



VEERMATA JIJABAI TECHNOLOGICAL INSTITUTE

**(VJTI)**

MATUNGA, MUMBAI 400 019

(Autonomous Institute affiliated to University of Mumbai)

Curriculum

(Scheme of Instruction & Evaluation and Course contents)

For

Second Year Syllabus

Bachelor of Technology (B.Tech.) Degree in Civil Engineering

**Implemented from the batch admitted in Academic Year 2024-25**

**[Working Professional syllabus]**

### Program Educational Objective

|      |  |
|------|--|
| PEO1 | Develop a professional to pursue career as a Civil Engineer with adequate technical knowledge and skills while using modern tools for problem solving and exhibiting qualities of communication, team membership, and leadership |
| PEO2 | Develop ability to practice ethically focusing on social relevance, environmental sustainability, optimal solutions and safety of stakeholders.  |
| PEO3 | Develop abilities of lifelong learning to continuously strive to enhance decision making abilities to investigate, design and develop complex facilities.  |

### Program Specific Outcomes

|      |  |
|------|--|
| PSO1 | Able to analyze various Civil Engineering structures and systems by using basic and advanced technologies.             |
| PSO2 | Able to design civil engineering facilities and their elements and also use of modern software tools for the same.     |
| PSO3 | Able to plan, monitor and supervise construction activities to complete civil engineering facilities satisfactorily.   |
| PSO4 | Able to practice as a construction professional through ethical practice while focusing on sustainability and economy. |

  
f Dean-Academics  
VJTI MUMBAI

### Program Outcomes


|       |  |
|-------|--|
| PO-1  | <b>Engineering knowledge:</b> Apply the knowledge of mathematics, science, engineering and technology to the solution of complex mechanical engineering Problems.  |
| PO-2  | <b>Problem analysis:</b> Identify, formulate, review existing literature, and analyze complex engineering problems to reach substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.                       |
| PO-3  | <b>Design/Development of solutions:</b> Design solutions for mechanical engineering problems and design system components or processes that meet the specified needs with appropriate consideration for societal, economical and environmental considerations. |
| PO-4  | <b>Conduct investigations of complex problems:</b> Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.                      |
| PO-5  | <b>Modern tool usage:</b> Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex mechanical engineering activities with an understanding of the limitations.            |
| PO-6  | <b>The engineer and society:</b> Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to professional engineering practice.                         |
| PO-7  | <b>Environment and sustainability:</b> Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.   |
| PO-8  | <b>Ethics:</b> Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.  |
| PO-9  | <b>Individual and team work:</b> Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.   |
| PO-10 | <b>Communication:</b> Communicate effectively with the engineering community and with society at large, including the ability to comprehend, create effective reports, make effective presentations, and give and receive clear instructions.                  |
| PO-11 | <b>Project management and finance:</b> Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.     |
| PO-12 | <b>Life-long learning:</b> Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.   |

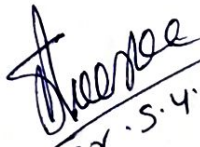
  
 f Dean-Academics  
 VJTI MUMBAI


**Credit Framework for UG Programme in Civil Engineering (Level 5.0- UG Diploma) -Semester - III**

| Sr.   | Course Code | Course Name  | L  | T | P | Hr | Cr | Examination Weightage in % |     |     |
|-------|-------------|--|----|---|---|----|----|----------------------------|-----|-----|
|       |             |  |    |   |   |    |    | TA                         | MST | ESE |
| 1     | WPMA2001T   | Mathematics for Civil Engineers                      | 3  | 0 | 0 | 3  | 3  | 20                         | 30  | 50  |
| 2     | WPCE2001T   | Fluid Mechanics                                      | 3  | 1 | 0 | 4  | 4  | 20                         | 30  | 50  |
| 3     | WPCE2002T   | Geomatics  | 3  | 0 | 0 | 3  | 3  | 20                         | 30  | 50  |
| 4     | WPCE2003T   | Construction Engineering and Infrastructure Projects | 3  | 0 | 0 | 3  | 3  | 20                         | 30  | 50  |
| 5     | WPSE2001T   | Mechanics of Solids                                  | 3  | 1 | 0 | 4  | 4  | 20                         | 30  | 50  |
| 6     | WPSE2001L   | Mechanics of Solids Laboratory                       | 0  | 0 | 2 | 2  | 1  | ISCE :60                   |     | 40  |
| 7     | WPCE2001L   | Fluid Mechanics Laboratory                           | 0  | 0 | 2 | 2  | 1  | ISCE :60                   |     | 40  |
| 8     | WPCE2002L   | Geomatics Laboratory                                 | 0  | 0 | 2 | 2  | 1  | ISCE :60                   |     | 40  |
| Total |             |  | 15 | 2 | 6 | 23 | 20 |                            |     |     |

Abbreviations: **T** Theory Course, **L** Laboratory Course, **I** Internship, **P** Project, **TA** Teacher Assessment / Term work Assessment, **MST** Mid Semester Test, **ESE** End Semester Written Examination, **ISCE** In-semester Continuous Evaluation, **PCC** Program Core, **MDM** Multi-Disciplinary Minor **VSEC** Vocational and Skill Enhancement Course, **OE** Open Elective, **VEC** Value Education Course

  
 f Dean-Academics  
 VJTI MUMBAI

  
 Dr. S. Y. Mahaske

  
 Dr. A. S. Wayal






**Credit Framework for UG Programme in Civil Engineering (Level 5.0- UG Diploma) -Semester - IV**

| Sr. | Course Code | Course Name                              | L  | T | P | Hr | Cr | Examination Weightage in % |     |     |
|-----|-------------|--|----|---|---|----|----|----------------------------|-----|-----|
|     |             |  |    |   |   |    |    | TA                         | MST | ESE |
| 1   | WPSE2002T   | Structural Analysis – I                  | 3  | 1 | 0 | 4  | 4  | 20                         | 30  | 50  |
| 2   | WPCE2004T   | Hydrology and Water Resource Engineering | 3  | 1 | 0 | 4  | 4  | 20                         | 30  | 50  |
| 3   | WPCE2005T   | Applied Hydraulics                       | 3  | 0 | 0 | 3  | 3  | 20                         | 30  | 50  |
| 4   | WPCE2006T   | Construction Techniques                  | 3  | 0 | 0 | 3  | 3  | 20                         | 30  | 50  |
| 5   | WPSE2003T   | Soil Mechanics                           | 3  | 0 | 0 | 3  | 3  | 20                         | 30  | 50  |
| 6   | WPSE2003L   | Soil Mechanics Laboratory                | 0  | 0 | 2 | 2  | 1  | ISCE :60                   |     | 40  |
| 7   | WPCE2005L   | Applied Hydraulics Laboratory            | 0  | 0 | 2 | 2  | 1  | ISCE :60                   |     | 40  |
| 8   | WPCE2007L   | Geospatial Technology Laboratory         | 0  | 0 | 2 | 2  | 1  | ISCE :60                   |     | 40  |
|     |             | Total                                    | 15 | 2 | 6 | 23 | 20 |                            |     |     |

Abbreviations: **T** Theory Course, **L** Laboratory Course, **I** Internship, **P** Project, **TA** Teacher Assessment / Term work Assessment, **MST** Mid Semester Test, **ESE** End Semester Written Examination, **ISCE** In-semester Continuous Evaluation, **PCC** Program Core, **MDM** Multi-Disciplinary Minor **VSEC** Vocational and Skill Enhancement Course, **OE** Open Elective, **VEC** Value Education Course

  
**f Dean-Academics**  
**VJTI MUMBAI**

  
**Dr. S. Y. Mahasree**

  
**Dr. A. S. Woyal**  


# **Semester III**

| Semester - III  |             | Program Core Course (PCC)       |                    |        |    |     |     |           |
|---|-------------|---------------------------------|--------------------|--------|----|-----|-----|-----------|
| SN  | Course Code | Course Title                    | L-T-P (Hours/Week) | Credit | TA | MST | ESE | ESE hours |
| 1   | WPMA2001T   | Mathematics for Civil Engineers | 3-0-0=3            | 3      | 20 | 30  | 50  | 3         |
| <p><b>Course Outcome:</b><br/>After completion of course students will be able to:</p> <ol style="list-style-type: none"> <li>1. Demonstrate knowledge of Matrix calculations as an elegant and powerful mathematical language in connection with Eigen value and Eigen vector, Diagonalization.</li> <li>2. Use numerical methods to find integration and differentiation o find an approximate solution of algebraic equations using appropriate method.</li> <li>3. Understand and apply the basic concepts of probability, random variables, probability distribution.</li> <li>4. Use statistical methodology and tools in the engineering problem solving process.</li> </ol> <p>Compute and interpret descriptive statistics using numerical and graphical techniques.</p> |             |                                 |                    |        |    |     |     |           |

| Modules | Course Contents   |
|---------|---|
| 1       | <p><b>Matrices:</b><br/>Eigen values Eigen vectors of square matrix, Cayley Hamilton's theorem and function of square matrix, Diagonalization of square matrix, Minimal Polynomial and Minimal Equation of a Matrix.</p>  |
| 2       | <p><b>Numerical Methods:</b></p> <p>a). <b>Roots of Algebraic and Transcendental Equations:</b> Bisection, false position, Secant and Newton-Raphson methods, Rate of convergence, Power method for computation of Eigen values</p> <p>b) <b>Solution of a System of Linear Equations:</b> Gauss elimination, partial pivoting, Gauss-Jacobi and Gauss Seidel methods</p> <p>c) <b>Finite Differences and Interpolation:</b> Finite Differences, Forward, Backward and Central operators, Interpolation by polynomials: Newton's forward, backward interpolation formulae, Gauss &amp; Stirling's central difference formulae, Newton's divided and Lagrange's formulae for unequal Intervals</p> <p>d) Numerical Integration: Newton-Cotes formula, Trapezoidal and Simpson's formulae, error formulae, Gaussian quadrature formulae</p> <p>e) Numerical solution of Ordinary Differential Equations: Taylor series method, Euler method, Runge-Kutta method of order four, Milne's Predictor-Corrector method</p> |
| 3       | <p><b>Probability:</b><br/>Reorientation: Definition of probability, Exhaustive events, Pair wise independent events,</p>   |

