DEPARTMENT OF CIVIL ENGINEERING

Scheme of Instruction and Syllabus
of
M.E. (Civil Engineering)

Full time / Part time
(2015-16)

UNIVERSITY COLLEGE OF ENGINEERING
(Autonomous)
Osmania University
Hyderabad – 500 007, TS, INDIA

Scheme of Instruction & Examination

M.E. (Civil Engineering) 4 Semesters (Full Time)

Sl. No	Subject	Periods per Week		Duration (Hrs)	Max. Marks		Credits
		L/T	D/P		SEE	CIE	
Semester - I							
1.	Core	3	--	3	70	30	3
2.	Core	3	--	3	70	30	3
3.	Core / Elective	3	--	3	70	30	3
4.	Core / Elective	3	--	3	70	30	3
5.	Elective	3	--	3	70	30	3
6.	Elective	3	--	3	70	30	3
7.	Laboratory – I	--	2½	2½	--	50	2
8.	Seminar – I	--	2½	2½	--	50	2
	Total	**18**	**5**	**23**	**420**	**280**	**22**
Semester - II							
1.	Core	3	--	3	70	30	3
2.	Core	3	--	3	70	30	3
3.	Core / Elective	3	--	3	70	30	3
4.	Core / Elective	3	--	3	70	30	3
5.	Elective	3	--	3	70	30	3
6.	Elective	3	--	3	70	30	3
7.	Laboratory – II	--	2½	2½	--	50	2
8.	Seminar – II	--	2½	2½	--	50	2
	Total	**18**	**5**	**23**	**420**	**280**	**22**
Semester - III							
1.	Project+ Seminar*	--	4	4	--	**100****	**8**
Semester – IV							
1.	Dissertation	--	6	6	**200**	-	**16**

Note: Six core subjects, six elective subjects, Two Laboratory Courses and Two Seminars should normally be completed by the end of semester II.

* *One project seminar presentation.*

** *50 marks to be awarded by guide and 50 marks to be awarded by viva-voice committee comprising Guide and two internal senior faculty members (subject experts)*

Scheme of Instruction & Examination

M.E. (Civil Engineering) 6 Semesters (Part Time)

Sl. No	Subject	Periods per Week		Duration (Hrs)	Max. Marks		Credits
		L/T	D/P		SEE	CIE	
Semester - I							
1.	Core	3	--	3	70	30	3
2.	Core / Elective	3	--	3	70	30	3
3.	Elective	3	--	3	70	30	3
4.	Lab. I / Seminar – I	--	2½	2½	--	50	2
	Total	**9**	**2½**	**11½**	**210**	**140**	**11**
Semester - II							
1.	Core	3	--	3	70	30	3
2.	Core / Elective	3	--	3	70	30	3
3.	Elective	3	--	3	70	30	3
4.	Lab. I / Seminar – I	--	2½	2½	--	50	2
	Total	**9**	**2½**	**11½**	**210**	**140**	**11**
Semester - III							
1.	Core	3	--	3	70	30	3
2.	Core / Elective	3	--	3	70	30	3
3.	Elective	3	--	3	70	30	3
4.	Lab. II / Seminar – II	--	2½	2½	--	50	2
	Total	**9**	**2½**	**11½**	**210**	**140**	**11**
Semester – IV							
1.	Core	3	--	3	70	30	3
2.	Core / Elective	3	--	3	70	30	3
3.	Elective	3	--	3	70	30	3
4.	Lab. II / Seminar – II	--	2½	2½	--	50	2
	Total	**9**	**2½**	**11½**	**210**	**140**	**11**
Semester – V							
1.	Project+ Seminar*	--	4	4	--	**100****	**8**
Semester – VI							
1.	Dissertation	--	6	6	**200**	-	**16**

Note : Six core subjects, Six elective subjects, Two Laboratory Courses and Two Seminars should normally be completed by the end of semester IV.

* *One project seminar presentation.*

** *50 marks to be awarded by guide and 50 marks to be awarded by viva-voice committee comprising Guide and two internal senior faculty members (subject experts)*

M. E. CIVIL ENGINEERING

Subjects for

Specialization: Structural Engineering

With effect from the academic year 2015-2016

Course Code	Course Title	Contact hours per week	Max Marks		Credits
			Continuous Internal Evaluation	Semester End Evaluation (University)	
Core Subjects:					
CE 1101	Theory of Elasticity	3	30	70	3
CE 1102	Structural Analysis	3	30	70	3
CE 1103	Theory of Plates	3	30	70	3
CE 1104	Structural Design	3	30	70	3
CE 1105	Finite Element Methods	3	30	70	3
CE 1106	Structural Dynamics	3	30	70	3
Elective Subjects:					
MT 0101	Mathematics	3	30	70	3
CE 0111	Engineering Research Methodology	3	30	70	3
CE 1111	Theory of Shells and Folded Plates	3	30	70	3
CE 1112	Earthquake Resistant Design of Structures	3	30	70	3
CE 1113	Structural Optimization	3	30	70	3
CE 1114	Advanced Steel Design	3	30	70	3
CE 1115	Pre-stressed Concrete	3	30	70	3
CE 1116	Advanced Concrete Technology	3	30	70	3
CE 1117	Advanced Reinforced Concrete Design	3	30	70	3
CE 1118	Bridge Engineering	3	30	70	3
CE 1119	Structural Health Monitoring	3	30	70	3
CE 1120	Structural Stability	3	30	70	3
CE 1121	Retrofitting and Rehabilitation of Structures	3	30	70	3
CE 1122	Composite Construction	3	30	70	3
CE 1123	Green Building Technology	3	30	70	3
CE 1124	Neural, Fuzzy and Expert Systems	3	30	70	3
CE 1220	Geospatial Technology	3	30	70	3
CE 1221	Disaster Management	3	30	70	3
CE 1315	Design of Offshore Foundations	3	30	70	3
Departmental Requirements:					
CEL 1131	Structural Engineering Lab-I	2	50	-	2
CEL 1132	Structural Engineering Lab-II	2	50	-	2
CES 1133	Seminar-I	2	50	-	2
CES 1134	Seminar-II	2	50	-	2
CEP 1135	Project Seminar	4	100	-	8
CEP 1136	Dissertation	6	150	Viva Voce Grade	12

CIE: Continuous Internal Evaluation SEE: Semester End Examination

CE 1101 *With effect from the academic year 2015-2016*

THEORY OF ELASTICITY

No. of Credits	3 Credits
Instruction	4 Periods per week
Duration of University Examination	3 Hours
Semester End Evaluation	70 Marks
Continuous Internal Evaluation	30 Marks

Course Objectives:

1. Understand the concepts of elasticity and equip them with the knowledge to independently handle the problems of elasticity.
2. Enhance the competency level and develop the self confidence through quality assignments in theory of elasticity.
3. Inculcate the habit of researching and practicing in the field of elasticity.

Course Outcomes:

1. Solve the problems of 3-D elasticity with confidence.
2. Work independently with the problems of 2-D elasticity in Cartesian/polar coordinates.
3. Familiarize with the use of Airy's stress function in 2-D problems of elasticity in Cartesian/polar coordinates.
4. Equip with the knowledge of various theories of torsion of prismatic bars of various cross sections and can solve the problems of torsion.
5. Interpret and apply the theory of elasticity to practical problems of structural engineering.

UNIT – I

Definition and notation of stress in three dimensional Cartesian co-ordinates. Components of stress and strain. Generalized Hooke's law, Stress -strain relations in three directions. Stress components on an oblique plane. Transformation of stress components under change of co-ordinate system.

Equations of equilibrium and compatibility in Cartesian co-ordinates in three dimensions.

UNIT – II

Principal stresses and principal planes. Stress invariants. Mean and Deviator stress. Strain energy per unit volume. Distortion strain energy per unit volume. Octahedral shear stress. Strain of a line element. Principal strains. Strain invariants, Volume strain, Principle of superposition, reciprocal theorem.

UNIT – III

Two dimensional problems in Cartesian co-ordinates

Plane stress and plane strain situations, equilibrium equations. Compatibility equations, St. Venant's principe. Uniqueness of solution, Stress components in terms of Airy's stress function. Applications to Cantilever , Simply supported and fixed beams with simple loading.

UNIT – IV

Two dimensional problems in polar co-ordinates.

Equilibrium equations. Stress strain components. Compatibility equation. Applications using Airy's strain functions in polar co-ordinates for stress distributions symmetric about an axis. Effect of hole on stress distribution in a plate in tension. Stress due to load at a point on a semi-infinite straight boundary. Stresses in a circular disc under diametrical loading.

UNIT – V

Torsion – Torsion of various shapes of bars. Stress function method of solution applied to circular and elliptical bars. Torsion of rectangular bars - solution of Torsional problems by energy method - use of soap films in solving torsion problems - Prandtl's membrane analogy. Solution of torsion of rectangular bars by (i) Raleigh Ritz method and (ii) Finite difference method.

Suggested Reading:

1. "Theory of Elasticity", S. Timoshenko & N. Goodier, Mc Graw Hill.
2. "Theory of Elasticity", Valiappan, Mc Graw Hill.
3. "Theory of Elasticity", Sadhu Singh, Khanna publishers

STRUCTURAL ANALYSIS

No. of Credits	3 Credits
Instruction	4 Periods per week
Duration of University Examination	3 Hours
Semester End Evaluation	70 Marks
Continuous Internal Evaluation	30 Marks

Course Objectives:

1. Understand the concepts of matrix methods of analysis and equip them with the knowledge to independently handle the problems of structural analysis.
2. Enhance the competency level in analysis of continuous beam, portal frames, pin jointed structures by flexibility and stiffness matrix methods.
3. Understand the formation of global stiffness matrix from local stiffness matrix and equation solving techniques using direct stiffness method.
4. Know the shear center for any unsymmetrical prismatic section and unsymmetrical bending of beams.
5. Learn the concepts of beams on elastic foundation.

