the industry demand.

COURSE OUTCOME

On completion of the lab the student will be able to :

CO1 *:* *Get hands on experience for analysis and design of reinforced concrete and steel structures using softwares*

CO2 *:* *Perceive limitations of softwares for linear and non-linear systems*

1. **Direct stiffness approach by MATLAB**

2. **Design of RCC and Steel elements by programs in Excel**

3. **Structural modeling - Analysis for vertical and horizontal loading**

4. **Buckling of columns and plates**

5. **Free and Forced vibration problems**

6. **Plane Stress and Strain problems**

7. **Non-Linear Finite Element Analysis - Simple Problems**

TOTAL : 30

REFERENCE BOOKS

1. STAAD.Pro - manual volume 1 and 2, Bentley Systems India, Private Limited, New Delhi.

2. ETABS - Integrated Building Design Software, CSI, Berkeley, California.

3. SAP 2000 - Linear and Non-Linear Static and Dynamic Analysis and Design, CSI, Berkeley, California.

4. ANSYS Structural Analysis Guide, ANSYS, Inc.,Canonsburg, PA, USA.

5. MATLAB - Beginners Guide to MATLAB, MathWorks, Inc.,Clarkson University,New York.

6. MS Excel 2013 - Microsoft Corporation, USA.

15MCE21 - STRUCTURAL DYNAMICS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

Category : Professional Core

COURSE OBJECTIVE

To expose the students the principles and methods of dynamic analysis of structures and to prepare them for designing the structures for wind, earthquake and other dynamic loads

COURSE OUTCOME

On completion of the course the students will be able to

CO1 : *Formulate dynamic equilibrium equations for SDOF and MDOF systems.*

CO2 : *Analyse SDOF and MDOF systems using classical and numerical methods.*

CO3 : *Apprehend the behavior of structures subjected to dynamic loads*

INTRODUCTION AND PRINCIPLES OF STRUCTURAL DYNAMICS

Dynamic analysis and their importance to structural engineering problems - Elements of vibratory systems and simple Harmonic Motion - Vibration with and without damping - D'Alembert's principle - Lagrange's equation. **(9)**

Single degree of freedom

Mathematical models of SDOF systems - Principle of Virtual displacements - Assumed modes method - Free vibration - Damped and undamped - Critical damping - Logarithmic decrement - Response to support motion - Transmissibility - Evaluation of damping resonance - Band width method to evaluate damping - Vibration isolation.

RESPONSE TO GENERAL DYNAMIC LOADING

Fourier series expression for loading - response to general dynamic loading - (blast or earthquake) - Duhamel's integral - Numerical evaluation - Finite difference method. Computer Methods **(9)**

GENERALIZED DISTRIBUTED FLEXIBILITY

Expression for generalised system properties - Vibration analysis with Rayleigh's variational method - Rayleigh - Ritz method.

CONTINUOUS SYSTEMS

Differential equation of motion - Transverse vibration of linearly elastic beams - Hamilton's Principle - Beam flexure including shear deformation and rotatory inertia - Analysis of undamped free vibration of simply supported and cantilever beams - Numerical evaluation of modes - Frequencies and response system - Vibration analysis using finite element method for beams and frames - Component mode synthesis. Software Applications. **(9)**

MULTIDEGREE OF FREEDOM SYSTEM

Evaluation of structural property matrices - Natural vibration - Solution of the eigen value problem - Iteration due to Holzer and Stodola - Transfer matrix method - Orthogonality of natural modes - Rayleigh's method - Rayleigh - Ritz method, Computer Programming using C / C++. **(9)**

DESIGN OF STRUCTURES SUBJECTED TO DYNAMIC LOADS

Idealization of multi-storied frames for dynamic analysis - Machine foundations - analysis to blast loading - Earthquake response - Elastic rebound theory - Deterministic analysis of earthquake response - lumped SDOF system - Design of earthquake resistant structures - Wind induced vibrations - IS code provisions - Computer Applications. **(9)**

TOTAL : 45

TEXT BOOKS

1. Craig.R.R, "Structural Dynamics - An Introduction to Computer Methods", John Wiley & Sons, 1995.

2. Clough.R.W and Penzien, "Dynamics of Structures", McGraw Hill Book Company, 2015.

3. Anil K Chopra, "Dynamics of Structures - Theory and Applications to Earth Quake Engineering", Prentice Hall, New Delhi, 2007.

REFERENCES

1. Mario Paz, "Structural Dynamics - Theory of Computation", Kluwer Acadamic Publication, 2004.

2. Smith.J.W, "Vibration of Structures", Chapman and Hall, 1988.

3. Max Irvine, "Structural Dynamics", Allen & Unwin, London, 1986.

4. Fertis.D.G, "Dynamics and Vibrations of Structures", John Wiley & Sons, 1973.

5. Singiresu S. Rao, "Mechanical Vibrations", Pearson Education Inc., New Delhi, 2004.

15MCE22 - FINITE ELEMENT METHOD

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

Category : *Professional Core*

COURSE OBJECTIVE

To study the energy principles, finite element concept, stress-strain analysis and its applications

COURSE OUTCOME

On completion of the course the students will be able to

CO1 : *Apprehend the knowledge of basis of Finite Element Method*

CO2 : *Formulate element problems for structural engineering problems*

CO3 : *Apply Finite Element Method for common structural engineering problems*

INTRODUCTION AND BASICS

General description - Basic element shapes - Discretization process - Node numbering - Mesh generation - Energy principles - Variational methods - Raleigh Ritz method - Galerkin Method - Least squares approach.

(9)

ANALYSIS OF TRUSSES, BEAMS AND FRAMES

Stiffness matrix for an axial element - transformation of vectors - plane truss analysis - beam stiffness - solution for beam problems - Two Dimensional beam element - rigid plane frames - inclined or skewed supports - analysis of grids. **(9)**

PLANE STRESS AND PLANE STRAIN PROBLEMS

Basic concepts of plane stress and plane strain - derivation of stiffness matrix for constant - strain, linear strain triangular elements - rectangular elements - iso parametric elements - Lagrange and Serendipity elements - static condensation - axisymmetric elements. **(9)**

PLATE BENDING PROBLEMS

Basic concepts - derivation of element stiffness matrix - four noded, eight noded rectangular and isoparametric elements - shear deformation in plates - computer applications. **(9)**

OTHER APPLICATIONS

Three dimensional stress analysis - Torsion problems - Free vibration analysis - Buckling problems - Heat transfer - Fluid flow problems - Thermal analysis - Finite element packages. **(9)**

TOTAL : 45

TEXT BOOK

1. *Daryl L.Logan, "Finite Element Method", Thomson Canada Ltd., India Edition, 2016.*

REFERENCES

1. *Singiresu.S.Rao, "The Finite Element Method in Engineering", Butterworth-Heinemann, India Edition, 2001.*

2. *Krishnamoorthy.C.S, "Finite Element Analysis", Tata Mc Graw Hill Publishing Co., New Delhi, 2008.*

3. *Rajasekaran.S, "Finite Element Analysis in Engineering Design", S.Chand and Company Ltd., 2003.*

4. *Larry.J.Segerlind, "Applied Finite Element Analysis", John Wiley and Sons, New York, 2010.*

