Nagar Yuwak Shikshan Sanstha's

Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

Hingna Road, Wanadongri, Nagpur - 441 110

Post Graduation (M. Tech.)

SoE & Syllabus 2014

1 to 4 Semester

Department of Civil Engineering

Structural Engineering

Update on May 2017

Nagar Yuwak Shikshan Sanstha's

Yeshwantrao Chavan College of Engineering

(An Autonomous Institution affiliated to Rashtrasant Tukadoji Maharaj Nagpur University)

M. Tech. SCHEME OF EXAMINATION 2014

Department of Civil Engineering

Structural Engineering

Sl. No.	Course Code	Course Title	Contact Hours				Credits	% Weightage				ESE Duration Hrs.
			L	T	P	Total Contact Hrs.		MSE- I	MSE- II	TA	ESE	
I SEMESTER												
1	CV1901	Numerical Methods	3	0	0	3	3	15	15	10	60	3
2	CV1902	Theory of Elasticity and Elastic Stability	3	0	0	3	3	15	15	10	60	3
3	CV1903	Structural Dynamics	3	0	0	3	3	15	15	10	60	3
4	CV1904	Lab: Structural Dynamics	0	0	2	2	1			40	60	
5	CV1905	Matrix Analysis of Structures	3	0	0	3	3	15	15	10	60	3
6	CV1906	Lab: Matrix Analysis of Structures	0	0	2	2	1			40	60	
7	CV1907	Design of Substructures	3	0	0	3	3	15	15	10	60	3
8	CV1908	Research Practice	0	0	2	2	1			100		
Total			**15**	**0**	**6**	**21**	**18**					
II SEMESTER												
1	CV1911	Finite Element Method	3	0	0	3	3	15	15	10	60	3
2	CV1912	Theory of Plates and Shells	3	0	0	3	3	15	15	10	60	3
3	CV1913	Earthquake and wind effects on Structures	3	0	0	3	3	15	15	10	60	3
4	**Professional Elective-I**		3	0	0	3	3	15	15	10	60	3
	CV1914	Advanced Concrete Structures										
	CV1915	Prestressed Concrete										
	CV1916	Composite Structures										
5	**Professional Elective-II**		3	0	0	3	3	15	15	10	60	3
	CV1917	Advanced Steel Structures										
	CV1918	New Engineering Materials										
	CV1919	Smart Structures and Applications										
6	CV1920	Lab: Steel Design Studio	0	0	2	2	1			40	60	
7	CV1921	Lab: RCC Design Studio	0	0	2	2	1			40	60	
8	CV1922	Seminar	0	0	2	2	1			100		
Total			**15**	**0**	**6**	**21**	**18**					
III SEMESTER												
1	**Professional Elective-III**		3	0	0	3	3	15	15	10	60	3
	CV1923	Tall Building										
	CV1924	Design of Environmental Strucutres										
	CV1925	Bridge Engineering										
2	**Professional Elective-IV**		3	0	0	3	3	15	15	10	60	3
	CV1926	Plastic Analysis and Design of Structures										
	CV1927	Seismic Analysis and Design of Structures										
	CV1928	Design of Industrial Structures										
3	CV1929	Project Phase-I	0	0	16	16	8			100		
Total			**6**	**0**	**16**	**22**	**14**					
IV SEMESTER												
1	CV1931	Project Phase- II	0	0	24	24	12			40	60	
Total			**0**	**0**	**24**	**24**	**12**					
Grand Total of Credits							**62**					

Chairperson		**Date of Release**	May 2014	**Applicable for**
Dean (Acad. Matt.)		**Version**	**1**	**AY 2014-15 Onwards**

I SEMESTER

CV1901	Numerical Methods	L=3	T=0	P=0	Credits = 3

EVALUATION SCHEME					
MSE – I	**MSE – II**	**TA**	**ESE**	**TOTAL**	**ESE DURATION**
15	15	10	60	100	3 hours

COURSE OBJECTIVE	COURSE OUTCOMES
• Introduce students to the area of numerical methods and illustrate the far-reaching nature and usefulness of these methods for engineering applications. • Motivate students to learn more about, and to use numerical techniques in other courses and in future professional career • Provide a solid understanding of the basic elements underlying development and use of numerical methods in engineering applications. • Develop numerical skills and proficiency in using computer techniques • Expose students to elements and challenges involved in numerically implementing the underlying mathematical derivations • Provide a training environment in use of computational tools / languages	• An ability to understand the basic elements underlying development and use of numerical methods in engineering applications. • An ability to provide numerical solution of various types of problems such as Roots of equations, Systems of linear simultaneous equations, Numerical Differentiation and integration, Eigen value problems etc. • An ability to formulate algorithms to solve problems using modern computational tools.
PO mapped: a, b, d	

UNIT – I
Solution of algebraic and transcendental equation:
RegulaFalsi Method, Newton-Raphson method, Development of Computer Program

UNIT – II
Solution of linear algebraic equations:
Gauss elimination, Cholesky method, Given's method, Householder's method.
UNIT – III
Eigen values problems:
Direct, Jacobi, Rutishauser's LR method, QR method.

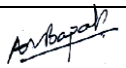
UNIT – IV
Initial & two point boundary value problem:
Euler's, Runge-Kutta, Milne's Methods, Development of Computer Program.
UNIT – V
Numerical Integration:
Trapezoidal Method, Simpson's Method, Gauss Quadrature method, Development of Computer Program.

UNIT – VI
Direct Integration Methods:
Central difference method, Houbolt method, Newmark's method, Wilson - θ method.
Text Books

1. BalachandraRao S., Santha C. K. ;Numerical Methods with programs in BASIC, FORTRAN and Pascal, University Press (India) Limited, Hyderabad 1992.
2. Bathe K. J., Wilson E. L., Numerical Methods in Finite Element Analysis, Prentice-Hall of India Private Limited, New Delhi, 1987

Referrence Books

1. KandasamyP. ,Thilagavathy K, Gunavathi K.; Numerical Methods, S. Chand & Company Ltd, New Delhi, Edition-I,1997.
2. Chapra S.C. and Canale,R.P., " Numerical Methods for Engineers with Programming and Software Applications"- 3 Ed., Tata McGraw Hill, New Delhi, 2009
3. Salvadori M., "Numerical Mehtods"- PHI learning Pvt., ltd., New Delhi, 1987
4. Jain, Iyanger& Jain "Numerical Methods for Scientific Engineering computation"- Wiley Eastern Ltd., 1985
5. Gupta S. K.; Numerical Methods for Engineers, New Age International Limited Publishers, New Delhi, 1997

Chairperson		Date of Release	May 2017	Applicable for AY 2017-18 Onwards
Dean (Acad. Matters)		Version	1.01	

I SEMESTER

CV1902	Theory of Elasticity and Elastic Stability		L=3	T=0	P=0	CREDITS = 3
EVALUATION SCHEME						
MSE – I	MSE – II	TA	ESE	TOTAL		ESE DURATION
15	15	10	60	100		3 hours

COURSE OBJECTIVE	COURSE OUTCOMES
• To provide clear and thorough understanding of the basic concepts of plane stress and plane strain condition. • To provide the knowledge of differential equations, boundary conditions and compatibility conditions for 2D and 3D stress analysis. • To provide the knowledge of bending of beams and torsion of non-circular sections. • To analyze the beam column, beam on elastic foundation. • To study the buckling of column and simply supported rectangular plate.	• An ability to understand the basic concepts of plane stress and plane strain condition. • An ability to derive differential equations, boundary conditions and compatibility conditions for 2D and 3D stress analysis • An ability to understand the effect of bending of beams and torsion of non-circular sections. • An ability to analyze the beam column, beam on elastic foundation. • An ability to understand the buckling of column and simply supported rectangular plate.
PO mapped: a, b	

UNIT- I
Introduction to Two-Dimensional Stress Analysis, Types of forces, Components of stresses and strains, Stress-strain relation, Plane stress and plane strain, Strain at a point, Differential equation of equilibrium, Boundary conditions and compatibility equations (rectangular coordinates), Airy's stress function.

UNIT- II
Introduction to Three-Dimensional Stress Analysis, Components of stress, Principal stresses, Stress invariants, Maximum shearing stress, Differential equation of equilibrium, Boundary conditions and compatibility equations.

UNIT- III
Bending of cantilever of narrow rectangular section loaded at end, bending of simply supported beam with uniform load, torsion of non-circular and elliptical cross section.