Course Outcomes:

1. Analyse the continuous beams, rigid jointed frames and pin jointed structures by stiffness and flexibility matrix methods.
2. Formulate the element and global stiffness matrices by direct stiffness method and learn equation solution techniques.
3. Discover the concepts of shear center and unsymmetrical bending of prismatic beams.
4. Solve the problems pertaining to beams on elastic foundation.

UNIT - I

Introduction to matrix methods of analysis – static indeterminacy and kinematic indeterminacy - degree of freedom Stiffness methods. Analysis of bar element - plane truss - continuous beam - plane frame and grids

UNIT-II

Flexibility methods. Analysis of bar element - plane truss - continuous beam - plane frame and grids

UNIT-III

Direct stiffness method -Analysis of plane truss - continuous beam - plane frame and grid frames , Assemblage of global stiffness matrix –Exposure to softwares-MSC NASTRAN & E-TAB

UNIT – IV

Shear centers for sections with one axis of symmetry, shear center for any unsymmetrical Section, UnSymmetrical Bending of beams-stress and deflection of beams subjected to unsymmetrical bending. Torsion of circular members, hollow members, Solid Prismatic bars, elliptical section, equilateral triangular section; Membrane Analogy

UNIT - V

Beams on Elastic Foundation- introduction-Modulus of foundation & Basic equation. Beams of infinite length under concentrated & uniformly distributed loads, Analysis of semi infinite beams making use of functions for infinite beams

References:

1. Advanced Structural Analysis by Ashok.K.Jain, New Channel Brothers.
2. DevdasMenon,"AdvancedStructuralAnalysis", Narosa Publishing House, 2009.
3. AsslamKassimali,"Matrix Analysis of Structures", Brooks/Cole Publishing Co., USA, 1999.
4. Amin Ghali,Adam M Neville and Tom G Brown,"StructuralAnalysis:A Unified Classical and Matrix Approach",Sixth Edition, 2007, Chapman & Hall.
5. William Weaver, Jr & James M. Gere, Matrix Analysis of Framed Structures, CBS Publishers & Distributors, Delhi. 2. Wang C.K., Matrix methods of Structural Analysis Mc Graw Hill book Company, New Delhi. 3.
6. Advanced mechanics of solids & structures, N.Krishna Raju, D.R Gururaja Narosa publishing house New Delhi.
7. Advanced Mechanics of Materials Seely and Smith

THEORY OF PLATES

No. of Credits	3 Credits
Instruction	4 Periods per week
Duration of University Examination	3 Hours
Semester End Evaluation	70 Marks
Continuous Internal Evaluation	30 Marks

Course Objectives:

1. Learn the analysis of rectangular and circular plates subjected to various loading conditions with different boundary conditions.
2. Understand fundamentals of buckling of plates.
3. Know the concepts of small deflection theory of laterally loaded plates.
4. Study the approximate methods of analysis of rectangular plates.
5. Derive the governing differential equations for orthotropic plates and apply them to practical problems.

Course Outcomes:

1. Analyse the rectangular and circular plates subjected to various loading conditions.
2. Decipher the problems of buckling of plates with different edge conditions.
3. Work out the problems of small deflection theory of laterally loaded plates with different edge conditions.
4. Understand the various numerical and approximate methods for analysis of plate problems.
5. Apply the concepts of orthotropic plates to simply supported structures.

UNIT I

Pure bending of Plates: Pure and Cylindrical Bending, Relations between slope and curvature of slightly bent plates Moment-curvature relations in pure bending. Strain energy in pure bending.Symmetrical bending of Circular Plates: Differential equation of equilibrium. Uniformly loaded plates at center. Circular plates with circular holes at the center.

UNIT II

Buckling of plates: Calculation of critical loads- Buckling of simply supported rectangular plates-uniformly compressed in one and two directions with different edge conditions. Web buckling.

UNIT III

Small deflections of Laterally Loaded Plates: Differential equation of equilibrium. Boundary conditions. Solution of simply supported rectangular plates under various loading conditions.viz unormally distributed load (full or partial) concentrated load by Navier's approach. Levy type solution for rectangular plates under U.D.L with all four edges simply supported or two opposite edges simply supported and other two fixed.

UNIT IV

Approximate methods for Rectangular Plates: Strain energy approaches Rayleigh-Ritz method. Finite difference method for simply supported or fixed rectangular plates carrying UDL (full or partial) or central point load.

UNIT V

Bending of Orthotropic Plates: Differential equation of the bent plate. Application of the theory to simply supported rectangular (i) laminates; (ii) RC slabs (iii) grids.

Suggested Reading:

1.”Theory of plates and shells” , S. Timoshenko and W.Krienger, Mc Graw Hill.
2. “Theory of plates and shells” , R.H. Wood.
3. “Theory of plates and shells” , Zienkiwicz, Mc Graw Hill Co.

CE 1104 *With effect from the academic year 2015-2016*

STRUTURAL DESIGN

No. of Credits	3 Credits
Instruction	4 Periods per week
Duration of University Examination	3 Hours
Semester End Evaluation	70 Marks
Continuous Internal Evaluation	30 Marks

Course objectives:

1. Brush-up the fundamentals of design of reinforced concrete and steel structures by limit state design and review the usage of relevant codes.
2. Become the competent and tailor-made, by covering contemporary engineering practices in the structural design.
3. Develop the mixed qualities - independently handling the design problems and working in a group for team works (through assignments).

Course Outcomes:

1. Comprehend the concepts of design of flat slabs, circular slabs, and waffle slabs, complexity in the design of slabs with openings.
2. Design the continuous beams and analyse the portal frames for gravity as well as lateral loads.
3. Attain confidence in reinforcement detailing of reinforced concrete structures and detailing of steel structures (good for construction drawings).
4. Answer the problems of analysis and design of indeterminate beams and frames by plastic theory.
5. Promote the latest structural systems like composite constructions.

UNIT – I

Design of continuous reinforced concrete beams.

Flat slabs: Introduction, components, IS code recommendations, design methods, design for flexure and shear – openings in flats slabs – moments in columns.

Circular Slabs: Introduction, IS code recommendations, Types of circular slabs, Analysis and Design of Circular Slabs.

Analysis and design of Ribbed and Waffle Slabs

UNIT – II

Reinforced Concrete Portal Frames: Introduction, analysis and design of rectangular portal frames for vertical loading – design of hinges.

Multi-Storeyed Building Frames: Analysis and Design due to vertical loads by substitute frame method, analysis and design of portal method, cantilever method and Factor method.

UNIT – III

Shear walls : Introduction, classification of shear walls, types of loads, analysis and design.
Ductile detailing of frames for seismic loads: Introduction, general principles, factors, specification of materials , design of rectangular and flanged shear wall, calculation of moment of resistance

UNIT – IV

Plastic Design of Steel Structures: Plastic analysis and design of indeterminate beams and portal frames of upto single bay two storeyed and two bay single storeyed – minimum weight design.

UNIT – V

Composite construction: Introduction, design principles, shear connectors and their types - IS codal provisions – design of slab-beam type composite construction systems.

Suggested Reading:

1. “R.C.C. Design”, by Punma, B.C., Laxmi Pub 1998.
2. “Reinforced Concrete” Vol.II. by H.J.Shah, Charotar Pub. 2000.
3. “Steel Structures” by Ramamrutham S., Dhanpat Rai Pub. 2001.
4. “Design of Steel Structures”, by S.A.Raj, New Age Pub. 2002.

FINITE ELEMENT METHODS

No. of Credits	3 Credits
Instruction	4 Periods per week
Duration of University Examination	3 Hours
Semester End Evaluation	70 Marks
Continuous Internal Evaluation	30 Marks

Course Objectives:

1. Learn the rudiments of finite element analysis.
2. Study the fundamentals of domain discretization, interpolation, application of boundary conditions, assembly of global matrices, and solution of the resulting algebraic systems.
3. Explain the core concepts of variational and weighted residual methods in FEM.
4. Derive the element stiffness matrix for 1-D, 2-D and 3-D problems.
5. Formulate the simple structural problems in to finite elements.

Course Outcomes:

1. Build and analyse the FEA models for various engineering problems.
2. Identify the information requirements and sources for analysis, design and evaluation.
3. Use the standard finite element software to solve the structural engineering problems.
4. Interpret the results obtained from FEA software, not only in terms of conclusions but also awareness of limitations.

UNIT – I

Introduction to FEM: Types of Problems – Types of Materials – Elastic / Inelastic situations – Types of forces: Body forces / Surface Traction / Point loads – Deformable bodies – Types of Deformations – Homogeneous / Non homogeneous Problems – Equations of equilibrium for elastic 2-D / 3-D continua - Equilibrium equations for 2-D / 3-D boundary elements – Boundary conditions – Strain-displacement relation for 2-D / 3-D – Stress-strain relation for 2-D / 3-D – Plane stress / Plane strain problems.

Virtual Work Formulation: Application to problems of plane trusses with static indeterminacy not exceeding three.

Finite Difference Method with Central Differences: Solving ODE's and PDE's with central differences. Application to beam and plate bending problems of simple geometry.

UNIT – II

Variational Formulation :

Finite Element Formulation - Stationarity of Functional – Given the Functional or Differential equation – Number of elements limited to two.