5. *Robert.D.Cook, David.S.Malkus, "Concepts and Applications of Finite Element Analysis", John Wiley and Sons, India Edition, 2007.*

15MCE23 - DESIGN OF FOUNDATION STRUCTURES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

Category : *Professional Core*

COURSE OBJECTIVE

To study, analyse and design the different types of foundations and retaining structures

COURSE OUTCOME

On completion of the course the students will be able to

CO1 *:* *Apprehend the concepts of design of foundation structures*

CO2 *:* *Acquire knowledge about various Indian Standards for shallow and deep foundations*

CO3 *:* *Solve practical geotechnical problems and special problems*

SHALLOW FOUNDATIONS

Bearing capacity and settlement - Spread footings - contact pressure - Structural design of individual footings, pedestals, combined footings (Rectangular and trapezoidal), Strap footings - Eccentrically loaded footings - Mat foundations. **(9)**

PILE FOUNDATIONS

Types of piles - Static and dynamic pile formula - Pile load tests - Negative skin friction - Pile groups - Efficiency of pile group - Settlement of piles - Batter piles - Analysis of pile groups - Structural design of piles and pile caps. **(9)**

RETAINING STRUCTURES

Stability of walls - Design of cantilever and counter fort walls - design of gravity walls - Cantilever sheet pile walls - Anchored bulkhead - Cofferdams - Braced cofferdams - Stability of bottom excavation - Anchorages - Walls and Tie rods. **(9)**

WELL FOUNDATIONS

Types of wells or caissons - components - Shapes of wells - Forces acting - Construction and sinking - Design of drilled caissons. **(9)**

MACHINE FOUNDATIONS AND FOUNDATIONS ON EXPANSIVE SOILS

Introduction to vibrations - Design criteria for satisfactory action of a machine foundation - Soil spring constants - Determination - Types of foundations - Design of Block foundation. Identification of swelling - Field conditions - consequences of swelling - Design. **(9)**

TOTAL : 45

TEXT BOOK

1. *Joseph E. Bowles, "Foundations Analysis and Design", McGraw Hill Co.,* 2001.

REFERENCES

1. *Teng, Wayne C, "Foundation Design", Published by Prentice hall of India, New Delhi, 1965*

2. *Gopal Ranjan and Rao ASR, "Basic and Applied soil Mechanics", New Age International Publishers, 2004.*

3. *Gulhati & Datta, " Geotechnical Engineering" ,Tata McGraw Hill, New Delhi,2005*

4. *Sam & Das, "Theory and Practice of Foundation Design", Prentice hall of India, New Delhi, 2006*

5. *Cuduto, "Geotechnical Engineering", Prentice hall of India, 2002*

6. *IRC-78: Standard Specifications and code of practice for Road Bridges.*

15MCE24 - ADVANCED STRUCTURAL ENGINEERING LABORATORY

L	T	P	C
0	0	2	1

ASSESSMENT : PRACTICAL

Category : *Professional Core*

COURSE OUTCOME

On completion of the course the students will be able to

CO1 : *Acquire knowledge about mix design as per Indian and International standards*

CO2 : *Conduct experiments as per Indian and International Codes of practice*

CO3 : *Solve real time problems related to structural engineering*

Experiments

1. Design of concrete mix as per IS 10262-2009.

2. Design of concrete mix as per ACI: 211 - 91 Method.

3. Study of Instruments used for measuring Forces, Deflections, strains and vibrations.

4. Testing of Simply Supported Reinforced Concrete beams for flexure and shear

5. Testing of Simply Supported Steel beams for flexure and shear

6. Testing of Reinforced Concrete columns

7. Half-cell Potential Test (Durability Tests on Concrete)

8. Rapid Chloride Penetration Test (Durability Tests on Concrete)

9. Rebound hammer Test (Non Destructive Test)

10. Ultrasonic Pulse Velocity Tester (Non Destructive Test)

11. Winsor Pin System Test (Non Destructive Test)

12. Rebar locator

13. Concrete Core Cutting and its limitations

TOTAL : 30

REFERENCES

1. *T P Ganesan, "Model Analysis of Structures", University Press India Private Limited, Hyderabad , 2013*

2. *Shetty.M.S, "Concrete Technology", S.Chand and Company, New Delhi, 2010*

3. *IS 10262 : 2009 Recommended guidelines for concrete mix design.*

4. *ACI: 211 - 91 Standard Practice for selecting Proportions for Normal, Heavy weight andMass concrete.*

5. *"Guidebook on Non-Destructive Testing of Concrete Structures", International Atomic Energy Agency, Vienna, 2002*

6. *Santhakumar A R "Concrete Technology", Oxford Higher Education, New Delhi, 2011*

15MCE31 - PRACTICAL TRAINING

L	T	P	C
			2

ASSESSMENT : PRACTICAL

Category : Employability Enhancement Course

COURSE OBJECTIVE

To train the students in the field work so as to have first-hand knowledge of practical problems related to Structural Engineering in carrying out engineering tasks.

COURSE OUTCOME

On completion of the project work students will be in a position to

CO1 *: Apprehend the field / industrial oriented problems in structural engineering, the inter-disciplinary advances and provide solutions to the problems*

The students undergo a Inplant training for 4 weeks period in selected industries / organization with approval of the Head of the Department.

This training makes them to learn trends and technologies in industry

Learn/doing part of design work in Steel / Concrete / Composite / Prestressed / Prefabricated structures

The students are expected to submit a report within a stipulated time covering the various technical aspects and the observation made during industry training period.

15MCE41 - PROJECT WORK AND VIVA-VOCE

L	T	P	C
			18

ASSESSMENT : PRACTICAL

Category : Employability Enhancement Course

COURSE OBJECTIVE

To inculcate and apply Structural Engineering knowledge, in solving the identified problem based on the formulated methodology, and to develop skills to analyze, discuss the test results, and make conclusions.

COURSE OUTCOME

On completion of the project work students will be in a position to

CO1   :   *Carry out analytical and / or experimental research on a real time and inter disciplinary projects and bring out sustainable solutions*

Identification of thrust areas

Problem Identification

Scope & Objective of research

Literature survey

Methodology specifying the process / specifications / parameters

List of alternate methodology if available

Justification for the methodology adopted

Time line of activities

Carrying out experimental / theoretical work as per the specified time line of activities

A presentation including all the above along with final results and conclusions

Consolidated report preparation.