UNIT- IV
Differential equation for beams columns with concentrated loads, continuous lateral loads and couples for simply supported ends, Application of trigonometric series, Lateral buckling of beams.

UNIT- V
Energy method for elastic bucking of columns, Approximate method, Buckling of Columns on elastic foundation, Columns with intermediate compressive forces and distributed axial load, Columns with varying cross section.

UNIT- VI
Effect of shearing force on critical load, buckling of built up columns, Buckling of simply supported rectangular plates uniformly compressed in middle plane.

Text Books
1. Timoshenko, S.P. and Goodier, J.N., Theory of Elasticity, 3rd Edition, Mc-Graw Hill Book Company, New Delhi, 1963
2. Timoshenko, S.P. and Gere J. M., Theory of Elastic Stability , 2nd Edition, Mc-Graw Hill Book Company, New Delhi,1963

Reference Books
1. Srinath, L.S., Advanced Mechanics of Solids India, 2nd Edition, Tata Mc-Graw Hill Book Company, 2003.
2. Ameen, M., Computational Elasticity—Theory of Elasticity, Finite and Boundary Element Methods, 1st Edition, Narosa publication, 2007
3. Mikhait Filonenko Borodich, Theory of Elasticity, 1st Edition, University press of pacific, 2003

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I SEMESTER

CV1903	Structural Dynamics		L=3	T=0	P=0	CREDITS = 3
EVALUATION SCHEME						
MSE – I	MSE – II	TA	ESE	TOTAL		ESE DURATION
15	15	10	60	100		3 hours

COURSE OBJECTIVE	COURSE OUTCOMES
• To provide the students clear and thorough understanding of modeling of discrete single-degree and multiple-degree vibratory systems and calculate the free and forced response of these systems. • To provide the students clear and thorough understanding of Calculation of the mode shapes and frequencies for the free response of continuous vibratory systems and use modal methods to calculate the forced response of these systems. • To provide the students understanding of modeling continuous vibratory systems – vibration of strings, axial and torsional vibration of bars and beams. • To provide the student with a basic understanding of IS codes related to earthquake loading.	• An ability to apply knowledge of mathematics, science, and engineering by developing the equations of motion for vibratory systems and solving for the free and forced response. • Ability to identify, formulate and solve engineering problems having motions varying with time. This will be accomplished by having students model, analyze and modify a vibratory structure, in order to achieve specified requirements. • Understanding professional and ethical responsibilities. This will be accomplished by emphasizing the importance of understanding how structural vibrations may affect safety and reliability of engineering systems. • An ability to Understand IS codes related to earthquake loading.
PO mapped: a, b, c	

UNIT - I
Fundamentals of Rigid / Deformable body dynamics, Analysis of undamped and viscously damped single degree freedom systems.

UNIT - II
Response of single degree freedom systems to harmonic loading, support motion and transmissibility, Duhamel's integral.

UNIT - III
Multiple degree of Freedom system: Vibration of undamped 2 DOF systems; Response of 2 DOF to harmonic excitation, mode superposition, vibration absorber, Free vibration of MDOF (up to 3 DOF) systems, Dynamic response of MDOF (2 DOF) systems-modal superposition method. Energy Principle, Rayleigh's method (2 DOF)

UNIT - IV
Dynamic analysis of systems with distributed properties, Approximate design method, Transformation factors.

UNIT – V
Response spectra, generation and types of response spectra, Vibration of Continuous Systems: Free vibrations of Continuous systems-axial and transverse vibration of bars / beams. Response of continuous systems to dynamic loads.

UNIT - VI
Introduction to vibrations due to earthquake, Study of IS 1893 applicable to Buildings and Water Tanks.

Text Books:

1. Mario Paz, Structural Dynamics Theory & Application, CBS Publ.; N-Delhi, 1995.
2. Chopra A. K., Dynamics of Structures, Theory & Application to Earthquake Engineering, 2nd Edition., Pearson Education (Singapore) Pvt. Ltd, New Delhi, 1995

I SEMESTER

CV1903	Structural Dynamics		L=3	T=0	P=0	CREDITS = 3
EVALUATION SCHEME						
MSE – I	MSE – II	TA	ESE	TOTAL		ESE DURATION
15	15	10	60	100		3 hours

Reference Books:

1. Clough / Penzien, "Dynamics of Structures", McGraw Hill, 1993
2. Humar, J. L., "Dynamics of Structures", Prentice Hall, 1993
3. Timoshenko, S., "Advanced Dynamics", McGraw Hill Book Co; NY, 1948
4. Biggs, J.M., "Introduction to Structural Dynamics", McGraw Hill; NY, 1964
5. Damodarasamy and Kavitha," Basics of structural Dyanamics and Aseismic design, Phi Publisher, New Delhi.

I SEMESTER

CV1904	Lab: Structural Dynamics		L=0	T=0	P=2	CREDITS = 1
EVALUATION SCHEME						
MSE – I	**MSE – II**	**TA**	**ESE**	**TOTAL**		**ESE DURATION**
--	--	40	60	100		--

COURSE OBJECTIVE	COURSE OUTCOMES
• To provide the students clear and thorough understanding of modeling of discrete single-degree and multiple-degree vibratory systems and calculate the free and forced response of these systems. • To provide the students clear and thorough understanding of damping of systems and their relevance in displacements • To demonstrate phenomenon of soil liquefaction and mode shapes in water medium • To provide the students clear and thorough understanding of IS codes related to dynamic loading for buildings and elevated water tanks	• An ability to understand the behavior of vibratory system during cyclic loading. • An ability to identify, formulate and solve engineering problems. This will be accomplished by understanding behavior of models during vibration. • An ability to understand professional and ethical responsibilities during an earthquake in relevance to building this will be accomplished by emphasizing the importance of the structural vibration on safety and reliability of an engineering system. • An ability to understand provision of various and design the structure from seismic safety point of view.
PO mapped: a, b, c, d	

PRACTICALS

1. To study various instruments for imparting dynamic forces.
2. To study various instruments for the response of vibrating structure.
3. To study the response of a single degree of lumped mass system subjected to base excitation.
4. To study the response of a two degree of freedom system building frame subjected to base motion.
5. To study the response of a multi degree of lumped mass system.
6. Verification of natural frequency of SDOF model under free vibration.
7. To study the liquefaction of soil structure.
8. To study the Earthquake induced waves in rectangular water tank.
9. To calculate horizontal seismic force of building using IS-1893.
10. To calculate the lateral forces in water tank due to Earthquake when water tank is empty and water tank is full by IS-1893.

I SEMESTER

CV1905	Matrix Analysis of Structures		L=3	T=0	P=0	CREDITS = 3
EVALUATION SCHEME						
MSE – I	MSE – II	TA	ESE	TOTAL		ESE DURATION
15	15	10	60	100		3 hours

COURSE OBJECTIVE	COURSE OUTCOMES
• To develop an understanding the basic principles of the matrix method of structural analysis • To expand knowledge of the stiffness methods • To analyze structural element (Beam, Frame, Truss, etc.,) by using Stiffness Method, • To make the student familiar with latest computational techniques and software used for structural analysis • To study the various approximate methods of structural analysis.	• An ability to understand the different types of structures. • An ability to apply the matrix stiffness method to model the behavior of planar trusses, beams, and frames; • An ability to analyze any multistoried building using approximate methods of structural analysis. • An ability to implement the method developing their own computer program to analyze structures.
PO mapped: a, b, d	

UNIT - I
Introduction to stiffness and flexibility approach, Stiffness matrix for spring, Bar, torsion, Beam (including 3D), Frame and Grid elements, Displacement vectors, Local and Global co-ordinate system, Transformation matrices, Global stiffness matrix and load vectors, Assembly of structure stiffness matrix with structural load vector, application to spring and bar problems.

UNIT - II
Analysis of Plane Truss, Space Truss by Stiffness Method

UNIT - III
Analysis of Beam, Plane Frame, Space Frame by Stiffness Method

UNIT - IV
Analysis of Plane Grid by Stiffness Method

UNIT - V
Analysis for member loading (self, Temperature & Imposed) Inclined supports, Lack of Fit, Initial joint displacements. Effect of shear deformation, internal member end releases

UNIT - VI
Analysis of building systems for horizontal loads, Buildings with and without rigid diaphragm, various mathematical models and introduction to Solution techniques.