|   |  |
|---|--|
|   | Multiplicative law of probability, Conditional probability, Baye's theorem. Random variable, Mathematical Expectation, Standard Deviation, Binomial, Poisson and Normal distributions, Mean, Median, Mode  |
| 4 | <p><b>Statistics:</b></p> <p>Correlation between two variable, application of correlation, evaluation of coefficients of correlation, Rank correlation, Regression, frequency distribution, Binomial, Poisson's distribution and Normal distribution, application to industrial problem.</p>   |
|   | <p><b>Recommended Reading</b></p> <ol style="list-style-type: none"> <li>1. Erwin Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley &amp; Sons, 2006.</li> <li>2. Ramana B. V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.</li> <li>3. Wiley C. R., "Advanced Engineering Mathematics", McGraw Hill Inc., New York Ed.1993.</li> <li>4. O'Neel Peter., "Advanced Engg. Mathematics", Thompson, Singapore, Ind. Ed. 2002.</li> <li>5. Greenbar Michael D., "Advanced Engg. Mathematics", Pearson, Singapore, Ind. Ed. a. 2007.</li> <li>6. Marsden J. E., Tromba A., Weinstein A., "Basic multivariable calculus", Springer, 1993. (ISBN 354097976X)</li> <li>7. A. R. Vasishtha, A. K. Vasishtha, "Matrices", Krishna Prakashan Media, 1991. (ISBN 8182837294)</li> <li>8. Froberg C.E., "Introduction to Numerical Analysis (2nd Edition), Addison Wesley, 1981.</li> <li>9. Johnson Richard A., Miller and Freund's, "Probability and Statistics (8th Edition)", PHI. (ISBN 0130417734)</li> <li>10. Gupta S.C. and Kapoor V. K., "Fundamentals of Mathematical Statistics (11<sup>th</sup> Edition)", Sultan Chand &amp; Sons. (ISBN 180545288)</li> <li>11. T. J. Akai, Applied Numerical Methods for Engineers, John Wiley &amp; Sons, Singapore, 1994. (ISBN-0471575232/978-0471575238).</li> </ol> |

| Semester - III |             | Program Core Course (PCC)  |                    |        |    |     |     |           |
|----------------|-------------|--|--------------------|--------|----|-----|-----|-----------|
| SN             | Course Code | Course Title   | L-T-P (Hours/Week) | Credit | TA | MST | ESE | ESE hours |
| 2              | WPSE2001T   | Mechanics of Solids  | 3-1-0 = 4          | 4      | 20 | 30  | 50  | 3         |
|                |             | <b>Course Outcome:</b> <ol style="list-style-type: none"> <li>1. Evaluate stress-strain behaviour and other physical properties of materials.</li> <li>2. Determine the internal forces in any type of structural elements and their graphical representation.</li> <li>3. Analyze structural elements subjected to various forces using fundamental concepts of elastic stress-strain behaviour of materials.</li> <li>4. Apply the concept of principal stresses and strains for analysis of structural elements.</li> </ol> |                    |        |    |     |     |           |

| Module | Course Contents   |
|--------|---|
| 1      | <b>Simple stress and strain:</b><br>Definitions of stress, strain, modulus of elasticity, modulus of rigidity, bulk modulus, yield stress, ultimate stress, factor of safety, and shear stress. Poisson ratio, bars of varying sections, stresses due to self-weight. Composite sections, temperature stresses, strain energy, and resilience.  |
| 2      | <b>Shear force and bending moment:</b><br>Axial force, shear force and bending moment diagram for statically determinate beams and frames.  |
| 3      | <b>Theory of pure bending and shear stresses in beams:</b><br>Flexure formula for straight beams, moment of inertia, product of inertia, and polar moment of inertia of plane areas, principal axes of inertia, moments of inertia about principal axes, transfer theorem, and flitched beams.<br>Distribution of shear stress across plane sections and shear connectors. Shear center of thin-walled sections such as angle, tee, channel, and I section. |
| 4      | <b>Simple theory of torsion</b><br>Torsion of circular solid and hollow shafts, stepped shaft, stresses in the shaft when transmitting power, close-coiled helical springs under axial load.  |
| 5      | <b>Bending moment combined with axial loads</b><br>Application to members subjected to eccentric loads, the core of a section, problems on chimneys, retaining walls, etc., involving lateral loads.  |
| 6      | <b>Thin cylinder and spherical shell</b><br>Stresses and strains in thin cylindrical and spherical shells under internal pressure.  |

|   |  |
|---|--|
| 7 | <p><b>Principal stresses and strains</b><br/> General equations for the transformation of stress, principal planes, and principal stresses, maximum shear stress, determination using Mohr's circle, principal stresses in beams, and theories of failure-</p>   |
| 8 | <p><b>Trusses and compression member</b><br/> Analysis of determinate trusses (method of joint and method of section)<br/> Struts subjected to axial loads, the concept of buckling. Euler's buckling theory of struts with different boundary conditions. Rankine's buckling theory for columns.</p>  |
|   | <p><b>Text Books:</b></p> <ol style="list-style-type: none"> <li>1. S.B. Junnarkar, Mechanics of Structures Vol I, Charotar Publication house, 32th Edition, 2016, (ISBN-9385039024/978-9385039027).</li> <li>2. E.P. Popov, Mechanics of Materials, Prentice Hall of India Pvt. Ltd.,2nd edition, 1976. (ISBN- 0135713560/978-0135713563).</li> <li>3. 3. F.L. Singer and Pytel, Strength of Materials, Harper Collins Publishers, 2002.</li> <li>4. S. Timoshenko, Strength of Materials: Part-I (Elementary Theory and Problems), CBS Publishers, New Delhi.</li> <li>5. S.S. Bhavikatti, Strength of Material, Vikas Publishing House Pvt. Ltd,3rd edition, 2013. (ISBN: 9789325971578/9325971577).</li> </ol>   |
|   | <p><b>Recommended Reading:</b></p> <ol style="list-style-type: none"> <li>1. S. Timoshenko and Young, Engineering Mechanics, Tata McGraw Hill,2013. (ISBN: 9781259062667/125906266X).</li> <li>2. W. A. Nash Strength of Material, Schaum's Outline Series, McGraw Hill, 4th edition, 1998. (ISBN- 9780071830805/978-0071830805).</li> <li>3. S. Timoshenko and Gere, Mechanics of Materials, PWS Publication Co. Ltd.,3rd edition, 1997. (ISBN-0534921744/9780534921743).</li> <li>4. J. M. Gere, Mechanics of Materials, Brooks/Cole. Publishing Co.,6th edition, 2008. (ISBN- 1111577730/9781111577735).</li> <li>5. G.H. Ryder, Strength of Materials, Prentice Hall Publications, 3rd edition,2002. (ISBN:9780333935361/0333935365).</li> <li>6. S.H. Crandall, N.C. Dahl and T.J.Lardner, An introduction to the Mechanics of Solids, Tata McGraw Hill, Third Edition, 2017</li> </ol> |

| Semester - III   |             | Program Core Course (PCC)      |                    |        |    |         |     |           |
|--|-------------|--------------------------------|--------------------|--------|----|---------|-----|-----------|
| SN   | Course Code | Course Title                   | L-T-P (Hours/Week) | Credit | TA | MST     | ESE | ESE hours |
| 3  | WPSE2001L   | Mechanics of Solids Laboratory | 0-0-2 = 2          | 1      |    | ISCE:60 | 40  | 3         |
| <p><b>Course Outcome:</b><br/>           After completion of this course, students will be able to,</p> <ol style="list-style-type: none"> <li>1. Identify the standard codes and specifications which should be used for physical testing of different materials.</li> <li>2. Evaluate the strength of a material under bending, shear and torsion loads</li> <li>3. Evaluate hardness and impact properties of materials.</li> <li>4. Evaluate stress strain behavior of different materials.</li> </ol> |             |                                |                    |        |    |         |     |           |

| <b>Course Contents</b> |  |
|------------------------|--|
|                        | <p><b>List of Experiments:</b></p> <ol style="list-style-type: none"> <li>1. Tension test on mild steel bar</li> <li>2. Elastic modulus of concrete</li> <li>3. Tension test on tor steel bar</li> <li>4. Shear test on mild steel bar</li> <li>5. Tension test on steel plates</li> <li>6. Flexural test on steel plates</li> <li>7. Bend and re-bend test on mild and tor steel</li> <li>8. Torsion test on mild and tor steel.</li> <li>9. Brinell's Hardness tests on metal specimen</li> <li>10. Impact test on metal</li> <li>11. Compression test on wood</li> <li>12. Tensile test on wood specimen</li> <li>13. Flexural test on wood</li> </ol> <p><b>Text Books:</b></p> <ol style="list-style-type: none"> <li>1. S.B. Junnarkar, Mechanics of Structures Vol I, Charotar Publication house, 32th Edition, 2016, (ISBN-9385039024/978-9385039027).</li> <li>2. E.P. Popov, Mechanics of Materials, Prentice Hall of India Pvt. Ltd., 2nd edition, 1976. (ISBN-0135713560/978-0135713563).</li> <li>3. S.S. Bhavikatti, Strength of Material, Vikas Publishing House Pvt. Ltd., 3rd edition, 2013. (ISBN: 9789325971578/9325971577).</li> </ol> |