15MCEE1 - STABILITY OF STRUCTURES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

Category : Professional Elective

COURSE OBJECTIVE

To study the concept of buckling and analysis of structural elements

COURSE OUTCOME

On completion of the course the students will be able to:

CO1 : *Apprehend the concepts of stability of various structural elements*

CO2 : *Perceive knowledge about buckling of diverse elements*

CO3 : *Apply current knowledge in structural stability issues*

INTRODUCTION

Static 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 - Timoshenko's Imperfect and kinetic methods. **(4)**

SOLUTION PROCEDURES FOR COLUMN BUCKLING

Approximate methods - Rayleigh Ritz, Galerkins approach - Numerical Techniques - Finite difference method - NewMark"s method -finite element method - Effect of shear on buckling - Design of columns. Buckling of Columns using Computer Programming/ Software Packages. **(7)**

BEAM COLUMNS

Theory of beam column - Stability analysis of beam column with single & several concentrated loads, distributed load and end couples - column on elastic foundation - Continuous column - Failure of beam columns - Design criteria. Buckling of Beam-Columns using Computer Programming/ Software Packages.
(5)

FRAMES

Analysis of rigid jointed frames with and without sway - Moment distribution - Slope deflection & stiffness method. Buckling of Frames using Computer Programming/ Software Packages. **(4)**

THIN WALLED OPEN SECTIONS

Pure torsion - torsional buckling - Torsional and flexural buckling - Local buckling. Buckling of Open Sections using Computer Programming/ Software Packages

Lateral buckling of beams - Narrow rectangular beams - Symmetrical sections - Design simplifications for lateral buckling. **(9)**

PLATES

Governing differential equation - Analysis by equilibrium & energy approach - Approximate and Numerical techniques - Composite plates. Inelastic buckling of plates - Post buckling behavior of plates.. Application of Software Packages **(7)**

NON LINEAR THEORY OF BUCKLING

Perfect systems - imperfect systems - imperfection in-sensitive and sensitive systems - symmetric and asymmetric Bifurcation - simple examples

Double modulus theory - Tangent modulus theory - Shanley's model - Eccentrically loaded inelastic column. Application of Software Packages **(9)**

TOTAL : 45

TEXT BOOKS

1.   Chajes.A, "Principles of Structural Stability Theory", Prentice Hall, Inc., New Jersey, 1974.

2.   H.G.Allen & P.S.Bulson, "Background to Buckling", Mc Graw Hill Co., 1980.

3.   Timoshenko.S.P and Gere.J.M, "Theory of Elastic Stability", McGraw Hill Company, 1963.

REFERENCES

1.   Zdeneic P Basanth & Luigi Cedolin, "Stability of Structures", World Scientific Co., Singapore, 2010

2.   Iyenger,N.G.R., "Structural stability of columns and plates", Affiliated East West Press Pvt. Ltd., New Delhi, 1988.

3.   Ashwini kumar, "Stability of structures", Allied Publishers Ltd, New Delhi, 1998.

4.   Gambhir, "Stability Analysis and design of structures", Springer, New York, 2004.

15MCEE2 - ADVANCED CONCRETE TECHNOLOGY

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

Category : *Professional Elective*

COURSE OBJECTIVE

To study the properties of concrete and to know the state of the art developments in concrete

COURSE OUTCOME

On completion of the course the students will be able to:

CO1 : *Apprehend the knowledge of concrete ingredients and special concretes*

CO2 : *Acquire knowledge about durability of concrete*

CO3 : *Assess the fresh and hardened properties of concrete as per codes of practices*

CONCRETE INGREDIENTS

Composition of OPC - Manufacture - Modified Portland Cements - Hydration Process of Portland Cements - Structure of Hydrated Cement Paste

Mineral Admixtures - Hydration of Admixtures - Slags - Pozzolanas and Fillers - Chemical Admixtures - Solutes - Retarders - Air Entraining Agents - Water Proofing Compounds - Plasticizers and Superplasticizers - Compatibility issues with Chemical Admixtures.

Aggregates - Properties and testing of fine and coarse aggregates - combining of aggregates - Substitute material for aggregates - recent advancements. **(15)**

SPECIAL CONCRETES

Fibre Reinforced Concrete - High performance concrete - Ultra high strength concrete - Self Compacting Concrete - Polymer Concrete - Sulphur concrete - Geo polymer concrete **(8)**

CONCRETING UNDER SPECIAL CIRCUMSTANCES

Underground construction - concreting in marine environment - underwater construction - extreme weather concreting **(7)**

MECHANICAL PROPERTIES OF CONCRETE

Interfacial Transition Zone - Fracture Strength - Compressive strength - Tensile strength - Impact strength - Bond strength - Creep - Shrinkage **(7)**

DURABILITY OF CONCRETE

Factors affecting durability - Tests on chemical Attack - permeability - chloride penetration - water absorption - fire - frost action **(8)**

TOTAL : 45

TEXT BOOKS

1. *Santhakumar.A.R, "Concrete Technology", Oxford University press, New Delhi 2015*

2. *Gambhir.M.L, "Concrete Technology", Tata McGraw Hill Book Co. Ltd., Delhi, 2004.*

3. *Neville.A.M, "Properties of Concrete", Pearson Education Ltd., New Delhi, 2013.*

REFERENCES

1. *Metha.P.K and Montreio.P.J.M, "Concrete Microstructure, Properties and Materials", Prentice Hall, 2005.*

2. *Gupta.B.L and Amit Gupta, "Concrete Technology", Standard Publishers and Distributers, New Delhi, 2004.*

3. *Shetty.M.S, "Concrete Technology", S.Chand and Company, New Delhi, 2010*

4. *IS 456-2000 : Plain and Reinforced Concrete - Code of Practice.*

15MCEE3 - EXPERIMENTAL TECHNIQUES AND INSTRUMENTATION

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

Category : *Professional Elective*

COURSE OBJECTIVE

To learn the principles of measurements in static and dynamic response of structures and carryout the analysis of results

COURSE OUTCOME

On completion of the course the students will be able to:

CO1 : *Apprehend knowledge of instrumentation to carry out experiments*

CO2 : *Use Non Destructive Testing to evaluate structural adequacy*

CO3 : *Acquire inspiration for carrying out research works*

FORCE AND STRAIN MEASUREMENTS

Strain gauges, principles, types, performance and uses - Photo elasticity, principle and applications - - Hydraulics jacks and pressure gauges - Electronic load cells - Proving Rings - Calibration of Testing Machines - Long term Monitoring - Vibrating wire sensors - fibre optic sensors **(9)**

VIBRATION MEASUREMENTS

Characteristics of structural vibrations - Linear - 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. **(9)**

ACOUSTICS AND WIND MEASUREMENTS

Principles of pressure and flow measurements - pressure transducer - sound level meter - venturimeter and flow meters - wind tunnel and its use in structural analysis- structural modelling - direct and indirect model analysis. **(9)**

DISTRESS MEASUREMENTS

Diagnosis of distress in structures - crack observation and measurement - Corrosion of reinforcement in concrete - Half cell, construction and use - Damage assessment - controlled blasting for demolition - structural health monitoring. **(9)**

NON DESTRUCTIVE TESTING METHODS

Load testing of structures, Buildings, bridges and towers - Rebound Hammer - acoustic emission - holography - use of laser for structural testing - Brittle coatings, Ultrasonic testing principles and applications.

