Nagar Yuwak Shikshan Sanstha's

# Yeshwantrao Chavan College of Engineering

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

**(Accredited 'A' Grade by NAAC with a score of 3.25)**

Hingna Road, Wanadongri, Nagpur - 441 110

## SoE & Syllabus 2018-19

## M. Tech. Structural Engineering

28 June 2018

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 2018-19**

**Structural Engineering**

| SN | Sem | Sub Code | Subject | T/P | Contact Hours | | | | Credits | % Weightage | | | | ESE Duration Hours |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | Hrs | | MSE-I | MSE-II | TA | ESE | |
| **I SEMESTER** | | | | | | | | | | | | | | |
| 1 | 1 | CV2901 | Numerical Methods | T | 3 | 0 | 0 | 3 | 3 | 15 | 15 | 10 | 60 | 3 |
| 2 | 1 | CV2902 | Theory of Elasticity and Elastic Stability | T | 3 | 0 | 0 | 3 | 3 | 15 | 15 | 10 | 60 | 3 |
| 3 | 1 | CV2903 | Structural Dynamics | T | 3 | 0 | 0 | 3 | 3 | 15 | 15 | 10 | 60 | 3 |
| 4 | 1 | CV2904 | **Lab:** Structural Dynamics | P | 0 | 0 | 2 | 2 | 1 | - | - | 40 | 60 | - |
| 5 | 1 | CV2905 | Matrix Analysis of Structures | T | 3 | 0 | 0 | 3 | 3 | 15 | 15 | 10 | 60 | 3 |
| 6 | 1 | CV2906 | **Lab:** Matrix Analysis of Structures | P | 0 | 0 | 2 | 2 | 1 | - | - | 40 | 60 | - |
| 7 | 1 | CV2907 | Design of Substructures & Foundations | T | 3 | 0 | 0 | 3 | 3 | 15 | 15 | 10 | 60 | 3 |
| 8 | 1 | CV2908 | Research Practice | P | 0 | 0 | 2 | 2 | 1 | - | - | 40 | 60 | - |
| **Total** | | | | | **15** | **0** | **6** | **21** | **18** | | | | | |
| **II SEMESTER** | | | | | | | | | | | | | | |
| 1 | 2 | CV2911 | Finite Element Method | T | 3 | 0 | 0 | 3 | 3 | 15 | 15 | 10 | 60 | 3 |
| | 2 | CV2912 | **Lab:** Finite Element Method | P | 0 | 0 | 2 | 2 | 1 | - | - | 40 | 60 | - |
| 2 | 2 | CV2913 | Theory of Plates and Shells | T | 3 | 0 | 0 | 3 | 3 | 15 | 15 | 10 | 60 | 3 |
| 3 | 2 | CV2914 | Earthquake and wind effects on Structures | T | 3 | 0 | 0 | 3 | 3 | 15 | 15 | 10 | 60 | 3 |
| 4 | 2 | CV2915 | Advanced Concrete Structures | T | 3 | 0 | 0 | 3 | 3 | 15 | 15 | 10 | 60 | 3 |
| 5 | 2 | | Professional Elective-I | T | 3 | 0 | 0 | 3 | 3 | 15 | 15 | 10 | 60 | 3 |
| 6 | 2 | CV2919 | **Lab:** RCC Design Studio | P | 0 | 0 | 2 | 2 | 1 | - | - | 40 | 60 | - |
| 7 | 2 | CV2920 | Seminar | | 0 | 0 | 2 | 2 | 1 | - | - | 100 | | - |
| **Total** | | | | | **15** | **0** | **6** | **21** | **18** | | | | | |

**List of Professional Electives-I**

| | | |
|---|---|---|
| 2 | CV2916 | PE I: New Engineering Materials |
| 2 | CV2917 | PE I: Prestressed Concrete |
| 2 | CV2918 | PE I: Smart Structures and Applications |

| SN | Sem | Sub Code | Subject | T/P | Contact Hours | | | | Credits | % Weightage | | | | ESE Duration Hours |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | Hrs | | MSE-I | MSE-II | TA | ESE | |
| **III SEMESTER** | | | | | | | | | | | | | | |
| 1 | 3 | CV2931 | Advanced Steel Structures | T | 3 | 0 | 0 | 3 | 3 | 15 | 15 | 10 | 60 | 4 |
| 2 | 3 | CV2932 | **Lab:** Steel Design Studio | P | 0 | 0 | 2 | 2 | 1 | - | - | 40 | 60 | - |
| 3 | 3 | | Professional Elective-II | T | 3 | 0 | 0 | 3 | 3 | 15 | 15 | 10 | 60 | 3 |
| 4 | 3 | | Professional Elective-III | T | 3 | 0 | 0 | 3 | 3 | 15 | 15 | 10 | 60 | 3 |
| 5 | 3 | CV2939 | Project Phase-I | P | 0 | 0 | 12 | 12 | 6 | - | - | 100 | | - |
| **Total** | | | | | **9** | **0** | **14** | **23** | **16** | | | | | |

**List of Professional Electives-II**

| | | |
|---|---|---|
| 3 | CV2933 | PE II: Tall Building |
| 3 | CV2934 | PE II: Composite Strucutres |
| 3 | CV2935 | PE II: Bridge Engineering |

**List of Professional Electives-III**

| | | |
|---|---|---|
| **3** | **CV2936** | PE III: Plastic Analysis and Design of Structures |
| **3** | **CV2937** | PE III: Seismic Analysis and Design of Structures |
| **3** | **CV2938** | PE III: Design of Industrial Structures |

| SN | Sem | Sub Code | Subject | T/P | Contact Hours | | | | Credits | % Weightage | | | | ESE Duration Hours |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | L | T | P | Hrs | | MSE-I | MSE-II | TA | ESE | |
| **IV SEMESTER** | | | | | | | | | | | | | | |
| 1 | 4 | CV2940 | Project Phase-II | | 0 | 0 | 20 | 20 | 10 | | | 40 | 60 | |
| **Total** | | | | | **0** | **0** | **20** | **20** | **10** | | | | | |
| **Total Credits** | | | | | | | | | **62** | | | | | |