Text Books:-
1. Gere, W. and Weaver; J. M., Matrix Method of Structural Analysis 3rd Edition, Van Nostrand Reinhold; New York; 1990
2. Meghre A.S. &Deshmukh S.K. ; Matrix Method of Structural Analysis, 1st edition, Charotar publishing house, Anand, 2003
3. KasmaliAslam, Matrix Analysis of Structures, Brooks /Cole Publishing Co. 1999
4. Kanchi, M. B., Matrix Method of Structural Analysis, 2nd Edition; John Willey & Sons, 1999

Reference Books:-
1. Cheng, F.Y., M. Dekke; Matrix Analysis of Structural Dynamics, NY 2000
2. Bathe, K.J., Finite Element Procedures, 2nd Edition Springer,; 2002
3. Cook, R.D Concepts and Applications of Finite Element Analysis, et. al, John Willey &Sons;NY 1995
4. Martin; H.C., Introduction to Matrix Method of Structural Analysis, McGraw Hill Book Co. 1966
5. Chandrapatla T.R., Belegundu A. D. Introduction to Finite Elements in Engineering, Prentice Hall India, 1991

Chairperson		Date of Release	May 2017	Applicable for AY 2017-18 Onwards
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I SEMESTER

CV1906	Lab: Matrix Analysis of Structures		L= 0	T= 0	P= 2	CREDITS = 1
EVALUATION SCHEME						
MSE – I	**MSE – II**	**TA**	**ESE**	**TOTAL**		**ESE DURATION**
--	--	40	60	100		--

COURSE OBJECTIVE	COURSE OUTCOMES
• To be able to analyze structural elements (Beams, Trusses, Frames, grids etc.,) by matrix method of structural analysis. • To be able to analyze multistoried frame structures using approximate methods • To be able to develop models (Beam model, Plane truss model, Frame model) in the software package, apply the required properties, boundary conditions and forces in the developed models • To be able to execute the programme using standard software package without any error	• An ability to understand the latest computational techniques and software used for structural analysis. • An ability to analyze beam for various loading and boundary conditions using Stiffness Method. • An ability to analyze truss for various loading and boundary conditions using Stiffness Method. • An ability to analyze plane frame and grid for various loading and boundary conditions using Stiffness Method.
PO mapped: a, b, d	

PRACTICALS

Analysis of following structural elements by using commercial software

1. Continuous beam without sinking of support.
2. Continuous beam with sinking of support.
3. Plane truss.
4. Plane truss with inclined roller.
5. Plane truss with temperature effect and lack of fit.
6. Space truss.
7. Plane frame without axial deformation.
8. Plane frame with axial deformation.
9. Plane grid.

I SEMESTER

CV1907	Design of Substructures		L=3	T=0	P=0	CREDITS = 3
EVALUATION SCHEME						
MSE – I	MSE – II	TA	ESE	TOTAL	ESE DURATION	
15	15	10	60	100	3 hours	

COURSE OBJECTIVE	COURSE OUTCOMES
• To provide the students' knowledge of different types of foundation structures. • To provide the students' knowledge of different types of loading applied on foundation structures. • To provide the students' knowledge of different methods used for the analysis of foundation structures. • To provide the students' knowledge of different codal provisions applicable to advanced design of foundation structures. • To provide the students' knowledge of design of deep foundation systems, machine foundations etc. including the analysis of various foundation failures.	• Ability to identify the type of foundations to be used for various site conditions. • An ability to analyze and design different types of foundation structures. • An ability to draw RCC detailing and to prepare working drawing. • An ability to understand the importance of various codes used for different types of foundation structures.
PO mapped: a, b, c, f	

UNIT – I
Introduction to soil structure interaction, Bearing Capacity of Foundations, Theories, In-situ tests; Settlement Analysis, factors affecting settlement, control of excessive settlements; Soil classification, Geotechnical design parameters. Design of different isolated and combined footings including eccentric loading.

UNIT – II
Design of raft foundation. Types of rafts, Design of Flat slab raft foundation and Design of beam and slab raft foundation.

UNIT – III
Function and Classification of piles, Concrete piles, Precast and cast-in-situ piles, Static point and skin resistance capacity of a Pile, pile load tests, Pile settlements, design of RCC piles, Various pile group patterns, Efficiency of Pile in group, Negative skin friction, Pile Cap design, Under reamed pile foundation, design of well foundation.

UNIT – IV
Introduction to machine foundations and its practical considerations for construction IS code of practice, introduction to analysis and design of simple machine foundation. Theory of sub grade reaction, beam on elastic foundation.

UNIT – V
Effects of earthquakes on foundation structures, IS1893-2002 recommendations for layout of foundation, classification of foundation strata, types of foundations allowed in sandy and other soils, soil liquefaction, ground settlement, methods to prevent liquefaction and settlement.

UNIT – VI
Analysis and design of Cantilever, counter fort and basement retaining walls and abutments. Introduction to reinforced earth retaining walls, skin walls.

Text Books
1. Sawmi Saran, " Analysis and Design of Substructures", , Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi.
2. Kurain N. P," Design of foundation systems- Principles and Practice", Narosa Publishing house, New Delhi, 2005.
3. Poulose H.G. and Davis E.H.," Pile foundation Analysis and Design", John-Wiley Sons, NY, 1980.
4. Karuna Moy Ghosh , "Foundation Design in practice", PHI Learning Pvt. Ltd, New Delhi 2012
5. P. C. Varghese, "Design of Reinforced Concrete Foundations", PHI Learning Pvt. Ltd., New Delhi, 2009.

I SEMESTER

CV1907	Design of Substructures		L=3	T=0	P=0	CREDITS = 3
EVALUATION SCHEME						
MSE – I	MSE – II	TA	ESE	TOTAL	ESE DURATION	
15	15	10	60	100	3 hours	

References Books

1. J. E. Bowles, "Foundation Analysis and Design", Tata McGraw Hill New York
2. Kurain N.P," Modern Foundations: Introduction to Advance Techniques", Tata McGraw Hill, 1982
3. Winterkorn H.F. and Fang H.Y. Ed., "Foundation Engineering Hand Book", Van-NostrandReynold, 1975
4. Bowles J.E., "Foundation Analysis and Design" (4th Ed.), Mc.Graw –Hill, NY, 1996
5. Sreenivasalu&Varadarajan, "Handbook of Machine Foundations", Tata McGraw Hill
6. Hetenyi, M. "Beam on Elastic Foundation", University of Michigan Press, 1946.
7. Swami Saran, "Soil Dynamics and machine Foundations", Galgotia Publications (P) Ltd, New Delhi, 1999..

I SEMESTER

CV1908	Research Practice	L=0	T=0	P=2	CREDITS = 1

EVALUATION SCHEME					
MSE – I	**MSE – II**	**CA**	**ESE**	**TOTAL**	**ESE DURATION**
----	---	100		100	----

COURSE OBJECTIVE	COURSE OUTCOMES
• To make the students aware about various aspect of research methodology with special emphasis on literature review and research objective framing	• An ability to carry out literature review and frame objectives of research.
• To provide the students the knowledge about technical paper writing with special emphasis on abstract drafting	• An ability to understand essential of technical paper writing and drafting good abstract.
• To teach the students various aspect of preparing and presenting effective power point presentation of technical paper	• An ability to prepare and deliver effective power point presentation.
• To make students aware about effective research data compilation, graphical presentation of data and interpretation from the graphs.	• An ability draws different graphs, effectively use trends line equation and interpret graphs
PO mapped: d, e, f, g	

Contents

I. Research Methodology
II. Literature Review
III. Data compilation and interpretation
IV. Writing a technical paper
V. Writing a funding proposal

Each student shall prepare a paper and funding proposal based on the reviewed literature and shall submit a copy to the department. Marks will be awarded on the basis of content and presentation.

II SEMESTER

CV1911	Finite Element Method		L=3	T=0	P=0	CREDITS = 3
EVALUATION SCHEME						
MSE – I	MSE – II	TA	ESE	TOTAL		ESE DURATION
15	15	10	60	100		3 hours

COURSE OBJECTIVE	COURSE OUTCOMES
• To provide the student with knowledge and analysis skills in applying basic laws and steps used in solving the problem by finite element method. • To provide the student the knowledge of various interpolation functions and elements to solve simple problems by finite element method. • To provide the student with some knowledge in ISO parametric transformation. • To provide students the knowledge of mathematical modelling techniques. • To develop the student's skills in applying FEM solution steps by using software.	• An ability to derive element matrix equation by different methods by applying basic laws in structural analysis. • An ability to apply the knowledge of finite element method to solve simple problems. • An ability to extend the knowledge of finite element method to solve complex problems using various elements. • An ability to understand solution and modeling techniques used in finite element method.
PO mapped: a, b, d	

UNIT – I

Principles and discretization, Elements stiffness formulation based on direct and, variational techniques, Rayleigh Ritz Method for Bar and Beam analysis.