Advanced NDT methods - Ultrasonic pulse echo, impact echo, impulse radar techniques, GECOR, Ground Penetrating Radar (GPR)   **(9)**

TOTAL : 45

TEXT BOOKS

1. *Sadhu Singh, "Experimental Stress Analysis", Khanna Publishers, New Delhi, 2014.*

2. *J.W.Dalley and W.F.Riley, "Experimental Stress Analysis", McGraw Hill Book Company, New York, 1991.*

3. *L.S.Srinath et.al, "Experimental Stress Analysis", Tata McGraw Hill Co, New Delhi, 1984.*

REFERENCES

1. *R.S.Sironi, H.C.Radha Krishna, "Mechanical Measurements", New Age International (P) Ltd, 1997.*

2. *F.K.Garas, J.L.Clarke and G.S.T Armer, "Structural Assessment", Butterworths London, 1987.*

3. *D.E.Bray and R.K.Stanley, "Non-Destructive Evaluation", McGraw Hill Publishing Co., New York, 1989.*

15MCEE4 - EARTHQUAKE RESISTANT DESIGN OF STRUCTURES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

Category : *Professional Elective*

COURSE OBJECTIVE

To study the effect of earthquakes, analysis and design of earthquake resistant Structures

COURSE OUTCOME

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

CO1 : *Evaluate seismic forces for various structures as per relevant Indian standards.*

CO2 : *Design the structures for seismic resistance as per Indian Standards*

CO3 : *Apply concepts of repair and rehabilitation to earthquake affected structures*

INTRODUCTION

Basic Seismology - General features of Tectonics of Seismic Regions- Earthquake Terminology - Definitions -Earthquake History - Behaviour of Buildings, Dams and Bridges in Past Earthquakes - Seismographs - Accelerographs - Theory of Vibrations - Damped and undamped system - free and forced vibrations - SDOF and MDOF systems - Analytical and Numerical methods. **(9)**

EARTHQUAKE RESPONSE

Earthquake Response to Elastic and Inelastic Buildings - Application to Response Spectrum Theory - base exited motion - ground motion parameters - Modal response contribution - modal participation factor - response history - spectral analysis - multiple support excitation - earthquake response to continuous systems on rigid base - approximate methods for lateral load analysis - Pushover Analysis. **(9)**

IS CODE PROVISIONS

Design Criteria Strength, Deflection, Ductility and Energy Absorption - Cyclic Behaviour of Structures- Design of Buildings as per IS 1893 and IS 4326 - Ductile Detailing of Structures as per IS 13920. Behaviour and Design of Masonry Structures as per IS 13827 and IS13828. **(9)**

EARTHQUAKE RESISTANT DESIGN OF RC AND MASNORY STRUCTURES

Analysis and Design of Frames for Lateral Loads - Capacity Design - Shear Wall Frame System - Coupled Shear Wall - Design of Rectangular and Flanged Shear Walls - Ductile Detailing of Frames for Earthquake Forces - Strengthening of Existing Buildings - Retrofitting and Rehabilitation -earthquake resistant masonry buildings - guide line as per IS codes. **(9)**

SPECIAL TOPICS

Modern Concepts - Base Isolation, Passive Control and Active Control Systems - Computer Analysis and Design of Buildings for Earthquake Loads using Software Packages. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Pankaj Agarwal and Manish Shrikhande, "Earthquake Resistant Design Structures", Prentice Hall of India Private Ltd., New Delhi-110001, 2006.*

2. *Paulay.T and Priestley.M.J.N, "Seismic Design of Reinforced Concrete and Masonry Buildings, John Wiley and Sons Inc., New York, 1992.*

3. *S.K.Duggal, "Earthquake Resistant Design of Structures", Oxford University Press, 2008.*

REFERENCES

1. *Anil K.Chopra, "Dynamics of Structures - Theory and applications to Earthquake Engineering", Prentice Hall of India Pvt. Ltd., New Delhi, 2002.*

2. *Miha Tomazevic, "EarthQuake Resistant Design of Masonry Buildings", Imperial College Press, 1999.*

3. *IS 1893 (Part 1) - 2002 Criteria for earthquake resistant design of structures.*

4. *IS 4326 : 1993 Code of practice for earthquake resistant design and construction of buildings.*

5. *IS 13827 : 1993 Improving earthquake resistance of earthen buildings - Guidelines.*

6. *IS 13828 : 1993 Improving earthquake resistance of low strength masonary buildings - Guidelines.*

7. *IS 13920 : 1993 Ductile detailing of reinforced concrete structures subjected to seismic forces - Code of practice.*

15MCEE5 - STRUCTURAL OPTIMIZATION

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

Category : *Professional Elective*

COURSE OBJECTIVE

To study the optimization methodologies applied to structural engineering

COURSE OUTCOME

On completion of the course the students will be able to:

CO1 *:* *Apprehend the concepts of optimization*

CO2 *:* *Apprehend the different methods and algorithms developed for solving various types of optimization problems*

CO3 *:* *Apply the optimization techniques in the real time situations*

BASIC PRINCIPLES

Definition - Objective Function; Constraints - Equality and inequality - Linear and non-linear, Side, Non-negativity, Behavior and other constraints - Design space - Feasible and infeasible - Convex and Concave - Active constraint - Local and global optima. **(9)**

CLASSICAL OPTIMIZATION TECHNIQUES

Differential calculus - Optimality criteria - Single variable optimization - Multivariable optimization with no constraints - (Lagrange Multiplier method) - with inequality constraints (Khun - Tucker Criteria).

LINEAR PROGRAMMING

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. Computer Algorithm for Linear Programming **(10)**

NON-LINEAR PROGRAMMING

One Dimensional minimization methods: Unidimensional - Unimodal function - Exhaustive and unrestricted search - Dichotomous search - Fibonacci Method - Golden section method - Interpolation methods. Unconstrained optimization Techniques

(Multivariables): Unconstrained multivariable functions - Univariate method - Cauchy's steepest descent method - Conjugate gradient method (Fletcher Reeves) - Variable metric methods - (Davidon - Fletcher Powell).

Constrained optimization techniques: Direct and indirect methods - Cutting plane method - Methods of feasible direction - Interior penalty function - Exterior penalty function method. Computer Algorithm for Non-Linear Programming.

GEOMETRIC PROGRAMMING

Posynomial - degree of difficulty - reducing G.P.P to a set of simultaneous equations - Unconstrained and constrained problems with zero difficulty - Concept of solving problems with one degree of difficulty. Computer Algorithm for Geometric Programming. **(8)**

DYNAMIC PROGRAMMING

Bellman's principle of optimality - Representation of a multistage decision problem - concept of sub-optimization problems using classical and tabular methods. Computer Algorithm for Dynamic Programming

(9)

STRUCTURAL APPLICATIONS

Methods for optimal design of structural elements, continuous beams and single storied frames using plastic theory - Minimum weight design for truss members - Fully stressed design - Optimization principles to design of R.C. Structures such as multistorey buildings, water tanks, bridges, shell roofs. Use of Software packages for optimization **(9)**

TOTAL : 45

TEXT BOOKS

1. *Rao.S.S, "Optimization theory and applications", Wiley eastern (P) Ltd., 1995.*

2. *Uri Krish, "Optimum Structural Design", Mc Graw Hill Book Company, 1981.*

REFERENCES

1. *Verma, A.P., "Operations Research", S.K.Kataria & Sons, New Delhi 2001.*

2. *Kalyanmoy Deb, "Optimization for Engineering Deisgn", Prentice Hall of India, New Delhi.2002*

3. *Ravindran, Ragsdell and Reklatis, "Engineering Optimization", Wily IndiaEdition, New Delhi, 2006*

4. *Majid. K.I., "Optimum Design of Structures", John Wiley & Sons, New York, 1974.*

5. *SPUNT, "Optimization in Structural Design", Prentice Hall, New Jersey, 1971.*

15MCEE6 - HEALTH MONITORING OF STRUCTURES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