| Semester - III |             | Program Core Course (PCC)  |                    |        |    |     |     |           |
|----------------|-------------|--|--------------------|--------|----|-----|-----|-----------|
| SN             | Course Code | Course Title   | L-T-P (Hours/Week) | Credit | TA | MST | ESE | ESE hours |
| 4              | WPCE2001T   | Fluid Mechanics  | 3-1-0=4            | 4      | 20 | 30  | 50  | 3         |
|                |             | <p><b>Course Outcome:</b></p> <ol style="list-style-type: none"> <li>1. Use the various units of measure and basic fluid mechanics concepts to analyse incompressible fluids at rest or in motion.</li> <li>2. Analyse and solve problems involving hydrostatic pressure and buoyancy forces.</li> <li>3. Apply mass balance and momentum equations to analyze, model and solve problems involving water motion in open channels</li> <li>4. Solve problems in fluid flow system.</li> </ol> |                    |        |    |     |     |           |

| Module | Course Contents   |
|--------|---|
| 1      | <p><b>Properties of Fluid:</b><br/>           Properties of Fluid Mass density, specific weight, specific gravity, specific volume, vapour pressure, compressibility, elasticity, surface tension, capillarity; Newton's law of viscosity, classification of fluids, dynamic viscosity and kinematics viscosity, variation of viscosity with temperature; Basic concept applicable to fluid mechanics.</p>  |
| 2      | <p><b>Fluid Statics:</b><br/>           Measurement of Pressure. Pressure variation in a static fluid, Pascal's law, units and scales of pressure measurement – Atmospheric Pressure, Absolute Pressure, Gauge Pressure and Vacuum Pressure, Hydrostatic Paradox. Piezometer, U-Tube Manometer, Single Column Manometer, U-Tube Differential Manometer, Inverted U-Tube Differential Manometer, Micromanometers. Mechanical Pressure Gauges; Hydrostatic force on plane and curved surface: Total Pressure and Center of Pressure, Pressure Diagram, Total Pressure on Plane Surfaces and Depth of Center of Pressure, Total Pressure on Curved Surfaces, Practical applications of Total Pressure and Center of Pressure; Buoyancy and Flotation: Buoyant force, Buoyancy and Center of Buoyancy, Archimedes Principle, Principle of Flotation Metacentre and Metacentric Height, Equilibrium of Floating bodies and Submerged bodies Evaluation of Metacentric Height – Theoretical Method and Experimental Method Oscillation of Floating Body; Fluids in Relative Equilibrium: Static fluid subjected to uniform linear acceleration Liquid containers subjected to constant horizontal acceleration and constant vertical acceleration, Liquid containers subjected to constant rotation</p> |

|   |  |
|---|--|
| 3 | <p><b>Fluid Kinematics:</b><br/> Fluid flow Methods of analysis of fluid motion, Streamlines, Pathlines, Streaklines and Streamtubes. Types of fluid flow Steady and unsteady flow, Uniform and non-uniform flow, Laminar, Transitional and Turbulent flow Reynolds number, Reynolds Experiment, Rotational and Irrotational flow, Subcritical, Critical and Supercritical flow, Compressible and Incompressible Flow, One, Two and Three-dimensional Circulation and vorticity, Velocity potential and Stream function, Flow net</p>  |
| 4 | <p><b>Fluid Dynamics</b><br/> Euler's equation, Bernoulli's equation, Energy correction factor</p>   |
| 5 | <p><b>Flow Measuring Devices:</b><br/> Measurement of discharge: Venturi meter, Orifice meter, Nozzle meter, Bend meter, Rotameter. Measurement of velocity-Pitot tube. Orifice - Classification, Flow through a Reservoir Opening i.e. Orifice, Trajectory of free –jet, Hydraulic Coefficients, Experimental determination of hydraulic coefficient, small and large orifice, Time of emptying a tank with orifice Mouthpieces-Classification, External cylindrical mouthpiece, Convergent – divergent mouthpiece, Borda's mouthpiece. Notches and Weirs - Discharge over a rectangular notch and a triangular notch, Velocity of approach, End contractions, Cippoletti Notch, Discharge over a stepped notch, Time of emptying a tank with notch or weir, Ventilation of weir, Proportional Weir or Sutro Weir</p> |
| 6 | <p><b>Flow Past immersed bodies:</b><br/> Drag and lift, Types of drag, drag on a sphere, cylinder, flat plate and Airfoil, Karman Vortex Street, effect of free surface and compressibility on drag. Development of lift on immersed bodies, Lift, Magnus Effect and Circulation, lift characteristics of airfoils, polar diagram.</p>  |
| 7 | <p><b>Compressible flow and Ideal fluid flow:</b><br/> Compressible flow, Mach number, Mach cone, Uniform flow, source and sink, doublet, free vortex.</p>   |
|   | <p><b>Text Books:</b></p> <ol style="list-style-type: none"> <li>1. K L Kumar, Engineering Fluid Mechanics S Chand &amp;Company Ltd 8th Edition, (ISBN – 9788121901000)</li> </ol> <p><b>Recommended Reading:</b></p> <ol style="list-style-type: none"> <li>1. Dr. P M Modi and Dr S M Seth, Hydraulics and Fluid Mechanics, Standard Book House (ISBN-8189401262)</li> <li>2. K Subramanya, Theory and Applications of Fluid Mechanics, Tata McGraw Hill Publishing co. Ltd. (ISBN - 0074603698)</li> <li>3. A. K. Jain, Fluid Mechanics, 4th edition, Khanna Publishers (ISBN - 8174091947)</li> </ol>  |

| Semester - III |             | Program Core Course (PCC)  |                    |        |    |         |     |           |
|----------------|-------------|--|--------------------|--------|----|---------|-----|-----------|
| SN             | Course Code | Course Title   | L-T-P (Hours/Week) | Credit | TA | MST     | ESE | ESE hours |
| 5              | WPCE2001L   | Fluid Mechanics Laboratory   | 0-0-2 = 2          | 1      |    | ISCE:60 | 40  | 3         |
|                |             | <b>Course Outcome:</b> <ol style="list-style-type: none"> <li>1. Calculate the force exerted by fluid on object boundary.</li> <li>2. Measure the rate of flow in open channel and pipe system.</li> <li>3. Select proper discharge measurement techniques.</li> </ol> |                    |        |    |         |     |           |

| Course Contents |  |
|-----------------|--|
|                 | <p><b>List of Experiments:</b></p> <ol style="list-style-type: none"> <li>1. Verification of Hydrostatics law</li> <li>2. Study of Pressure Measuring Devices</li> <li>3. Determination of metacentric height</li> <li>4. Determination of hydrostatics Force on surface</li> <li>5. Verification of Bernoulli's Theorem</li> <li>6. Determination of coefficient of discharge of flow meter</li> <li>7. Determination of hydraulic coefficient of orifice</li> <li>8. Determination of coefficient of discharge of notch/weir</li> <li>9. Flow Visualisation -Ideal Flow</li> <li>10. Study of wind tunnel and determination of force acting on object</li> </ol> |
|                 | <p><b>Text Books:</b></p> <ol style="list-style-type: none"> <li>1) K L Kumar, Engineering Fluid Mechanics S Chand &amp; Company Ltd 8<sup>th</sup> Edition, (ISBN – 9788121901000)</li> <li>2) Dr. P M Modi and Dr S M Seth, Hydraulics and Fluid Mechanics, Standard Book House (ISBN -8189401262)</li> <li>3) K Subramanya, Theory and Applications of Fluid Mechanics, Tata McGraw Hill Publishing co. Ltd. (ISBN – 0074603698)</li> <li>4) K Subramanya, Open channel Flow, Tata McGraw Hill Publishing Co. Ltd. (ISBN – 9789332901339)</li> </ol>  |

| Semester - III |             | Program Core Course (PCC)  |                    |        |    |     |     |           |
|----------------|-------------|--|--------------------|--------|----|-----|-----|-----------|
| SN             | Course Code | Course Title   | L-T-P (Hours/Week) | Credit | TA | MST | ESE | ESE hours |
| 6              | WPCE2002T   | Geomatics  | 3-0-0 = 3          | 3      | 20 | 30  | 50  | 3         |
|                |             | <b>Course Outcome:</b> <ol style="list-style-type: none"> <li>Describe the principles of surveying and field procedures to conduct the Land survey.</li> <li>Develop skills for collection of field data using traditional surveying equipments such as Levels, Compass, plane table and theodolite.</li> <li>Prepare topographic map including contours of any site.</li> <li>Record the field data and analyze the same.</li> <li>Calculate the area of land parcel, volume of earthwork and to do the setting out works.</li> </ol> |                    |        |    |     |     |           |

| Module | Course Contents   |
|--------|---|
| 1      | <b>Introduction:</b><br>Various types of surveying- based on methods and instruments, classifications, uses and necessity of geodetic surveying, photographic, astronomy and hydrographic surveying; Diagonal scale, various types of venires, micrometers on surveying instruments, principles of surveying; Chain surveying, instruments required for linear measurement, minor instruments for setting out right angle   |
| 2      | <b>Leveling and contouring:</b><br>Definitions, technical terms, different types of levels such as dumpy, quickset, precise, auto level; Temporary and permanent adjustments of dumpy and auto level; Different methods of leveling, reduction of levels, problems; Difficulties in leveling work, corrections and precautions to be taken in leveling work; Contour – definitions, contour interval, equivalent, uses and characteristics of contour lines, direct and indirect methods of contouring Running a level line, L section, cross section, methods of interpolation; Grade contour- definition, use, setting out in field; Computation of volume by trapezoidal and prismoidal formula, volume from spot levels, volume from contour plan |
| 3      | <b>Plane Table Surveying:</b><br>Definitions, uses and advantages, temporary adjustments, Different methods of plane table surveying, Two-point problem Errors in plane table survey, use of telescopic alidade   |