UNIT – II

Shape functions, Finite Element Formulation using Cartesian Coordinates, Application to 1D problems, Convergence criteria

UNIT – III

Triangular and Rectangular element formulation using Cartesian Coordinates, Application to 2D stress analysis.

UNIT – IV

Natural coordinates, Numerical integration**,**Isoparametric elements, Application to 1D Problems, Isoparametric elements for two-dimensional stress analysis.

UNIT – V

Shape Functions for three Dimensional Stress analysis, Axi-symmetric Stress Analysis.

UNIT – VI

Modelling techniques and solution techniques, Computer Implementation of FEM Procedure for 1D & 2D problems.

Text Books:

1. Chandrapatla T.R., Belegundu A. D. Introduction to Finite Elements in Engineering, Prentice Hall India, 1991
2. Rajasekaran S, Finite Element Analysis in Engineering Design, S. Chand &Co.Ltd.New Delhi, 1999.

Reference Books:

1. Zienkiewicz O.C. and Taylor R.L., The Finite Element Method (Volume -I), 1st Edition, Tata McGraw Hill Publishing Company Limited, New Delhi, 1989
2. Cook R. D. , Concepts and Applications of Finite Element Analysis, 3rd Edition, Wiley India Text books, Wiley India Pvt Limited, New Delhi, 1989.
3. Krishnamurthi C. S. ,Finite Element Analysis: Theory and Programming , 2nd Edition, Tata McGraw Hill Publishing Company Limited, 1994, Reprint 2005.
4. Bathe K. J., Finite Element Procedure, Prentice-hall of India, New Delhi, 1997.

II SEMESTER

CV1912	Theory of Plates and Shells		L=3	T=0	P=0	CREDITS = 3
EVALUATION SCHEME						
MSE – I	MSE – II	TA	ESE	TOTAL	ESE DURATION	
15	15	10	60	100	3 hours	

COURSE OBJECTIVES	COURSE OOTCOMES
• To correlate moment curvature relation in pure bending and to derive equation of deflection for circular and thin rectangular plates. • To derive Lagrange's equation and Navier's solution for thin plates. • To explain the concept of finite difference method and its application. • To study the shear deformation theories for plates. • To classify the shells and its geometry and to explain the concept of various theory for shells.	• An ability to correlate moment curvature relation in pure bending. • An ability to derive equations of deflection for thin circular and rectangular plate. • An ability to explain the concept of finite difference method and its application. • An ability to understand the shear deformation theories for plates. • An ability to classify the shells and its geometry and to explain the concept of various theories.
PO mapped: a, b	

UNIT – I
Development of governing differential equations by Kirchoff'stheory with reference to thin rectangular plates with various boundary conditions. Symmetrical bending of laterally loaded circular plates with different boundary conditions.

UNIT- II
Study of Simply supported plates under different loadings.Navier's solution. Introduction to Levis solution.Finite difference method.

UNIT – III
Introduction to shear deformation theories for plates.

UNIT – IV
Classification of Shells.Membrane theory of cylindrical shells with different directrix such as circular, cycloidal, catenary, and parabolic.

UNIT – V
Bending theory of cylindrical shells, Finsterwalde, Schorer's, and D-K-J theory.

UNIT – VI
Approximate analysis of cylindrical shells by beam arch method.

Text Books
1. Timoshenko S.P and Krieger S.W, Theory of Plates and Shells,2nd Edition, McGraw-Hill Book Company, New Delhi, 1970.
2. Chadrashekhara K, Theory of Plates, 1st Edition, Universities Press (India) Ltd, Hyderabad, 2001.
3. Ramaswamy, G.S, Design of Concrete Shells, Krieger Publ. Co., 1984

Reference Books
1. Ramachandran S., Thin Shells (Theory and Problems) 1st Edition, Universities Press (India) Ltd, Hyderabad
2. Szilard R., Theory and Analysis of Plates, Prentice Hall Publication, 1974.
3. Philipee G Ciarlet, Mathematical elasticity Vol.II: Theory of plates, 1st Edition, Elsevier Science B V, 1997.

II SEMESTER

CV1913	Earthquake & Wind Effects on Structures		L=3	T=0	P=0	CREDITS = 3
EVALUATION SCHEME						
MSE – I	MSE – II	TA	ESE	TOTAL	ESE DURATION	
15	15	10	60	100	3 hours	

COURSE OBJECTIVE	COURSE OUTCOMES
• Understand basic concepts of earthquake engineering • Understand behavior of structural components under earthquake and wind loading • Understand concepts of earthquake resistance design • Understand various codes related to earthquake and wind effects on structures • Understand Wind Characteristics and concept of Mathematical Modeling.	• An ability to apply the knowledge of geological feature, plate tectonics in understanding occurrence of earthquake. • An ability to understand causes and sources of earthquake damages and possible response of structure and system to earthquake. • An ability to understand characteristics of wind and its static and dynamic effects on structures • An ability to understand relevant I.S. codes and philosophy in design of earthquake& Wind resistant structure
PO mapped: a, c, d, e, g	

UNIT – I
Origin of earthquake, Engineering geology of earthquakes, faults, Propagation of earthquake waves, quantification of earthquake (magnitude, energy, intensity of earthquake), Measurement of earthquake (accelerograph, accelogram recording and analysis of earthquake records), determination of magnitude, epicenter distances, Seismicity of the world.

UNIT- II
Causes or sources of earthquake damage, damage due to ground failure, History of past Earthquakes, generation of response spectrum from available earthquake records, Earthquake design spectrum and inelastic spectrum. Evolution of seismic risk.

UNIT – III
Concepts of earthquake resistance design, Design philosophy, four virtues of earthquake resistance design (stiffness, strength, ductility and configuration). Introduction to capacity design concept, Study of IS: 1893, Study of IS: 13920 for analysis and ductile design of RCC structures.

UNIT – IV
Wind Characteristics: Historical Wind Speed Data, Mathematical Models, Wind Speed Map of India, Practical Knowledge of Cyclones and Tornadoes.

UNIT-V
Static Wind effects and Building Codes with particular reference to IS – 875 (Part III).

UNIT-VI
Dynamic Wind Effects: Wind Induced Vibrations, Self excited motion, Analysis for dynamic wind loads, Vibration Control and Structural Monitoring.

Text Books:
1. Kramer, S.L, "Geotechnical Earthquake Engineering", Prentice Hall, New Jersey, 1996.
2. Arya A. S., "Introduction to earthquake engineering structures".
3. C. Scruton, "An Introduction to Wind Effects on Structures", Oxford University Press, Oxford, UK., 1981

II SEMESTER

CV1913	Earthquake & Wind Effects on Structures		L=3	T=0	P=0	CREDITS = 3
EVALUATION SCHEME						
MSE – I	MSE – II	TA	ESE	TOTAL	ESE DURATION	
15	15	10	60	100	3 hours	

Reference books

1. Murthy, C.V.R, "Earthquake tips", IIT Kanpur documents.
2. Chopra A. K., Dynamics of Structures, Theory & Application to Earthquake Engineering, 2nd Edition., Pearson Education (Singapore) Pvt. Ltd, New Delhi, 1995
3. Dowrick, D.J, "Earthquake Resistant Design for Engineers and Architects", 2nd Edition; 1987
4. Peter Sachs, "Wind Forces in Engineering", Pergamon Press. Oxford UK, 1972
5. Lawson T. V., "Wind Effects on Buildings", Applied Science Publishers, London, UK, 1980
6. Emil Simiu and R. H. Scanlan, "Wind Effects on Structures – An Introduction to Wind Engineering", John Wiley and Sons, New York., 1986
7. Cook, N. J., The designer's guide to wind loading of building structures. Part 1 Background, damage survey, wind data and structural classification. Building Research Establishment, Butterworths, U. K., 1985
8. Cook, N. J., Designer's guide to wind loading of building structures. Part 2: Static structures. Building Research Establishment, Butterworths, U. K., 1990
9. Simiu, E., Scanlan, R. H. Wind Effects on Structures: fundamentals and applications to design. 3rd Edition., John Wiley & Sons, New York, 1996.
10. Dyrbye, C., Hansen, S. O., Wind loads on structures., John Wiley, New York, 1997

Reference IS codes:

IS 1893-2002 Earthquake criteria

II SEMESTER

CV1914	PE-I Advanced Concrete Structures		L=3	T=0	P=0	CREDITS = 3
EVALUATION SCHEME						
MSE – I	MSE – II	TA	ESE	TOTAL		ESE DURATION
15	15	10	60	100		3 hours

COURSE OBJECTIVE	COURSE OUTCOMES
• To provide the students' knowledge of different types of concrete structures. • To provide the students' knowledge of different types of loading conditions applied on various structures. • To provide the students' knowledge of different methods used for the analysis of multistoried buildings. • To provide the students' knowledge of different codal provisions applicable to design of advanced concrete structures. • To develop the ability for analysis, design and detailing of concrete structures.	• Ability to identify, the type of structure to be used for various site conditions • Understanding professional and ethical responsibilities. This will be accomplished by emphasizing the importance of various codes used for different structures. • An ability to analyze and design advanced concrete structures • An ability to draw RCC detailing and to prepare working drawing.
PO mapped: a, b, f, g	

UNIT – I
Analysis and design of Multistoried buildings, calculation of loads, Approximate analysis, Preliminary sizing, Ductile detailing.