Category : *Professional Elective*

COURSE OBJECTIVE

To study the damages, repair and rehabilitation of structures

COURSE OUTCOME

On completion of the course the students will be able to:

CO1 : *Apprehend the assessment procedure for evaluating a damaged structures*

CO2 : *Apprehend and reduce the design and construction errors in concrete construction*

CO3 : *Perceive the materials and techniques for repair distressed structures*

DIAGNOSTICS

Maintenance, repair and rehabilitation, Facets of Maintenance, importance of Maintenance, various aspects of Inspection, Assessment procedure for evaluating a damaged structure, causes of deterioration. **(9)**

SERVICEABILITY AND DURABILITY OF CONCRETE

Quality assurance for concrete construction, concrete properties - Strength, permeability, thermal properties and cracking - Effects due to climate, temperature, chemicals, corrosion - Design and construction errors - Effects of cover thickness and cracking **(9)**

MATERIALS AND TECHNIQUES FOR REPAIR

Special concretes and mortar, concrete chemicals, special elements for accelerated strength gain, Expansive cement, polymer concrete, sulphur infiltrated concrete, Ferro cement and polymers, coating for rebars during repair, foamed concrete, mortar and dry pack, vacuum concrete, Gunite and Shotcrete, Epoxy injection. **(9)**

REPAIRS TO STRUCTURES

Mortar repair for cracks, shoring and underpinning. Methods of corrosion protection, corrosion inhibitors, corrosion resistant steels and cathodic protection.

Repair of structures distressed due to earthquake - Strengthening using FRP- Strengthening and stabilization techniques for repair. **(9)**

SAFETY AND PRECAUTIONS

Safety measures - Dismantling of structures - Safety in finishing works - NDT testing procedures - Engineered demolition techniques for structures. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Denison Campbell, Allen and Harold Roper, "Concrete Structures, Materials, Maintenance and Repair", Longman Scientific and Technical UK, 1991.*

2. *Allen R.T and Edwards S.C, "Repair of Concrete Structures", Blakie and Sons, UK, 1987.*

3. *SP: 25 - 1984, "Handbook on Causes and Prevention of Cracks in Buildings, Bureau of Indian Standards", New Delhi, 1999.*

REFERENCES

1. *Guha.P.K, "Maintenance and Repairs of Buildings", New Central Book Agency (P) Ltd, Kolkata, 1998.*

2. *Raikar, R.N., "Learning from failures - Deficiencies in Design, Construction and Service" - R&D Centre (SDCPL), Raikar Bhavan, Bombay, 1987.*

3. *Santhakumar A.R., "Concrete Technology" Oxford University Press, Printed in India by Radha Press, New Delhi, 2007.*

4. *Peter H.Emmons, "Concrete Repair and Maintenance Illustrated", Galgotia Publications pvt. Ltd., 2001.*

15MCEE7 - PRESTRESSED CONCRETE STRUCTURES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

Category : *Professional Elective*

COURSE OBJECTIVE

To study the principle of prestressing, analysis and design of prestressed concrete structures.

COURSE OUTCOME

CO1 : *Apprehend the knowledge of Prestressed Concrete Structures*

CO2 : *Use Indian standard for the design of prestressed concrete members*

CO3 : *Use Computer programs to design Prestressed Concrete Structures*

PRINCIPLES OF PRE-STRESSING

Difference between reinforced and prestressed concrete. Principles of prestressing - Methods and systems of prestressing - Principles of Electrothermal prestressing & chemical prestressing - Classification of prestressed concrete structures - Materials - High strength concrete and High strength steel - stress - strain diagrams. Losses in Prestress: Loss due to elastic shortening in pretensioned and post tensioned beams. Loss due to creep, shrinkage, relaxation, friction - Approximate percentage of various losses in pretensioned and post tensioned beams. **(10)**

DESIGN OF FLEXURAL MEMBERS

Design of prismatic prestressed concrete members for bending at working loads - Magnel's graphical method - check for ultimate load stage (Limit State Design) - Non prismatic members (Design principles only) - Simple cable profiles - calculation of deflections - Design Using Computer Programming. **(8)**

DESIGN FOR SHEAR TORSION AND END BLOCK

Design of beams for shear and Torsion at working and ultimate loads. Design of Anchorage Zone by Guyon's method - Concept of Mangel's method - IS 1343 recommendations. Design of end blocks - Design Using Computer Programming. **(10)**

DESIGN OF TENSION, COMPRESSION AND COMPOSITE MEMBER

Design of tension members - Design of columns subjected to bending moment and axial compression for working and ultimate loads. Composite prestressed concrete beams - Design procedure - calculation of stresses at important stages both for propped and unpropped constructions - Design of shear connectors - Shrinkage Stresses. **(7)**

DESIGN OF CONTINUOUS BEAMS

Statically indeterminate structures - concept of concordant cable and linear transformations - sketching of pressure lines for continuous beams and single span single storey rigid frame. Design principles of

partially prestressed concrete structures - circular prestressing - Design of a circular tank for circular and vertical prestressing. Determination of Concordant Cable profile Using Computer Programming. **(10)**

TOTAL : 45

TEXT BOOKS

1. *Krishna Raju.N, "Prestressed Concrete", Tata Mc Graw Hill Publishing Company Ltd, New Delhi, 2012.*

2. *Rajagopalan.N, "Prestressed Concrete", Alpha Science International Ltd., UK, 2005.*

REFERENCES

1. *Dayaratnam.P, "Prestressed Concrete Structures", Oxford and India Book House Ltd., Chennai, 2014.*

2. *Lin.T.Y and Ned H Burns, "Design of Prestressed Concrete Structures", John Willey and Sons, NewYork, 1982.*

3. *Sinha. N.C and Roy. S.K, "Fundamentals of Prestressed Concrete", S. Chand and Company, New Delhi, 2011.*

4. *Kachaturian and Gurfinkel, "Prestressed Concrete", McGraw Hill, New York, 1961.*

5. *IS 1343-2012: Code of Practice for Prestressed Concrete.*

15MCEE8 - CORROSION AND ITS PREVENTION

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

Category : Professional Elective

COURSE OBJECTIVE

To study the causes and effects of detection and prevention of corrosion on structures

COURSE OUTCOME

On completion of the course the students will be able to:

CO1 : *Perceive about phenomenon of corrosion and its propagation*

CO2 : *Monitor corrosion using various techniques*

CO3 : *Apprehend the different types of protective measures*

INTRODUCTION

Corrosion of steel reinforcement in concrete, definition of corrosion, forms of corrosion, phenomenon of corrosion, corrosion initiation-environment-cover thickness-quality of cover concrete -type of steel and critical chloride-presence of cracks, corrosion propagation - electrochemical process - physical process, theory of reinforcement corrosion-basic corrosion cell-anode and cathode-electrolyte- corrosion potential and rate of corrosion.   **(10)**

IDENTIFICATION AND APPRAISAL OF CORROSION

Corrosion process and mechanism - approach to investigation-visual observation and documentation, insitu testing of concrete-rebound hammer test, cover meter survey-ultrasonic pulse velocity (UPV) test - core sampling and testing, insitu testing of steel rebar -carbonation test and pH value, chloride content-half cell potential survey-resistivity mapping -measurement of corrosion rate.   **(10)**

MONITORING OF CORROSION

Methods used for monitoring corrosion - open circuit potential measurement, resistivity measurement, corrosion cell ratio, electrical resistance probe method, polarization resistance technique, impedance technique, guard ring technique, electrochemical noise analysis.   **(9)**

PROTECTIVE MEASURES

Coating to reinforcement-metallic coatings-epoxy coatings-cement based coatings -coating to prestressing steel, galvanized reinforcement, stainless steel, non-ferrous reinforcement and coating to concrete surface, improving the concrete, corrosion resistant steel.   **(8)**

INHIBITORS FOR CONCRETE

Definition of inhibitor-anodic and cathodic inhibitors-rice husk ash, fly ash, electrochemical removal of chloride from concrete, non-metallic materials, carbon FRP, Glass FRP, parafil tendons.   **(8)**

TOTAL : 45

TEXT BOOK

1. *Fontanna, G.Mars, "Corrosion Engineering", Third Edition, McGraw - Hill Book Company,1986.*

REFERENCES

1. *Kumar Mehta, P., "Concrete-Structure, Properties and Materials", Prentice - Hall, INC, Englewood Cliffs, New Jersey 07632 - 1986.*

15MCEE9 - THEORY OF PLATES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

Category : *Professional Elective*

COURSE OBJECTIVE

To study the behaviour and analysis of thin plates and the behaviour of thick plates and its computer application

COURSE OUTCOME

On completion of the course the students will be able to:

CO1 : *Apprehend the behavior of various types of plates.*

CO2 : *Develop the governing differential equation for thin and thick plates*

CO3 : *Analyse plates with different loading and boundary conditions and shapes*

INTRODUCTION

Thin and thick plates - Plate behaviour - Material behaviour - Isotropic and orthotropic Materials. **(10)**

SMALL DEFLECTION THEORY AND CLASSICAL METHODS

Differential equation of plates in Cartesian co-ordinate system - boundary conditions - Rigorous solution - Navier's Method - Levy's Method.

SYMMETRICAL BENDING OF CIRCULAR PLATES

Differential equation for symmetrical bending of laterally loaded circular plates - Simply supported edges - Clamped edges - Circular plate with a circular hole at the center - Circular plate concentrically loaded.

(10)

APPROXIMATE METHODS

Energy methods - Galerkin's Method - Ritz Method, Method of Images - Plate strip - Influence surfaces - Membrane and Various Analogies - Simultaneous Bending and Stretching. **(9)**

NUMERICAL METHODS

Finite difference method - Improvements for solution, matrix displacement analysis of Grids - introduction to Finite Element Method. Computer Applications. **(8)**

PLATES OF OTHER SHAPES

Triangular plates - Elliptic plates - Sector plates - Skew plates - Plates on elastic foundation - Continuous plates. Computer Applications

ADVANCED TOPICS

Large Deflection theory - Thermal stresses - Multilayered plates. - Mindlin's theory of plates - Flat slabs - Engineering approach to design of Rectangular floor slabs. Computer Applications. **(8)**

TOTAL : 45

TEXT BOOKS

1.   *Rudolph Szilard, "Theory and Analysis of Plates - Classical and Numerical Methods", Prentice Hall, 1995.*

2.   *Timoshenko.S and Krieger.S.W, "Theory of Plates and Shells", Mc-Graw Hill Book Company, New York, 1990.*

REFERENCES

1.   *Donnel.L.H, "Beams, Plates and Shells", McGraw Hill Inc., 1976.*

2.   *Chandrashekhara, K., "Theory of plates" , University Press(India) limited, Hyderabad, 2001*

3.   *Bairagi.N.K, "A Text Book of Plate Analysis", Khanna Publishers, New Delhi, 1996.*

15MCEE10 - DESIGN OF CONCRETE BRIDGES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

Category : *Professional Elective*

COURSE OBJECTIVE

To study the loads, forces on bridges and design of several types of bridges.

COURSE OUTCOME

On completion of the course the students will be able to:

CO1 : *Apprehend the planning and investigation of bridges.*

CO2 : *Design the superstructure of bridge using different methods.*

CO3 : *Design the substructure of bridges.*

1. Introduction - Classification, Investigations and planning, choice of type, I.R.C Specifications for road bridges, standard live loads, other forces acting on bridges, general design considerations.

    (5)

2. Short Span Bridges - Load distribution theories, analysis and design of slab culverts, tee beam and slab bridges. **(6)**

3. Design principles of Long span Girder Bridges and continuous bridges **(5)**

4. Design Principles of box girder bridges, and balanced cantilever bridges. **(5)**

5. Design of prestressed Concrete Bridges **(6)**

6. Bearings and expansion joints. **(6)**

7. Substructures and footings for bridges. **(6)**

8. Analysis and Design of bridges using Software packages **(6)**

TOTAL : 45

TEXT BOOKS

1. Raina.V.K, "Concrete Bridge Practice", Tata McGraw Hill Publishing Co, New Delhi, 2007.

2. Krishnaraju.N, "Design of Bridges", Oxford Publishing Co, 2015.

REFERENCES

1. *Ponnuswamy.S, "Bridge Engineering", Tata McGraw Hill, New Delhi, 2008.*

2. *IRC 5:1998 Standard Specifications and code of practice for Road Bridges. Section I-General Features and Design*

4. *IRC 6:2014 Standard Specifications and code of practice for Road Bridges. Section I-Loads and stresses.*

5. *IRC 78:2014 Standard Specifications and code of practice for Road Bridges. Section VII-Foundation and substructures.*

6. *IRC 83:2015 Standard Specifications and code of practice for Road Bridges. Section IX-Metallic Bearings*

7. *IRC 112:2011.Code of practice for concrete road bridges.*

15MCEE11 - DESIGN OF STEEL CONCRETE COMPOSITE STRUCTURES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

Category : *Professional Elective*

COURSE OBJECTIVE

To develop an understanding of the behavior, analysis and design of Steel concrete composite elements and structures.

COURSE OUTCOME

On completion of the course the students will be able to:

CO1 : *Analyse steel concrete composite structures*

CO2 : *Design composite structures and its connections*

CO3 : *Conduct case studies related to steel concrete composite constructions of buildings*

INTRODUCTION

Introduction to steel - concrete composite construction - theory of composite structures - Introduction to steel - concrete - steel sandwich construction. **(9)**

DESIGN OF COMPOSITE MEMBERS

Behavior of composite beams, columns, design of composite beams, steel, concrete composite columns - design of composite trusses. **(9)**

DESIGN OF CONNECTIONS

Types of connections, Design of connections in the composite structures - shear connection, Design of connections in composite trusses. **(9)**

COMPOSITE BOX GIRDER BRIDGES

Introduction - behaviour of box girder bridges - design concepts

GENERAL CASE STUDIES on steel - concrete composite construction in buildings - seismic behaviour of Composite structures **(9)**

USE OF SOFTWARE PACKAGES

Analysis and design of Composite structures using Software Packages **(9)**

TOTAL : 45

TEXT BOOKS

1. *Johnson.R.P, "Composite structures of steel and concrete", Blackwell Scientific Publications (Third Edition), UK, 2013.*

REFERENCES

1. *Owens.G.W and Knowels.P, "Steel Designers manual", (Fifth edition), Steel Concrete Institute (UK), Oxford Blackwell Scientific Publications, 1992.*

2. *Proceedings of workshop on "Steel Concrete Composite Structures", conducted at Anna University,2007.*

3. *IRC 24:2010 Standard Specifications and code of practice for Road Bridges. Section V- Steel Road Bridges.*

15MCEE12 - OFFSHORE STRUCTURES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

Category : *Professional Elective*

COURSE OBJECTIVE

To study the concept of wave theories, forces, analysis and design of jacket towers and cables.