1-D Elements: Strain-displacement relation matrix / stiffness matrix / Minimum Potential Energy Approach / Rayleigh-Ritz Method / introduction to natural coordinates / stiffness matrix of second order bar element / Axial bar subjected to point loads, body forces and surface traction forces / Problems with kinematic indeterminacy not exceeding two.

2-D Triangular Elements: Displacement models / criterion for convergence / geometric invariance / conforming and non conforming elements - 3-node triangular elements (CST) / determination of strain-displacement matrix / area coordinates-shape functions / determination of element stiffness and load matrices, assembling global stiffness and load matrices / Problems with kinematic indeterminacy not exceeding three.
2nd Order triangular elements: Shape functions – degradation technique / strain-displacement matrix / Expression for stiffness matrix / Load matrices due to body forces and surface traction.

UNIT – III
Iso-parametric elements:
Quadrilateral elements: Construction of shape functions using natural coordinates/Strain-displacement matrices/Load matrices for body force and surface traction/ Expressions for stiffness matrix, load matrices for 4-noded quadrilateral elements/ Gauss Quadrature of numerical integration / Problems with rectangular elements, kinematic indeterminacy not exceeding three.
2nd Order Quadrilateral elements: - Determination of shape functions for 2nd order quadrilateral elements and for elements of with serendipity / Strain-displacement matrices / Load matrices for body force and surface traction.

UNIT – IV
Method of Weighted Residuals:
Galerkin's Method of Weighted Residuals – Application to problems of mathematics / structural engineering, number of trial functions not exceeding two.
Galerkin's Finite Element Method – Weak form of Trial Function - Application to problems of mathematics / structural engineering, number of elements limited to two.
Axi-symmetric Problems: Strain-displacement relationship/stress-strain relationship / determination of stiffness matrix for 3-noded ring element and load matrices for body force and surface traction/ Problems with kinematic indeterminacy not exceeding three for 3-noded ring elements only.

UNIT – V
Tetrahedron elements: Volume coordinates, Strain-displacement matrix, stiffness matrix, load matrices due to body force and surface traction/ introduction to Hexahedron (brick) elements.
Non-linear Finite element analysis: Introduction – problems with material non-linearity – problems with geometric non-linearity – problems with both material and geometric non-linearity.
Introduction to MSC Nastran: Illustration on different modules of Nastran / Structural engineering applications of the package/Creation of a simple 1-D model, 2-D model and a 3-D model/ analysis and post processing of the results.

Suggested Reading:

1. Cook, R. D. (1981). "Concepts and Application of Finite Element Analysis", John Wiley and Sons.
2. Zienkiewicz, O. C. And Taylor, R. L, (1989). "The Finite Element Method", Vol.1, McGraw Hill Company Limited, London.

3. Reddy, J. N, (1993). “An Introduction to the Finite Element Method”, McGraw Hill, New York.
4. Chandrupatla, T. R. And Belegundu, A. D, (2001). “Introduction to Finite Elements in Engineering”, Prentice Hall of India, New Delhi.
5. Seshu. P, (2003). “Finite Element Analysis”, Prentice Hall of India Private Limited, New Delhi.
6. David V. Hutton, (2005). “Fundamentals of Finite Element Analysis”, Tata McGraw-Hill Publishing Company Limited, New Delhi.
7. Bathe, K. J, (2006). “Finite Element Procedures”, Prentice Hall of India, New Delhi.

CE 1106 *With effect from the academic year 2015-2016*

STRUCTURAL DYNAMICS

No. of Credits	3 Credits
Instruction	4 Periods per week
Duration of University Examination	3 Hours
Semester End Evaluation	70 Marks
Continuous Internal Evaluation	30 Marks

Course Objectives:

1. Study the various types as well as characteristics of loading and formulate the equations of motion.
2. Learn the response of un-damped and damped SDOF and MDOF systems under various loadings.
3. Employ the approximate and iterative methods to model continuous vibratory systems.
4. Use the seismic codes in analysis and design of civil engineering structures.
5. Understand the dynamic response by numerical methods.

Course Outcomes:

1. Know the fundamental theory of dynamic equation of motions and analysis methods for dynamic systems.
2. Understand the modeling approach of dynamic response in civil engineering applications.
3. Create the simple computer models for engineering structures using knowledge of structural dynamics.
4. Evaluate the dynamic response analysis results and understand the possible error sources.
5. Interpret the dynamic analysis results for design, analysis and research purposes.
6. Apply the structural dynamics theory to earthquake analysis, response, and design of structures.

UNIT – I

Objectives of dynamic analysis – Types of prescribed dynamic loading – Characteristics of a dynamic problem – Methods of dicretization: Lumped mass Procedure / Consistent mass procedure/generalised displacements – Single Degree Freedom Systems – Formulation of Equation of Motion: d'Alemberts's Principle / Method of Virtual Work / Hamilton's Principle – Influence of Gravity Forces and Ground Motion on equation of motion – Generalised SDOF systems: Rigid Body Assemblage/Distributed Flexibility.

UNIT – II

Response of Un-damped/Damped free vibrations of SDOF systems – Un-damped/Damped vibrations of SDOF systems subjected to Harmonic loading: Dynamic equilibrium / Accelero Meters / Displacement Meters / Resonant Response / Vibration Isolation – Un-damped / Damped vibrations of SDOF systems subjected Periodic loading – Response of SDOF systems subjected Impulse loads: Half-sine pulse/Rectangular pulse/Triangular Pulse/ Shock spectra / Approximate method of impulse load analysis – Un-damped / Damped vibrations of SDOF systems subjected General dynamic loading / Duhamel Integral - Un-damped / Damped vibrations of SDOF systems subjected arbitrary dynamic loading.

UNIT – III

Multi Degree Freedom Systems: Formulation of Equations of Motion / Evaluation of Lumped Mass Matrix and consistent mass matrix/ Evaluation of Stiffness Matrix.

Un-damped Free Vibrations: Analysis of Frequency matrix and mode shape matrices using determinental equation/Flexibility Formulation/Orthogonality Conditions/ Normalizing Mode shapes/Analysis of Dynamic Response/Normal Coordinates/ Uncoupled Equations of Motion for un-damped systems/Conditions for damping orthogonality – Mode super position procedure for damped forced vibrations – Time History Analysis – Direct Integration Methods due to New Mark(average acceleration, linear acceleration), Wilson theta correction.

UNIT – IV

Practical Vibration Analysis: Stodola Method, Holtzer Method – Fundamental mode only, Reduction of degrees of freedom, basic concepts in matrix iteration.

Variational Formulation of Equations of Motion: Generalised coordinates, Lagrange's Equations of Motion, Application to simple un-damped and damped problems of 2-DOF systems.

UNIT – V

Distributed Parameter Systems: Partial Differential Equation of Motion – Beam Flexure (Elementary case) – Undamped free vibrations (Elementary case) – Analysis of dynamic response – normal coordinates.

Earthquake Resistant Design: Brief exposure to relevant IS Codes of Practice, Method of constructing Response Spectra.

Suggested Reading:

1. Walter C. Hurty & Moshe F. Rubinstein, (1964). "Dynamics of Structures", Prentice Hall India.
2. Clough, Ray. W, and Penzien, Joseph (1982). "Dynamics of Structures", McGraw Hill Company Limited, New Delhi.
3. Mario Paz, (1987). "Structural Dynamics", CBS Publishers.
4. Chopra, A. K, (1996). "Dynamics of Structures", Prentice Hall India.

MT 0101 *With effect from the academic year 2015-2016*

MATHEMATICS

No. of Credits	3 Credits
Instruction	4 Periods per week
Duration of University Examination	3 Hours
Semester End Evaluation	70 Marks
Continuous Internal Evaluation	30 Marks

Course Objectives:

1. Study the orthogonality of functions using Fourier series.
2. Learn the statistics, tests of significance and acceptance.
3. Study the solution to mathematical problems using special functions.
4. Learn the transforms of differentials and integrals.
5. Study the Beta and Gamma functions and theory of errors.

Course Outcomes:

1. Apply the orthogonality of functions using Fourier series to engineering problems.
2. Apply the concepts of statistics to the tests of significance and its acceptance.
3. Solve mathematical problems using Bessels and Legendre differential equations.
4. Use the transforms of differentials and integrals for solving engineering problems.
5. Apply the Beta and Gamma functions to the theory of errors.

UNIT - I

Fourier Series: Concept of orthogonality of functions, Fourier series corresponding to functions in intervals of length '2II" and "2I', Half range series.

UNIT – II

Statistics : Tests of significance and acceptance, chi-square, F and T tests, Trends, Oscillations, moving averages.

UNIT – III

Special functions: Solution in series of Bessels and Legendre differential equations, Recurrence, relation of Jn(X) and Pn(X), Orthogonality of Legendre polynomials.

UNIT – IV

Transforms: Laplace transforms – transformations of standard functions – Shuffing theorems, convolution theorem, transforms of differentials and integral – application to differential equations – Fourier sine and cosine transforms, application to differential equations, brief introduction to fast Fourier transforms.

UNIT - V

Beta and Gamma functions and their properties, applications to theory of errors, Chebhshov polynomias – Orthogonality both $T_{ii}(X)$ and $U_{ii}(X)$, Recurrence relation.

Suggested Reading:

1. B. S. Grewal, “Higher Engineering Mathematics,” Khanna Publishers, 2001.
2. S. Gupta and V.K. Kapoor, “Fundamentals of Mathematics Statistics,” Sultan Chand & Sons, 1996.