UNIT – II
Analysis and Design of Elevated service Reservoirs, IS Recommendations for wind & earthquake, Ductile detailing.

UNIT – III
Analysis and Design of bridges and Culverts, IRC Recommendations.

UNIT – IV
Analysis and design of Cylindrical Shells, Silos, and Bunkers, IS recommendations.

Text Books:
1. Bhavikatti S. S., Advanced R. C. C. Design Volume-II, New age international publisher, New Delhi, Ist edition - 2006
2. Krishna Raju N, Advanced R. C. C. Design, CSB Publisher and Distributor, New Delhi, 2nd edition-2005
3. Ramaswamy, G.S, Design of Concrete Shells, Krieger Publ. Co., 1984

Reference Books:
1. Johnson and Victor, "Essentials of Bridge Engineering" Oxford and IBH publisher, 1980
2. Jain O.P. and Jai Krishna, Plain and Reinforced concrete structures–Volume –II, Nemchand and brothers, 1987
3. Chattergee, B K, "Theory and design of Concrete Shells" Oxford and IBH publisher, 1978
4. Chen, W.F. and Duan, L. "Bridge engineering Handbook"

II SEMESTER

CV1915	PE-I Prestressed Concrete		L=3	T=0	P=0	CREDITS = 3
EVALUATION SCHEME						
MSE – I	MSE – II	TA	ESE	TOTAL		ESE DURATION
15	15	10	60	100		3 hours

COURSE OBJECTIVES	COURSE OUTCOMES
• To understand the basic concepts of Prestressed concrete. • To study various devices used for Prestressing. • To analysis and design the basic structural members in Prestressed concrete • To analysis and design the special structures like Prestressed Concrete Pipes, Liquid Storage Tanks and Ring Beams	• An ability to apply basic concepts of Prestressed concrete in construction industry. • Ability to identify, formulate and solve engineering problems pertaining to prestressed concrete. • An ability to understand IS codes related to prestressed concrete. • An ability to design special prestressed structures.
PO mapped: a, b, c, d, f	

UNIT – I

Limit state design of statically determinate prestressed beams - limit state of collapse against flexure, shear, torsion - limit state of serviceability - Design of end block - Anchorage zone stresses for post tensioned members.

UNIT – II

Statically indeterminate structures - analysis and design of continuous beams and frames Choice of cable profile - linear transformation - concordancy.

UNIT – III

Composite sections of prestressed concrete beam and cast in situ RC slab - analysis of stresses - differential shrinkage - deflections - Flexural and shear strength of composite sections - Design of composite sections.

UNIT – IV

Time dependant effects such as creep, shrinkage - Partial prestressing - Limit State design of partially prestressed concrete beams - Balanced moment capacity of rectangular and flanged sections - Crack and crack width computations. Analysis and design of prestressed concrete pipes, tanks, slabs – one way and two way (numerical problems restricted to pipes and tanks only).

Text Books:

1. N. Krishnaraju, Prestressed Concrete, 3rd edition, Tata McGraw Hill Publishing Co., 1995
2. S.K. Mallick and A.P.Gupta, Prestressed concrete, Oxford and IBH Publishing Co., New Delhi.

Reference Books:

1. Lin, T.Y. and Burns, N.H. , Design of Prestressed Concrete Structures, , 3rd edition, John Wiley &Son's, 2004
2. IS : 1343 – 1980, Code of Practice of Prestressed Concrete, Indian Standards Institution.
3. Guyon Y., Prestressed Concrete vol.I and II, Contractors Record Ltd., London.
4. Abels P.W., An Introduction to Prestressed Concrete, Vol.I and II', Concrete Publications Ltd., London.
5. Dayaratnam P. ,Prestressed Concrete Structures, , 5th edition, Oxford & IBH, 1996

II SEMESTER

CV1916	PE-I Composite Structures			L=3	T=0	P=0	CREDITS =3
EVALUATION SCHEME							
MSE – I	MSE – II	TA	ESE	TOTAL		ESE DURATION	
15	15	10	60	100		3 hours	

COURSE OBJECTIVES	COURSE OUTCOMES
• To understand the characteristic of different composite material • To understand the relation of materials and its property • To understand the failure theory of structures • To understand the function of laminated plated under bending and vibration.	• An ability to understand basic concepts and characteristics of Composite materials. • An ability to understand elastic behavior of lamina. • An ability to understand various failure theories. • An ability to analyze laminated plates under Bending and vibration.
PO mapped: a, b, c, g	

Unit I
Introduction: definition, Classification and characteristics of Composite materials, advantages and limitations. Current Status and Future Prospects; Basic Concepts and characteristics: Homogeneity and Heterogeneity, Isotropy, Orthotropy and Anisotropy; Characteristics and configurations of lamina, laminate, micromechanics and macromechanics.

Unit II
Constituent materials and properties ; Elastic behavior of unidirectional lamina: Anisotropic, separately orthotropic and transversely isotropic materials, stress-strain relations for thin lamina, transformation of stress and strain, transformation of elastic parameters ; Strength of unidirectional lamina:

Unit III
Macromechanical failure theories- Maximum stress theory, maximum strain theory, Deviatoric strain energy theory (Tsai-Hill), Interactive tensor polynomial theory (Tsai-Wu); Elastic Behavior of multidirectional laminates: Basic assumptions, Stress-strain relations, load deformation relations, symmetric and balanced laminates, laminate engineering properties ;

Unit IV
Bending and vibration of laminated plates: Governing equations, Deflection of simply supported rectangular symmetric angle-ply, specially orthotropic, anti-symmetric cross-ply laminates ; Recent advances: Functionally graded materials, Smart materials.

Text / Reference Books:
1. R.M. Jones, Mechanics of Composite materials, Taylor and Francis, 1999.
2. M. Daniel and O. Ishai, Engineering mechanics of Composite materials, Oxford university press, 1999
3. P.K. Mallick, Fiber-reinforced Composites, Marcel Dekker Inc, 1988.
4. D. Hull and T. W. Clyne, An introduction to composite materials, Cambridge university press, Second Edition, 1996.
5. J.N. Reddy, Mechanics of laminated composite plates and shells-Theory and Analysis, CRC Press, BocaRaton, Second Edition, 2003.

II SEMESTER

CV1917	PE-II Advanced Steel Structures			L=3	T=0	P=0	CREDITS = 3
EVALUATION SCHEME							
MSE – I	MSE – II	TA	ESE	TOTAL		ESE DURATION	
15	15	10	60	100		3 hours	

COURSE OBJECTIVES	COURSE OUTCOMES
• To develop the fundamental design philosophies of steel structures • To understand basic principles of reliability based design on steel structures • To have an experience in the complete design of an Industrial building • To learn the analysis and design of Chimney structure • To learn the concept of design of truss bride • To learn analysis and design of storage vessels.	• An ability to understand the relationship between structural analysis and design provisions • An ability to understand the basic principles of reliability based design on steel structures • An ability to apply the provisions of IS: 875 part I to V, IS: 800, and other Indian Standards for columns, beams, beam-columns and connections efficiently
PO mapped: a, b, c, f, g	

UNIT – I
Design of steel industrial buildings

UNIT – II
Design of Steel Storage Vessels

UNIT – III
Design of steel Bridges.