|   |   |
|---|---|
| 4 | <p><b>Traverse Surveying:</b><br/>Compass: Bearings - different types, compass – prismatic, surveyor, whole circle, reduced bearings, Local Attraction; Theodolite:- Various parts and axis of transit, technical terms, temporary and permanent adjustments of a transit, horizontal and vertical angles, methods of repetition and reiteration; Different methods of running a theodolite traverse, Gales’ traverse table, balancing of traverse by Bow-Ditch’s transit and modified transit rules; Problems on one-plane and two-plane methods, omitted measurements, precautions in using theodolite, errors in theodolite survey, Use of theodolite for various works such as prolongation of a straight line, setting out an angle</p>                |
| 5 | <p><b>Setting out Works:</b><br/>General horizontal and vertical control, setting out of foundation plan for load bearing and framed structure, batter board, slope and grade stakes, setting out with theodolite; Setting out of sewer line, culvert, use of laser for works; Setting out center line for tunnel, transfer of levels to underground work; Project / route survey for bridge, dam and canal; Checking verticality of high rise structures</p>   |
| 6 | <p><b>Areas:</b><br/>Area of an irregular figure by Trapezoidal rule, average ordinate rule, Simpson’s 1/3 rule, various coordinate methods; Planimeter: types of planimeter including digital planimeter, area of zero circle, use of planimeter</p>   |
| 7 | <p><b>Maps</b><br/>Importance of maps to engineering projects, Types of maps, Scales and uses, Plotting accuracy, Map sheet numbering, Coordinate systems- Cartesian and geographical, map projections, map datum – MSL, Geoid, spheroid,<br/><b>Aerial Photogrammetry</b><br/>Types of photographs, Flying height and scale, Relief (height), displacement, Stereoscopy, 3-D Model, Height determination using Parallax Bar, Digital Elevation. Model (DEM), Slope.</p>  |
|   | <p><b>Text Books:</b></p> <ol style="list-style-type: none"> <li>1. N.N.Basak, Surveying and Leveling, Tata McGraw Hill Publications, 2nd Edition. (ISBN - 9789332901537)</li> <li>2. B C Punmiya, Surveying and Leveling, Vol I-16<sup>th</sup> edition &amp; Vol II- 4th edition, Laxmi Publications. (ISBN - 9788170088530)</li> <li>3. R Agor, Surveying, Khanna Publishers- 11th edition. (ISBN - 8174092358)</li> </ol> <p><b>Recommended Reading:</b></p> <ol style="list-style-type: none"> <li>1. Kanetkar and Kulkarni, Surveying and Leveling, Vol I &amp; II, Pune Vidyarthi Griha, Pune, 24<sup>th</sup> edition.( ISBN- 8185825114)</li> <li>2. R Agor, Surveying, Khanna Publishers- 11<sup>th</sup> edition. (ISBN - 8174092358)</li> </ol> |

| Semester - III |             | Program Core Course (PCC)  |                    |        |    |         |     |           |
|----------------|-------------|--|--------------------|--------|----|---------|-----|-----------|
| SN             | Course Code | Course Title   | L-T-P (Hours/Week) | Credit | TA | MST     | ESE | ESE hours |
| 7              | WPCE2002L   | Geomatics Laboratory   | 0-0-2 = 2          | 1      |    | ISCE:60 | 40  | 3         |
|                |             | <b>Course Outcome:</b> <ol style="list-style-type: none"> <li>1. Demonstrate the use of minor and major surveying equipments.</li> <li>2. Use equipments/instruments for conducting chain and compass traversing, levelling, theodolite traversing, Plane table survey and setting out curves and civil works.</li> <li>3. Record observations in field book and prepare the various types of maps.</li> </ol> |                    |        |    |         |     |           |

| Course Contents |  |
|-----------------|--|
|                 | <p><b>Concepts:</b></p> <ol style="list-style-type: none"> <li>1. Linear and angular measurements</li> <li>2. Traditional surveying and mapping techniques</li> <li>3. Contour maps, irregular area calculations and volumes of earthworks</li> <li>4. Fieldwork record keeping and drawing sheet preparation</li> <li>5. Land record documentation, height of buildings / Towers etc.</li> </ol> <p><b>Practicals:</b></p> <ol style="list-style-type: none"> <li>1. Use of Amslar polar planimeter for finding the area of irregular figures and certifying it by using Digital Planimeter</li> <li>2. Use of optical theodolite / Electronic theodolite for measurement of horizontal and vertical angles</li> <li>3. Theodolite traverse, Gale's traverse table</li> <li>4. A two day project on theodolite traversing and plane table detailing,</li> <li>5. Use of optical theodolite / Electronic theodolite for one plane and two plane methods</li> <li>6. Simple and compound leveling by using Dumpy / Auto Level, booking methods</li> <li>7. Methods of plane tabling: - Radiation. Intersection and Traversing</li> <li>8. Setting out a simple foundation plan in the field</li> <li>9. Introduction to LiDAR/ LADAR</li> </ol> |

**Text Books:**

1. N. N. Basak, Surveying and Leveling, Tata McGraw Hill Publications, 2nd Edition. (ISBN - 9789332901537)
2. B C Punmiya, Surveying and Leveling, Vol I-16<sup>th</sup> edition & Vol II- 4th edition, Laxmi Publications. (ISBN - 9788170088530)
3. R Agor, Surveying, Khanna Publishers- 11th edition. (ISBN - 8174092358)
4. P. Dong & Q. Chen, Lidar Remote Sensing and Applications, CRC press 2017, (ISBN - 9781138747241)

| Semester - III  |             | Program Core Course (PCC)                            |                    |        |    |     |     |           |
|---|-------------|--|--------------------|--------|----|-----|-----|-----------|
| SN  | Course Code | Course Title   | L-T-P (Hours/Week) | Credit | TA | MST | ESE | ESE hours |
| 8   | WPCE2003T   | Construction Engineering and Infrastructure projects | 3-0-0=3            | 3      | 20 | 30  | 50  | 3         |
| <p><b>Course Outcome:</b><br/>After completion of course students will be able to:</p> <ol style="list-style-type: none"> <li>1. Identify factors to be considered in implementation of different Civil engineering projects</li> <li>2. Describe the procedures and techniques of construction of infrastructures projects.</li> <li>3. Draw layout and components of various Civil Engineering projects.</li> </ol> |             |  |                    |        |    |     |     |           |

| Modules | Course Contents:  |
|---------|---|
| 1.      | <p><b>Types of structures:</b><br/>Framed structure &amp; Load bearing structure. Components of a Building, Types of Loads and load combination</p>   |
| 2.      | <p><b>Excavation and foundations:</b><br/>Excavation in different types of soils and rocks., Shoring and strutting, Scaffolding, Shuttering Formwork, underpinning dewatering, types of foundation.</p>   |
| 3.      | <p><b>Masonry Construction:</b><br/>Masonry: Definitions of terms used in masonry, Materials used. Stone masonry, Brick masonry, Different bonds used for brick masonry and stone masonry, Composite masonry. Concrete blocks and light weight block, Reinforced masonry, Paver Block-Sizes</p> |
| 4.      | <p><b>Doors &amp; windows:</b><br/>Location of roofs and windows, Aluminium windows, types of plywood Wood joinery Definition of technical terms, Size of doors and windows, Door frames, Types of doors and windows, Ventilators, Fixtures and fastenings.</p>                                 |
| 5.      | <p><b>Floor and Roofs:</b><br/>Components of a floor, materials used for floor construction, Different types of Flooring, Ground floor and upper floors, Types of roofs, Basic roofing elements and Roof coverings. Tile adhesives</p>  |
| 6.      | <p><b>Vertical Transportation: Stairs and Lift:</b><br/>Materials for lifts, Definition of technical terms, Location of Stairs and Lift, Types of Stairs, Design.</p>   |
| 7.      | <p><b>Arches and Lintels:</b><br/>Definition of technical terms, Classification of Arches and Lintels, Types of</p>   |

|     |  |
|-----|--|
|     | Arches and Lintels.  |
| 8.  | <p><b>Damp proofing &amp; Fire proofing:</b><br/>Causes and effect of dampness on buildings, Materials and methods used for damp proofing, Fire hazards, Grading of buildings according to fire resistance, Fire resisting properties of common building materials, Fire resistant construction, General methods of thermal insulation and thermal insulating materials.</p>   |
| 9.  | <p><b>Pointing and Plastering:</b><br/>Terminology used in Pointing and Plastering Work, Types of Mortars for Pointing and Plastering, Methods of Pointing and Plastering, Defects in Pointing and Plastering Works.</p>   |
| 10. | <p><b>Infrastructure projects:</b><br/>Introduction, need, purpose, function, classification, various terminologies of various infrastructure projects like railways, airport, harbour, ports and docks, bridge, sewage disposal system, water treatment plant, dams and reservoir, canals and tunnel.</p>   |
|     | <p><b>Text Books:</b></p> <ol style="list-style-type: none"> <li>1. Dr. B.C. Punmia, Building construction Laxmi publications, 10th edition 2016,( ISBN 9788131804285)</li> <li>2. S. P. Bindra, S. P. Arora, Building Construction, DhanpatRai Publication, New delhi, Fourth Edition, 2010 (ISBN - 1234567144035)</li> <li>3. R. Srinivasan, Harbour dock and tunnelling, Charotar publishing house private limited. (ISBN - 9385039199)</li> <li>4. Saxena S.C. And Arora S. P., A Text Book of Railway Engineering, Dhanpat Rai Publications, New Delhi, 2010. (ISBN-9788189928834)</li> <li>5. Khanna and Arora, Airport planning &amp; design, Nemchand Bros,Roorkee (ISBN-9788185240688)</li> <li>6. S. P. Bindra, Docks and Harbour Engineering, Dhanpat Rai and Sons, 2012. (ISBN-9788189928858)</li> <li>7. S K Garg, Water Resources Engineering Vol. II Irrigation Engineering &amp; Hydraulic Structures, Khanna Publishers (2017), (ISBN: 8174090479)</li> <li>8. S. K. Garg, Sewage Disposal and Air Pollution Engineering, Khanna Publishers, Delhi, Thirty seventh edition, 2017. (ISBN: 9788174092304)</li> <li>9. S. K. Garg, Water Supply Engineering, Khanna Publishers, Delhi, 28th edition, 2010. (ISBN: 9788174091208/8174091203)</li> </ol> |