THEORY OF SHELLS AND FOLDED PLATES

No. of Credits	3 Credits
Instruction	4 Periods per week
Duration of University Examination	3 Hours
Semester End Evaluation	70 Marks
Continuous Internal Evaluation	30 Marks

Course Objectives:

1. Learn the analysis and design of cylindrical shells, short and long shells.
2. Study the concepts of bending theory using D.K.J. equations and Schorer theory.
3. Understand the beam theory and beam arch analysis.
4. Gain knowledge of the analysis and design of different shells of double curvature and axi-symmetrical shells by membrane theory.
5. Analyse different types of folded plates using Simpson's and Whitney's methods.

Course Outcomes:

1. Analyse the cylindrical shells and design the short and long shells.
2. Solve the problems of bending theory using appropriate equations.
3. Evaluate and design the different shells using beam theory and membrane theory.
4. Analyse the numerous types of folded plates using pertinent method.

UNIT I

Introduction: definition and classification of shells.

Cylindrical Shells: Membrane Theory – Equilibrium equations for differential shell elements – Calculation of stresses and displacement due to dead loads and snow loads for circular cylindrical shell.

UNIT II

Bending Theory - Necessicity of bending theory (i) D.K.J theory Assumption – Equilibrium equations for a differential element - stress strain relations - Moment curvature relations – Derivation of D.K.J. Differential and characteristics equations – Roots of the Characteristic equation – Expression for defection. (ii) Schorer theory – assumptions – Equilibrium equations for a differential shell element – stress strain relations – Moment curvature relations – Derivation of Schorer differential and characteristic equation – Roots of the characteristic equation – Expression of defection.

UNIT III

Beam Theory – Assumptions and range of their validity – Outline of the beam arch analysis – Advantages of beams theory over other theories.

UNIT IV

Shells of Doubles Curvature: Membrane theory of shells of revolution- Equilibrium equations for a differential shell element – Calculation of stresses in a spherical dome due to uniform load over the surface and due to concentrated load around a skylight opening. Shells of translation equilibrium equations for a differential shell element. Pucher's stress function, derivation of a differential equation from equations of equilibrium using Pucher's stress function calculation of stresses in hyperbolic parabolids with straight edges under uniform load over the surface.

UNIT V

Folded Plates: Assumptions – Structural behavior – Resolutions of ridge loads – Edge shears – Stress distribution – Plate deflections and rotations. Effect of joint moments – Analysis of V shaped folded plates using (i) Simpson and (ii) Whitney methods.

Suggested Reading:

1.”Theory of plates and shells”, S. Timoshenko and W.Krienger, Mc Graw Hill.1959
2. “Design and construction of concrete shell roofs”, G.S.Ramaswamy, CBS Pub 1986
3.”Thin Shells Theory and Problems”, J.Ramchandran, Universities press, 1993.

EARTHQUAKE RESISTANT DESIGN OF STRUCTURES

No. of Credits	3 Credits
Instruction	4 Periods per week
Duration of University Examination	3 Hours
Semester End Evaluation	70 Marks
Continuous Internal Evaluation	30 Marks

Course Objectives:

1. Learn the causes of earthquake and effects of ground motion and modeling of structures.
2. Study the response spectra and structural dynamics of MDOF systems.
3. Discover the different analysis and design approaches like equivalent lateral force method and inelastic time history analysis.
4. Be trained in the ductile detailing of reinforced concrete structures as per IS 4326 and IS 13920.
5. Learn the seismic analysis of masonry buildings.

Course Outcomes:

1. Apply the concepts of structural dynamics of MDOF systems for analysis of structures.
2. Model and analyse the structures to resist earthquake forces by different methods.
3. Design the various structural elements resisting earthquake forces as per IS Codes.
4. Practice ductile detailing of reinforced concrete and masonry buildings as per codal provisions.

Unit-I

Earthquake Ground Motion: Engineering seismology, Seismic zoning map of India, Strong motion studies in India, Strong motion characteristics, Evaluation of seismic design parameters.
Structural Dynamics: Initiation into structural dynamics, Dynamics of SDOF systems, Theory of seismic pickup, Numerical evaluation of dynamic response, Response spectra, Dynamics of MDOF systems.

Unit-II

Concepts of Earthquake Resistant Design of RCC Structures: Basic elements of earthquake resistant design, Identification of seismic damages in RCC buildings, Effect of structural irregularities on performance of RCC buildings during earthquakes, earthquake resistant building architecture.

Unit-III

Seismic Analysis and Modelling of RCC Structures: Code based procedure for determination of design lateral loads, Infill walls, Seismic analysis procedure as per IS 1893 code, Equivalent static force method, Response spectrum method, Time history analysis, Mathematical modelling of multi-storey RCC buildings.

Unit-IV

Earthquake Resistant Design of RCC Structures: Ductility considerations, Earthquake resistant design of multi-storey RCC buildings and shear walls based on IS 13920 code, Capacity based design.

Unit-V

Earthquake Resistant Design of Masonry Structures: Identification of damages and non-damages in masonry buildings, Elastic properties of structural masonry, Lateral load analysis of masonry buildings, Seismic analysis and design of one-storey and two-storey masonry buildings.

Suggested Reading:

1. Bruce A Bolt, "Earthquakes", W H Freeman and Company, New York, 2004.
2. C. A. Brebbia,"Earthquake Resistant Engineering Structures", WIT Press, 2011.
3. Mohiuddin Ali Khan "Earthquake-Resistant Structures: Design, Build and Retrofit", Elsevier Science & Technology, 2012.
4. Pankaj Agarwal and Manish Shrikhande, "Earthquake Resistant Design of Structures", Prentice Hall of India, 2009.
5. Paulay,T and Priestley, M.J.N., "Seismic Design of Reinforced Concrete and Masonry buildings", John Wiley and Sons, 1992.
6. S K Duggal, "Earthquake Resistant Design of Structures", Oxford University Press, 2007.

STRUTURAL OPTIMIZATION

No. of Credits	3 Credits
Instruction	4 Periods per week
Duration of University Examination	3 Hours
Semester End Evaluation	70 Marks
Continuous Internal Evaluation	30 Marks

Course Objectives:

1. Learn the optimization techniques and linear optimization.
2. Study the non-linear optimization and non-linear constrained optimization.
3. Understand the dynamic programming, decision theory and simulations.
4. Apply optimization techniques for simple structures.

Course Outcomes:

1. Become confident at optimization techniques, linear optimization, algorithm, etc.
2. Learn the nonlinear optimization-I and one dimensional minimization methods.
3. Study the non-linear optimization-II by different methods.
4. Use the optimization techniques for simple structures.

UNIT – I

Introduction: Introduction of optimization, basic theory and elements of optimization, Terminology and definitions, Basic principles and procedure of optimization.
Classical Methods of Optimization: Trial and error method, Monte-Carlo method, Lagrangian multiplier method, illustrative examples
Linear Programming: Introduction, terminology, formulation of LPP, graphical and algebric methods of solving LPP, standard form and canonical form of linear programming, geometrical intepretation, illustrative examples.

UNIT – II

Linear Programming: Simplex methods, Artificial variable techniques, solution of simultaneous equations, Dual formulations - illustrative examples.
Network analysis: Modifications and improvements on CPM/PERT
Transportation and Assignment problem: Introduction, terminology, formulation and solution of mathematical models, illustrative examples.

UNIT – III

Non-Linear Programming: local and global optimum, problem formulation, Unconstrained and constrained methods of optimization-Kuhn Tucker conditions, Lagrangian Multiplier methods, graphical method, Univariate search method, Steepest Descent Methods, quadratic programming problem, Wolfs modified simplex method, illustrative examples.

UNIT – IV

Dynamic programming: Introduction, terminology, need and characteristics of dynamic programming, formulation, solution of LPP, applications, illustrative examples

Decision theory: Introduction, types, decision trees.

Simulation : Introduction, advantages, limitations, types, applications.

UNIT – V

Structural Optimization: Optimum structural design of rectangular timber beam, reinforced concrete rectangular, T and L beams, concrete mix proportioning, reinforced concrete deep beams, planner trusses, Procedure of optimization for structural grid and slab.

Suggested Reading:

1. "Engineering Optimization", S.S.Rao, New Age Internationals (1999).
2. "Systems Analysis for Civil Engineers", Paul, J.O., john wiley & Sons (1988)
3. "Fundamentals of Optimum Design in Engineering" S.S.Bhavikatti, New Age International Publishers.
4. "Operation Research", S.Kalavathy, Vikas Publishing house Pvt Ltd. Second edition

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ADVANCED STEEL DESIGN

No. of Credits	3 Credits
Instruction	4 Periods per week
Duration of University Examination	3 Hours
Semester End Evaluation	70 Marks
Continuous Internal Evaluation	30 Marks

Course Objectives:

1. Learn the fundamentals of design of steel tanks and grillage foundations.
2. Solve the practical problems pertaining to steel tanks and grillage foundations.
3. Study the concepts of analysis and design of various members of tubular structures.
4. Gain knowledge of the design of bunkers and silos using appropriate method and solve the practical problems pertaining to it.
5. Study the fundamentals of design of transmission line towers and solve the practical problems pertaining to it.
6. Learn the concepts of analysis and design of various members of light-gauge steel structures.

Course Outcomes:

1. Design and detail the rectangular plated and pressed steel tanks.
2. Propose the grillage foundations for structures.
3. Design and detail the hollow rectangular, square and circular tubular members in a truss including its joints.
4. Formulate the rectangular and square bunkers and silos using appropriate method.
5. Propose the geometry and analyse and design the transmission towers subjected to various loads.
6. Design the light gauge steel compression and flexural members.

UNIT-I

Steel Tanks: Introduction, Types, Loads, Permissible stresses, Detailed design of elevated rectangular and pressed steel tanks including columns.

UNIT-II

Grillage Foundations: Introduction, Necessity of grillage foundation, Various types, Grillage foundations for single and double columns.