UNIT – IV
Design of steel multistoried building

Reference Book

1. Arya A.S and Ajmani J.L. Design of Steel Structures, Nemchand&bross, Roorkee, new edition
2. Duggal S.K., Design of Steel Structures, McGraw Hill publication, 2007
3. RamChandra Design of Steel structures Vol-I &Vol-II Std. book house / Rajsons Publication Pvt. Ltd.,, Delhi, 2006
4. Gaylords, E.H. &Gaylords, C. N., Design of Steel Structures, Blackwell, 1994.
5. Dayaratnam P., Design of Steel Structures, Wheeler Publications, Allahabad, 1992
6. Ghosh, " Analysis and Design practice of Steel Structure", (Forthcoming), Phi Publisher, New Delhi

II SEMESTER

CV1918	PE-II New Engineering Materials		L=3	T=0	P=0	CREDITS = 3
EVALUATION SCHEME						
MSE – I	MSE – II	TA	ESE	TOTAL		ESE DURATION
15	15	10	60	100		3 hours

COURSE OBJECTIVES	COURSE OUTCOMES
• Understand various civil engineering materials • Understand various methods of testing of materials • Understand and use various codes related to the civil engineering materials	• To introduce different high-quality materials for civil engineering applications. • To be able to use engineering materials for better and durable Civil Engineering Structures.
PO mapped: a, b, g	

UNIT-I
Steel fiber reinforced concrete, Properties, Aspect ratio, strength and durability.
Fiber reinforced plastics, other types of fibers and their applications.

09 Hrs.

UNIT-II
Light weight concrete, foam concrete,flyash concrete, workability, durability and application.

10 Hrs.

UNIT-III
High-grade concrete, high strength performance concrete, trimix concrete.

New engineering materials like light weight steel profile, aluminum profile, pressed steel sections.

10 Hrs.

UNIT-IV
Introduction to steel concrete composite including infill, encased section, properties of shear connectors, use of IS:11384, IRC 220.

10 Hrs.

Text books:
1. Neville A. M., Properties of Concrete, Pearson Education Limited.
2. Rafatsiddhequi , Special Concretes, Galgotia Publications.
3. M Gambhir, Concrete Technology, Tata Mcgraw Hill Education Private Limited.

Reference books:
1. Mehta P, Concrete Technology, Tata Mcgraw Hill Education Private Limited.
2. Shetty M. S, Concrete Technology, S. Chand Publisher.

II SEMESTER

CV1919	PE-II Smart Structures and Applications		L=3	T=0	P=0	CREDITS = 3
EVALUATION SCHEME						
MSE – I	MSE – II	TA	ESE	TOTAL		ESE DURATION
15	15	10	60	100		3 hours

COURSE OBJECTIVES	COURSE OUTCOMES
• To understand smart system • To understand characteristics and behavior of smart materials • To understand control system and its applications • To understand modeling of control system and its applications	• An ability to understand passive and active systems. • An ability to understand characteristics and behavior of smart materials • An ability to understand control systems and its applications. • An ability to understand modeling of control systems.
PO mapped: c, d	

UNIT – I

Introduction to passive and active systems – need for active systems– smart systems – definitions and implications - active control and adaptive control systems – examples.

UNIT – II

Components of smart systems– system features and interpretation of sensor data – pro active and reactive systems – demo example in component level – system level complexity Materials used in smart systems – characteristics of sensors – different types smart materials – characteristics and behavior of smart materials – modeling smart materials – examples

UNIT – III

Control Systems – features – active systems – adaptive systems – electronic, thermal and hydraulic type actuators – characteristics of control systems – application examples.

UNIT – IV

Integration of sensors and control systems – modeling features – sensor-response integration– processing for proactive and reactive components – FE models – examples.

References Books

1. Srinivasan, A.V. and Michael McFarland, D., Smart Structures: Analysis and Design, Cambridge University Press, 2000.
2. Yoseph Bar Cohen, Smart Structures and Materials 2003, The International Society for Optical Engineering 2003.
3. Brian Culshaw, Smart Structures and Materials ,Artech House, Boston, 1996.
4. M.V.Gandhi and B.S.thompson, Smart Materials and Structures , Chapman and Hall 1992.

II SEMESTER

CV1920	Lab: Steel Design Studio		L=0	T=0	P=2	CREDITS = 1
EVALUATION SCHEME						
MSE – I	MSE – II	TA	ESE	TOTAL		ESE DURATION
--	--	40	60	100		--

COURSE OBJECTIVES	COURSE OUTCOMES
• To understand the basic concepts and fundamentals of steel design • To provide advanced knowledge of steel structural design and apply the principles to solve a structural steel problem. • To study (modeling, analysis and design) aspects of structures using commercial software.	• An ability to understand the basic knowledge of structural engineering to advanced steel structure • An ability to understand the various parameters considered in analysis of complex structure • An ability to design advanced steel structure • An ability to present analysis and design result in schematic way
PO mapped: a, b, e, f	

Contents

1. Review of IS 800
2. Elementary Design of Beam including open web sections
3. Elementary Design of various types of truss.
4. Design of Plate Girders
5. Structural Fasteners and Connections (Bolted/ Welded Connections all types)

ReferenceBooks:

1. Duggal S.K., Design of Steel Structures, McGraw Hill publication, 2007
2. Arya A.S and Ajmani J.L. Design of Steel Structures Nemchand&bross, Roorkee, New Edition
3. Inglekrik
4. Subramanyam

II SEMESTER

CV1921	Lab: RCC Design Studio		L=0	T=0	P=2	CREDITS = 1
EVALUATION SCHEME						
MSE – I	MSE – II	CA	ESE	TOTAL		ESE DURATION
--	--	40	60	100		--

COURSE OBJECTIVES	COURSE OUTCOMES
• To understand the basic concepts and fundamentals of RCC design • To provide advanced knowledge of RCC structural design and apply the principles to solve a problem. • To study (modeling, analysis and design) aspects of structures using commercial software.	• An ability to demonstrate basic knowledge of structural engineering to advance concrete structure. • An ability to understand the various parameter considered in analysis of complex structures • An ability to design advanced concrete structures • An ability to present analysis and design result in schematic way
PO mapped: a, b, e, f	

PRACTICALS

1. Review of IS 456, IS 962 Basics of Limit State Design (Beams, Columns, Slabs) Design of Multistoried buildings
2. Design for axial force, flexural, shear and combined effects
3. Slabs (one way & two way) and slabs on grades. Preliminary sizing and modeling of RC structures.

Reference Books:

1. Bhavikatti S. S., Advanced R. C. C. Design Volume-II, New age international publisher, New Delhi, Ist edition – 2006
2. Krishna Raju N, Advanced R. C. C. Design, CSB Publisher and Distributor, New Delhi, 2nd edition-2005.

II SEMESTER

CV1922	SEMINAR		L=0	T=0	P=2	CREDITS = 1
EVALUATION SCHEME						
MSE – I	MSE – II	CA	ESE	TOTAL		ESE DURATION
-----	-----	100		100		-----

COURSE OBJECTIVES	COURSE OUTCOMES
• To provide the students the academic environment to carry out literature survey of advanced topics in structural engineering • To provide the students the academic environment for effective communication skills, working independently and in a team and the importance of lifelong learning.	• An ability to understand the importance of lifelong learning. • An ability to understand the advances in structural engineering • An ability to communicate effectively. • An ability to work independently and in a team.
PO mapped: c, d, f, g	

Each Student shall prepare a Paper and present a Seminar based on the reviewed literature from various sources on current topic related to the structural engineering under the guidance of a staff member. The student shall submit typed copy of the paper to the Department. Grades will be awarded on the basis of contents of the paper and the presentation.

III SEMESTER

CV1923	PE-III Tall Buildings		L=3	T=0	P=0	CREDITS = 3
EVALUATION SCHEME						
MSE – I	MSE – II	TA	ESE	TOTAL	ESE DURATION	
15	15	10	60	100	3 hours	

COURSE OBJECTIVES	COURSE OUTCOMES
• To understand horizontal load acting on a building i.e. earthquake and wind and design the building for above loading by providing shear walls / shear core. • To understand various aspects of high rise building such as the effect of torsion, soft storey effect, p-delta effect and drift index. • To understand detailing of RCC members for ductile behavior as IS Codes provisions.	• An ability to analyze the high-rise structures by considering various loads. • An ability to design RCC structures with ductile detailing. • An ability to use mathematical modeling techniques to design high rise structures. • An ability to understand IRC codes related to earthquake and wind load.
PO mapped: a, b, c, g	

UNIT – I
Earthquake & wind load Calculations along with dead load & live loads by Static analysis. Introduction to Frame – shear wall buildings, Mathematical modeling of buildings with different Structural systems. Analysis & Design of shear walled buildings.

UNIT – II
Special aspects in Multi- Story buildings like effect of torsion, flexible first storey, p- delta effect, Soil – Structure Interaction on building response, drift limitations. Ductility of reinforced members subjected to flexure. Design of braced columns using codal provisions.

UNIT – III
Beam – column jointed for ductile behaviors.
Multistory building with bracings &infills.

UNIT – IV
Introduction to Diaphragm. Seismic design of floor diaphragm.

TextBooks:
1. Agrawal P. & , Shrikhande M., Earthquake Resistant Design of Structures, Prentice hall India, New Delhi, 4th Edition, 2007.
2. Verghese P.C., Advance Reinforced Concrete Design, Prentice hall of India, New Delhi, 2001.

Reference Books:
1. Park, R. &Paulay, T., Reinforced Concrete Structures, John Willey & Sons; 2nd Edition, 1975
2. Paulay, T. &Prestiley, M.J.N., Seismic design of R C & Masonry Buildings, John Willey & Sons; 2nd Edition, 1999
3. FarzadNaeim, Handbook on Seismic Analysis and Design of Structures, Kluwer Academic Publisher, 2001
4. Booth, E., Concrete Structures in Earthquake Regions, Longman Higher Education, 1994

III SEMESTER

CV1924	PE-III Design of Environmental Structures		L=3	T=0	P=0	CREDITS = 3
EVALUATION SCHEME						
MSE – I	MSE – II	TA	ESE	TOTAL	ESE DURATION	
15	15	10	60	100	3 hours	

COURSE OBJECTIVES	COURSE OUTCOMES
• To provide the students clear and thorough understanding of various environmental structures. • To provide the knowledge of analysis and design of water supply and treatment plants and reservoirs. • To provide the knowledge of analysis and design of jack well/Pump house / approach bridges. • To provide the knowledge of analysis and design of pretreatment units i.e. clariflocculator aerators, flash Mixture, sand filters etc.	• An ability to analyze and design water supply and treatment plants depending upon the capacity. • An ability to analyze and design reservoirs depending upon the capacity. • An ability to analyse and design jack well/Pump house / approach bridges. • An ability to analyse and design pretreatment units i. e. clariflocculator aerators, flash Mixture, sand filters etc.
PO mapped: a, b, e, f, g	

UNIT - I
Design of rectangular RCC reservoirs.

UNIT - II
Design of circular RCC reservoirs.

UNIT - III
Design of jack well/Pump house / approach bridges.

UNIT - IV
Design of pretreatment units: clariflocculator, aerators, flash Mixture, sand filters etc.

Text Books:
1. Ramamrutham S., "Design of Reinforced Concrete Structures", Dhanpat Rai& Sons publications, 12th edition, 1995
2. Jain A.K., "Reinforced Concrete limit stste design", Nem Chand & Bros. Roorkee., 4th edition, 1993

Reference Books:
1. Ghali, A., Circular Storage Tanks and Silos, E & F N Spon, London, (1979)
2. Jain, S.K. &Jaiswal, O.R., Guidelines for seismic design of liquid storage tanks, NICEE, IITK, 2004
3. Anchor, R.D., Design of liquid retaining concrete structure, Edward Arnold, London, (1992)

III SEMESTER

CV1925	PE-III Bridge Engineering			L=3	T=0	P=0	CREDITS = 3
EVALUATION SCHEME							
MSE – I	MSE – II	TA	ESE	TOTAL		ESE DURATION	
15	15	10	60	100		3 hours	

COURSE OBJECTIVES	COURSE OUTCOMES
• To provide the students clear and thorough understanding of various types of bridges and loadings. • To provide the knowledge of seismic behavior and design philosophy for bri • To provide the concept of earthquake behavior and design philosophy for retaining wall and Abutments. • To provide the student with a thorough understanding of IS codes related to bridges.	• Ability to identify the type of bridge to be used for various site and loading conditions. • An ability to analyze and design various types of bridges and the components. • An ability to draw RCC detailing and to prepare working drawing. • An ability to Understand IS codes related to bridges.
PO mapped: a, b, e, f, g	

UNIT – I
Types of bridge superstructure and introduction to their design, sub-structure, bearings, IRC / IRS Bridge loadings and other codal recommendations.

UNIT – II
Seismic design philosophy for Bridges, State of art modeling of bridges, Seismic Design of Substructures, Capacity design of substructures and ductile detailing, Seismic design of well and pile foundations.

UNIT – III
Earthquake behavior and Design of retaining wall and Abutments, IS code recommendations.

UNIT – IV
Design of Bearings (Free, Guided and Restrained). Introduction to long span bridges: cable stayed bridges and suspension bridges.

Text Books:
1. N. Krishna Raju, Design of bridges, Oxford & IBH publishing Co. Ltd., New Delhi.
2. D. Johnson Victor, Essentials of bridge engineering, Oxford & IBH publishing Co. Ltd., New Delhi.
3. Jagdeesh R. and Jairam M., " Design of bridges", PHI Publication New Delhi, 2nd edition,

Reference Books:
1. IRC: 5 -1970, Standard specifications and code of practice for road bridges, Sections I to V, Indian Roads Congress, New Delhi.
2. Chen, W.F. and Duan, L., Bridge Engineering Handbook, CRC Press, 1999
3. Indian railway standard code of practice for the design of steel or wrought iron bridge carrying rail, road or pedestrian traffic, Govt. of India, Ministry of Railways, 1962.
4. Hambly, E.C., Bridge deck behaviour, Chapman and Hall, London
5. O'Brien E.J. and Keogh D.L., Bridge deck analysis, E& FN Spon, New York

III SEMESTER

CV1926	PE-IV Plastic Analysis & Design of Steel Structure	L=3	T=0	P=0	CREDITS = 3

EVALUATION SCHEME					
MSE – I	**MSE – II**	**TA**	**ESE**	**TOTAL**	**ESE DURATION**
15	15	10	60	100	3 hours

COURSE OBJECTIVES	COURSE OUTCOMES
• To provide the students clear and thorough understanding of modeling of discrete single-degree and multiple-degree vibratory systems and calculate the free and forced response of these systems. • To provide the students clear and thorough understanding of Calculation of the mode shapes and frequencies for the free response of continuous vibratory systems and use modal methods to calculate the forced response of these systems. • To provide the students understanding of modeling continuous vibratory systems – vibration of strings, axial and torsional vibration of bars and beams. • To provide the student with a basic understanding of IS codes related to earthquake loading.	• An ability to understand behavior of steel structure elements beyond yield point loading and basic concepts of plastic analysis. • An ability to understand techniques for estimation of collapse loads on steel structures • An ability to understand the effects of axial and shear forces on plastic moment of resistance • An ability to understand philosophies of plastic design of steel structural elements
PO mapped: b, c, e	

UNIT I:
Plastic behavior, review curves of structural steel, plastic moments, shape factors, load factors, plastic hinge, types of collapse, collapse mechanism, collapse load factor.

UNIT II:
Upper and lower bound, uniqueness theorems, principle of virtual work, statical method, minimum and maximum theorems, step by step method.

UNIT III:
Methods of release of restrains, load interaction diagrams, method of inequalities.

UNIT IV:
Plastic Moment distribution applied to continuous beams & portal frames (Max. two bays single storey)

UNIT V:
Effect of Axial force & Shear force on Plastic moment of resistance

UNIT VI:
Design of beams, continuous beams and portal frames up to two storey – two bays. Minimum weight analysis, introduction to stability.

Reference Books:
1. "Limit state Design of Steel Structures", S K Duggal , McGraw Hill education, 2010
2. "Limit State Design of Steel Structures", Dr. M R Shiyekar, PHI Publication, 3rd Print
3. A.S. Arya and J.L. Ajmani – Design of Steel Structures, Nemchand& Bros., Roorkee
4. Ramchandra – Design of Steel Structures Vol – II, Standard Book House, Delhi
5. B.G. Neal – Plastic Method of Structural Analysis, Chapman & Hall
6. L.S. Beedle – Plastic Design of Steel Frames, John Willey & Sons
7. Structural design in steel by SalwarAlamRaz New Age International Publishers 15/44
8. Steel Designers Manual – ELBS

General Reading Suggested:
1. Codes: IS: 800 - 2007 Code of Practice for General Construction in SteelHand books
2. SP: 6 (6) – 1972 Handbook for Structural Engineers: Application of plastic Theory in Design of Steel Structures
3. Handbook for Structural Engineers SP 6 (8) 1972 (Reaffirmed 1993) – Bureau of Indian Standards.
4. NPTEL

Chairperson		Date of Release	May 2017	Applicable for AY 2017-18 Onwards
Dean (Acad. Matters)		Version	1.01	

III SEMESTER

CV1927	PE-IV Seismic Analysis and Design of Structures		L=3	T=0	P=0	CREDITS = 3
EVALUATION SCHEME						
MSE – I	MSE – II	TA	ESE	TOTAL	ESE DURATION	
15	15	10	60	100	3 hours	

COURSE OBJECTIVES	COURSE OUTCOMES
• To provide the students clear and thorough understanding of the basic concepts of Earthquake resistant design • To provide the students clear and thorough understanding of analysis and design aspects of RCC and Steel members subjected to earthquake loads. • To provide the students clear and thorough understanding of detailing of RCC and steel members for ductile behavior. • To provide the students clear and thorough understanding of various Indian codes related to earthquake engineering.	• An ability to apply basic concepts Earthquake resistant design in construction industry. • Ability to identify, formulate and solve engineering problems pertaining to earthquake effects on structures. • An ability to Understand IS codes related to static as well as dynamic analysis of high rise buildings. • An ability to design special structures subjected to more effective earthquake forces.
PO mapped: a, b, c	

RCC Structures

UNIT - I

Performance of RC buildings, behavior of RC buildings in past earthquakes, influence of asymmetry, infill walls, foundations, soft story, confinement of concrete, and ductility.

UNIT - II

Capacity Design of RC Members, Design for Strong column & weak beam, Design of Beam-Column Joints.

UNIT - III

Shear wall with ductile detailing. Preliminary sizing and Modeling of RC Buildings, Ductility and factors affecting ductility of RC members.

Steel Structures

UNIT - IV

Performance of steel structures in past earthquakes, basics of Steel Design, introduction to plastic analysis and design, design philosophy for steel structures.

UNIT - V

Capacity design concept, Ductility of steel buildings, Seismic behavior of steel structures, Stability considerations.

UNIT - VI

Seismic Design and detailing of Moment Resistant Frames, Beams and Columns.

Text Books:

1. Agrawal P. & , Shrikhande M., Earthquake Resistant Design of Structures, Prentice hall India, New Delhi, 4th Edition, 2007.
2. Agrawal P. &, Shrikhande M., Earthquake Resistant Design of Structures, PHI Publisher, New Delhi.
3. Bruneau, M.; Uang, C.M.; & Whittaker, A Ductile Design of Steel Structures McGraw Hill.
4. Mazzolani, F.M.; &Piluso Theory and Design of Seismic Resistant Steel Frames E&FN Spon

Reference Books:

1. Paulay, T. &Prestiley, M.J.N., Seismic design of R C & Masonry Buildings, John Willey & Sons; 2nd Edition, 1999
2. FarzadNaeim, Handbook on Seismic Analysis and Design of Structures, Kluwer Academic Publisher, 2001
3. Booth, E., Concrete Structures in Earthquake Regions, Longman Higher Education, 1994

III SEMESTER

CV1928	PE-IV Design of Industrial Structures		L=3	T=0		P=0	CREDITS = 3
	EVALUATION SCHEME						
MSE – I	MSE – II	TA	ESE	TOTAL		ESE DURATION	
15	15	10	60	100		3 hours	

COURSE OBJECTIVES	COURSE OUTCOMES
• To understand the various classification and components of industrial structure • To understand the various loads calculation of large span structures • To understand the concept of silos and bunker structures • To understand the foundation steps of industrial structures	• An ability to understand planning of industrial structures. • An ability to analyse large span structures. • An ability to understand stability of silos and bunkers under dynamic loads. • An ability to analyse and design foundations for industrial structures.
PO mapped: a, b, c, g	

UNIT-I:
PLANNING OF INDUSTRIAL STRUCTURES:
Classification of industries and local regulations - Factors affecting planning - General Aspects – Civil Engineering Aspects - Light and Ventilation.

UNIT-II:
LARGE SPAN STRUCTURES IN INDUSTRIES
Cable roofs - Types of cable roofs - Analysis of a cable subjected to concentrated loads and uniformly distributed load, Complexities in the analysis of a cable roof, Overview of deep beams, Virrendel Girder,Castellated Girders - Introduction to earthquake forces.

UNIT-III
SILOS AND BUNKERS
Concept of Angle of Repose - Pressure distribution - Dynamic loads - Stability of bunkers – Foundations.

UNIT-IV:
FOUNDATIONS FOR INDUSTRIAL STRUCTURES
Machine foundations - General requirements - Design criteria - General analysis - Design of a block foundation for vertical compressor - Vibration Isolation - Foundations for Chimney and Microwave Towers.

Text books:
1. Srinivasula P. Hand Book of Machine FoundationTata McGraw Hill Publications, New Delhi. First Edition, 2000
2. RamchandraDesign of Steel StructuresStandard Book House, New DelhiSeventh Edition, 2000
3. Raghupati M. Design of Steel StructuresTata McGraw Hill Publication, DelhiFirst Edition, 2003
4. Dayaratnam P. Design of Steel StructuresWheelr's Publishers, Allahabad1995
5. AnandArya&Ajmani J. L. Design of Steel StructuresNemchand& Bros., Roorkee, U.P., IndiaForth Edition, 2004
6. Lambert F.W. The Theory & Practical Design of BunkersThe British Constructional Steelwork Association Ltd., London, UK2000

III SEMESTER

CV1929	Project Phase I		L=0	T=0	P=12	CREDITS = 6
EVALUATION SCHEME						
MSE – I	MSE – II	CA	ESE	TOTAL		ESE DURATION
		100		100		

COURSE OBJECTIVES	COURSE OUTCOMES
• To provide the students the academic environment to carry out literature survey of advanced topics in structural engineering • To motivate the students to use the modern tools and software's • To provide the students the understanding of various aspects like effective communication skills, working independently and in a team and the importance of lifelong learning etc. to carry out project.	• An ability to solve real world structural engineering problems. • An ability to understand the importance of lifelong learning and the use of modern tools. • An ability to understand the importance of lifelong learning and the use of modern tools • An ability to work independently and in a team for effective communication
PO mapped: a, c, d, e, f, g	

The Project Phase – I shall start in semester III, and should preferably be literature survey of a live problem or a macro issue in the industry.

The work shall be continuously evaluated as per the norms/ guidelines set up by the B.O.S. for its assessment of 100 marks.

Evaluation of Project Phase – I shall consist of submission of report in a prescribed format based on a comprehensive and critical review of literature related to the topic selected for dissertation. Report should cover introduction, literature review, objective and scope of investigation and pilot studies carried out during the semester. The student will deliver the seminar thereon which will be assessed by panel of examiners.

IV SEMSTER

CV1931	Project Phase II		L=0	T=0	P=20	CREDITS = 10
EVALUATION SCHEME						
MSE – I	**MSE – II**	**CA**	**ESE**	**TOTAL**		**ESE DURATION**
-----	-----	**40**	**60**	**100**		-----

COURSE OBJECTIVES	COURSE OUTCOMES
• To provide the students the academic environment to carry out literature survey of advanced topics in structural engineering • To provide the students the understanding of real world structural engineering problems and their solution. • To motivate the students to use the modern tools and software's • To provide the students the understanding of various aspects like effective communication skills, working independently and in a team and the importance of lifelong learning etc. to carry out project.	• An ability to solve real world structural engineering problems. • An ability to understand the importance of lifelong learning and the use of modern tools. • An ability to understand the importance of lifelong learning and the use of modern tools • An ability to work independently and in a team for effective communication.
PO mapped: a, b, c, d, e, f, g	

The Project Phase – II shall consist of detailed study of a work that the student has executed in continuation with report submitted by the student in the Project Phase – I and should involve scientific research, design, collection and analysis of data, determining solutions and must preferably bring out the individuals contribution.

The work shall be continuously evaluated as per the norms/ guidelines set up by the B.O.S. for its assessment of 40 marks.

End Semester Evaluation of Project Phase –II shall consist of submission of dissertation in a prescribed format. The student shall present the entire work on Dissertation, followed by viva-voce which will be assessed by panel of examiners.