**Recommended Reading:**

1. B. C. Punmia, Irrigation and water power engineering, Laxmi publications ltd. Sixteenth edition. (ISBN – 9788131807637)
2. Construction planning, equipments, and methods-Tata mcgraw- hill edition, sixth edition.
3. Roy Chudley, Roger Greeno, Building Construction Handbook, Butterworth- Heinemann, Tenth Edition, 2006 (ISBN - 113890709X)

# **Semester IV**

| Semester - IV  |             | Program Core Course   |                       |        |    |     |     |              |
|--|-------------|-----------------------|-----------------------|--------|----|-----|-----|--------------|
| SN   | Course Code | Course Title          | L-T-P<br>(Hours/Week) | Credit | TA | MST | ESE | ESE<br>hours |
| 1  | WPSE2002T   | Structural Analysis-I | 3-1-0=4               | 4      | 20 | 30  | 50  | 3            |
| <p><b>Course Outcome:</b><br/>After completion of this course, students will be able to,</p> <ol style="list-style-type: none"> <li>1. Determine deflection of statically determinate structures under various loading and support Conditions.</li> <li>2. Apply basic concepts of structural mechanics for the analysis of statically determinate structures.</li> <li>3. Apply concepts of structural mechanics for the analysis of statically determinate arches and Stiffened suspension bridges.</li> <li>4. Apply concept of Influence Line Diagram to statically determinate structures.</li> </ol> |             |                       |                       |        |    |     |     |              |

| Module | Course Content:  |
|--------|--|
| 1      | <p><b>General theorems</b><br/>Theorems relating to elastic structures, principle of virtual work, strain energy in elastic structures, complementary energy, Castigliano's theorems, and Maxwell-Betti's reciprocal theorem.</p> <p>Classification of structural forms such as plane frame, space frames, plane and space trusses, arches, cables and surface structures, stability of structures, static and kinematic indeterminacy of structures, behavior of symmetric structures subjected to symmetric and anti-symmetric loads, the distinction between linear and nonlinear material, and geometric behavior of structures.</p> |
| 2      | <p><b>Elastic arches</b><br/>Normal thrust, shear force and bending moment for parabolic and segmental three hinged arches. Influence lines for normal thrust, shear force and bending moment for three hinged parabolic arches.</p>   |
| 3      | <p><b>Influence lines for statically determinate structures</b><br/>Influence lines for cantilever beam, simply supported beam, overhanging beam. Criteria for maximum shear force, bending moment and absolute maximum bending moment under moving loads for simply supported beams.</p>  |
| 4      | <p><b>Deflection of statically determinate structures</b><br/>Deflection of determinate beams by double integration (Macaulay's) method, moment area and conjugate beam methods, principle of virtual work (unit load method) and Castigliano</p>  |

|   |   |
|---|---|
|   | theorems, Deflection of determinate pin jointed trusses and rigid jointed frames by principle of virtual work (unit load method), Strain Energy and Castigliano's theorems.   |
| 5 | <p><b>Analysis of indeterminate structures by flexibility method</b></p> <p>Flexibility coefficients and their use in the formulation of compatibility equations.</p> <p>Application of Castigliano's theorem of least work to propped cantilevers, fixed beams, continuous beams, and rigid jointed frames (without sway), two hinged arch.</p>  |
| 6 | <p><b>Analysis of indeterminate structures by stiffness method</b></p> <p>Stiffness coefficients and their use for formulation of equilibrium equation, direct stiffness method, slope deflection method, moment distribution method, applications of these methods to indeterminate beams and rigid jointed frames (without sway).</p>   |
|   | <p><b>Text Books</b></p> <ol style="list-style-type: none"> <li>1. S.B Junnarkar, Structural Mechanics Vol.I, Charotar Publishers, 2016. (ISBN:978-9385039270).</li> <li>2. D. Menon, Structural Analysis Volume – I, Narosa Publication, 2010. (ISBN- 978-1842653371/1842653377).</li> <li>3. C.S. Reddy, Basic Structural Analysis, Publisher: Tata McGraw Hill, 2010. (ISBN-1283187140/978-1283187145).</li> </ol> <p><b>Recommended Reading</b></p> <ol style="list-style-type: none"> <li>1. C.K. Wang, Intermediate Structural Analysis, McGraw Hill, 1984. (ISBN-10:0070666237/978-0070666238).</li> <li>2. B.G. Neal, Structural theorems and their application, Pergaman Press, 1972. (ISBN:978-1483139029).</li> <li>3. S.S. Bhavikatti, Structural Analysis Volume – I, Vikas Publishers, 3rd edition, 2011. (ISBN: 9788125942696/8125942696).</li> <li>4. S. Timoshenko and Young, Theory of Structures, Publisher: Tata McGraw Hill, 1965.(ISBN-9780070648685/978-0070648685).</li> <li>5. Norries and Wilbur, Elementary Structural Analysis, Publisher: McGraw Hill, 1990.(ISBN-0071008365/978-0071008365).</li> <li>6. H I Laursen, Structural Analysis, Publisher: McGraw Hill, 1988. (ISBN-0070366454/978-0070366459).</li> </ol> |

| Semester - IV  |             | Program Core Course (PCC)                |                    |        |    |     |      |           |
|--|-------------|--|--------------------|--------|----|-----|------|-----------|
| SN   | Course Code | Course Title                             | L-T-P (Hours/Week) | Credit | TA | MST | ES E | ESE hours |
| 2  | WPCE2004T   | Hydrology and Water Resource Engineering | 3-1-0=4            | 4      | 20 | 30  | 50   | 3         |
| <p><b>Course Outcome:</b></p> <ol style="list-style-type: none"> <li>1. Measure and analyze rainfall, runoff and water losses</li> <li>2. Construct and analyze different hydrographs</li> <li>3. Use stream gauging techniques and determine ground water flow</li> <li>4. Compute the water requirement of crops.</li> <li>5. Carry out reservoir planning, describe hydraulic structures and design distribution systems</li> </ol> |             |  |                    |        |    |     |      |           |

| Module | Course Content:  |
|--------|--|
|        | <b>HYDROLOGY:</b>  |
| 1      | <b>Introduction</b><br>Hydraulic Cycle, Water Budget Equation, World Water Balance, History of hydrology, Applications in Engineering and Sources of Data.   |
| 2      | <b>Precipitation:</b><br>Introduction, Forms of Precipitation, Weather systems of Precipitation , Characteristics of Precipitation in India, Measurement of precipitation , Rain Gauge Network, Preparation of Data, Presentation of rainfall Data, Mean precipitation over an area , Depth Area Duration Relationship, Frequency of Point rainfall, Maximum Intensity- duration-frequency relationship, PMP, Rainfall data in India, Evapo-transpiration, Transpiration, Measurement of EV. |
| 3      | <b>Water losses</b><br>Evapo-transpiration, Transpiration, Measurement of Evapotranspiration, Evapo-transpiration equations, AET, PET, Infiltration, Infiltration Capacity, Measurement of Infiltration capacity, Modeling of infiltration capacity, classification of infiltration capacity, Infiltration Indices.  |
| 4      | <b>Rainfall – runoff process</b><br>Introduction, Hydrograph, Runoff Characteristics of Streams, Runoff Volumes, Flow duration Curve, Flow Mass Curve, Drought, surface water resources in India.  |

|                                    |  |
|------------------------------------|--|
| 5                                  | <p><b>Hydrograph analysis</b><br/>Introduction, Factors affecting Flood Hydrograph, Components of Hydrograph, Base Flow separation, Effective Rainfall, Unit Hydrograph, Derivation of Unit Hydrograph, Unit hydrograph of different duration, Use and limitation of Unit Hydrograph, Duration of Unit Hydrograph, Distribution graph, Synthetic unit hydrograph, IUH.</p>   |
| 6                                  | <p><b>Stream gauging:</b><br/>Introduction, Measurement of stage, measurement of velocity, Area velocity Method, Dilution Techniques, Electromagnetic Method, Ultrasonic Method, Indirect method.</p>  |
| 7                                  | <p><b>Flood and Flood Routing</b><br/>Introduction, Rational method, Empirical Formulae, unit Hydrograph Method, Flood Frequency Studies, Gumbell Method, Design Flood, Design Storm, Risk Reliability and safety Factor Introduction of flood routing , Basic equation, storage routing, reservoir routing, attenuation, hydrologic channel routing, hydraulic method of flood routing, Flood control, Flood control in India.</p>  |
| <b>WATER RESOURCE ENGINEERING:</b> |  |
| 1                                  | <p><b>Water requirement of crops:</b><br/>Irrigation systems: Need, minor and major, command area development, Crops and crop seasons in India, cropping pattern, duty and delta, Quality of irrigation water, Soil-water relationships: soil characteristics significant from irrigation considerations, root zone soil water, infiltration, consumptive use, irrigation requirement, frequency of irrigation, Methods of applying water to the fields: surface, sub-surface, sprinkler and trickle / drip irrigation</p>   |
| 2                                  | <p><b>Reservoirs:</b><br/>Types, capacity of reservoir, fixing of control levels, yield of reservoir, reservoir regulation, erosion and sedimentation, economic height of dam, selection of suitable site, Reservoir Planning, Reservoir sizing, Sequent Peak Algorithm, Mass Flow Curve.</p>  |
| 3                                  | <p><b>Dams and spillways:</b><br/>Embankment dams: Classification, selection of site for dam, design considerations, estimation and control of seepage, slope protection, failure of earthen dams. Gravity dams: forces on gravity dams, causes of failure, elementary and practical profile, structural joints, keys and water seals, galleries, outlets, Arch and buttress dams: types of Spillways: components of spillways, types, terminal structures, types of gates for spillway crests, Weir and barrage- types of weirs, Theories of seepage for design of weirs, failure of gravity dams</p> |
| 4                                  | <p><b>Distribution system:</b><br/>Canal systems, alignment of canals, canal losses, estimation of design discharge<br/><br/>Design of channels: Kennedy's and Lacey's theory of regime channels</p>   |

|   |   |
|---|---|
|   | <p>Canal Outlets: non-modular, semi-modular and modular outlets</p> <p>Water logging: causes, effects and remedial measures, Lining of canals: economics of lining, types of lining, Drainage of irrigated lands: necessity, methods</p>  |
| 5 | <p><b>Hydraulic structures:</b></p> <p>Surface and sub-surface flow considerations for design of canal structures: hydraulic jump, seepage forces, uplift forces</p> <p>Canal falls, cross regulator, distributary head regulator, canal escapes: types, components and design considerations, Cross drainage works: need, types, design considerations, different units of headworks, sediment control in canals, river training for canal headworks,</p>  |
|   | <p><b>Text Books:</b></p> <ol style="list-style-type: none"> <li>1) G L Asawa, Irrigation Engineering, Wiley eastern, New Age International Publisher (1999) (ISBN: 8122412025)</li> <li>2) K. Subramanya “Engineering Hydrology”, McGraw Hill Education; Fourth edition (1 July 2017), (ISBN: 1259029972)</li> <li>3) S K Garg, Water Resources Engineering Vol. II Irrigation Engineering &amp; Hydraulic Structures, Khanna Publishers (2017), (ISBN: 8174090479)</li> <li>4) P N Modi, Irrigation Engineering &amp; Hydraulic Structures, Standard Book House; Edition: 9th, Year-2014 edition (2014), (ISBN: 8189401297)</li> <li>5) V.P. Singh, Elementary Hydrology, Prentice-Hall; Facsimile edition (13 December 1991), (ISBN: 0132493845)</li> </ol> <p><b>Recommended Reading:</b></p> <ol style="list-style-type: none"> <li>1) R. S. Varshney, S. C. Gupta, R. L. Gupta, Theory and Design of Irrigation Structures, Nem Chand &amp; Bros, (ISBN 13: 9788185240473)</li> <li>2) Punmia B. C., Ashok Kumar Jain &amp; Pande B. B. Lal, Irrigation Engineering and Water Power Engineering, Laxmi Publications; Revised edition (2016), (ISBN: 9788131807637)</li> <li>3) J D Zimmerman, Irrigation, John Wiley &amp; Sons; 99th edition (1 September 1966), (ISBN: 0471983799)</li> <li>4) IS:1192-1981 Velocity area methods for measurement of flow of water in open channels (First Revision).</li> <li>5) IS:2800 Code of Practice for Tube Well.</li> <li>6) IS:3910-1992 Requirements for Water Flow Measurement in Open Channels- Rotating elements current meters (first revision).</li> <li>7) IS:3918-1966 Code of Practice for use of Current Meter (cup type) for Water Flow Measurement.</li> <li>8) IS:6936-1992 Methods for Determination of Evaporation from Reservoirs (first revision).</li> <li>9) IS:3860-1966 precast cement concrete slabs for canal lining.(superseded by IS:10646).</li> <li>10) IS:3872-1966 code of practice for lining of canals with burnt clay tiles.</li> <li>11) IS:4410 glossary of terms relating to the river valley projects.</li> <li>12) IS:4877-1968 canals structures, drains outlets jungle clearance, plantation and regulations (second revision)</li> <li>13) IS: 5477 methods for fixing the capacities of reservoirs.</li> </ol> |

| Semester - IV   |             | Program Core Course (PCC) |                    |        |    |     |     |           |
|---|-------------|---------------------------|--------------------|--------|----|-----|-----|-----------|
| SN  | Course Code | Course Title              | L-T-P (Hours/Week) | Credit | TA | MST | ESE | ESE hours |
| 3   | WPCE2005T   | Applied Hydraulics        | 3-0-0=3            | 3      | 20 | 30  | 50  | 3         |
| <p><b>Course Outcome:</b></p> <ol style="list-style-type: none"> <li>1. Apply knowledge of integrated mass continuity and energy/ momentum balance equations to pressurized pipe and open channel system.</li> <li>2. Design and develop the Civil Engineering system (pipe and open channel flow)</li> <li>3. Use basic concepts of Hydraulics to analyse flow in open channel and pipes.</li> </ol> |             |                           |                    |        |    |     |     |           |

| Module | Course Content:  |
|--------|--|
| 1      | <b>Laminar Flow:</b><br>Laminar flow through: circular pipes, annulus and parallel plates. Stokes law, Measurement of viscosity.   |
| 2      | <b>Turbulent Flow:</b><br>Reynolds experiment, Transition from laminar to turbulent flow. Definition of turbulence, scale and intensity, Causes of turbulence, instability, mechanism of turbulence and effect of turbulent flow in pipes. Reynolds stresses, semi-empirical theories of turbulence, Prandtl's mixing length theory, universal velocity distribution equation. Resistance to flow of fluid in smooth and rough pipes, Moody's diagram. |
| 3      | <b>Boundary Layer Analysis:</b><br>Assumption and concept of boundary layer theory. Boundary-layer thickness, displacement, momentum & energy thickness, laminar and Turbulent boundary layers on a flat plate; Laminar sub-layer, smooth and rough boundaries. Local and average friction coefficients. Separation and Control.   |
| 4      | <b>Dimensional Analysis and Hydraulic Similitude:</b><br>Dimensional homogeneity, Rayleigh method, Buckingham's Pi method and other methods. Dimensionless groups. Similitude, Model studies, Types of models. Application of dimensional analysis and model studies to fluid flow problem.  |
| 5      | <b>Introduction to Open Channel Flow:</b><br>Comparison between open channel flow and pipe flow, geometrical parameters of a channel, classification of open channels, classification of open channel flow, Velocity Distribution of channel section.  |

|    |  |
|----|--|
| 6  | <p><b>Uniform Flow:</b><br/>Continuity Equation, Energy Equation and Momentum Equation, Characteristics of uniform flow Chezy's formula, Manning's formula Factors affecting Manning's Roughness Coefficient 'n'. Hydraulic Channel Design, Most economical section of channel.<br/>Computation of Uniform flow Normal depth.</p>  |
| 7  | <p><b>Non-Uniform Flow</b><br/>Specific energy, Specific energy curve, critical flow, discharge curve Specific Force Specific depth, and Critical depth. Channel Transitions. Measurement of Discharge and Velocity – Venturi Flume, Standing Wave Flume, Parshall Flume, Broad Crested Weir. Measurement of Velocity- Current meter, Floats, Hot-wire anemometer.</p>     |
| 8  | <p><b>Gradually Varied Flow</b><br/>Dynamic Equation of Gradually Varied Flow, Classification of channel bottom slopes, Classification of surface profile, Characteristics of surface profile. Computation of water surface profile by graphical, numerical and analytical approaches. Direct Step method, Graphical Integration method and Direct integration method.</p> |
| 9  | <p><b>Hydraulic Jump</b><br/>Theory of hydraulic jump, Elements and characteristics of hydraulic jump in a rectangular Channel, length and height of jump, location of jump, Types, applications and location of hydraulic jump. Energy dissipation and other uses, surge as a moving hydraulic jump. Positive and negative surges.</p>                                    |
| 10 | <p><b>Dynamics of Fluid Flow:</b><br/>Momentum principle, applications: Force on plates, pipe bends, moments of momentum equation</p>  |
| 11 | <p><b>Flow through Pipes:</b><br/>Loss of head through pipes, Darcy-Wiesbatch equation, minor losses, total energy equation, hydraulic gradient line, Pipes in series, equivalent pipes, pipes in parallel, flow through laterals, flows in dead end pipes, siphon, power transmission through pipes, nozzles.</p>   |
| 12 | <p><b>Analysis of pipe networks:</b><br/>Hardy Cross method, water hammer in pipes and control measures, branching of pipes , three reservoir problem</p>  |
| 13 | <p><b>Hydraulic Machinery:</b><br/>Pumps, Turbines basics and classification, design and capacity of pumps, submersible pumps</p>  |
| 14 | <p><b>Hydraulic Design:</b><br/>Pipe flow and channel flow.</p>  |
|    | <p><b>Text Books:</b><br/>1 Dr. P.M. Modi and Dr. S.M. Seth, Hydraulics and Fluid Mechanics, Standard Book House. Edition: 20th, Year-2015 ISBN - 8189401262</p>   |

**Recommended Reading:**

- 1) Dr. P M Modi and Dr S M Seth, Hydraulics and Fluid Mechanics, Standard Book House (ISBN -8189401262)
- 2) K Subramanya, Theory and Applications of Fluid Mechanics, Tata McGraw Hill Publishing co. Ltd. (ISBN - 0074603698)
- 3) Dr A K Jain, Fluid Mechanics, 4th edition, Khanna Publishers (ISBN - 8174091947)
- 4) Ven Te Chow, Open channel Hydraulics, Tata McGraw Hill Publications. 30057th edition (1 January 2009) (ISBN -1932846182)

| Semester - IV  |             | Program Core Course (PCC)     |                    |        |    |          |     |           |
|--|-------------|-------------------------------|--------------------|--------|----|----------|-----|-----------|
| SN   | Course Code | Course Title                  | L-T-P (Hours/Week) | Credit | TA | MST      | ESE | ESE hours |
| 4  | WPCE2005L   | Applied Hydraulics Laboratory | 0-0-2=2            | 1      |    | ISCE: 60 | 40  | 3         |
| <b>Course Outcome:</b> <ol style="list-style-type: none"> <li>1. Calculate the force exerted by air on object boundary.</li> <li>2. Design an open channel.</li> <li>3. Design a pipe system.</li> </ol> |             |                               |                    |        |    |          |     |           |

| SN  | Course Content: (List of Experiments)                          |
|---|--|
| 1   | Study of different type flow using Reynolds apparatus          |
| 2   | Study of open channel and control structure                    |
| 3   | Determination of Chezy's constant and Manning's constant       |
| 4   | Gradually Varied Flow  |
| 5   | Determination of characteristics of hydraulic jump             |
| 6   | Determination of coefficient of discharge of control structure |
| 7   | Determination of friction factor                               |
| 8   | Determination minor losses in pipeline                         |
| 9   | Hydraulic design of small pipeline system                      |
| 10  | Hydraulic design of small channel                              |
| <b>Text Books:</b><br>1 Dr. P.M. Modi and Dr. S.M. Seth, Hydraulics and Fluid Mechanics, Standard Book House. Edition: 20th, Year-2015 ISBN - 8189401262<br><b>Recommended Reading:</b><br>1) Dr. P M Modi and Dr S M Seth, Hydraulics and Fluid Mechanics, Standard Book House (ISBN -8189401262)<br>2) K Subramanya, Theory and Applications of Fluid Mechanics, Tata McGraw Hill Publishing co. Ltd. (ISBN - 0074603698)<br>3) Dr A K Jain, Fluid Mechanics, 4th edition, Khanna Publishers (ISBN - 8174091947)<br>4) Ven Te Chow, Open channel Hydraulics, Tata McGraw Hill Publications. 30057th edition (1 January 2009) (ISBN -1932846182) |  |

| Semester - IV   |             | Program Core Course (PCC) |                    |        |    |     |     |           |
|---|-------------|---------------------------|--------------------|--------|----|-----|-----|-----------|
| SN  | Course Code | Course Title              | L-T-P (Hours/Week) | Credit | TA | MST | ESE | ESE hours |
| 5   | WPCE2006T   | Construction Techniques   | 3-0-0=3            | 3      | 20 | 30  | 50  | 3         |
| <p><b>Course Outcome:</b></p> <p>After completion of course students will be able to:</p> <ol style="list-style-type: none"> <li>1. Describe different construction techniques used at site.</li> <li>2. Justify use of various construction equipments with reference to cost and site conditions.</li> <li>3. Analyze and suggest ground improvement techniques.</li> </ol> |             |                           |                    |        |    |     |     |           |

| Modules | Course Content  |
|---------|---|
| 1.      | <p><b>Pile construction:</b></p> <p>Types of piles &amp; construction, pile driving equipments</p>  |
| 2.      | <p><b>Dewatering:</b></p> <p>Well point system, deep well, selection of pumps, types of pumps, numericals based on HP &amp; selection of pump.</p>  |
| 3.      | <p><b>Tunelling:</b></p> <p>Geotechnical investigations, selection of alignment, methods of tunneling in soft soils and in hard rock, sequence of operations for drilling and blasting method, mechanical moles, boomers, tunnel boring machines, mucking, ventilation of tunnels, dust control, types of tunnel supports, sequence of lining operation, lining with pneumatic placers and by pumpcrete method.</p> |
| 4.      | <p><b>Bridge construction:</b></p> <p>Geotechnical investigation, Site selection, launching of bridges by incremental launching, using false work, balanced cantilever construction method, Cofferdams' types and applications</p>  |
| 5.      | <p><b>Ground improvement techniques:</b></p> <p>stone column, sand drain, grouting</p>  |
| 6.      | <p><b>Equipment costs:</b></p> <p>Owning and operating costs, numerical</p>   |

|    |  |
|----|--|
| 7. | <b>Owning and operating costs, numerical:</b><br>Capacity, effects of altitude   |
| 8. | <b>Cranes:</b><br>Types, lifting capacity, safety, types of cranes   |
| 9. | <b>Dragline, clamshell:</b><br>Operation, dragline, production, numerical based on probable production & time required, Size of dragline, clamshell operation, production rate, Maintenance of Equipments.   |
|    | <b>Text Books:</b> <ol style="list-style-type: none"> <li>1. Construction planning, equipments, and methods-Tata McGraw- hill edition, sixth edition</li> <li>2. B. C. Punmia, Building construction Laxmi publications lt. tenth edition (ISBN 9788131804285)</li> <li>3. R. Srinivasan Harbour dock and tunneling- Charotar publishing house private limited (ISBN 9385039199)</li> </ol> <b>Recommended Reading:</b> <ol style="list-style-type: none"> <li>1. Dr.V.K.Raina, Concrete Bridge Practice, Tata McGraw Hill Publications, 2nd edition (ISBN - 818404805X)</li> <li>2. Dr.P.Purushothama Raj, Ground Improvement Techniques, Bangalore University Press, 7th edition (ISBN - 9788131805947)</li> <li>3. N.V.Nayak, Foundation Design Manual, Dhanpatrai Prakashan, 3rd edition (ISBN -9383182903)</li> <li>4. Mahesh Varma, Metropolitan Book Co. Constuction Equipment and its Planning and Applications (P) Ltd., New Delhi, India.</li> <li>5. Construction Macinery and Equipment in India, (A compilation of articles Published in Civil Engineering and Construction Review), Publish by Civil Engineering and Construction Review New Delhi,1991</li> </ol> |

| Semester - IV  |             | Program Core Course (PCC) |                    |        |    |     |     |           |
|--|-------------|---------------------------|--------------------|--------|----|-----|-----|-----------|
| SN   | Course Code | Course Title              | L-T-P (Hours/Week) | Credit | TA | MST | ESE | ESE hours |
| 6  | WPSE2003T   | Soil Mechanics            | 3-0-0=3            | 3      | 20 | 30  | 50  | 3         |
| <p><b>Course Outcome:</b></p> <ol style="list-style-type: none"> <li>1. Determine basic properties and index properties of soil using knowledge of engineering mechanics and hydraulics.</li> <li>2. Evaluate hydraulic properties and compaction of soil, identify the soil classification</li> <li>3. Estimate the compressibility potential and analyze shear strength parameters.</li> <li>4. Apply shear strength parameters for stability of slopes and soil exploration.</li> </ol> |             |                           |                    |        |    |     |     |           |

| Module | Course Content:   |
|--------|---|
| 1      | <p><b>Introduction:</b><br/>Definitions: soils, soil mechanics, soil engineering, rock mechanics, geotechnical engineering. Scope of soil engineering.</p>  |
| 2      | <p><b>Phase relationship and basic soil properties:</b><br/>Soil as three-phase system in terms of weight, volume, voids ratio, and porosity<br/>Definitions: moisture content, unit weights, degree of saturation, void ratio, porosity, specific gravity, mass specific gravity etc. Relationships between volume- volume, weight-volume and weight-weight. Discussion on Grain size Analysis, Specific Gravity and Relative Density.</p> |
| 3      | <p><b>Plasticity characteristics of soil:</b><br/>Introduction to definitions of: plasticity of soil, consistency limits-liquid limit, plastic limit, shrinkage limit, consistency indices, Determination of: liquid limit, plastic limit and shrinkage limit.</p>  |
| 4      | <p><b>Classification of soils:</b><br/>Introduction of soil classification: particle size classification, Indian standard soil classification system.</p>   |
| 5      | <p><b>Permeability of soil:</b><br/>Introduction to hydraulic head, Darcy's law, validity of Darcy's law. Determination of coefficient of permeability by Laboratory. Permeability aspects: permeability of stratified soils, Graded filters.</p>   |
| 6      | <p><b>Seepage analysis:</b><br/>Introduction, stream and potential functions, characteristics of flow nets.</p>   |

|    |  |
|----|--|
| 7  | <p><b>Effective stress principle:</b><br/>Introduction, effective stress principle, nature of effective stress, effect of water table<br/>Fluctuations of effective stress, quick sand condition.</p>  |
| 8  | <p><b>Compaction of soil:</b><br/>Introduction, theory of compaction, laboratory determination of optimum moisture content and maximum dry density.</p>  |
| 9  | <p><b>Consolidation of soil:</b><br/>Introduction, types of clay deposits, initial, primary &amp; secondary consolidation, spring analogy for primary consolidation, one dimensional consolidation test results, Terzaghi's theory of consolidation.</p>   |
| 10 | <p><b>Shear strength:</b><br/>Principle planes, Mohr's circle, Mohr-Coloumb theory, Drainage conditions, types of shear test: direct shear test, triaxial compression tests, test, relation between major and minor principal stresses, unconfined compression test, Shear strength of sand and clay,</p>  |
| 11 | <p><b>Stability of slopes:</b><br/>Introduction, different factors of safety, types of slope failures, analysis of finite and infinite slopes, wedge failure Swedish circle method.</p>  |
| 12 | <p><b>Soil exploration</b><br/>Boring of holes, Drilling and sampling in soil and rock.</p>  |
|    | <p><b>Text Books:</b><br/>1) G. Ranjan and A.S.R. Rao, Basic and Applied Soil Mechanics, New Age International Pvt. Ltd., 2005 (ISBN: 9788122440393/8122440398).<br/>2) V.N.S. Murthy, Advanced Foundation Engineering, CBS Publishers and Distributors, New Delhi, 2016. (ISBN- 978-8123915067).<br/>3) B. M. Das, Principles of Foundation Engineering, PWS Publishing Company, 2012. (ISBN- 978-8131518786).<br/><b>Recommended Reading:</b><br/>1) R F Craig, Soil Mechanics, Chapman &amp; Hall. 2004. (ISBN- 9780415327039 / 0415327032).<br/>2) C. Venktatramaiyah, Geotechnical Engineering, New Age International.2009. (ISBN- 9386649705/978-9386649706).<br/>3) Robert D. Holtz, William D. Kovacs, Thomas C. Sheahan, (2010) "An Introduction to Geotechnical Engineering" Pearson Pub.<br/>4) Terzaghi Karl, Peck Ralph and Mesri Gholamreza, 1996. Soil Mechanics in Engineering Practice. John Wiley &amp; Sons Inc; 3rd edition (11 March 1996).</p> |

| Semester - IV  |             | Program Core Course (PCC) |                    |        |    |          |     |           |
|--|-------------|---------------------------|--------------------|--------|----|----------|-----|-----------|
| SN   | Course Code | Course Title              | L-T-P (Hours/Week) | Credit | TA | MST      | ESE | ESE hours |
| 7  | WPSE2003L   | Soil Mechanics Laboratory | 0-0-2=2            | 1      |    | ISCE: 60 | 40  | 3         |
| <b>Course Outcome:</b> <ol style="list-style-type: none"> <li>Determine the basic and index physical properties of soil/rock.</li> <li>Evaluate consistency of soil for its classification.</li> <li>Determine the hydraulic behaviour and mechanical properties of soil</li> <li>Measure shear strength and consolidation behaviour of soil.</li> </ol> |             |                           |                    |        |    |          |     |           |

| SN | Course Content:<br>(List of Experiments- Minimum 14)             |
|----|--|
| 1  | Natural moisture content using Oven Drying method.               |
| 2  | Specific gravity of Soil grains                                  |
| 3  | Field Density using Core Cutter method                           |
| 4  | Field Density using Sand replacement method                      |
| 5  | Grain size distribution by Sieve Analysis                        |
| 6  | Field identification of Fine-Grained soils.                      |
| 7  | Consistency limits by Atterberg Limit                            |
| 8  | Permeability test using Constant Head test method.               |
| 9  | Permeability test using Falling Head method                      |
| 10 | Compaction test: Standard Proctor test or Modified Proctor test. |
| 11 | Direct Shear Test  |
| 12 | Unconfined Compression Test                                      |
| 13 | Triaxial Compression Test  |
| 14 | Consolidation Test   |
| 15 | Grain size distribution by Hydrometer Analysis (optional)        |

|    |  |
|----|--|
| 16 | Lab. CBR method (optional)   |
|    | <p><b>Text Books:</b></p> <p>1) Prof. Krishna Reddy, “Engineering Properties of Soils Based on Laboratory Testing.” Department of Civil and Materials Engineering, University of Illinois at Chicago.</p> <p><b>Recommended Reading:</b></p> <p>1) R F Craig, Soil Mechanics, Chapman &amp; Hall. 2004. (ISBN-9780415327039/0415327032).</p> <p>2) C. Venkatramaiah, Geotechnical Engineering, New Age International.2009. (ISBN-9386649705/978-9386649706).</p> <p>3) A. Singh, Soil Engineering in Theory and Practice, Standard Publishers and Distributors, New Delhi. 2009. (ISBN-8123900392/978-8123900391).</p> <p>4) D.W. Taylor, Fundamentals of Soil Mechanics, Asia publications Bombay, 1967. (ASIN: 5) B002XBX0HY).</p> <p>6) T.W. Lambe and R.V. Whitman (1979). ‘Soil Mechanics’, John Wiley and Sons, New York, USA (ISBN: 978-0-471-51192-2).</p> |

| Semester - IV   |             | Program Core Course (PCC)        |                    |        |    |          |     |           |
|---|-------------|----------------------------------|--------------------|--------|----|----------|-----|-----------|
| SN  | Course Code | Course Title                     | L-T-P (Hours/Week) | Credit | TA | MST      | ESE | ESE hours |
| 8   | WPCE2007L   | Geospatial Technology Laboratory | 0-0-2=2            | 1      |    | ISCE: 60 | 40  | 3         |
| <p><b>Course Outcome:</b></p> <ol style="list-style-type: none"> <li>1. Design and set out horizontal and vertical curve.</li> <li>2. Use of various electronic instruments such as Digital Planimeter, Electronic Theodolite, Total station, Auto and Digital Levels and GPS receiver.</li> <li>3. Apply geospatial techniques such as Geographical Information System (GIS), Global Positioning System (GPS) and Remote Sensing in the field of Surveying and Mapping.</li> </ol> |             |                                  |                    |        |    |          |     |           |

| Module | Course Content:  |
|--------|--|
| 1      | <p><b>Tachometric surveying:</b><br/>Principles and uses, advantages, stadia formula, different methods of tachometer, subtense bar method, location details by tachometer, stadia diagram and tables, error and accuracy in tachometry survey work</p>  |
| 2      | <p><b>Curves:</b><br/>Definitions of different terms, necessity of curves and types of curves. Simple circular curves and compound curves, office and field work, linear methods of setting out of curves<br/>Angular methods for setting out of curves, two theodolite and Rankine deflection angle methods<br/>Reverse and transition curves, their properties and their advantages, design of transition curves, shift, spiral angle<br/>Composite curves – office and field work, setting out of curve by angular method, composite curve problems<br/>Vertical curves – definitions, geometry and types, tangent correction and chord gradient methods, sight distance on a vertical curve, difficulties in setting out curves and solutions for the same</p> |

|   |  |
|---|--|
|   |  |
| 3 | <p><b>Global Positioning System (G.P.S):</b><br/> G.P.S. Segments: Spaces Segment, Control Segment, User Segment, Features of G.P.S. Satellites, Principle of Operation, Surveying with G.P.S.: Methods of observations, Absolute Positioning, Relative Positioning, differential G.P.S., Kinematics of G.P.S., G.P.S. Receivers: Navigational Receivers, Surveying Receivers, Geodetic Receivers, Computation of Co- ordinates:- Transformation from Global to Local Datum , Geodetic Coordinates to map co- ordinates , G.P.S. Heights and mean sea level Heights, Applications of G.P.S</p>   |
| 4 | <p><b>Remote Sensing:</b><br/> Electromagnetic remote sensing process, Physics of radiant energy: Nature of Electromagnetic radiation, Electromagnetic spectrum, Energy Source and its Characteristics, Atmospheric influences: Absorption, Scattering<br/> Energy interaction with Earth Surfaces: Spectral reflectance Curve, Image Acquisition: Photographic sensors, Digital Data, Earth Resource satellites, Image resolution, Image Interpretation, Application of Remote Sensing</p>  |
| 5 | <p><b>Geographical Information System (GIS):</b><br/> Information systems, spatial and non- spatial information, geographical concept and terminology, advantages of GIS, Basic component of GIS, Commercially available GIS hardware and Software, Field data, statistical data, maps, aerial Photographs, satellite data, points, lines, and areas features, vector and raster data, data entry through keyboard, digitizer and scanners, pre-processing of data rectification and registration, interpolation technique</p>   |
| 6 | <p><b>Introduction to surveying with Drones:</b><br/> Introduction to Drones, History of Drone/UAS/UAVs, payload, battery life, Specs for good results, Regulations of DGCA and Drone license, Pre and Post Flight planning- Flight execution and photography, data collection- Image Format, GSD, Scale and Resolution. Consideration for hardware selections, comparison on surveying drone and its accuracy, Techniques of controlling errors, Consideration of GCP in vertical and horizontal accuracies, Planning and estimation of drone surveying jobs, Autonomous flight vs. manual and hybrid flight profiles.</p>                      |
| 7 | <p><b>Practical's:</b></p> <ol style="list-style-type: none"> <li>1. To find the constants of a tacheometer and to verify field distances</li> <li>2. Height and distance problems in tacheometric surveying</li> <li>3. Setting out the circular curve by Rankine's method of deflection of angles</li> <li>4. A two-day project on L section and cross section, block contouring and tachometric survey (Mandatory)</li> <li>5. Study of satellite images and its interpretation, false color combination etc.</li> <li>6. Determination of horizontal, sloping and vertical distance between any two points by using Total Station</li> </ol> |

|  |  |
|--|--|
|  | <ol style="list-style-type: none"> <li>7. Preparation of contour map by using road suitable software such as Surfer or Road Master Q-GIS, Arc-GIS</li> <li>8. Geo-registration Geo-Referencing of map and its digitization by using suitable GIS software.</li> <li>9. Map editing, vector and raster analysis of digitized map by using suitable GIS software</li> <li>10. Preparation of Contour map by using Triangulated Irregular Network (TIN) or contour extraction tools in GIS software</li> <li>11. Generation of 2D and 3D digital elevation model (DEM) from contour map using GIS software</li> <li>12. Collection of field data like point data, line data and area data by using surveying and mapping GPS receiver</li> <li>13. Post-processing the GPS data by using post processing software such as Pathfinder Software Q-GIS, Arc-GIS.</li> <li>14. Generation of Databases and relation database management system (RDBMS) using MS ACCESS.</li> <li>15. Application of drone for Surveying &amp; Mapping- Construction project, Irrigation plot.</li> </ol>  |
|  | <p><b>Text Books:</b></p> <ol style="list-style-type: none"> <li>1) Satheesh Gopi, R. Sathikumar, N. Madhu, Advanced Surveying - Total station, GIS and Remote sensing, First edition Pearson education (ISBN No 9788131700679)</li> <li>2) Lo C P, Yeung A K W, Concepts and Techniques of Geographic Information Systems, 2<sup>nd</sup> edition, Prentice Hall India.</li> </ol> <p><b>Recommended Reading:</b></p> <ol style="list-style-type: none"> <li>1) N. N. Basak, Surveying and Leveling, Tata McGraw Hill Publications, 2<sup>nd</sup> Edition. (ISBN - 9789332901537)</li> <li>2) B C Punmiya, Surveying and Leveling, Vol I-16<sup>Th</sup> edition &amp; Vol II- 4<sup>th</sup> edition, Laxmi Publications. (ISBN - 9788170088530)</li> <li>3) R Agor, Surveying, Khanna Publishers- 11<sup>th</sup> edition. (ISBN - 8174092358)</li> <li>4) Concepts and Techniques of Geographical Information System, Lo C. P. Yeung A K W, Prentice Hall India</li> <li>5) Kang-tsung Chang, Introduction to Geographical Information System Tata McGraw Hill, 8 edition (16 February 2015) (ISBN - 0078095131)</li> <li>6) K. Anji Rao, Remote sensing and Geographical information system, BS Publications (ISBN -9381075972)</li> </ol> |