COURSE OUTCOME

On completion of the course the students will be able to:

CO1 : *Apprehend the static and dynamic effect of wind on structures*

CO2 : *Possess the knowledge on wave hydrodynamics*

CO3 : *Analyse and design of offshore structures*

WIND EFFECTS

Wind on Structures - Rigid Structures - Flexible Structures -Static and dynamic effects. **(9)**

WAVE HYDRODYNAMICS

Wave generation and propagation of small and finite amplitude wave theories - wave energy and pressure distribution. **(9)**

WAVE LOADING

Wave forces on structures - Environmental loadings - use of Morrison equation. **(9)**

OFFSHORE STRUCTURE MODELLING

Different types of structures, Foundation modelling, static methods of analysis, Dynamics of Offshore structures. Software applications. **(9)**

DESIGN OF OFFSHORE STRUCTURES

Loads, design of platforms, Derricks, Helipads, Design principles and examples of Jacket towers, Mooring cables. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Chakrabarti.S.K, "Hydrodynamics of Offshore Structures", Computational Mechanics Publications, 1987.*

2. *Thomas M.Dawson, "Offshore Structural engineering", Prentice Hall Inc Englewood Cliffs, N.J., 1983.*

REFERENCES

1. *API, Recommended Practice for Planning, Designing and Construction, Fixed Offshore Platforms, American Petroleum Institute Publication, RP2A, Dalls, Tex, 2000.*

2. *PeterSachs, "Wind forces in Engineering", Pergomon press, New York, 1972.*

3. *Ippen.J, "Esterany and Coast line hydrodynamics", McGraw Hill Book, Co., 1966.*

15MCEE13 - SHELL STRUCTURES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

Category : *Professional Elective*

COURSE OBJECTIVE

Study the behaviour and design of shells, folded plates and application of software.

COURSE OUTCOME

On completion of the course the students will be able to:

CO1 : *Analyse and design various shells and spatial structures*

CO2 : *Apprehend the behaviour of folded plates*

CO3 : *Design double curvature shells using membrane theory*

INTRODUCTION

Structural behavior of shells and folded plates - Theory of surfaces - Generation of surfaces - Classification - IS code provisions.

ANALYSIS OF CYLINDRICAL SHELLS

Membrane theory; Bending theory; Beam - Arch approximation; Continuous Cylindrical shells - Long and Short shells. Shells with and without edge members - Multibarrel shells.   **(10)**

DESIGN OF CYLINDRICAL SHELLS

Design by ASCE Manual No.31 tables - Shells of various boundary conditions - North light shells - proportioning shells - Reinforcement in shell and edge members - Prestressing of edge members - Review of recommendations of codes - Constructional aspects - Design of Traverses. Analysis/ Design of Cylindrical Shells using Software Packages.   **(10)**

FOLDED PLATES

Various steps in the analysis - Analysis by ASCE Task committee method - Analysis by Finite Strip approach - Design of reinforcement - Transverses. Analysis/Design of Folded plates using Software Packages

(6)

SHELLS OF DOUBLE CURVATURE

Membrane theory for shells of revolution - Membrane theory for general shells of double curvature - Synclastic and anticlastic shells - Approximate bending theory of shallow shells - Design of H.P cooling tower shells. Analysis/Design of Shells of Double Curvature using Software Packages.   **(9)**

DESIGN OF DOUBLY CURVED SHELLS

Hyperbolic paraboloid roofs - Determination of forces in shells and edge members - Design of umbrella and inverted umbrella roof - Design of conoidal shells - Skew Hypars - H.P shells on parabolic directrix

boundary - New Shell forms - Funicular shells. Analysis/ Design of Doubly Curved Shells using Software Packages. **(10)**

TOTAL : 45

TEXT BOOKS

1. *G.S.Ramaswamy, "Design and Construction of concrete shell roofs", CBS publishers and distributors, New Delhi, 2005.*

2. *Vasanth.S.Kelkar & Robert T.Sewell, "Fundamentals of the Analysis and Design of shell structures", Prentice hall,inc,New Jersy,1987*

REFERENCES

1. *Billington.D.F, "Thin shell concrete roofs", Mc Graw Hill Book Company, New York, 1982.*

2. *Chatterjee.B.K, "Theory and design of concrete shells", Champman and Hall Ltd., London, 1988.*

3. *K.Chandrashekara, "Analysis of thin concrete shells, Tata McGraw Hill Book Co., 1986.*

4. *N.K.Bairagai, "Shell Analysis", Khanna Publishers, New Delhi, 1990.*

15MCEE14 - COMPUTER AIDED ANALYSIS AND DESIGN OF TALL BUILDINGS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

Category : *Professional Elective*

COURSE OBJECTIVE

To study the behaviour, analysis and design RC frames and steel frame

COURSE OUTCOME

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

CO1 : *Apprehend the design concepts and the different types of loading*

CO2 : *Analyse the components of tall structures for various effects*

CO3 : *Design the various structural systems used in the construction of tall structures*

STRUCTURAL SYSTEMS AND CONCEPTS

History - structural systems and concepts - criteria and loading - materials and construction - Strcutural steel system - reinforced concrete - pre-stressed concrete - composite system - gravity and lateral systems - loads - gravity - wind - earthquake - temperature load - creep - shrinkage - fire loading - blast loading.

(8)

GRAVITY SYSTEMS - DESIGN AND BEHAVIOUR

Floor systems in concrete and steel - one way and two way slabs - flat slabs with capitals - prestressed concrete floor - shell systems- bearing walls - composite steel concrete floors - columns - open web truss system in steel - stub girder system. **(8)**

LATERAL SYSTEMS - DESIGN AND BEHAVIOUR

Static and dynamic approach, analytical method, Wind Tunnel, Earthquake loading - Equivalent lateral load analysis- Response spectrum method, Combination of loads. **(8)**

SHEAR WALL

Moment resisting frame - braced - shear trusses -shear wall- frame system - framed tube - outrigger - bundled tube system - diagonal trussed tube - mega tube system - approximate methods of analysis - design of frames for lateral load - p- Δ effects - detailing of shear walls for ductility.

FRAMED TUBE SYSTEM

Behaviour - approximate methods - preliminary design - design of frame work - design of transfer girders.