Tubular Structures: Introduction, Permissible stresses, Design considerations, Design of tension members, compression members and flexural members, Design of tubular trusses including joints.

UNIT-III

Bunkers and Silos: Introduction, General design principles, Design theories for bunkers and silos, Detailed design of bunkers and silos.

UNIT-IV

Transmission Line Towers: Classification, Economical spacing, Design loads, IS codal provisions, Calculation of wind loads, Permissible stresses, Overall arrangement and design procedure, detailed design including foundations.

UNIT-V

Design of Light Gauge Steel Structures: Introduction, Forms of light-gauge sections, Behaviour of compression elements, Effective width for load and deflection calculation, Behaviour of unstiffened and stiffened elements, Design of compression members, Design of laterally supported beams and laterally unsupported beams, Connections.

Suggested Reading:

1. S.K. Duggal, “Design of Steel Structures”, Tata McGraw Hill, 2009.
2. B.C Punmia, “Design of Steel Structures”, Laxmi Publications, 2001.
3. Ram Chandra, “Design of Steel Structures”, Vol. I & II, Standard Book House, 1989.
5. P. Dayaratnam, “Design of Steel Structures”, Orient Longman Publications, 1987.
6. I.C. Syal and S. Singh, “Design of Steel Structures”, Standard Book House, 2000.

PRE-STRESSED CONCRETE

No. of Credits	3 Credits
Instruction	4 Periods per week
Duration of University Examination	3 Hours
Semester End Evaluation	70 Marks
Continuous Internal Evaluation	30 Marks

Course Objectives:

1. Learn the concept of pre-stressed concrete, methods and systems of pre-stressing, losses of pre-stress.
2. Analyse and design the sections for flexure, torsion and shear using different methods.
3. Learn the design of sections for bond and anchorage and deflections of pre-stressed concrete beams.
4. Study the analysis and design of statically indeterminate beams.
5. Understand the analysis and design of axial members and slabs and grid floors.

Course Outcomes:

1. Familiarize with fundamentals of pre-stressed concrete, methods and systems of pre-stressing and losses of pre-stress.
2. Analyse and design the sections for flexure, shear bond and anchorages.
3. Estimate the deflections of pre-stressed concrete elements.
4. Know the circular pre-stressing, analysis and design of statically indeterminate beams.
5. Solve the problems pertaining to axial members, slabs and grid floors.

UNIT I

Introduction: Basic concepts, materials, permissible stress – Systems of prestressing – losses in pre-stress.

Design: Analysis in design of PSC beams for flexure using elastic and limit state methods.

UNIT II

Deflections: Importance of deflections, factors influencing deflections, codal provisions, short term and long term deflections.

Shear: Shear in principal stresses – cracked and uncracked sections - codal provisions – Design of shear reinforcement.

Torsion and Bond: Torsion for cracked and uncracked sections, codal provisions and design – Bond, codal provisions expressions and design.

UNIT III

End Blocks: Nature of stresses, Stress distribution – Magnel and Guyol's Methods -codal provisions - Design.

Continuous beams: Advantageous of Continuous members – Code provisions – Design of two span and three span Continuous beams – concordant cable profiles.

UNIT IV

Tension Members: Introduction, Ties, Circular prestressing – Design of PSC pipes and tanks.
Compression Members: Introduction – Design of PSC columns, poles and piles.

UNIT V:

Slabs: Introduction – Types – circular , rectangular and flat slabs – cracking and strength – Codal provisions – Design of PSC floor slabs, one way and two way slabs, and simple flat slabs.
Grid Floors: Introduction – Analysis and design of PSC Grid floor systems.

Suggested Reading:

1. "Prestressed Concrete" by N. Krishna Raju, Tata Mc Graw Hill, 2001.
2. "Prestressed Concrete" by G.S.Pandit and S.P. Gupta, CBS Pub., 1995.
3. "Design of prestressed Concrete" by Arthur H. Nilson, John Wiley, 1987.

ADVANCED CONCRETE TECHNOLOGY

No. of Credits	3 Credits
Instruction	4 Periods per week
Duration of University Examination	3 Hours
Semester End Evaluation	70 Marks
Continuous Internal Evaluation	30 Marks

Course Objectives:

1. Learn the concept of cement and its properties, mechanical and thermal properties of aggregates.
2. Study the properties and testing of concrete in fresh and hardened state.
3. Learn the shrinkage and creep mechanisms, curing and durability of concrete.
4. Design concrete mix by various methods as per different codes.
5. Study the different types of admixtures, mix design, properties and applications of special concretes.

Course Outcomes:

1. Learn hydration of cement and tests on properties of cement and aggregates.
2. Comprehend the properties and testing of concrete in fresh and hardened state.
3. Understand the shrinkage and creep mechanisms, curing and durability of concrete.
4. Design concrete mixes by various methods.
5. Familiarize with the types of admixtures, and applications of special concretes.

UNIT - I

Cement: Types of cement and their composition, manufacture of Portland cement, hydration of cement and hydration product, structure of hydrated cement, heat of hydration, gel theories, review of tests on properties of cement.

Aggregate: Classification of aggregates, particle shape and texture, bond and strength of aggregate and its influence on strength of concrete, porosity, absorption and moisture content and their influence, soundness of aggregate, alkali aggregate reaction, sieve analysis and grading of aggregate, review of tests on properties of aggregate.

UNIT - II

Properties of Concrete: Mixing and batching, workability, factors affecting workability, measurements of workability, various tests and procedures, segregation and bleeding, vibration of concrete, types of vibrators and their influence on composition, analysis of fresh concrete, strength of concrete, water-cement ratio, gel space ratio, effective water in the mix, mechanical properties of concrete, tests and procedure, influence of various parameters on strength of concrete, relationship between various mechanical strengths of concrete.

UNIT - III

Shrinkage and Creep of Concrete: Types of shrinkage, mechanism of shrinkage, factors affecting shrinkage, creep mechanism, factors influencing creep, rheological model, effects of creep.
Curing of Concrete: Methods of curing, maturity concept, influence of temperature on strength of concrete.
Durability of Concrete: Permeability of concrete, chemical attack of concrete, tests on sulphate resistance, effect of frost, concreting in cold weather, hot weather concreting, and air entrained concrete.

UNIT - IV
Mix Design of Concrete: Basic considerations, process of mix design, factors in the choice of mix proportions and their influence, quality control, various methods of mix design, I.S. Code method, British and ACI methods.

UNIT - V
Admixtures: Classification of admixtures, chemical and mineral admixtures, influence of various admixtures on properties of concrete, their applications.
Fly Ash Concrete: Mix design, properties and its applications.
High Strength Concrete: Mix design, properties and its applications.
Fiber Reinforced Concrete: Mix design, properties and its applications.
Ferro cement, lightweight concrete, high-density concrete, recycled aggregate concrete and their applications.

Suggested Reading:

1. Neville. A.M, (1988), Properties of Concrete, English Language Book Society/Longman Publications.
2. Mehta. P.K and Paulo. J.M.M, (1997), Concrete – Microstructure – Properties and Material, McGraw-Hill.
3. Krishna Raju. N., (1985), Design of Concrete Mix, CBS Publications.

ADVANCED REINFORCED CONCRETE DESIGN

No. of Credits	3 Credits
Instruction	4 Periods per week
Duration of University Examination	3 Hours
Semester End Evaluation	70 Marks
Continuous Internal Evaluation	30 Marks

Course Objectives:

1. Learn the analysis and design of beams curved in plan and deep beams.
2. Design and detail the deep beams.
3. Analyse, design and detail the domes, water tanks, bunkers and silos.
4. Analyse and design the raft, pile and machine foundations.

Course Outcomes:

1. Design the beams curved in plan and deep beams.
2. Propose the deep beams, domes and various type water tanks.
3. Differentiate and design the bunkers and silos.
4. Formulate the raft, pile and machine foundations.

UNIT -I

Beams Curved in Plan: Introduction - design principles – Terminologies, structural design of beams curved in plan of circular and rectangular type.

UNIT - II

Deep Beams: Introduction to deep beams, Flexural and Shear stresses in deep beams, IS Code provisions - design of deep beams.

UNIT - III

Domes: Introduction - Stresses and forces in domes - design of spherical and conical domes. **Water Tanks**: Types, Codal specifications, Design of circular, rectangular and Intze type water tanks.

UNIT - IV

Bunkers and Silos: Introduction - Design principles and theories Code provisions - design of square and circular bunkers - design of cylindrical silos. IS specifications.

UNIT-V

Raft and Pile Foundations: Introduction, Need for the design, Design principles - Structural design of raft and pile foundations including the design of pile caps.

Machine Foundations: Introduction, Types, Design Principles, Case studies, detailed designs.

Suggested Reading:

1. "Advanced Reinforced Concrete Design", by N. Krishna Raju, CBS Pub. 1986.
2. "Reinforced Concrete", by H.J. Shah, Charotar Pub. 2000. Vol. II.
3. "R .C.C. Designs" by B.C. Punmia, Laxmi Pub. 1998.

BRIDGE ENGINEERING

No. of Credits	3 Credits
Instruction	4 Periods per week
Duration of University Examination	3 Hours
Semester End Evaluation	70 Marks
Continuous Internal Evaluation	30 Marks

Course Objectives:

1. Learn the hydraulic, geological and geo-technical aspects in bridge design.
2. Analyse, design and detail the bridge deck and box girder systems, steel and composite bridges.
3. Analyse and design the sub-structures, bridge bearings and various long span bridges.

