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 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** | | | | | |

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| **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.<br>• Motivate students to learn more about, and to use numerical techniques in other courses and in future professional career<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 using computer techniques<br>• Expose students to elements and challenges involved in numerically implementing the underlying mathematical derivations<br>• 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.<br>• 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>• 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

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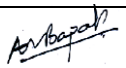
|---|---|---|---|---|
| Chairperson |  | Date of Release | May 2017 | Applicable for AY 2017-18 Onwards |
| Dean (Acad. Matters) |  | Version | 1.01 | |

**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.<br>• To provide the knowledge of differential equations, boundary conditions and compatibility conditions for 2D and 3D stress analysis.<br>• To provide the knowledge of bending of beams and torsion of non-circular sections.<br>• To analyze the beam column, beam on elastic foundation.<br>• 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.<br>• An ability to derive differential equations, boundary conditions and compatibility conditions for 2D and 3D stress analysis<br>• An ability to understand the effect of bending of beams and torsion of non-circular sections.<br>• An ability to analyze the beam column, beam on elastic foundation.<br>• 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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|---|---|---|---|---|
| Chairperson | | Date of Release | May 2017 | Applicable for AY 2017-18 Onwards |
| Dean (Acad. Matters) | | Version | 1.01 | |

**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.<br>• 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>• To provide the students understanding of modeling continuous vibratory systems – vibration of strings, axial and torsional vibration of bars and beams.<br>• 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.<br>• 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>• 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>• 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.<br>• To provide the students clear and thorough understanding of damping of systems and their relevance in displacements<br>• To demonstrate phenomenon of soil liquefaction and mode shapes in water medium<br>• 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.<br>• An ability to identify, formulate and solve engineering problems. This will be accomplished by understanding behavior of models during vibration.<br>• 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.<br>• 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<br>• To expand knowledge of the stiffness methods<br>• To analyze structural element (Beam, Frame, Truss, etc.,) by using Stiffness Method,<br>• To make the student familiar with latest computational techniques and software used for structural analysis<br>• To study the various approximate methods of structural analysis. | • An ability to understand the different types of structures.<br>• An ability to apply the matrix stiffness method to model the behavior of planar trusses, beams, and frames;<br>• An ability to analyze any multistoried building using approximate methods of structural analysis.<br>• 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 |
|---|---|---|---|---|
| Dean (Acad. Matters) | | Version | 1.01 | |

**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.<br>• To be able to analyze multistoried frame structures using approximate methods<br>• 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<br>• 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.<br>• An ability to analyze beam for various loading and boundary conditions using Stiffness Method.<br>• An ability to analyze truss for various loading and boundary conditions using Stiffness Method.<br>• 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.<br>• To provide the students' knowledge of different types of loading applied on foundation structures.<br>• To provide the students' knowledge of different methods used for the analysis of foundation structures.<br>• To provide the students' knowledge of different codal provisions applicable to advanced design of foundation structures.<br>• 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.<br>• An ability to analyze and design different types of foundation structures.<br>• An ability to draw RCC detailing and to prepare working drawing.<br>• 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.