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|---|---|---|---|---|
| | | **June 2018** | **1.00** | **Applicable for Sem 1 & 2 AY 2018-19 & Sem 3 & 4 AY 2019-20 Onwards** |
| **Chairperson** | **Dean (Acad. Matters)** | **Date of Release** | **Version** | |

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**I SEMESTER**

| CV2901 | 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 usefulness of numerical methods for engineering applications.<br>• Provide a solid understanding of the basic elements underlying development and use of numerical methods in engineering applications.<br>• Develop numerical skills and proficiency in solving the problems of structural engineering using numerical methods.<br>• Provide a training environment in use of computational tools / languages | 1. An ability to understand the basic elements underlying development and use of numerical methods in engineering applications.<br>2. 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.<br>3. An ability to formulate algorithms to solve problems using modern computational tools. |

**UNIT – I** **[06 Hrs.]**
**Solution of algebraic and transcendental equation:**
RegulaFalsi Method, Newton-Raphson method, Development of Computer Program

**[07 Hrs.]**

**UNIT – II**
**Solution of linear algebraic equations:**
Gauss elimination, Cholesky method, Given's method, Householder's method.

**[07 Hrs.]**

**UNIT – III**
**Eigen values problems**:
Direct, Jacobi, Rutishauser's LR method, QR method.

**[06 Hrs.]**

**UNIT – IV**
**Initial &two point boundary value problem**:
Euler's, Runge-Kutta, Milne's Methods, Development of Computer Program.

**[06 Hrs.]**

**UNIT – V**
**Numerical Integration:**
Trapezoidal Method, Simpson's Method, Gauss Quadrature method, Development of Computer Program.

**[07 Hrs.]**

**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 Book**

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

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|---|---|---|---|---|
| | | June 2018 | 1.00 | Applicable for Sem 1 & 2 AY2018-19 & Sem 3 & 4 AY 2019-20 Onwards |
| Chairperson | Dean (Acad. Matters) | Date of Release | Version | |

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**I SEMESTER**

| CV2902 | 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 |
|---|---|
| 1. To define plane stress and plane strain condition.<br>2. To derive differential equations, boundary conditions and compatibility conditions for 2D and 3D stress analysis.<br>3. To study the effect of bending of beams and torsion of non-circular sections.<br>4. To analyze the beam column, beam on elastic foundation.<br>**5.** To study the buckling of column and simply supported rectangular plate. | 1. An ability to define plane stress and plane strain condition.<br>2. An ability to derive differential equations, boundary conditions and compatibility conditions for 2D and 3D stress analysis.<br>3. An ability to understand the effect of bending of beams and torsion of non-circular sections.<br>4. An ability to analyze the beam column, beam on elastic foundation.<br>5. An ability to understand the buckling of column and simply supported rectangular plate.<br>6. An ability to understand the effect of shear on critical load on column. |

**UNIT- I** **[07 Hrs.]**

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** **[06 Hrs.]**

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** **[06 Hrs.]**

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** **[07 Hrs.]**

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** **[07 Hrs.]**

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** **[06 Hrs.]**

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 Filonenkoborodich, Theory of Elasticity, 1st Edition, University press of pacific, 2003

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|---|---|---|---|---|
| | | June 2018 | 1.00 | Applicable for Sem 1 & 2 AY2018-19 & Sem 3 & 4 AY 2019-20 Onwards |
| Chairperson | Dean (Acad. Matters) | Date of Release | Version | |

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**I SEMESTER**

| CV2903 | 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 |
|---|---|
| 1. 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.<br>2. 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.<br>3. To provide the students understanding of modeling continuous vibratory systems – vibration of strings, axial and torsional vibration of bars and beams.<br>4. To provide the student with a basic understanding of IS codes related to earthquake loading. | 1. 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.<br>2. 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.<br>3. 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.<br>4. An ability to Understand IS codes related to earthquake loading. |

**UNIT - I** **[07 Hrs.]**
Fundamentals of Rigid / Deformable body dynamics, Analysis of undamped and viscously damped single degree freedom systems.

**[06 Hrs.]**

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

**[06 Hrs.]**

**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)

**[06 Hrs.]**

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

**[07 Hrs.]**

**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.

**[06 Hrs.]**

**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

**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.

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**I SEMESTER**

| CV2904 | 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 |
|---|---|
| 1. To provide the students clear and thorough understanding of modeling of discrete single-degree and multiple-degree vibratory systems and calculate the free response of these systems.<br>2. To provide the students clear and thorough understanding of damping of systems and their relevance<br>3. To demonstrate phenomenon of soil liquefaction and mode shapes in water medium<br>4. To provide the students clear and thorough understanding of IS codes related to earthquake loading for buildings and elevated water tanks | 1. An ability to understand the behavior of vibratory system during cyclic loading.<br>2. An ability to understand phenomenon like damping and its relevance in actual structural applications.<br>3. An ability to understand the effect of earthquake phenomenon on water media and subsoil.<br>4. An ability to understand provision of various Indian standards for design of structures from seismic safety point of view. |

**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.

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**I SEMESTER**

| CV2905 | 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 |
|---|---|
| After completion of syllabus students will able to,<br>1. Understand basic concepts of stiffness method of matrix analysis.<br>2. Analyse the structures using stiffness method.<br>3. Apply softwares of structural analysis based on this method. | 1. An ability to understand the different types of structures<br>2. An ability to apply the matrix stiffness method to model the behavior of planar trusses, beams, and frames;<br>3. An ability to analyze any multistoried building using approximate methods of structural analysis.<br>4. An ability to implement the method developing their own computer program to analyze structures. |

**UNIT - I** **[07 Hrs.]**
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** **[06 Hrs.]**
Analysis of Plane Truss, Space Truss by Stiffness Method

**UNIT - III** **[06 Hrs.]**
Analysis of Beam, Plane Frame, Space Frame by Stiffness Method

**UNIT - IV** **[07 Hrs.]**
Analysis of building systems for horizontal loads, Buildings with and without rigid diaphragm, various mathematical models and introduction to Solution techniques.

**UNIT - V** **[06 Hrs.]**
Analysis of Plane Grid by Stiffness Method

**UNIT - VI** **[07 Hrs.]**
Analysis for member loading (self, Temperature & Imposed) Inclined supports, Lack of Fit, Initial joint displacements. Effect of shear deformation, internal member end releases

**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. Kanchi, M. B., Matrix Method of Structural Analysis, 2nd Edition; John Willey & Sons, 1999
4. Godbole P., Sonparote R., Dhote S. Matrix Methods of Structural Analysis, PHI Learning Pvt. Ltd. 2014

**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
6. Kassimali A., Matrix Analysis of Structures SI Version, Cengage Learning, 2011
7. Livesley R. K. Matrix Methods of Structural Analysis: Pergamon International Library of Science, Technology, Engineering and Social Studies, Elsevier, 2013
8. McGuire W. Gallaghar R. H. & Zimian R. D., Matrix Structure Analysis. John Willey Publication
9. Przemieniecki J. S., Theory of Matrix Structural Analysis, Dover Publication Inc. New York

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**I SEMESTER**

| CV2906 | 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 |
|---|---|
| 1. To provide knowledge to develop models of various structures in the software package, and apply the required properties, boundary conditions and forces in the developed models<br>2. To provide knowledge to analyse various structural elements by stiffness method of structural analysis.<br>3. To provide knowledge to execute the programme using standard software package without any error<br>4. To provide knowledge to understand the comparison of result between manual analysis and software analysis. | 1. An ability to understand the latest computational techniques and software used for structural analysis.<br>2. An ability to analyze beam for various loading and boundary conditions using Stiffness Method.<br>3. An ability to analyze truss for various loading and boundary conditions using Stiffness Method.<br>4. An ability to analyze plane frame and grid for various loading and boundary conditions using Stiffness Method |

1. Analyze a continuous beam with maximum three degree of Kinematic Indeterminacy using software package. Compare the software result of analysis with manual analysis result. For manual analysis use stiffness matrix method.
2. Analyze a continuous beam with sinking of support with maximum three degree of Kinematic Indeterminacy using software package. Compare the software result of analysis with manual analysis result. For manual analysis use stiffness matrix method.
3. Analyze a plane truss with maximum three degree of Kinematic Indeterminacy using software package. Compare the software result of analysis with manual analysis result. For manual analysis use stiffness matrix method. Conclude it from both the result.
4. Analyze a plane truss subjected to inclined roller support with maximum three degree of Kinematic Indeterminacy using software package. Compare the software result of analysis with manual analysis result. For manual analysis use stiffness matrix method.
5. Analyze a plane truss subjected to temperature effect and lack of fit with maximum three degree of Kinematic Indeterminacy using software package. Compare the software result of analysis with manual analysis result. For manual analysis use stiffness matrix method.
6. Analyze a space truss with maximum three degree of Kinematic Indeterminacy using software package. Compare the software result of analysis with manual analysis result. For manual analysis use stiffness matrix method.
7. Analyze a rigid sway frame one bay one story with maximum three degree of Kinematic Indeterminacy, using software package. Compare the software result of analysis with manual analysis result. For manual analysis use stiffness matrix method.
8. Analyze a plane grid using software package. Compare the software result of analysis with manual analysis result. For manual analysis use stiffness matrix method.
9. Analyze a multi storied frame structure subjected to horizontal forces using software package.

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**I SEMESTER**

| CV2907 | Design of Substructures & Foundations | | 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 |
|---|---|
| 1. To provide the students knowledge of different types of foundation structures.<br>2. To provide the students knowledge of different types of loading applied on foundation structures.<br>3. To provide the students knowledge of different methods used for the analysis of foundation structures.<br>4. To provide the students, knowledge of different codal provisions applicable to advanced design of foundation structures.<br>5. To provide the students knowledge of design of deep foundation systems, machine foundations etc. | 1. Ability to identify the type of foundations to be used for various site conditions<br>2. An ability to analyze and design different types of foundation structures.<br>3. An ability to draw RCC detailing and to prepare working drawing.<br>4. An ability to understand the importance of various codes used for different types of foundation structures. |

**[07Hrs.]**

**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.

**[06 Hrs.]**

**UNIT – II**

Design of raft foundation. Types of rafts, Design of beam and slab raft foundation. Introduction to Design of Flat slab raft foundation.

**[07 Hrs.]**

**UNIT – III**

Function and Classification of 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, Introduction to design of well foundation. IS 2911 Part I to Part V

**[06 Hrs.]**

**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.

**[06 Hrs.]**

**UNIT – V**

Effects of earthquakes on foundation structures, IS1893-2016 recommendations for layout of foundation. Ground improvements: Various methods, sand drains, stone columns, stabilization, grouting, reinforced earth, geotextiles, diaphragm walls, reinforced earth retaining walls, skin walls.

**[07 Hrs.]**

**UNIT – VI**

Analysis and design of Cantilever, counter fort and basement retaining walls and abutments

**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.

**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-Nostrand Reynold, 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.

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**I SEMESTER**

| CV2908 | 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 |
|---|---|
| 1. To make the students aware about various aspect of research methodology with special emphasis on literature review and research objective framing<br>2. To provide the students the knowledge about technical paper writing with special emphasis on abstract drafting<br>3. To teach the students various aspect of preparing and presenting effective power point presentation of technical paper<br>4. To make students aware about effective research data compilation, graphical presentation of data and interpretation from the graphs. | 1. An ability to carry out literature review and frame objectives of research.<br>2. An ability to understand essential of technical paper writing and drafting good abstract.<br>3. An ability to prepare and deliver effective power point presentation.<br>4. An ability draw different graphs, effectively use trends line equation and interpret graphs. |

**Contents**

1. General concept of Research Methodology, developing objectives of research
2. Essential of effective technical paper writing, writing of technical paper abstract
3. Presentation of technical paper, effective power point presentation.
4. Research data analysis and interpretation

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**II SEMESTER**

| CV2911 | 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 |
|---|---|
| 1. To provide the student with knowledge and analysis skills in applying basic laws and steps used in solving the problem by finite element method.<br>2. To provide the student the knowledge of various interpolation functions and elements to solve simple problems by finite element method.<br>3. To provide the student the knowledge of is oparametric transformation.<br>4. To provide students the knowledge of mathematical modelling techniques.<br>5. To develop the student's skills in applying FEM solution steps by using software. | 1. An ability to derive element matrix equation by different methods by applying basic laws in structural analysis.<br>2. An ability to apply the knowledge of finite element method to solve simple problems.<br>3. An ability to extend the knowledge of finite element method to solve complex problems using various elements.<br>4. An ability to understand solution and modeling techniques used in finite element method. |

**UNIT – I** **[06 Hrs.]**
Principles and discretization, Elements stiffness formulation based on direct and, variational techniques, Rayleigh Ritz Method for Bar and Beam analysis.

**[07 Hrs.]**

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

**[06 Hrs.]**

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

**[07 Hrs.]**

**UNIT – IV**
Natural coordinates, Isoparametric elements, Application to 1D Problems, Isoparametric elements for two-dimensional stress analysis.

**[07 Hrs.]**

**UNIT – V**
Shape Functions for three Dimensional Stress analysis, Axi-symmetric Stress Analysis.

**[06 Hrs.]**

**UNIT – VI**
Modelling techniques and solution techniques, Computer Implementation of FEM Procedure for 1D & 2D problems, Numerical integration.

**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.

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|---|---|---|---|---|
| | | June 2018 | 1.00 | Applicable for Sem 1 & 2 AY2018-19 & Sem 3 & 4 AY 2019-20 Onwards |
| Chairperson | Dean (Acad. Matters) | Date of Release | Version | |

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**II Semester**

| CV2912 | **Lab: Finite Element Method** | **L=0** | **T=0** | **P=2** | **CREDITS = 1** |
|---|---|---|---|---|---|

| **EVALUATION SCHEME** | | | | | |
|---|---|---|---|---|---|
| **MSE – I** | **MSE – II** | **CA** | **ESE** | **TOTAL** | **ESE DURATION** |
| ----- | ----- | 40 | 60 | 100 | ----- |

| **COURSE OBJECTIVE** | **COURSE OUTCOMES** |
|---|---|
| 1. To provide the students the academic environment to conduct a structural analysis using finite element software<br>2. To motivate the students to use the modern tools and software.<br>3. To provide the students the basic skills in using commercial finite element software and effective presentation of their analysis results.<br>4. To provide the students the knowledge of finite element method for the analysis of structural engineering problems and their solution. | 1. An ability to identify the information required to conduct a structural analysis using finite element software<br>2. An ability to interpret the solutions obtained from finite element analyses.<br>3. An ability to have basic skills in using commercial finite element software and effective presentation of their analysis results.<br>4. An ability to communicate effectively in writing to report (both textually and graphically) the method used, the implementation and the numerical results obtained. |

Minimum **Six** practical based on theory syllabus

1. Analysis of 2D truss
2. Analysis of Bar subjected to various loading conditions
3. Analysis of beam subjected to various loading conditions
4. Analysis of Plane Stress problem (Plate, Plate with hole) using triangular & Quadrilateral element
5. Analysis of Plain Strain problem (Retaining wall, Culvert) using triangular & Quadrilateral element
6. Analysis of Axisymmetric problem (Cylinder, foundation) using triangular & Quadrilateral element
7. Analysis of 3D beams (Cantilever and Simply Supported) subjected to various loading conditions

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**II SEMESTER**

| CV2913 | 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 OUTCOMES |
|---|---|
| 1. To correlate moment curvature relation in pure bending and to derive equation of deflection for circular and thin rectangular plates.<br>2. To derive Lagrange's equation and Navier's solution for thin plates.<br>3. To explain the concept of finite difference method and its application.<br>4. To study the shear deformation theories for plates.<br>5. To classify the shells and its geometry and to explain the concept of various theory for shells. | 1. An ability to correlate moment curvature relation in pure bending and to derive equation of deflection for circular and thin rectangular plates.<br>2. An ability to derive Lagrange's equation and Navier's solution for thin plates and explain the concept of finite difference method and its application.<br>3. An ability to understand the shear deformation theories for plates.<br>4. An ability to Classify the shells and its geometry and to explain the concept of membrane theory for shells<br>5. An ability to explain concepts of bending theory.<br>6. An ability to apply the fundamentals of beam theory |

**UNIT – I** **[07 Hrs.]**

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.

**[06 Hrs.]**

**UNIT- II**

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

**[06 Hrs.]**

**UNIT – III**

Introduction to shear deformation theories for plates.

**[07 Hrs.]**

**UNIT – IV**

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

**[06 Hrs.]**

**UNIT – V**

Bending theory of cylindrical shells, Finster walder, Schorer's, and D-K-J theory.

**[07 Hrs.]**

**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

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**II SEMESTER**

| CV2914 | 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 OBJECTIVES | COURSE OUTCOMES |
|---|---|
| 1. After completion of syllabus students will able to<br>2. Understand basic concepts of earthquake engineering<br>3. Understand behavior of structural components under earthquake and wind loading<br>4. Understand concepts of earthquake resistance design<br>5. Understand various codes related to earthquake and wind effects on structures<br>6. Understand Wind Characteristics and concept of Mathematical Modeling. | 1. An ability to apply the knowledge of geological feature, plate tectonics in understanding occurrence of earthquake.<br>2. An ability to understand causes and sources of earthquake damages and possible response of structure and system to earthquake.<br>3. An ability to understand characteristics of wind and its static and dynamic effects on structures<br>4. An ability to understand relevant I.S. codes and philosophy in design of earthquake& Wind resistant structure |

**UNIT – I** **[07 Hrs.]**

Origin of earthquake, Engineering geology of earthquakes, faults, Propagation of earthquake waves, quantification of earthquake (magnitude, & 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** **[07 Hrs.]**

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** **[06 Hrs.]**

Concepts of earthquake resistance design, Design philosophy, and 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** **[05 Hrs.]**

Wind Characteristics: Historical Wind Speed Data, Wind Speed Map of India, Practical Knowledge of Cyclones and Tornadoes.

**UNIT-V** **[07 Hrs.]**

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

**UNIT-VI** **[07 Hrs.]**

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

**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 1893-2016 Part I Earthquake criteria
IS 13920-2016 ductile detailing

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| | | June 2018 | 1.00 | Applicable for Sem 1 & 2 AY2018-19 & Sem 3 & 4 AY 2019-20 Onwards |
| Chairperson | Dean (Acad. Matters) | Date of Release | Version | |

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**II SEMESTER**

| CV2915 | 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 OBJECTIVES | COURSE OUTCOMES |
|---|---|
| After completion of syllabus students will able to get the knowledge about the design of<br>1. Bridges.<br>2. Water tanks.<br>3. Multistoried buildings.<br>4. Silos & Bunkers. | 1. Ability to identify the type of structure to be used for various site conditions<br>2. An ability to understand the importance of various codes used for different structures.<br>3. An ability to analyze and design advanced concrete structures<br>4. An ability to draw RCC detailing and to prepare working drawing. |

**UNIT – I** **[09 Hrs.]**

Analysis and design of Multistoried buildings, calculation of loads, Approximate analysis, Preliminary sizing, Ductile detailing as per IS 13920 :2015

**UNIT – II** **[10 Hrs.]**

Analysis and Design of Elevated service Reservoirs, IS Recommendations for wind & earthquake, Ductile detailing. as per IS 13920 :2015

**UNIT – III** **[10 Hrs.]**

IRC Recommendations, Analysis, Design & Detailing of bridges and Culverts.

**UNIT – IV** **[10 Hrs.]**

Analysis and design of, 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"

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|---|---|---|---|---|
| | | June 2018 | 1.00 | Applicable for Sem 1 & 2 AY2018-19 & Sem 3 & 4 AY 2019-20 Onwards |
| Chairperson | Dean (Acad. Matters) | Date of Release | Version | |

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**II SEMESTER**

| CV2916 | PE-I 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 OBJECTIVE | COURSE OUTCOMES |
|---|---|
| 1. Understand various civil engineering materials<br>2. Understand various methods of testing of materials<br>3. Understand and use various codes related to the civil engineering materials | 1. An ability to introduce different high quality materials for civil engineering applications.<br>2. An ability to use engineering materials for better and durable Civil Engineering Structures. |
| **Mapped program outcomes:** | |

**UNIT-I** **[09 Hrs.]**

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

**[10 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 22.

**Text books:**

1. Neville A. M., Properties of Concrete, Pearson Education Limited.
2. Rafat Siddequi , 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.

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**II SEMESTER**

| CV2917 | 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 |
|---|---|
| 1. To understand the basic concepts of Prestressed concrete.<br>2. To study various devices used for Prestressing.<br>3. To analyse and design the basic structural members in Prestressed concrete<br>4. To analyse and design the special structures like Prestressed Concrete Pipes, Liquid Storage Tanks and Ring Beams | 1. An ability to apply basic concepts of prestressed concrete in construction industry.<br>2. An ability to identify, formulate and solve engineering problems pertaining to prestressed concrete.<br>3. An ability to Understand IS codes related to prestressed concrete.<br>4. An ability to design special prestressed structures. |

**UNIT – I** **[06 Hrs.]**

Introduction to prestressed concrete, types of prestressing, systems and devices, materials, losses in prestress. Analysis of PSC flexural members: basic concepts, stresses at transfer and service loads

**[07 Hrs.]**

**UNIT – II**

IS1343 – 2012 codal provisions, Limit state of collapse and serviceability for analysis and design of rectangular, I and box sections for flexure and shear, control of deflection, Transmission of pre-stress in pre-tensioned members; Anchorage zone stresses for post-tensioned members.

**[07 Hrs.]**

**UNIT – III**

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

**[06 Hrs.]**

**UNIT – IV**

Composite construction with precast PSC beams and cast in-situ RC slab - Analysis and design, creep and shrinkage, deflection effects. Partial prestressing - principles, analysis and design concepts, crack-width calculations

**[07 Hrs.]**

**UNIT – V**

Analysis and design of prestressed concrete slabs – one way and two way
Analysis and design of prestressed concrete pipes, tanks

**[06 Hrs.]**

**UNIT – VI**

Intoduction to prestressed concrete flat slabs, grids, folded plates and shells, railway sleepers
(No numerical problems).

**Text Books:**

1. N. Krishnaraju, Prestressed Concrete, 3rd edition, Tata McGraw Hill Publishing Co., 2004
2. S.K. Mallick and A.P.Gupta, Prestressed concrete, Oxford and IBH Publishing Co., New Delhi.
3. Praveen Nagarajan, "Prestressed Concrete Design", PEARSON Publishing Co., Delhi, 2013
4. K.U.Muthu, Azmi Ibrahim, MagantiJanardhana, M. Vijayananad, " Prestressed Concrete", PHI Learning Pvt. Ltd., Delhi 2016

**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 – 2012, 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. DayaratnamP. ,Prestressed Concrete Structures, , 5th edition, Oxford & IBH, 1996

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**II SEMESTER**

| CV2918 | PE I: 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 OBJECTIVE | COURSE OUTCOMES |
|---|---|
| 1. To understand smart system<br>2. To understand characteristics and behavior of smart materials<br>3. To understand control system and its applications<br>4. To understand modeling of control system and its applications | 1. An ability to understand passive and active systems.<br>2. An ability to understand the characteristics and behavior of smart materials<br>3. An ability to understand control system and its applications<br>4. An ability to understand modeling of control system and its applications |

**UNIT – I**

Introduction to passive and active systems – need for active systems– smart systems – definitions and implications - active control and adaptive control systems – examples. **[10 Hrs.]**

**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 **[09 Hrs.]**

**UNIT – III**

Control Systems – features – active systems – adaptive systems – electronic, thermal and hydraulic type actuators – characteristics of control systems – application examples. **[10 Hrs.]**

**UNIT – IV**

Integration of sensors and control systems – modeling features – sensor-response integration– processing for proactive and reactive components – FE models – examples. **[10 Hrs.]**

**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

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**II SEMESTER**

| CV2919 | 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 |
|---|---|
| 1. To provide the students clear & thorough understanding of IS code related to reinforced concrete structures.<br>2. To provide the students clear & thorough understanding of reinforcement of essential parts of R. C. structures as per SP 34.<br>3. To provide the knowledge to understand the comparison of results between manual analysis & design and software analysis & design of simple member of R. C. structure. | 1. An ability to demonstrate basic knowledge of structural engineering to advanced concrete structure.<br>2. An ability to understand the various parameter considered in analysis & design of simple members R. C. structures<br>3. An ability to design advanced concrete structures<br>4. An ability to present analysis and design result in schematic way |

**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 Slabs (one way & two way) and slabs on grades. Preliminary sizing, modeling, designing & detailing of R. C. C. structures
3. Design of Bunker/ Design of Bridge (Any One)

**Reference Books:**

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

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**II SEMESTER**

| CV2920 | **SEMINAR** | **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** |
|---|---|
| 1. To provide the students the academic environment to carry out literature survey of advanced topics in structural engineering.<br>2. To provide the students the academic environment for effective communication skills, working independently and in a team and the importance of lifelong learning. | 1. An ability to understand the advances in structural engineering.<br>2. An ability to understand the importance of lifelong learning.<br>3. An ability to communicate effectively.<br>4. An ability to work independently and in a team. |

**Contents:**

1. Literature review on current topic related to the structural engineering.
2. Preparation and presentation of progress seminars on topic based on the reviewed literature.
3. Submission of hard copy of the paper to the Department.

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**III SEMESTER**

| CV2931 | 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 | | 4 hours |

| COURSE OBJECTIVE | COURSE OUTCOMES |
|---|---|
| 1. To understand basic principles of reliability based design on steel structures<br>2. To understand the effect of natural phenomenon (wind and earthquake), for structural engineering applications<br>3. To have an experience in the complete design of an industrial building<br>4. To learn design of storage vessel<br>5. To be able to learn method of analysis of truss bridge and design of its structural components<br>6. To be able to analyze multistoried frame structures by approximate methods and design of structural component of multistoried frame structures | 1. An ability to understand the configuration (component of structures civil\structural engineering drawing etc.)of structures<br>2. An ability to understand the effect of natural phenomenon (wind and earthquake), in structural engineering applications<br>3. An ability to analyze and design the industrial building by applying the provision of Indian Standard Code<br>4. An ability to analyze and design the storage vessel by applying the provision of Indian Standard Code<br>5. An ability to analyze and design the of truss bridge by applying the provision of Indian Standard Code<br>6. An ability to analyze and design the component of multistoried building frame bridge by applying the provision of Indian Standard Code |

**UNIT – I** **[10 Hrs.]**
Design of steel industrial buildings

**UNIT – II** **[09 Hrs.]**
Design of Steel Storage Vessels

**UNIT – III** **[10 Hrs.]**
Design of steel Bridges.

**UNIT – IV** **[10 Hrs.]**
Design of steel multistoried building

**Text Books:**

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, Mc Graw Hill publication, 2007
3. Dayaratnam P., Design of Steel Structures, Wheeler Publications, Allahabad, 1992

**Reference Book :**

1. Ram Chandra Design of Steel structures Vol-I & Vol-II Std. book house / Rajsons Publication Pvt. Ltd.,, Delhi, 2006
2. Gaylords, E.H. & Gaylords, C. N., Design of Steel Structures, Blackwell, 1994.
3. Ghosh, "Analysis and Design practice of Steel Structure", (Forthcoming), Phi Publisher, New Delhi

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**III SEMESTER**

| CV2932 | 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 OBJECTIVE | COURSE OUTCOMES |
|---|---|
| 1. To understand the basic concepts and fundamentals of steel design<br>2. To provide basic knowledge of steel structural design and apply its principles to design complex steel structures.<br>3. To study modeling, analysis and design aspects of steel structures using commercial software. | 1. An ability to understand the basic knowledge of structural steel structure<br>2. An ability to develop plane frame models for analyze and design of structure using software for different loading condition and present analysis and design result in schematic way.<br>3. An ability to develop space frame models for analyze and design of structure using software for different loading condition and present analysis and design result in schematic way.<br>4. An ability to develop space frame models of storage vessel structure for analyze and design using software and present analysis and design result in schematic way.<br>5. An ability to develop space frame models of truss type bridge structure for analyze and design using software and present analysis and design result in schematic way. |

**Any Four**
Analysis & Design of Plane frame for gravity load
Analysis & Design of Plane frame for gravity & horizontal forces.
Analysis & Design of multistoried building structure.
Analysis & Design of storage vessels
Analysis & Design of truss type bridge.

**Reference Book :**

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

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**III SEMESTER**

| CV2933 | PE II: 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 OBJECTIVE | COURSE OUTCOMES |
|---|---|
| 1. To understand earthquake load acting on a building and design the building for above loading by providing shear walls<br>2. To understand various aspects of high rise buildings such as the effect of torsion, soft storey effect, p- delta effect and drift index.<br>3. To understand detailing of RCC members for ductile behavior as IS Code provisions | 1. An ability to understand fundamental concept, principle and application of earthquake engineering.<br>2. An ability to analyze and design RCC structures with ductile detailing as per Indian standards.<br>3. An ability to apply technical design principles and techniques such as P-delta effect, soil structure interaction for a design of high rise structures.<br>4. An ability to apply various provisions for earthquake resistance design of structures as per Indian standards. |

**UNIT – I** **[10 Hrs.]**

Earthquake load Calculations along with dead load & live loads by Static analysis as per IS 1893-2016
Introduction to Frame – shear wall buildings, Mathematical modeling of buildings with different Structural systems. Analysis & Design of shear walled buildings with ductile detailing as per IS 13920-2016

**UNIT – II** **[10 Hrs.]**

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** **[10 Hrs.]**

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

**UNIT – IV** **[09 Hrs.]**

Introduction to Diaphragm. Seismic design of floor diaphragm.

**Text Books:**

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
3. S.K. Duggal , Earthquake – Resistant Design of Structures , Oxford university Press second edition 2013

**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
4. Farzad Naeim, Handbook on Seismic Analysis and Design of Structures, Kluwer Academic Publisher, 2001
5. Booth, E., Concrete Structures in Earthquake Regions, Longman Higher Education, 1994

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| | | June 2018 | 1.00 | Applicable for Sem 1 & 2 AY2018-19 & Sem 3 & 4 AY 2019-20 Onwards |
| Chairperson | Dean (Acad. Matters) | Date of Release | Version | |

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**III Semester**

| CV2934 | PE II: 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 OBJECTIVE | COURSE OUTCOMES |
|---|---|
| 1. To provide the student knowledge of basic concepts and characteristics of Composite materials<br>2. To provide the student the knowledge of behavior of lamina<br>3. To provide the student with knowledge of various failure theories<br>4. To provide students the knowledge of analysis of laminated plates under bending and vibration. | 1. An ability to understand basic concepts and characteristics of Composite materials.<br>2. An ability to understand elastic behavior of lamina.<br>3. An ability to understand various failure theories.<br>4. An ability to analyse laminated plates under Bending and vibration. |

**Unit I** **[Hrs.]**

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 macro-mechanics.

**Unit II** **[Hrs.]**

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** **[Hrs.]**

Macro-mechanical 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** **[Hrs.]**

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.

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**III SEMESTER**

| CV2935 | PE II: Bridge Engineering | L=3 | T=0 | P=0 | CREDITS = 3 |
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| EVALUATION SCHEME | | | | | |
|---|---|---|---|---|---|
| **MSE – I** | **MSE – II** | **TA** | **ESE** | **TOTAL** | **ESE DURATION** |
| 15 | 15 | 10 | 60 | 100 | 3 hours |

| COURSE OBJECTIVE | COURSE OUTCOMES |
|---|---|
| 1. To provide the students clear and through understanding of various types of bridges and loadings.<br>2. To provide the students the knowledge of design philosophy for bridges and design of its components.<br>3. To provide the concept of earthquake behavior and design philosophy for retaining wall and abutments.<br>4. To provide the students a thorough understanding of IRC codes related to bridges. | 1. An ability to identify the types of bridge to be used for various site and loading conditions.<br>2. An ability to analyze and design various types of bridges and its components.<br>3. An ability to draw RCC detailing and to prepare working drawing.<br>4. An ability to understand IRC codes related to bridges. |

**UNIT – I** **[10 Hrs.]**

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

**[09 Hrs.]**

**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.

**[10 Hrs.]**

**UNIT – III**

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

**[10 Hrs.]**

**UNIT – IV**

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

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**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

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| | | June 2018 | 1.00 | Applicable for Sem 1 & 2 AY2018-19 & Sem 3 & 4 AY 2019-20 Onwards |
| Chairperson | Dean (Acad. Matters) | Date of Release | Version | |

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**III SEMESTER**

| CV2936 | PE III: 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 OBJECTIVE | COURSE OUTCOMES |
|---|---|
| After completion of syllabus students will able to<br>1. Understand behavior of steel structural members beyond yield point, understand the theories of plastic analysis and will be able to design steel structures considering plastic design approaches | 1. An ability to understand behavior of steel structure elements beyond yield point loading and basic concepts of plastic analysis.<br>2. An ability to understand techniques for estimation of collapse loads on steel structures<br>3. To understand the effects of axial and shear forces on plastic moment of resistance<br>4. To understand philosophies of plastic design of steel structural elements |

**UNIT I:** **[07 Hrs.]**
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:** **[07 Hrs.]**
Upper and lower bound, uniqueness theorem, principle of virtual work, statical method, minimum and maximum theorems, step by step method.

**UNIT III:** **[06 Hrs.]**
Methods of release of restrains, load interaction diagrams, method of inequalities.

**UNIT IV:** **[06 Hrs.]**
Plastic Moment distribution applied to continuous beams & portal frames (Max. two bays single storey)

**UNIT V:** **[07 Hrs.]**
Effect of Axial force & Shear force on Plastic moment of resistance, Design of simply supported and continuous beams.

**UNIT VI:** **[06 Hrs.]**
Design of portal frames up to single storey – two bays. Minimum weight design.

**Text Book:**
1. Steel Skeleton, J. F. Baker, Volume II, Cambridge University Press 196
2. B.G. Neal – Plastic Method of Structural Analysis, Chapman & Hall

**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., Roorke
4. Ramchandra – Design of Steel Structures Vol – II, Standard Book House, Delhi
5. L.S. Beedle – Plastic Design of Steel Frames, John Willey & Sons
6. Structural design in steel by SalwarAlamRaz New Age International Publishers 15/44
7. 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
5. Teaching Resource for Structural Steel Design – INSDAG Kolkatta

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**III SEMESTER**

| CV2937 | **PE III: 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 OBJECTIVE** | **COURSE OUTCOMES** |
|---|---|
| 1. To provide the students clear and through understanding of the basic concepts of earthquake resistance design.<br>2. To provide the students clear and through understanding of analysis and design aspects of RCC and steel members subjected to earthquake loads.<br>3. To provide the students clear and through understanding of detailing of RCC and steel members for ductile behavior.<br>4. To provide the students clear and through understanding of various Indian codes related to earthquake engineering. | 1. An ability to apply basic concepts Earthquake resistant design in construction industry.<br>2. An ability to identify, formulate and solve engineering problems pertaining to earthquake effects on structures.<br>3. An ability to understand IS codes related to static as well as dynamic analysis of high rise buildings.<br>4. An ability to design special structures subjected to more effective earthquake forces. |

**RCC Structures**

**[07 Hrs.]**

**UNIT - I**

Review of IS 1893:2016 Part I , IS 13920:2015 Performance of RC buildings, behavior of RC buildings in past earthquakes, influence of unsymmetry, infill walls, foundations, soft story, confinement of concrete, and ductility.

**[06 Hrs.]**

**UNIT - II**

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

**[06 Hrs.]**

**UNIT - III**

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

**Steel Structures**

**[06 Hrs.]**

**UNIT - IV**

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

**[07 Hrs.]**

**UNIT - V**

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

**[07 Hrs.]**

**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. Farzad Naeim, Handbook on Seismic Analysis and Design of Structures, Kluwer Academic Publisher, 2001
3. Booth, E., Concrete Structures in Earthquake Regions, Longman Higher Education, 1994

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**III Semester**

| CV2938 | **PE III: 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 OBJECTIVE** | **COURSE OUTCOMES** |
|---|---|
| 1. To provide the students the knowledge of various aspects of industrial structures.<br>2. To provide the knowledge of analysis and design of large span structures.<br>3. To provide the knowledge of stability of silos and bunkers under dynamic loads.<br>4. To provide the knowledge of analysis and design of foundations for industrial structures | 1. An ability to understand planning of industrial structures.<br>2. An ability to analyse large span structures.<br>3. An ability to understand stability of silos and bunkers under dynamic loads.<br>4. An ability to analyse and design foundations for industrial structures. |

**UNIT-I:** **[10 Hrs.]**

**PLANNING OF INDUSTRIAL STRUCTURES :**

Classification of industries and local regulations - Factors affecting planning - General Aspects – Civil Engineering Aspects - Light and Ventilation

**[09 Hrs.]**

**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.

**[10 Hrs.]**

**UNIT-III**

**SILOS AND BUNKERS**

Concept of Angle of Repose - Pressure distribution - Dynamic loads - Stability of bunkers – Foundations.

**[10 Hrs.]**

**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 Foundation Tata McGraw Hill Publications, New Delhi. First Edition, 2000
2. Ramchandra Design of Steel Structures Standard Book House, New Delhi Seventh Edition, 2000
3. Raghupati M. Design of Steel Structures Tata McGraw Hill Publication, Delhi First Edition, 2003
4. Dayaratnam P. Design of Steel Structures Wheelr's Publishers, Allahabad1995
5. AnandArya&Ajmani J. L. Design of Steel Structures Nemchand& Bros., Roorkee, U.P., IndiaForth Edition, 2004
6. Lambert F.W. The Theory & Practical Design of Bunkers The British Constructional Steelwork Association Ltd., London, UK2000

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| | | June 2018 | 1.00 | Applicable for Sem 1 & 2 AY2018-19 & Sem 3 & 4 AY 2019-20 Onwards |
| Chairperson | Dean (Acad. Matters) | Date of Release | Version | |

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**III Semester**

| CV2939 | 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 OBJECTIVE | COURSE OUTCOMES |
|---|---|
| 1. To provide the students the academic environment to carry out literature survey of advanced topics in structural engineering<br>2. To motivate the students to use the modern tools and software.<br>3. 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. | 1. An ability to understand the advances in structural engineering.<br>2. An ability to understand the use of modern tools.<br>3. An ability to work independently and in a team for effective communication<br>4. An ability to understand the importance of lifelong learning. |

**Contents:**

1. Literature review on current topic related to the structural engineering.
2. Preparation and presentation of progress seminars on topic selected for dissertation.
3. Submission of project report including introduction, literature review, objective and scope of investigation and pilot studies carried out during the semester.

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**IV SEMSTER**

| CV2940 | 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 OBJECTIVE | COURSE OUTCOMES |
|---|---|
| 1. To provide the students the academic environment to carry out literature survey of advanced topics in structural engineering.<br>2. To provide the students the understanding of real world structural engineering problems and their solution.<br>3. To motivate the students to use the modern tools and software.<br>4. 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. | 1. An ability to understand the advances in structural engineering.<br>2. An ability to solve real world structural engineering problems.<br>3. An ability to understand the importance of lifelong learning and the use of modern tools.<br>4. An ability to work independently and in a team for effective communication. |

**Contents:**

1. The of detailed study of a work including collection and analysis of data, determining solution, design, scientific research on topic selected for dissertation.
2. Preparation and presentation of progress seminars on topic selected for dissertation.
3. Submission of project report on the entire studies carried out during the semester