Course Outcomes:

1. Understand the fundamentals and codes of practice of bridge design.
2. Design the bridge deck and box girder systems using appropriate method.
3. Devise the steel truss and composite steel-concrete bridges.
4. Propose the sub-structure components such as pier, abutments, etc. and bridge bearings.
5. Design the various types of long span bridges, curved and skew bridges.

UNIT –I

Introduction:

Types of bridges, materials of construction, codes of practice (Railway and Highway Bridges), aesthetics, loading standards (IRC, RDSO, AASHTO), recent developments box girder bridges, historical bridges (in India and overseas). Planning and layout of bridges, hydraulic design, geological and geo-technical considerations; Design aids, computer software, expert systems.

UNIT – II

Concrete Bridges: Bridge deck and approach slabs, Slab design methods, design of bridge deck systems, slab-beam systems (Guyon-Massonet and Hendry Jaeger Methods), box girder systems, analysis and design. Detailing of box girder systems.

UNIT – III

Steel and Composite Bridges: Introduction to composite bridges, Advantages and disadvantages, Orthotropic decks, box girders, composite steel-concrete bridges, analysis and design, truss bridges.

UNIT-IV

Sub-Structure: Piers, columns and towers, analysis and design, shallow and deep foundations, caissons, abutments and retaining walls.
Bridge appurtenances: Expansion joints, design of joints, types and functions of bearings, design of elastomeric bearings, railings, drainage system, lighting.

UNIT-V
Long span bridges: Design principles of continuous box girders, curved and skew bridges, cable stayed and suspension bridges, seismic resistant design, seismic isolation and damping devices. Construction techniques (cast in-situ, prefabricated, incremental launching, free cantilever construction), inspection, maintenance and rehabilitation, current design and construction practices.

Suggested Reading:

1. "Bridge Engineering Handbook", Wai-Fah Chen Lian Duan, CRC Press, USA, 2000.
2. "Design of Highway Bridges", Barker, P.M. and Puckett, J.A., John Wiley & Sons, New York, 1997.
3. "Theory and Design of Bridges", Xanthakos, P.P., John Wiley & Sons, New York, 1994.

STRUCTURAL HEALTH MONITORING

No. of Credits	3 Credits
Instruction	4 Periods per week
Duration of University Examination	3 Hours
Semester End Evaluation	70 Marks
Continuous Internal Evaluation	30 Marks

Course Objectives:

1. Learn the fundamentals of structural health monitoring.
2. Study the various vibration-based techniques for structural health monitoring.
3. Learn the structural health monitoring using fiber-optic and Piezoelectric sensors.
4. Study the structural health monitoring using electrical resistance and electromagnetic techniques.

Course Outcomes:

1. Understand the fundamentals of maintenance and repair strategies.
2. Diagnose for serviceability and durability aspects of concrete.
3. Know the materials and techniques used for repair of structures.
4. Decide the appropriate repair, strengthening, rehabilitation and retrofitting technique required for a case study building.
5. Use an appropriate health monitoring technique and demolition technique.

UNIT-I

Introduction to Structural Health Monitoring Definition of structural health monitoring (SHM), Motivation for SHM, SHM as a way of making materials and structures smart, SHM and biomimetics, Process and pre-usage monitoring as a part of SHM, SHM as a part of system management, Passive and active SHM,NDE, SHM and NDECS, Variety and multidisciplinarity: the most remarkable characters of SHM, Birth of the SHM Community.

UNIT-II

Vibration-Based Techniques for SHM Basic vibration concepts for SHM, Local and global methods, Damage diagnosis as an inverse problem, Model-based damage assessment, Mathematical description of structural systems with damage, General dynamic behavior, State-space description of mechanical systems, Modeling of damaged structural elements, Linking experimental and analytical data, Modal Assurance Criterion (MAC) for mode pairing, Modal Scaling Factor (MSF), Co-ordinate Modal Assurance Criterion (COMAC), Damping, Expansion and reduction, Updating of the initial model, Damage localization and quantification, Change of the flexibility matrix, Change of the stiffness matrix, Strain-energy-based indicator methods and curvature modes, MECE error localization technique, Static displacement method, Inverse eigensensitivity method, Modal force residual method, Kinetic and strain energy-based sensitivity methods, Forced vibrations and frequency response functions, Solution of the equation system, Regularization, Parameter subset selection, Other solution methods, Variances of the parameters, Neural network approach to SHM, The basic idea of neural networks, Neural networks in damage detection, localization and quantification, Multi-layer Perceptron (MLP), A simulation example, Description of the structure, Application of damage indicator methods, Application of the modal force residual method and inverse eigensensitivity method, Application of the kinetic and modal strain energy methods, Application of the Multi-Layer Perceptron neural network, Time-domain damage detection methods for linear systems, Parity equation method, Kalman filters, AR and ARX models, Damage identification in non-linear systems, Extended Kalman filter, Localization of damage using filter banks, A simulation study on a beam with opening and closing crack, Applications, I-40 bridge,,Steelquake structure, Application of the Z24 bridge, Detection of delamination in a CFRP plate with stiffeners.

UNIT-III

Fiber-Optic Sensors Classification of fiber-optic sensors, Intensity-based sensors, Phase-modulated optical fiber sensors, or interferometers, Wavelength based sensors, or Fiber Bragg Gratings (FBG), The fiber Bragg grating as a strain and temperature sensor, Response of the FBG to uniaxial uniform strain fields, Sensitivity of the FBG to temperature, Response of the FBG to a non-uniform uniaxial strain field, Response of the FBG to transverse stresses, Photoelasticity in a plane stress state, Structures with embedded fiber Bragg gratings, Orientation of the optical fiber optic with respect to the reinforcement fibers, Ingress/egress from the laminate, Fiber Bragg gratings as damage sensors for composites, Measurement of strain and stress variations, Measurement of spectral perturbations associated with internal stress release resulting from damage spread, Examples of applications in aeronautics and civil engineering, Stiffened panels with embedded fiber Bragg gratings, Concrete beam repair

UNIT-IV

SHM with Piezoelectric Sensors The use of embedded sensors as acoustic emission (AE) detectors, Experimental results and conventional analysis of acoustic emission signals, Algorithms for damage localization, Algorithms for damage characterization, Available industrial AE systems, New concepts in acoustic emission, State-the-art and main trends in piezoelectric transducer-based acousto-ultrasonic SHM research, Lamb wave structure interrogation, Sensor technology, Tested structures (mainly metallic or composite parts), Acousto-ultrasonic signal and data reduction methods, The full implementation of SHM of localized damage with guided waves in composite materials, Available industrial acousto-ultrasonic systems with piezoelectric sensors, Electromechanical impedance, E/M impedance for defect detection in metallic and composite parts, The piezoelectric implant method applied to the evaluation and monitoring of viscoelastic properties.

UNIT-V

SHM Using Electrical Resistance Composite damage, Electrical resistance of unloaded composite, Percolation concept, Anisotropic conduction properties in continuous fiber reinforced polymer, Influence of temperature, Composite strain and damage monitoring by electrical resistance, 0° unidrectional laminates, Multidirectional laminates, Randomly distributed fiber reinforced polymers, Damage localization.

Low Frequency Electromagnetic Techniques Theoretical considerations on electromagnetic theory, Maxwell’s equations, Dipole radiation, Surface impedance, Diffraction by a circular aperture, Eddy currents, Polarization of dielectrics, Applications to the NDE/NDT domain, Dielectric materials, Conductive materials, Hybrid method, Signal processing, Time-frequency transforms, The continuous wavelet transform, The discrete wavelet transform, Multiresolution, Denoising, Application to the SHM domain, General principles, Magnetic method, Electric method, Hybrid method.

Suggested Reading:

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

CE 1120 *With effect from the academic year 2015-2016*

STRUCTURAL STABILITY

No. of Credits	3 Credits
Instruction	4 Periods per week
Duration of University Examination	3 Hours
Semester End Evaluation	70 Marks
Continuous Internal Evaluation	30 Marks

Course Objectives:

1. Learn the buckling of columns, analysis using equilibrium, energy and approximate methods.
2. Know the stability analysis of beam-columns and frames with different loads.
3. Analyse for torsional, flexural and lateral buckling of beams.
4. Perform the buckling analysis of thin plates using different approaches.
5. Study the inelastic buckling analysis of plates.

Course Outcomes:

1. Understand the analysis of buckling of columns using appropriate method.
2. Analyse the practical problems of beam-columns and frames.
3. Analyse the beams for torsional, flexural and lateral buckling.
4. Perform buckling analysis of thin plates.
5. Analyse the plates for inelastic buckling and understand the post-buckling behaviour of plates.

UNIT-I

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

UNIT-II

Buckling of beam-columns and frames: Theory of beam column - Stability analysis of beam column with single and several concentrated loads, distributed load and end couples Analysis of rigid jointed frames with and without sway - Moment distribution - Slope deflection and stiffness method

UNIT-III

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

UNIT-IV

Buckling of plates: Governing differential equation - Buckling of thin plates, various edge conditions - Analysis by equilibrium and energy approach - Approximate and Numerical techniques

UNIT V

Inelastic buckling: Double modulus theory - Tangent modulus theory - Shanley's model – Eccentrically loaded inelastic column. Inelastic buckling of plates - Post buckling behaviour of plates

References:

1. Timoshenko, S., and Gere., "Theory of Elastic Stability", McGraw Hill Book Company, 1963.
2. Chajes, A. "Principles of Structures Stability Theory", Prentice Hall, 1974.
3. Ashwini Kumar, "Stability Theory of Structures", Tata McGraw Hill Publishing Company Ltd., New Delhi, 1995.
4. Iyenger.N.G.R.,, "Structural stability of columns and plates", Affiliated East West Press,1986.
5. Gambhir, "Stability Analysis and Design of Structures", springer, New York , 2004.