(4)

OUTRIGGER

Behaviour - approximate methods - belt trusses - columns - dynamics of outrigger systems. **(3)**

BUNDLED TUBE - DIAGONAL TRUSS - MEGA TUBES

Behaviour - approximate methods - preliminary design - damping in mega tubes - design of modular tubes. **(4)**

DESIGN OF CONNECTIONS

Behaviour of connections - design of moment connections- simple and semi-rigid - beam - column connections- braced frame connection - connections in outriggers - connections for plastic design - design of connection for ductility. **(5)**

EXPLOSION AND FIRE ON BUILDINGS

Review of bombed buildings - explosions - case studies - threats - wave scaling law - fire loading - restraints - codal provisions - limit state and plastic analysis - nonlinear behaviour- Nonlinear finite element - inelastic finite element analysis- design for ductility - plastic design and behaviour - limit analysis - Translational and torsional instability - out of plumb effects - Computer software for tall buildings. **(5)**

TOTAL : 45

TEXT BOOKS

1. Taranath.B.S, "Analysis and Design of Tall Buildings", McGraw-Hill co, 2011.

2. Ramaswamy.S.D and Yam.C.T, "Proceedings of the International Conference on Tall Buildings", Singapore , 1984.

3. Smith.B.S and Coull.A, "Tall Building Structures Analysis and Design", John Wiley and Sons, Inc, 2011.

REFERENCES

1. Fintel, M., "Hand Book of Concrete Engineering", Van Nostrand Reinhold co 1974.

2. Mehta, J.B., "High Rise Buildings"., M/S Skyline, 1978.

3. Coull,A., and Smith,S.B. "Tall Buildings", Pergamon Press, London, 1997.

4. Beedle, L.S.,"Advances in Tall Buildings CBS publishers and Distributors, Delhi, 1996.

5. Bangash, M.Y.H. "Prototype Building Structures - Analysis and Design", Thomas Telford, 1999.

15MCEE15 - WIND AND CYCLONE EFFECTS ON STRUCTURES

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

Category : *Professional Elective*

COURSE OBJECTIVE

To study the concept of wind and cyclone effects, analysis and design of structures.

COURSE OUTCOME

On completion of the course the students will be able to:

CO1 : *Apprehend the knowledge of wind force measurement.*

CO2 : *Carry out wind tunnel studies and its applications.*

CO3 : *Analyse the effect of wind on high rise structures.*

1. Introduction, Spectral studies, Gust factor, wind velocity, Return Period, Method of measurement, variation of speed with height, shape factor, aspect ratio, drag effects. **(10)**

2. Wind Tunnel Studies, Types of tunnels, Modeling requirements, Interpretation of results, Aero - elastic models. Computer applications **(5)**

3. Wind on structures, Rigid structures, Flexible structures, Static and dynamic effects, Tall buildings, Chimneys. Computer applications. **(12)**

4. Application to design, Buildings, Chimneys, Roofs and Shelters. **(12)**

5. Cyclone effect on structures, cladding design, window glass design. **(6)**

TOTAL : 45

TEXT BOOKS

1. Cook.N.J, "The Designer's Guide to Wind Loading of Building Structures", Butterworths, 1990.

2. Kolousek. et.al, "Wind Effects on Civil Engineering Structures", Elsevier Publications, 1984.

REFERENCES

1. Peter Sachs, "Wind Forces in Engineering", Pergamon Press, New York, 1972.

2. Lawson.T.V, "Wind Effects on Building", Vol.I and II, Applied Science Publishers, London, 1980.

15MCEE16 - SOIL STRUCTURE INTERACTION

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

Category : *Professional Elective*

COURSE OBJECTIVE

To study and analyse soil foundation interaction.

COURSE OUTCOME

On completion of the course the students will be able to:

CO1 : *Apprehend the soil-foundation behavior*

CO2 : *Analyse the beams on elastic foundation*

CO3 : *Analyse the plates and laterally loaded piles*

SOIL-FOUNDATION INTERACTION

Introduction to soil-foundation interaction problems - Soil behaviour, Foundation behaviour, Interface behaviour, Scope of soil foundation interaction analysis, Soil response models, Winkler, Elastic continuum, two parameter models, Elastic plastic behaviour, Time dependent behaviour **(9)**

BEAM ON ELASTIC FOUNDATION-SOIL MODELS

Infinite beams, two parameters, Isotropic elastic half space, Analysis of beams of finite length, Classification of finite beams based on their stiffness. **(9)**

PLATE ON ELASTIC MEDIUM

Infinite plate, Winkler, Two parameters, Isotropic elastic medium, Thin and thick plates, Analysis of finite plates, rectangular and circular plates, Numerical analysis of finite plates - Simple solutions. **(9)**

ELASTIC ANALYSIS OF PILE

Elastic analysis of single pile, Theoretical solutions for settlement and load distributions, Analysis of pile group, Interaction analysis, Load distribution in groups with rigid cap. **(9)**

LATERALLY LOADED PILE

Load deflection prediction for laterally loaded piles, Subgrade reaction and elastic analysis, Pile raft system, Solutions by influence charts. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Selvadurai.A.P.S, "Elastic Analysis of Soil Foundation Interaction", Elsevier, 2011.*

2. *Poulos.H.G and Davis.E.H, "Pile Foundation Analysis and Design", John Wiley, 1990.*

REFERENCES

1. *Scott.R.F, "Foundation Analysis", Prentice Hall of India, 1981.*

2. *ACI 336, "Suggested Analysis and Design Procedure for combined footings and mats", American Concrete Institute, Delhi, 1988.*

15MCEE17 - MECHANICS OF COMPOSITE MATERIALS

L	T	P	C
3	0	0	3

ASSESSMENT : THEORY

Category : Professional Elective

COURSE OBJECTIVE

To study the behaviour of composite materials and to investigate the failure and fracture characteristics

COURSE OUTCOME

On completion of the course the students will be able to:

CO1 : *Apprehend the stress strain relationship of orthotropic and anisotropic materials*

CO2 : *Analyse laminated composites*

CO3 : *Assess the failure criterion and fracture mechanics of composites*

INTRODUCTION

Introduction to Composites, Classifying composite materials, commonly used fiber and matrix constituents, Composite Construction, Properties of Unidirectional Long Fiber Composites, Short Fiber Composites.
(9)

STRESS STRAIN RELATIONS

Concepts in solid mechanics, Hooke's law for orthotropic and anisotropic materials, Linear Elasticity for Anisotropic Materials, Rotations of Stresses, Strains, Residual Stresses. **(9)**

ANALYSIS OF LAMINATED COMPOSITES

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. **(9)**

FAILURE AND FRACTURE OF COMPOSITES

Netting Analysis, Failure Criterion, Maximum Stress, Maximum Strain, Fracture Mechanics of Composites, Sandwich Construction. **(9)**

APPLICATIONS AND DESIGN

Metal and Ceramic Matrix Composites, Applications of Composites, Composite Joints, Design with Composites, Review, Environmental Issues. **(9)**

TOTAL : 45

TEXT BOOKS

1. *Daniel and Ishai, "Engineering Mechanics of Composite Materials", Oxford University Press, 2013.*

2. *Jones.R.M, "Mechanics of composite materials", McGraw-Hill, Koghkusha, International Students Edition, Tokyo, 2015.*

REFERENCES

1. *Agarwal.B.D and Broutman.L.J, "Analysis and Performance of fiber composites", John-Wiley and Sons, 1980.*

2. *Michael W.Hyer, "Stress Analysis of Fiber-Reinforced Composite Materials", McGraw Hill, 1999.*

3. *Mukhopadhyay.M, "Mechanics of Composite Materials and Structures", University Press, India, 2004.*