CE 1121 *With effect from the academic year 2015-2016*

RETROFITTING AND REHABILITATION OF STRUCTURES

No. of Credits	3 Credits
Instruction	4 Periods per week
Duration of University Examination	3 Hours
Semester End Evaluation	70 Marks
Continuous Internal Evaluation	30 Marks

Course Objectives:

1. Learn the fundamentals of maintenance and repair strategies.
2. Study the quality assurance, serviceability and durability of concrete.
3. Know the various materials and techniques used for repair of structures.
4. Educate the different repair, strengthening, rehabilitation and retrofitting techniques.
5. Instruct the various health monitoring and demolition techniques.

Course Outcomes:

1. Understand the fundamentals of maintenance and repair strategies.
2. Diagnose for serviceability and durability aspects of concrete.
3. Know the materials and techniques used for repair of structures.
4. Decide the appropriate repair, strengthening, rehabilitation and retrofitting technique required for a case study building.
5. Use an appropriate health monitoring and demolition techniques.

UNIT - I

Maintenance: Repair and Rehabilitation, Facets of Maintenance, importance of Maintenance various aspects of Inspection, Assessment procedure for evaluating damaged structure, causes of deterioration.

Repair Strategies: Causes of distress in concrete structures, Construction and design failures, Condition assessment and distress-diagnostic techniques, Assessment procedure for Inspection and evaluating a damaged structure,

UNIT - II

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.

UNIT - III

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, Fibre reinforced concrete. Bacterial concrete, 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, coating and cathodic protection

UNIT - IV

Repair, Rehabilitation and Retrofitting Techniques: Repairs to overcome low member strength, Deflection, Cracking, Chemical disruption, weathering corrosion, wear, fire, leakage and marine exposure, Repair of Structure – Common Types of Repairs – Repair in Concrete Structures – Repairs in Under Water Structures – Guniting – Shot Create – Underpinning. Strengthening of Structures – Strengthening Methods – Retrofitting – Jacketing.

UNIT – V

Health Monitoring and Demolition Techniques: Long term health monitoring techniques, Engineered demolition techniques for dilapidated structures, Use of Sensors – Building Instrumentation.

Suggested Reading:

1. Concrete Technology by A.R. Santakumar, Oxford University press
2 Defects and Deterioration in Buildingts, E F & N Spon, London
3. Non-Destructive Evaluation of Concrete Structures by Bungey - Surrey University
4. Maintenance and Repair of Civil Structures, B.L. Gupta and Amit Gupta, Standard Publications.
5. Concrete Repair and Maintenance Illustrated, RS Means Company Inc W. H. Ranso, (1981)
6. Building Failures : Diagnosis and Avoidance, EF & N Spon, London, B
.7 .Mehta, P.K and Montevic. P.J., Concrete- Microstructure, Properties and Materials, ICI, 1997.,
8Jackson, N., Civil Engineering Materials, ELBS, 1983.

COMPOSITE CONSTRUCTION

No. of Credits	3 Credits
Instruction	4 Periods per week
Duration of University Examination	3 Hours
Semester End Evaluation	70 Marks
Continuous Internal Evaluation	30 Marks

Course Objectives:

1. Study the concepts of composite construction.
2. Learn analysis and designs of composite beams, floors, columns and trusses as per the recommendations of IS codes of practice.
3. Apply the concepts for design of multi-storey composite buildings.
4. Scope of analysis is restricted to skeletal structures subjected to prescribed dynamic loads.

Course Outcomes:

1. Understand the fundamentals of composite construction, and analysis and designs of composite beams.
2. Analyse and design the composite floors and columns, composite trusses and understand connection details.
3. Analyse and design the multi-storey composite buildings.

UNIT-I

Introduction of Composite Constructions: Benefits of composite construction, Introduction to IS, BS and Euro codal provisions.

Composite Beams: Elastic behaviour of composite beams, No and Full Interaction cases, Shear connectors, Ultimate load behaviour, Serviceability limits, Effective breadth of flange, Interaction between shear and moment, Basic design consideration and design of composite beams.

UNIT-II

Composite Floors: Structural elements, Profiled sheet decking, Bending resistance, Shear resistance, Serviceability criterion, Analysis for internal forces and moments, Design of composite floors.

UNIT-III

Composite Columns: Materials, Concrete filled circular tubular sections, Non-dimensional slenderness, Local buckling of steel sections, Effective elastic flexural stiffness, Resistance of members to axial compressions, Composite column design, Fire resistance.

UNIT-IV

Composite Trusses: Design of truss, Configuration, Truss members, Analysis and design of composite trusses and connection details.

UNIT-V

Design of Multi-Storey Composite Buildings: Design basis, load calculations, Design of composite slabs with profile decks, composite beam design, design for compression members, vertical cross bracings, design of foundation.

Suggested Reading:

1. R. P. Johnson, "Composite Structures of Steel and Concrete", Vol-I, Beams, Columns and Frames in Buildings, Oxford Blackwell Scientific Publications.
2. "INSDAG Teaching Resources for Structural Steel Design", Vol-2, Institute for Steel Development and Growth Publishers, Calcutta.
3. "INSDAG Handbook on Composite Construction – Multi-Storey Buildings", Institute for Steel Development and Growth Publishers, Calcutta.
4. "INSDAG Design of Composite Truss for Building", Institute for Steel Development and Growth Publishers, Calcutta.
5. "INSDAG Handbook on Composite Construction – Bridges and Flyovers", Institute for Steel Development and Growth Publishers, Calcutta.
6. IS:11384, 1985 Code of Practice for Composite Construction in Structural Steel and Concrete, Bureau of Indian Standards, New Delhi.

CE 1123 *With effect from the academic year 2015-2016*

GREEN BUILDING TECHONOLOGY

No. of Credits	3 Credits
Instruction	4 Periods per week
Duration of University Examination	3 Hours
Semester End Evaluation	70 Marks
Continuous Internal Evaluation	30 Marks

Course Objectives:

1. Exposure to the green building technologies and their significance.
2. Understand the judicial use of energy and its management.
3. Educate about the Sun-earth relationship and its effect on climate.
4. Enhance awareness of end-use energy requirements in the society.
5. Develop suitable technologies for energy management.

Course Outcomes:

1. Understand the fundamentals of energy use and energy processes in building.
2. identify the energy requirement and its management.
3. Know the Sun-earth relationship vis-a-vis its effect on climate.
4. Be acquainted with the end-use energy requirements.
5. Be familiar with the audit procedures of energy.

UNIT I

Overview of the significance of energy use and energy processes in building - Indoor activities and environmental control - Internal and external factors on energy use and the attributes of the factors - Characteristics of energy use and its management - Macro aspect of energy use in dwellings and its implications.

UNIT II

Indoor environmental requirement and management - Thermal comfort - Ventilation and air quality – Air-conditioning requirement - Visual perception - Illumination requirement - Auditory requirement.

UNIT III

Climate, solar radiation and their influences - Sun-earth relationship and the energy balance on the earth's surface - Climate, wind, solar radiation, and temperature - Sun shading and solar radiation on surfaces - Energy impact on the shape and orientation of buildings.

UNIT IV

End-use, energy utilization and requirements - Lighting and day lighting - End-use energy requirements - Status of energy use in buildings Estimation of energy use in a building. Heat gain and thermal performance of building envelope - Steady and non steady heat transfer through the glazed window and the wall - Standards for thermal performance of building envelope - Evaluation of the overall thermal transfer

UNIT V

Energy management options - Energy audit and energy targeting - Technological options for energy management.

Reference Books:

1. Bryant Edwards (2005): Natural Hazards, Cambridge University Press, U.K.
2. Carter, W. Nick, 1991: Disaster Management, Asian Development Bank, Manila.
3. Sahni, Pardeep et.al. (eds.) 2002, Disaster Mitigation Experiences and Reflections, Prentice Hall of India, New Delhi.
4. Bryant Edwards (2005): Natural Hazards, Cambridge University Press,U.K.

NEURAL, FUZZY AND EXPERT SYSTEMS

No. of Credits	3 Credits
Instruction	4 Periods per week
Duration of University Examination	3 Hours
Semester End Evaluation	70 Marks
Continuous Internal Evaluation	30 Marks

Course Objectives:

1. Explain the concepts of neural networks, fuzzy logic, and genetic algorithms.
2. Solve problems that are appropriately solved by neural networks, fuzzy logic, and genetic algorithms.
3. Understand the structure of expert systems.
4. Get exposure to software packages in practice.

Course Outcomes:

1. Learn the mathematical theory behind the intelligent problem solving approaches and apply them to write the code to solve a particular design problem.
2. Carry out three design projects in the course in neural networks, fuzzy logic, and genetic algorithms.
3. Covers intelligent approaches to solving engineering problems that are appropriate for pattern matching, control, optimization, and other areas.
4. Solve the problems pertaining to artificial neural networks, fuzzi logic and expert systems using standard software packages.

UNIT- I

Introduction: Brief introduction to the study of artificial intelligence. An Insight to the concept of natural intelligence followed by the development of artificial neural networks, fuzzy logic systems and expert systems tool .Demonstration of the importance of artificial neural networks, fuzzy logic and expert systems with the help of at least two practical examples civil engineering for each study. Importance of nuero-fuzzy systems.

UNIT - II

Neural Networks: Components of artificial neural networks - neurons, inputs, outputs, error, error propagation, hidden layers, threshold logic, weights, bias, noise, momentum, rate of learning, training and testing - Hebb's rule, Delta rule - Supervised learning - Generalized Delta rule -unsupervised learning.

Types of Neural Networks - Perceptions - feed forward back propagation networks - Hop field networks.

UNIT - III

Fuzzy sets: Crispness, vagueness, uncertainty, and fuzzy sets. Basic. Definitions and operations of Fuzzy sets, approximate reasoning, and membership function. Fuzzy Relations: Fuzzy relation and fuzzy composition, fuzzy aggregation procedures, Dominance Matrix, Weightages, applications of Fuzzy sets to civil engineering problems, and pattern recognition.

UNIT - IV

Expert systems: Structure of expert systems, Knowledge acquisition, Knowledge organization, methods of representing knowledge, types of inference engines, reasoning under uncertainty, various types of expert system tools, heuristics, search mechanism, expert system developmen[1] and hybrid expert systems.

UNIT - V

Exposure to software packages: Neural networks (Mat lab tool kit)— fuzzy logic — expert systems (L5 object).Applications of Artificial Neural Networks, Fuzzy logic and expert systems in civil engineering — Case studies with at least one problem on each aspect of ANN, FL and Expert systems.

Suggested Readings::

1. *"Fuzzy Sets, Decision Making, and Expert Systems*-, **Zimmerman, H. J., Kluwer Academic Publications, Boston, 1987.**
2. *"Artificial Intelligence and Expert System",* **Elaine Rich, Juda Pearl,** *Heuristics.*
3. *"Expert Systems in Construction and* ***Structural Engineering"*** **Adeli H., Chapman, 1988.**
4. *"Neural Networks Algorithms, Applications and Programming"* **Freeman, J.A., and Skapura, D.M. Addition-Wesley, Reading**

MA, 1991.

DISASTER MANAGEMENT

No. of Credits	3 Credits
Instruction	4 Periods per week
Duration of University Examination	3 Hours
Semester End Evaluation	70 Marks
Continuous Internal Evaluation	30 Marks

Course Objectives:

1. To provide students an exposure to disasters, their significance and types.
2. To ensure that students begin to understand the relationship between vulnerability, disasters, disaster prevention and risk reduction.
3. To gain a preliminary understanding of approaches of Disaster Risk Reduction (DRR)
4. To enhance awareness of institutional processes in the country.
5. To develop rudimentary ability to respond to their surroundings with potential disaster response in areas where they live,with due sensitivity.

Course Outcomes: After completion of this course, the student shall able to

1. Understand the fundamentals of disasters and its impacts.
2. Understand the cyclones, local storms and floods.
3. Know the procedures to prevent, mitigate and prepare community based disaster risk reduction.
4. Know the inter-relationship between disasters and development.
5. Know the disaster risk management in India and case studies on reducing disaster risks.

UNIT-I

Introduction to Disasters: Concepts and definitions of Disaster, Hazard, Vulnerability, Resilience, Risks.

Natural and Manmade disasters, impact of drought, review of past disasters and drought in India, its classification and characteristics. Classification of drought, causes, Impacts (including social, economic. political, environmental, health, psychosocial, etc.).

UNIT-II

Disaster: Classifications, Causes, Impacts including social, economic, political, environmental, health, psychosocial etc.

Differential Impacts - in terms of caste, class, gender, age, location, disability Global trends in disasters, urban disasters, pandemics, complex emergencies, climate change.

Cyclones and Floods: Tropical cyclones & Local storms, Destruction by tropical cyclones and local storms, Cumulative atmospheric hazards/ disasters, Cold waves, Heat waves, Causes of floods, Rood hazards in India.

UNIT-III

Approaches to Disaster Risk Reduction: Disaster cycle - its analysis, Phases, Culture of safety, prevention, mitigation and preparedness community based DRR, Structural- nonstructural sources, roles and responsibilities of community, Panchayati Raj Institutions/Urban Local Bodies (PRis/ULBs), states, Centre, and other stake-holders.

UNIT-IV

Inter-relationship between Disasters and Development: Factors affecting Vulnerabilities, differential impacts, impact of development projects such as darns, embankments, changes in Land-use etc. Climate change adaptation, Relevance of indigenous knowledge, appropriate technology and local resources.

UNIT-V

Disaster Risk Management in India: Hazard and Vulnerability profile of India Components of Disaster Relief: Water, Food, Sanitation, Shelter, Health, Waste Management Institutional arrangements (Mitigation, Response and Preparedness, OM Act and Policy, other related policies, plans, programmes and legislation)

Field Work and Case Studies: The field work is meant for students to understand vulnerabilities and to work on reducing disaster risks and to build a culture of safety. Projects must be conceived creatively based on the geographic location and hazard profile of the region where the college is located.

Suggested Reading:

1. Sharma, V. K. (1999), "Disaster Management", National Centre for Disaster Management, IIPE, Delhi.
2. Anil, K. Gupta and Sreeja, S. Nair (2011), "Environmental Knowledge for Disaster Risk Management", NIDM, New Delhi.
3. Nick (1991), "Disaster Management: A Disaster Manager's Handbook", Asian Development Bank, Manila Philippines.
4. Kapur, et al. (2005), "Disasters in India: Studies of Grim Reality", Rawat Publishers, Jaipur.
5. Pelling Mark (2003), "The Vulnerability of Cities: Natural Disaster and Social Resilience", Earthscan Publishers, London.

CEL 1131 *With effect from the academic year 2015-2016*

STRUCTURAL ENGINEERING LABORATORY – I

No. of Credits 2 Credits
Instruction 2 Periods per week
Continuous Internal Evaluation 50 Marks

Course Objectives:

1. Evaluate the properties of constituents of concrete.
2. Evaluate the properties of various building materials.
3. Evaluate the properties of concrete with variable workability.
4. Evaluate the properties of concrete with variable parameters.

Course Outcomes:

1. Learn the properties of constituents of concrete.
2. Assess the properties of various building materials.
3. Correlate the properties of concrete with variable workability.
4. Correlate the properties of concrete with variable parameters.

1. Evaluation of properties: Cement, Fine aggregates and coarse aggregates.
2. Evaluation of properties of reinforcing steel, timber, building blocks and tiles.
3. Variation of workability with time for different grades of concrete – experimental observations.
4. Experimental observations on influence of following parameters on strength characteristics of concrete (some of these parameters may be considered depending upon the time).
   - (i) Size, Shape and grade of coarse aggregate.
   - (ii) Grading of fine aggregate.
   - (iii) Hand mixing/machine mixing.
   - (iv) Aggregate – cement ratio
   - (v) Coarse aggregate – Fine Aggregate ratio
   - (vi) Size and Shape of test specimen
   - (vii) Admixtures.

CEL 1131 *With effect from the academic year 2015-2016*

STRUCTURAL ENGINEERING LABORATORY – II

No. of Credits	2 Credits
Instruction	2 Periods per week
Continuous Internal Evaluation	50 Marks

Course Objectives:

1. Study the concrete mix design using various codes and evaluate the properties of concrete.
2. Evaluate the properties of concrete and correlate them with the non-destructive testing results.
3. Evaluate the effect of different parameters on non-destructive testing results.
4. Evaluate the crack propagation in a beam under single-point / two-point loading.

Course Outcomes:

1. Design the concrete mixes using various codes and assess the properties of concrete.
2. Correlate the properties of concrete with the non-destructive testing results.
3. Appraise the effect of different parameters on non-destructive testing results.
4. Estimate the crack propagation and crack patterns in a beam.

1. Concrete Mix Design – by BIS, ACI and BS method – proportioning, Batching, Mixing, Moulding of specimens for compression, Modulus of Elasticity and Modulus of Rupture – Testing of specimens as per relevant codes of practice (comparative study).
2. Development of correlation between Non-Destructive and Destructive Tests using Rebound Hammer and UPV instruments.
3. Influence of following parameters on NDT readings – experimental observations.
   (i) Aggregate – cement ratio
   (ii) Water cement ratio
   (iii) Excess / Deficient cement
   (iv) Aggregate type

   (Some of the above parameters may be considered depending upon time).
4. Strain and deflection measurement for a structural member under single-point / two-point loading – crack propagation observation, measurement and plotting.

CEL 1133 *With effect from the academic year 2015-2016*

SEMINAR – I

No. of Credits	2 Credits
Instruction	2 Periods per week
Continuous Internal Evaluation	50 Marks

Course Objectives:

1.

Course Outcomes:

CEL 1134 *With effect from the academic year 2015-2016*

SEMINAR – II

No. of Credits	2 Credits
Instruction	2 Periods per week
Continuous Internal Evaluation	50 Marks

Course Objectives:

1.

Course Outcomes:

CEL 1135 *With effect from the academic year 2015-2016*

PROJECT SEMINAR

No. of Credits	8 Credits
Instruction	4 Periods per week
Continuous Internal Evaluation	100 Marks

Course Objectives:

1.

Course Outcomes:

Each student will be attached to a faculty member, (guide) for Mini Project during the Second Semester. The student will carry out the project which may be the development of Software / Hardware / Simulation Studies / Design / Analysis / Experimental related to the specialization. The work will be monitored regularly by the guide. At the end of the Semester, Student will write the report on the work done and submit to the guide. Student has to present the work before two faculty members (one guide and other to be appointed by Chairman BOS) on a fixed day during the last week of the semester in which mini project is offered. The sessional marks will be awarded jointly by these two examiners based on the report, the presentation and viva voce.

CEL 1136 *With effect from the academic year 2015-2016*

DISSERTATION

No. of Credits	12 Credits
Instruction	6 Periods per week
Semester End Evaluation	Viva Voce Grade*
Continuous Internal Evaluation	150 Marks

*Excellent / Good / Satisfactory / Unsatisfactory.

Course Objectives:

1.

Course Outcomes: