

**Course Curriculum**  
**Third Year**  
**B. Tech. in Civil Engineering**  
**In line with National Education Policy 2020**  
**(Effective from AY 2026-27 for Affiliated Institutes)**



**Dr. Babasaheb Ambedkar Technological University**  
**Lonere 402 103, Dist- Raigad, Maharashtra, INDIA**

Established vide Maharashtra Act No. XXII of 1989 and Act. No. XXIX of 2014  
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# Dr. Babasaheb Ambedkar Technological University, Lonere

## Teaching & Evaluation Scheme for Third Year B. Tech. Civil Engineering

| Sr. No.     | Course Code    | Course Title                                      | Teaching Scheme |   |    | Evaluation Scheme |     |     |       | Credits |
|-------------|----------------|---------------------------------------------------|-----------------|---|----|-------------------|-----|-----|-------|---------|
|             |                |                                                   | L               | T | P  | ISE               | MSE | ESE | Total |         |
| Semester-V  |                |                                                   |                 |   |    |                   |     |     |       |         |
| 1           | 26AF1191PC501  | Structural Mechanics-II                           | 3               | 0 | 0  | 20                | 20  | 60  | 100   | 3       |
| 2           | 26AF1191PC502  | Design of Steel Structures                        | 3               | 0 | 0  | 20                | 20  | 60  | 100   | 3       |
| 3           | 26AF1191PC503  | Open Channel Flow & Hydraulics Machines           | 3               | 0 | 0  | 20                | 20  | 60  | 100   | 3       |
| 4           | 26AF1191PC504  | Geotechnical Engineering                          | 3               | 0 | 0  | 20                | 20  | 60  | 100   | 3       |
| 5           | 26AF1ARPOE05   | OPEN ELECTIVE-III                                 | 3               | 0 | 0  | 20                | 20  | 60  | 100   | 3       |
| 6           | Refer Bucket   | Multi-Disciplinary Minor-III                      | 3               | 0 | 0  | 20                | 20  | 60  | 100   | 3       |
| 7           | 26AF1191PCL507 | Design of Steel Structures Lab                    | 0               | 0 | 2  | 50                | -   | 50  | 100   | 1       |
| 8           | 26AF1191PCL508 | Open Channel Flow & Hydraulics Machines Lab       | 0               | 0 | 2  | 25                | -   | 25  | 50    | 1       |
| 9           | 26AF1191PCL509 | Geotechnical Engineering Lab                      | 0               | 0 | 2  | 25                | -   | 25  | 100   | 1       |
| 10          | 26AF1191HM510  | Soft Skills Development                           | 0               | 2 | 0  | -                 | -   | -   | AU    | GR      |
| 11          | 26AF1191VS511  | Construction Equipment and Site Safety Management | 2               | 0 | 0  | 50                | -   | 25  | 75    | 2       |
| TOTAL       |                |                                                   | 20              | 2 | 6  | 270               | 120 | 485 | 875   | 23      |
| Semester-VI |                |                                                   |                 |   |    |                   |     |     |       |         |
| 1           | 26AF1191PC601  | Design of Concrete Structures                     | 3               | 0 | 0  | 20                | 20  | 60  | 100   | 3       |
| 2           | 26AF1191PE602  | Program Elective-I                                | 3               | 0 | 0  | 20                | 20  | 60  | 100   | 3       |
| 3           | 26AF1191PE603  | Program Elective -II                              | 3               | 0 | 0  | 20                | 20  | 60  | 100   | 3       |
| 4           | 26AF1191PE604  | Program Elective-III                              | 3               | 0 | 0  | 20                | 20  | 60  | 100   | 3       |
| 5           | 26AF1191PC605  | Foundation Engineering                            | 3               | 0 | 0  | 20                | 20  | 60  | 100   | 3       |
| 6           | Refer Bucket   | Multi-Disciplinary Minor-IV                       | 3               | 0 | 0  | 20                | 20  | 60  | 100   | 3       |
| 7           | 26AF1191PCL607 | Design of Concrete Structures Lab                 | 0               | 0 | 2  | 50                | -   | 50  | 100   | 1       |
| 8           | 26AF1191PEL608 | Program Elective-II- Lab                          | 0               | 0 | 2  | 25                | -   | 25  | 50    | 1       |
| 9           | 26AF1191PEL609 | Program Elective-III- Lab                         | 0               | 0 | 2  | 25                | -   | 25  | 50    | 1       |
| 10          | 26AF1191EL610  | Seminar                                           | 0               | 0 | 2  | 25                | -   | 25  | 50    | 1       |
| 11          | 27AF1191EL711  | Project Phase-I                                   | 0               | 0 | 4  | 50                | -   | 50  | 100   | 2       |
| TOTAL       |                |                                                   | 18              | 0 | 12 | 295               | 120 | 535 | 950   | 24      |

| Course Type          | Course Code    | Course Name                        | Course Type                  | Course Code    | Course Name                      |
|----------------------|----------------|------------------------------------|------------------------------|----------------|----------------------------------|
| Program Elective-I   | 26AF1191PE602A | Hydraulics Structures              | Open elective-III            | 26AF1ARPOEM05O | Geomatics Engineering            |
|                      | 26AF1191PE602B | Dams and Reservoirs                |                              | 26AF1ARPOEM05P | Ground Improvement Techniques    |
| Program Elective-II  | 26AF1191PE603A | Water Quality Engineering          |                              | 26AF1ARPOEM05Q | Sustainable Construction Methods |
|                      | 26AF1191PE603B | Environment Health and Safety      | Multi-Disciplinary Minor-III | Refer Bucket   | Refer Bucket                     |
| Program Elective-III | 26AF1191PE604A | Highway & Railway Engineering      | Multi-Disciplinary Minor-IV  | Refer Bucket   | Refer Bucket                     |
|                      | 26AF1191PE604B | Intelligent Transportation Systems |                              |                |                                  |
|                      | 26AF1191PE604C | Traffic Engineering & Management   |                              |                |                                  |

**Type of course:**

|                                                          |                                                       |
|----------------------------------------------------------|-------------------------------------------------------|
| Basic Science: <b>BS</b>                                 | Engineering Science: <b>ES</b>                        |
| Program Elective: <b>PE</b>                              | Program Core: <b>PC</b>                               |
| Modern Indian Language: <b>MIL</b>                       | Indian Knowledge System: <b>IK</b>                    |
| Value Education Course: <b>VEC</b>                       | Ability Enhancement Course: <b>AE</b>                 |
| Vocational and Skill Enhancement: <b>VS</b>              | Audit Course: <b>AU</b>                               |
| Open Elective: <b>OE</b> (Other than particular program) | Co-curricular & Extracurricular Activities: <b>CC</b> |
| Humanities, Management, language and Commerce: <b>HM</b> | Multidisciplinary Courses: <b>MD</b>                  |

**LIST OF ELECTIVE / OPEN ELECTIVE/ MULTIDISCIPLINARY MINOR COURSES**

Below listed courses will be offered as per student's requirement and availability of subject expert with the approval of the head of the institute/department.

**OPEN ELECTIVE OTHER THAN PARTICULAR PROGRAM**

| Sr.No. | Course Offered                   | Teaching Scheme (Hrs) |    |    |       | Credits |
|--------|----------------------------------|-----------------------|----|----|-------|---------|
|        |                                  | L                     | T  | P  | TOTAL |         |
| 1      | Building Materials               | 02                    | 00 | 00 | 02    | 02      |
| 2      | Design of Masonry Structures     | 02                    | 00 | 00 | 02    | 02      |
| 3      | Energy Efficient Buildings       | 02                    | 00 | 00 | 02    | 02      |
| 4      | Advanced Surveying               | 03                    | 00 | 00 | 03    | 03      |
| 5      | Modern Surveying                 | 03                    | 00 | 00 | 03    | 03      |
| 6      | Geomatics Engineering            | 03                    | 00 | 00 | 03    | 03      |
| 7      | Ground Improvement Techniques    | 03                    | 00 | 00 | 03    | 03      |
| 8      | Sustainable Construction Methods | 03                    | 00 | 00 | 03    | 03      |

### **PROGRAM ELECTIVE COURSE**

| Sr.No. | Course Offered                     | Teaching Scheme (Hrs) |    |    |       | Credits |
|--------|------------------------------------|-----------------------|----|----|-------|---------|
|        |                                    | L                     | T  | P  | TOTAL |         |
| 1      | Hydraulics Structures              | 03                    | 00 | 00 | 03    | 03      |
| 2      | Irrigation Engineering             | 03                    | 00 | 00 | 03    | 03      |
| 3      | Water Quality Engineering          | 03                    | 00 | 02 | 05    | 04      |
| 4      | Water Supply Engineering           | 03                    | 00 | 02 | 05    | 04      |
| 5      | Environment Health and Safety      | 03                    | 00 | 02 | 05    | 04      |
| 6      | Highway & Railway Engineering      | 03                    | 00 | 02 | 05    | 04      |
| 7      | Intelligent Transportation Systems | 03                    | 00 | 02 | 05    | 04      |
| 8      | Bridge & Tunnel Engineering        | 03                    | 00 | 02 | 05    | 04      |
| 9      | Pollution Control & Treatment      | 03                    | 00 | 02 | 05    | 04      |
| 10     | Waste Water Engineering            | 03                    | 00 | 02 | 05    | 04      |
| 11     | Industrial Waste water Management  | 03                    | 00 | 02 | 05    | 04      |
| 12     | Professional Practices             | 03                    | 00 | 02 | 05    | 04      |
| 13     | Construction Cost Analysis         | 03                    | 00 | 02 | 05    | 04      |
| 14     | Estimation and Costing             | 03                    | 00 | 02 | 05    | 04      |

### **HONORS- CIVIL ENGINEERING**

| Sr.No. | Course Offered                          | Teaching Scheme (Hrs) |    |    |       | Credits |
|--------|-----------------------------------------|-----------------------|----|----|-------|---------|
|        |                                         | L                     | T  | P  | TOTAL |         |
| 1      | Finite Element Method                   | 03                    | 00 | 00 | 03    | 03      |
| 2      | Advanced Structural Design              | 03                    | 00 | 00 | 03    | 03      |
| 3      | Legal aspects in Civil Engineering      | 03                    | 00 | 00 | 03    | 03      |
| 4      | Advanced Environmental Engineering      | 03                    | 00 | 00 | 03    | 03      |
| 5      | Multimodal Urban Transportation Systems | 03                    | 00 | 00 | 03    | 03      |
| 6      | Theory of Plates and Shells             | 03                    | 00 | 00 | 03    | 03      |

### **RESEARCH - CIVIL ENGINEERING**

| Sr.No. | Course Offered                                               | Teaching Scheme (Hrs) |    |    |       | Credits |
|--------|--------------------------------------------------------------|-----------------------|----|----|-------|---------|
|        |                                                              | L                     | T  | P  | TOTAL |         |
| 1      | Problem Identification and Definition                        | 03                    | 01 | 00 | 04    | 04      |
| 2      | Experimental Work/Analytical Tools and Prototype Development | 03                    | 01 | 00 | 04    | 04      |
| 3      | Research Project Phase-I                                     | 00                    | 00 | 12 | 12    | 06      |
| 4      | Research Project Phase-II                                    | 03                    | 01 | 12 | 12    | 06      |

### **SELF STUDY COURSE(MOOC/SWAYAM)**

| Sr.No. | Course Offered                        | Duration of Online Course |
|--------|---------------------------------------|---------------------------|
| 1      | Research Methodology                  | 08 to 12 weeks            |
| 2      | Problem Identification and Definition |                           |
| 3      | Literature Review                     |                           |
| 4      | Publication & Ethics                  |                           |
| 5      | Data Analysis                         |                           |

**Teaching Scheme:** Students must enroll any above mentioned course on online platform like MOOC/SWAYAM or can attend the offline workshops during the SEM-VII/VIII as per availability and produce the certificate to faculty co coordinator of institute/department. Assessment work can be done by faculty coordinator based on the student's performance.

**MULTIDISCIPLINARY MINOR BUCKET**  
**for AFFILIATED INSTITUTES**  
**MINOR DEGREE IN CIVIL ENGINEERING**  
**(For other than B.Tech. in Civil Engineering program students)**

| Semester                                                                        | Subject Code   | Subject Name                                      | Total Credit |
|---------------------------------------------------------------------------------|----------------|---------------------------------------------------|--------------|
| SEM-III                                                                         | 25AF1191MD306A | Building Construction                             | 3            |
| SEM-III                                                                         | 25AF1191MD306  | Introduction to Engineering Geology               | 3            |
| SEM-IV                                                                          | 25AF1191MD406  | Concrete Technology                               | 3            |
| SEM-V                                                                           | 25AF1191MD506  | Geomatics Engineering                             | 3            |
| SEM-VI                                                                          | 25AF1191MD606  | Project Management                                | 3            |
| SEM-VII                                                                         | 25AF1191MD706  | Construction Equipment and Site Safety Management | 2            |
| <b>MINIMUM CREDITS REQUIRED TO COMPLETE A MINOR DEGREE IN CIVIL ENGINEERING</b> |                |                                                   | <b>14</b>    |

**MINOR DEGREE IN PLANNING ENGINEERING**  
**(only for B.Tech. Civil Engineering program students)**

| Semester                                                                           | Subject Code   | Subject Name                           | Total Credit |
|------------------------------------------------------------------------------------|----------------|----------------------------------------|--------------|
| SEM-III                                                                            | 25AFMDPLAN306A | Site Planning                          | 3            |
| SEM-III                                                                            | 25AF1191MD306  | Introduction to Engineering Geology    | 3            |
| SEM-IV                                                                             | 25AFMDPLAN406A | Fundamentals of Urban Design           | 2            |
| SEM-IV                                                                             | 25AFMDPLAN406B | Town and Urban Planning                | 2            |
| SEM-V                                                                              | 25AFMDPLAN506A | Real Estate Development and Management | 3            |
| SEM-V                                                                              | 25AFMDPLAN506B | Planning Legislation                   | 3            |
| SEM-VI                                                                             | 25AFMDPLAN606A | Disaster Mitigation and Management     | 3            |
| SEM- VI                                                                            | 25AFMDPLAN606B | Project Management                     | 3            |
| SEM-VII                                                                            | 25AFMDPLAN706A | Sustainable Building Planning          | 3            |
| SEM-VII                                                                            | 25AFMDPLAN706B | Appropriate Building Technologies      | 3            |
| <b>MINIMUM CREDITS REQUIRED TO COMPLETE A MINOR DEGREE IN PLANNING ENGINEERING</b> |                |                                        | <b>14</b>    |

***Dr. Babasaheb Ambedkar Technological University, Lonere***

## Teaching & Evaluation Scheme for Third Year B. Tech. Civil Engineering

| Sr. No.    | Course Code    | Course Title                                      | Teaching Scheme |   |   | Evaluation Scheme |     |     |       | Credits |
|------------|----------------|---------------------------------------------------|-----------------|---|---|-------------------|-----|-----|-------|---------|
|            |                |                                                   | L               | T | P | ISE               | MSE | ESE | Total |         |
| Semester-V |                |                                                   |                 |   |   |                   |     |     |       |         |
| 1          | 26AF1191PC501  | Structural Mechanics-II                           | 3               | 0 | 0 | 20                | 20  | 60  | 100   | 3       |
| 2          | 26AF1191PC502  | Design of Steel Structures                        | 3               | 0 | 0 | 20                | 20  | 60  | 100   | 3       |
| 3          | 26AF1191PC503  | Open Channel Flow & Hydraulics Machines           | 3               | 0 | 0 | 20                | 20  | 60  | 100   | 3       |
| 4          | 26AF1191PC504  | Geotechnical Engineering                          | 3               | 0 | 0 | 20                | 20  | 60  | 100   | 3       |
| 5          | 26AF1ARPOE05   | OPEN ELECTIVE-III                                 | 3               | 0 | 0 | 20                | 20  | 60  | 100   | 3       |
| 6          | Refer Bucket   | Multi-Disciplinary Minor-III                      | 3               | 0 | 0 | 20                | 20  | 60  | 100   | 3       |
| 7          | 26AF1191PCL507 | Design of Steel Structures Lab                    | 0               | 0 | 2 | 50                | -   | 50  | 100   | 1       |
| 8          | 26AF1191PCL508 | Open Channel Flow & Hydraulics Machines Lab       | 0               | 0 | 2 | 25                | -   | 25  | 50    | 1       |
| 9          | 26AF1191PCL509 | Geotechnical Engineering Lab                      | 0               | 0 | 2 | 25                | -   | 25  | 100   | 1       |
| 10         | 26AF1191HM510  | Soft Skills Development                           | 0               | 2 | 0 | -                 | -   | -   | AU    | GR      |
| 11         | 26AF1191VS511  | Construction Equipment and Site Safety Management | 2               | 0 | 0 | 50                | -   | 25  | 75    | 2       |
| TOTAL      |                |                                                   | 20              | 2 | 6 | 270               | 120 | 485 | 875   | 23      |

| Course Type          | Course Code    | Course Name                        |  | Course Type                  | Course Code    | Course Name                      |
|----------------------|----------------|------------------------------------|--|------------------------------|----------------|----------------------------------|
| Program Elective-I   | 26AF1191PE602A | Hydraulics Structures              |  | Open elective-III            | 26AF1ARPOEM05O | Geomatics Engineering            |
|                      | 26AF1191PE602B | Dams and Reservoirs                |  |                              | 26AF1ARPOEM05P | Ground Improvement Techniques    |
| Program Elective-II  | 26AF1191PE603A | Water Quality Engineering          |  |                              | 26AF1ARPOEM05Q | Sustainable Construction Methods |
|                      | 26AF1191PE603B | Environment Health and Safety      |  | Multi-Disciplinary Minor-III | Refer Bucket   | Refer Bucket                     |
| Program Elective-III | 26AF1191PE604A | Highway & Railway Engineering      |  | Multi-Disciplinary Minor-IV  | Refer Bucket   | Refer Bucket                     |
|                      | 26AF1191PE604B | Intelligent Transportation Systems |  |                              |                |                                  |
|                      | 26AF1191PE604C | Traffic Engineering & Management   |  |                              |                |                                  |

### Type of course:

|                                                          |                                                          |
|----------------------------------------------------------|----------------------------------------------------------|
| Basic Science: <b>BS</b>                                 | Engineering Science: <b>ES</b>                           |
| Program Elective: <b>PE</b>                              | Program Core: <b>PC</b>                                  |
| Modern Indian Language: <b>MIL</b>                       | Indian Knowledge System: <b>IK</b>                       |
| Value Education Course: <b>VEC</b>                       | Ability Enhancement Course: <b>AE</b>                    |
| Vocational and Skill Enhancement: <b>VS</b>              | Audit Course: <b>AU</b>                                  |
| Open Elective: <b>OE</b> (Other than particular program) | Co-curricular & Extracurricular Activities: <b>CC</b>    |
| Multidisciplinary Courses: <b>MD</b>                     | Humanities, Management, language and Commerce: <b>HM</b> |

# Detailed Course Contents

| SUBJECT CODE                   |          | Structural Mechanics-II |       |                            |     |     |       | CREDITS |  |
|--------------------------------|----------|-------------------------|-------|----------------------------|-----|-----|-------|---------|--|
| 26AF1191PC501                  |          |                         |       |                            |     |     |       | 3       |  |
| Teaching Work Load/week (Hrs.) |          |                         |       | Examination Scheme (Marks) |     |     |       |         |  |
| Theory                         | Tutorial | Laboratory              | Total | ISE                        | MSE | ESE | Total |         |  |
| 3                              | 0        | 0                       | 3     | 20                         | 20  | 60  | 100   |         |  |

|                                                    |                                                                                |
|----------------------------------------------------|--------------------------------------------------------------------------------|
| <b>Course Objectives:</b> Students will be able to |                                                                                |
| COBJ1                                              | To learn concept of influence line and moving load analysis                    |
| COBJ2                                              | To learn structural response behavior of bridges and arches                    |
| COBJ3                                              | To understand forced based method of structural analysis                       |
| COBJ4                                              | To understand displacement-based method of structural analysis                 |
| COBJ5                                              | To understand concepts related to finite difference and finite element methods |

|                                                                           |                                                                                                                   |
|---------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------|
| <b>Course Outcomes:</b> On completion of course, students will be able to |                                                                                                                   |
| CO1                                                                       | Have a basic understanding of concept of influence line and moving load analysis                                  |
| CO2                                                                       | Have a basic understanding of structural response behavior of bridges and arches                                  |
| CO3                                                                       | Have a detailed understanding of forced based method of structural analysis                                       |
| CO4                                                                       | Have a detailed understanding of displacement-based method of structural analysis                                 |
| CO5                                                                       | Have a basic understanding of the principles and concepts related to finite difference and finite element methods |

## Course Contents

Application of all methods shall be restricted to beams, Frames and /or pin jointed frames or trusses of Degree of Indeterminacy up to three.

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                              |               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|---------------|
| <b>Module 1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>Analysis of trusses</b>                   | <b>Hrs. 6</b> |
| <p>Analysis of determinate and indeterminate pin jointed trusses by energy method, effects of settlement and pre-strains.</p> <p><b>Moving Loads and Influence Lines-</b> Introduction to moving loads, concept of equivalent UDL, absolute maximum bending moment and shear force, concept of influence lines, influence lines for reaction, shear force, bending and deflection of determinate beams, influence line diagram (ILD) for forces in determinate frames and trusses, analysis for different types of moving loads, single concentrated load, several concentrated loads, uniformly distributed load shorter and longer than span, application of Muller Breslau principle for determinate structures to construct ILD.</p> |                                              |               |
| <b>Module 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>Cables, Suspension Bridges and Arches</b> | <b>Hrs. 8</b> |
| <p>Analysis of forces in cables, suspension bridges with three hinged and two hinged stiffening girders, theory of arches, Eddy's theorem, circular, parabolic and geometric arches, concept of radial shear force and axial thrust, analysis of three hinged and two hinged arches, effect of yielding of supports, rib shortening and temperature changes. ILD for 3 hinged arches and suspension bridges.</p>                                                                                                                                                                                                                                                                                                                         |                                              |               |

|                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                          |               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------|---------------|
| <b>Module 3</b>                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>Analysis of Indeterminate Structures by direct Flexibility Method</b> | <b>Hrs. 8</b> |
| Fundamental concepts of flexibility method of analysis, flexibility coefficients and their use in formulation of compatibility equations, application of above methods to propped cantilevers, fixed beams, continuous beams, simple pin jointed frames including effect of lack of members, rigid jointed frames.                                                                                                                       |                                                                          |               |
| <b>Module 4</b>                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>Analysis of Indeterminate Structures by direct Stiffness Method</b>   | <b>Hrs. 9</b> |
| Fundamental concepts of stiffness method of analysis, stiffness coefficients for prismatic members and their use for formulation of equilibrium equation, applications of the above methods to indeterminate beams and simple rigid jointed frames, rigid jointed frames with inclined member but having only one translational DoF in addition to rotational DoF's, including the effect of settlement of supports, pin jointed frames. |                                                                          |               |
| <b>Module 5</b>                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>Finite Element Method (Contents to conceptual level)</b>              | <b>Hrs. 9</b> |
| Introduction to analysis by discretization such as finite difference method, Finite element method: types of elements-1D, 2D, 3D, Plane Strain and Plane Stress Problem, isoperimetric and axisymmetric, convergence criteria, Pascal's triangle, direct stiffness method, principle of minimum potential energy. Shape functions, concept of local and global stiffness matrix                                                          |                                                                          |               |

|                         |                                                                                                                                                                                                                   |
|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Text Books:</b>      |                                                                                                                                                                                                                   |
| <b>1</b>                | Reddy C. S., “Basic Structural Analysis”, Tata McGraw Hill                                                                                                                                                        |
| <b>2</b>                | Pandit G. S. and Gupta S. P., “Structural Analysis - a Matrix Approach”, Tata McGraw Hill, N.Delhi,                                                                                                               |
| <b>3</b>                | Chandrupatla T. R., Belegundu A. D., “Introduction to Finite Elements in Engineering, Prentice Hall                                                                                                               |
| <b>4</b>                | Thadani B. N. and Desai J. P., “Structural Analysis”                                                                                                                                                              |
| <b>5</b>                | Punmia B.C., “Structural Analysis”, Laxmi Publications                                                                                                                                                            |
| <b>6</b>                | Vazirani V.N., Ratwani M.M and Duggal S.K., “Analysis of Structures - Vol. II” Khanna Publishers, N. Dehli, Sadhu Singh, “Theory and Solved Problems in Adv. Strength of Materials”, Khanna Publishers, N. Dehli, |
| <b>7</b>                | Ramamrutham S. and Narayanan R., “Theory of Structures” Dhanpat Rai Publishers, Delhi                                                                                                                             |
| <b>Reference Books:</b> |                                                                                                                                                                                                                   |
| <b>1</b>                | Norris C. H. and Wilbur J. B., “Elementary Structural Analysis”, McGraw Hill                                                                                                                                      |
| <b>2</b>                | Beaufait F.W., “Basic Concepts of Structural Analysis”, Prentice Hall, N.J. Kinney J. S., “Indeterminate Structural Analysis”, Oxford and IBH                                                                     |
| <b>3</b>                | Krishnamurthy, C.S., “Finite Element Analysis – Theory and Programing”, Tata McGraw Hill                                                                                                                          |
| <b>4</b>                | Hibbler R. C., “Structural Analysis”, Pearson Publications                                                                                                                                                        |
| <b>5</b>                | Kanchi M. B., “Matrix Methods of Structural Analysis”, Wiley Eastern Ltd., N. Delhi                                                                                                                               |
| <b>6</b>                | Wang C. K., “Matrix Methods of Structural Analysis”, International Text-book, Scranton, Pennsylvania,                                                                                                             |
| <b>7</b>                | Gere J.M., Weaver W., “Analysis of Framed Structures”, D. Van Nostrand Company, Inc.                                                                                                                              |

|                                |          |                            |       |                            |     |     |         |  |
|--------------------------------|----------|----------------------------|-------|----------------------------|-----|-----|---------|--|
| SUBJECT CODE                   |          | Design of Steel Structures |       |                            |     |     | CREDITS |  |
| 26AF1191PC502                  |          |                            |       |                            |     |     | 3       |  |
| Teaching Work Load/week (Hrs.) |          |                            |       | Examination Scheme (Marks) |     |     |         |  |
| Theory                         | Tutorial | Laboratory                 | Total | ISE                        | MSE | ESE | Total   |  |
| 3                              | 0        | 0                          | 3     | 20                         | 20  | 60  | 100     |  |

**Pre-requisite: Engineering Mechanics, Mechanics of Solids**

|                                                    |                                                                                                                                  |
|----------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|
| <b>Course Objectives:</b> Students will be able to |                                                                                                                                  |
| COBJ1                                              | To impart knowledge of steel structural systems, material properties, loading conditions, and design philosophies.               |
| COBJ2                                              | To introduce the principles of Working Stress Method and Limit State Method for steel structure design.                          |
| COBJ3                                              | To familiarize students with the analysis and design of riveted, bolted, and welded connections.                                 |
| COBJ4                                              | To develop the ability to design tension members, compression members, columns, and flexural members as per codal provisions.    |
| COBJ5                                              | To enable students to apply plastic analysis concepts and modern steel design practices for structural engineering applications. |

|                                                                           |                                                                                                                |
|---------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|
| <b>Course Outcomes:</b> On completion of course, students will be able to |                                                                                                                |
| CO1                                                                       | Explain the fundamentals of steel structures, design philosophies, and codal provisions for structural design. |
| CO2                                                                       | Design riveted, bolted, and welded connections using Working Stress and Limit State approaches.                |
| CO3                                                                       | Design axially loaded tension and compression members, including built-up columns and their components.        |
| CO4                                                                       | Analyze and design laterally supported and unsupported steel beams subjected to bending and shear.             |
| CO5                                                                       | Apply Limit State Method and basic plastic analysis concepts in the design of steel structural elements.       |

## Course Contents

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                |               |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|---------------|
| <b>Module 1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>Introduction of Working Stress Method and Design of Connections</b>         | <b>Hrs. 8</b> |
| <p>Introduction, types of steel structures, grades of structural steel, various types of loads acting on steel structures, advantages/disadvantages of steel structures, working stress and limit state design philosophy.</p> <p>Introduction to Working State Method to design of steel structures, relevance to other materials such as timber, masonry, soil, fluid, concrete, modern materials stainless steel, aluminum, composites etc. permissible stresses, concept of factor of safety.</p> <p>Riveted and bolted connections, Welded connections-assumptions, types, design of fillet welds, intermittent fillet weld, failure of welded joints, welded joints vs bolted and riveted joints.</p> |                                                                                |               |
| <b>Module 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>Working Stress Design of Axially Loaded Members and Compression Members</b> | <b>Hrs. 6</b> |
| <p>Tension members: Common sections, net effective area, load capacity, connection using weld / bolts.</p> <p>Compression members: Common sections used, effective length and slenderness ratio, permissible stresses, load carrying capacity,</p> <p>Design of columns subjected to axial and eccentric loading, design of built-up columns, design of lacing, battening</p>                                                                                                                                                                                                                                                                                                                               |                                                                                |               |

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| <b>Module 3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>Working Stress Design of Flexural Members and Introduction to Plastic Analysis</b>  | <b>Hrs. 6</b> |
| Types of c/s, lateral stability of beams, lateral torsional buckling, bending and shear strength design procedure for laterally supported and unsupported beams, design of basic cross-section for plate girders<br>Introduction to Plastic Analysis: Hinge Formation, Collapse Mechanism, Approaches in Steel Structure design based on Plastic Analysis Method                                                                                                      |                                                                                        |               |
| <b>Module 4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>Introduction to Limit State Method and Design of Connections</b>                    | <b>Hrs.8</b>  |
| Introduction to Limit state design method, limit states of strength and serviceability, probabilistic basis for design, the partial safety factor for load and resistance, various design load combinations,<br>Provisions in IS 800:2007 for Design of Welded and bolted connections, design of fillet welds, failure of welded joints, design of bolted joints, treatment for axially loaded and eccentric connections                                              |                                                                                        |               |
| <b>Module 5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>Limit State Approach to design of axially loaded members &amp; Flexural Members</b> | <b>Hrs. 8</b> |
| Design of axially loaded tension members, axially loaded compression members, Design of columns subjected to axial and eccentric loading, bending and shear strength design procedure for laterally supported beams                                                                                                                                                                                                                                                   |                                                                                        |               |
| <b>Notes: 1)</b> Contents in Module 1 to part of 3 shall be taught with help of relevant text or reference books based on elastic design concept, IS 800: 1984. Contents in Module 4 & 5 shall be taught with help of relevant text or reference books based on limit state design concept as per IS 800: 2007.<br><b>2)</b> Use of IS 800: 1984 and 2007, IS 875 (All Parts), IS: Handbook No.1 for Steel Section & Steel Table is permitted for theory examination. |                                                                                        |               |

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|-------------------------|-------------------------------------------------------------------------------------------------------|
| <b>Text Books:</b>      |                                                                                                       |
| <b>1</b>                | Duggal S. K., “Design of Steel Structures”, Tata McGraw Hill Pub. Co. Ltd., New Delhi                 |
| <b>2</b>                | Gambhir, “Fundamentals of Structural Steel Design”, Tata McGraw Hill Pub. Co. Ltd., New Delhi         |
| <b>3</b>                | Negi L. S., “Design of Steel Structures”, Tata McGraw Hill Pub. Co. Ltd., New Delhi                   |
| <b>4</b>                | Chandra Ram, “Design of Steel Structures”, Vol. I & Vol. II, Standard Book House, New Delhi           |
| <b>5</b>                | Dayaratnam P., “Design of Steel Structures”, Wheeler Publishing, New Delhi                            |
| <b>6</b>                | Subramanian N., “Steel Structures: Design and Practice” Oxford Univ. Press, Delhi                     |
| <b>7</b>                | Vazirani V.N. and Ratwani M.M., “Design and Analysis of Steel Structures”                             |
| <b>8</b>                | Sai Ram K. S., “Design of Steel Structures”, Pearson Education, 2nd Edition                           |
| <b>Reference Books:</b> |                                                                                                       |
| <b>1</b>                | Arya A. S. and Ajamani J.L., “Design of Steel Structures”, Nemchand and Brothers, Roorkee             |
| <b>2</b>                | Vazirani&Ratwani, “Design of Steel Structures”, Standard Book House, New Delhi                        |
| <b>3</b>                | Duggal S. K., “Limit State Design of Steel Structures”, Tata McGraw Hill Pub. Co. Ltd., New Delhi     |
| <b>4</b>                | Publications of Bureau of Indian Standards, New Delhi, IS 800:1984, IS 800:2007, IS 875 (Part I to V) |
| <b>5</b>                | Gaylord E.H. and Gaylord C.N., “Design of Steel Structures” McGraw Hill, New York                     |
| <b>6</b>                | Lothers J.E., “Design in Structural Steel” Vol.-I, Prentice Hall New Jersey                           |
| <b>7</b>                | Salmon and Johnson, “Steel Structures: Design and Behaviour”, Harper and Row, New York                |
| <b>8</b>                | Steel Designers Manual.                                                                               |

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|--------------------------------|----------|-----------------------------------------|-------|----------------------------|-----|-----|---------|--|
| SUBJECT CODE                   |          | Open Channel Flow & Hydraulics Machines |       |                            |     |     | CREDITS |  |
| 26AF1191PC503                  |          |                                         |       |                            |     |     | 3       |  |
| Teaching Work Load/week (Hrs.) |          |                                         |       | Examination Scheme (Marks) |     |     |         |  |
| Theory                         | Tutorial | Laboratory                              | Total | ISE                        | MSE | ESE | Total   |  |
| 3                              | 0        | 0                                       | 3     | 20                         | 20  | 60  | 100     |  |

| Course Objectives |                                                                                    |
|-------------------|------------------------------------------------------------------------------------|
| COBJ1             | To understand the fundamentals of flow in open channels and discharge measurement. |
| COBJ2             | To study uniform flow and design of efficient channel sections.                    |
| COBJ3             | To learn the concepts and analysis of non-uniform flow in open channels.           |
| COBJ4             | To understand the impact of jets and working of hydraulic turbines.                |
| COBJ5             | To study the classification, working, and performance of pumps.                    |

| Course Outcomes: Students will be able to |                                                                                 |
|-------------------------------------------|---------------------------------------------------------------------------------|
| CO1                                       | Explain different types of open channel flow and discharge measurement methods. |
| CO2                                       | Apply Chezy's and Manning's equations for uniform flow analysis.                |
| CO3                                       | Analyze gradually varied flow and channel surface profiles.                     |
| CO4                                       | Understand the impact of jets and velocity relationships in hydraulic machines. |
| CO5                                       | Describe the working, performance, and selection of different types of pumps.   |

## Course Contents

| Module 1                                                                                                                                                                                                                                                                                                                                                                                       | Flow in Open Channel             | Hrs.8 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------|-------|
| Introduction, Types of channels, Types of flow in open channels, Geometric properties of open channel, Velocity distribution, Measurement of velocity-pitot tube and current meter, Weirs and notches- Flow over sharp, broad, round crested weir or notch, Calibration of weir, Ogee and Siphon spillway, Empirical formulae for discharge over weir, Time required to empty a reservoir.     |                                  |       |
| Module 2                                                                                                                                                                                                                                                                                                                                                                                       | Uniform Flow and Specific Energy | Hrs.6 |
| Uniform Flow- Chezy's and Manning's equation, Most efficient channel section-design and consideration, computation of uniform flow.<br><br>Specific Energy- Specific energy and critical depth, Specific energy curve, Concept of critical, sub-critical and super-critical flows, Criteria for critical state of flow, Critical flow and its computation, specific force, specific discharge. |                                  |       |
| Module 3                                                                                                                                                                                                                                                                                                                                                                                       | Non-uniform Flow in Open Channel | Hrs.6 |
| Gradually Varied Flow- Dynamic equation of gradually varied flow and conditions, Classification of channel bottom slopes, Classification and characteristics of surface profiles with practical examples, Step method of integration of varied flow equation.<br><br>Rapidly Varied Flow- Concept of rapidly varied flow-examples, Hydraulic jump- equation, computation of                    |                                  |       |

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|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|--------------|
| energy losses, relation between initial and sequent depths, Location of hydraulic jump, Classification of hydraulic jump, Uses, Surges in open channels.                                                                                                                                                                                                                                                                                                                                              |                                             |              |
| <b>Module 4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>Impact of Jet and Hydraulic Turbines</b> | <b>Hrs.6</b> |
| <p>Impact of Jet- Impulse momentum principle, Impact of jet on flat and curved vanes (Stationary and Moving), Inlet and outlet velocity triangles under various conditions, Series of Flat and Curved vanes mounted on wheel.</p> <p>Hydraulic Turbines- Elements of hydroelectric power plants, Classification of turbines, Working principle and basic design of Pelton wheel, Francis and Kaplan turbines, Performance of turbines, Selection of turbines, Cavitation in turbines, Draft tube.</p> |                                             |              |
| <b>Module 5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>Pumps</b>                                | <b>Hrs.6</b> |
| <p>Classification of pumps, Components and working of reciprocating and centrifugal pump, Performance of pumps, Selection of pumps under various conditions, Condition of self-priming, Introduction to different types of pumps- Multi-stage, Jet, Air lift, Submersible pump.</p>                                                                                                                                                                                                                   |                                             |              |

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|-------------------------|----------------------------------------------------------------------------------------------------|
| <b>Text Books:</b>      |                                                                                                    |
| <b>1</b>                | Hydraulics and Fluid Mechanics including Hydraulics Machines by Dr. P. N. Modi and Dr. S. M. Seth. |
| <b>2</b>                | A Textbook of Fluid Mechanics and Hydraulic Machines by Dr. R. K. Bansal, Laxmi Publications.      |
| <b>3</b>                | Flow in open channels by K. Subramanya, McGraw-Hill Higher Education.                              |
| <b>4</b>                | Open channel hydraulics by Ven Te Chow, McGraw-Hill Book Company.                                  |
| <b>5</b>                | Fluid Mechanics by K. L. Kumar, S. Chand publication. ISBN: 81-219-0100-6                          |
| <b>6</b>                | A Textbook of Hydraulics Engineering by N.H. Kulkarni, TECHSAR Publications.                       |
| <b>Reference Books:</b> |                                                                                                    |
| <b>1</b>                | Fluid Mechanics including Hydraulic Machines by A. K. Jain, Khanna Publishers.                     |
| <b>2</b>                | Introduction To Fluid Mechanics by Philip J. Pritchard, John Wiley & Sons, INC.                    |
| <b>3</b>                | Introduction to Fluid Mechanics & Fluid Machines by S. K. Som & G. Biswas, Tata McGraw-Hill.       |
| <b>4</b>                | Fluid Dynamics by V. L. Streeter, K. W. Bedford and E. B. Wylie, New York, McGraw-Hill.            |

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|--------------------------------|----------|--------------------------|-------|----------------------------|-----|-----|---------|--|
| SUBJECT CODE                   |          | Geotechnical Engineering |       |                            |     |     | CREDITS |  |
| 26AF1191PC504                  |          |                          |       |                            |     |     | 3       |  |
| Teaching Work Load/week (Hrs.) |          |                          |       | Examination Scheme (Marks) |     |     |         |  |
| Theory                         | Tutorial | Laboratory               | Total | ISE                        | MSE | ESE | Total   |  |
| 3                              | 0        | 0                        | 3     | 20                         | 20  | 60  | 100     |  |

| Course Objectives |                                                                    |
|-------------------|--------------------------------------------------------------------|
| COBJ1             | To understand the index properties of soil and its classification. |
| COBJ2             | To study the mechanics of compaction and clay mineralogy.          |
| COBJ3             | To learn the concept of permeability and dewatering.               |
| COBJ4             | To know how to evaluate the quantity of seepage discharge.         |
| COBJ5             | To study the shear strength of soil                                |
| COBJ6             | To understand the stress distribution & consolidation of soil      |

| Course Outcomes: Students will be able to |                                                                                  |
|-------------------------------------------|----------------------------------------------------------------------------------|
| CO1                                       | Classify soil based on index properties of soil.                                 |
| CO2                                       | Explain the principal of compaction and demonstrate quality control in field.    |
| CO3                                       | Determine the permeability of soil and explain methods of dewatering.            |
| CO4                                       | Evaluate the quantity of seepage discharge and design criteria of graded filter. |
| CO5                                       | Measure the shear strength of different types of soil using various methods.     |

## Course Contents

| Module 1                                                                                                                                                                                                                                                                                                                                 | Introduction                        | Hrs. 10 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|---------|
| History of development of soil mechanics, formation of soil, its significance to the field problems. Soil properties and its classification, Definition of soil, soil as a three-phase system, weight volume relationship, Index properties of course and fine-grained soil, BIS classification of fine grained and coarse-grained soil. |                                     |         |
| Module 2                                                                                                                                                                                                                                                                                                                                 | Compaction of Soil                  | Hrs. 7  |
| Mechanics of compaction, factors affecting compaction, standard and modified Proctor test, their field Determination, zero air void line, concept of wet of optimum and dry of optimum, different structures of soil, field compaction and their control, CBR test and CBR values for soaked and unsoaked conditions.                    |                                     |         |
| Module 3                                                                                                                                                                                                                                                                                                                                 | Permeability of Soil                | Hrs. 7  |
| Darcy's law and its validity, discharge and seepage velocity, factors affecting permeability, determination of coefficient of permeability in laboratory and field, permeability for stratified soil deposits, drainage and dewatering of soil and its various methods.                                                                  |                                     |         |
| Module 4                                                                                                                                                                                                                                                                                                                                 | Shear Strength and Seepage Analysis | Hrs. 10 |
| A physical concept of shear strength, introduction of Mohr's stress diagram, Mohr's failure criteria, Mohr-Coulomb's theory and development of failure envelopes, unconfined compression test, laboratory measurement of shear                                                                                                           |                                     |         |

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| strength for different drainage conditions by direct shear test, triaxial test, merits and demerits of various shear strength tests. Laplace equation and its derivation in Cartesian coordinate system, its application for the computation of discharge seepage, seepage pressure, quick sand condition, concept of flow net, characteristics and uses of flow net, preliminary problem of discharge, estimation of discharge through homogenous earthen embankment, Terzaghi's design criteria for graded filter, concept of piping and criteria of stability against piping |                          |               |
| <b>Module 5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>Stresses in soils</b> | <b>Hrs. 7</b> |
| State of stress at a point, stress distribution in soil mass, Boussinesq's theory and its applications, point load and uniformly loaded area, Newmark's Influence Chart, its preparation and use. Consolidation of Soil: Definition, Spring analogy, Terzaghi's theory of one-dimensional consolidation, Consolidometer test,                                                                                                                                                                                                                                                   |                          |               |

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|-------------------------|-------------------------------------------------------------------------------------------------------|
| <b>Text Books:</b>      |                                                                                                       |
| <b>1</b>                | Kasamalkar B. J., "Geotechnical Engineering", Pune Vidyarthi Griha Prakashan Pune                     |
| <b>2</b>                | Murthy V.N.S., "Soil Mechanics & Foundation Engineering", U.B.S. Publishers and Distributors N. Delhi |
| <b>3</b>                | Punmia B.S., "Soil Mechanics & Foundation Engineering", Laxmi Publications                            |
| <b>4</b>                | Arora K. R., "Soil Mechanics" Standard Publishers, N. Delhi                                           |
| <b>5</b>                | Dr. B.C.Punmia A.K.Jain, "Soil Mechanics and Foundations" Laxmi Publications(P)Ltd                    |
| <b>6</b>                | Gopal R Rao "Basic Soil Mechanics "                                                                   |
| <b>Reference Books:</b> |                                                                                                       |
| <b>1</b>                | Alam Singh, "Text book of soil mechanics in theory and practice", Asian Pub. House, Mumbai            |
| <b>2</b>                | Taylor D.W., "Fundamentals of Soil mechanics"                                                         |
| <b>3</b>                | Terzaghi and Peak "Soil mechanics" John Willey and Sons, New-York                                     |
| <b>4</b>                | Scott R. F., "Principal of soil mechanics"                                                            |
| <b>5</b>                | Lambe T.W, "Soil Testing" by Willey Eastern Ltd., New Delhi                                           |

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|--------------------------------|-----------------------|------------|-------|----------------------------|-----|-----|---------|
| SUBJECT CODE                   | OPEN ELECTIVE-III     |            |       |                            |     |     | CREDITS |
| 26AF1ARPOEM05O                 | Geomatics Engineering |            |       |                            |     |     | 3       |
| Teaching Work Load/week (Hrs.) |                       |            |       | Examination Scheme (Marks) |     |     |         |
| Theory                         | Tutorial              | Laboratory | Total | ISE                        | MSE | ESE | Total   |
| 3                              | 0                     | 0          | 3     | 20                         | 20  | 60  | 100     |

| Course Objectives |                                                                                                                 |
|-------------------|-----------------------------------------------------------------------------------------------------------------|
| COBJ1             | To introduce the fundamentals and principles of remote sensing.                                                 |
| COBJ2             | To understand image interpretation and digital image processing techniques.                                     |
| COBJ3             | To learn the concepts and implementation of spatial databases and spatial analysis.                             |
| COBJ4             | To comprehend the components, functions, and applications of GIS.                                               |
| COBJ5             | To explore the implementation steps and real-life applications of GIS in civil engineering and related domains. |

| Course Outcomes: On completion of course, students will be able to |                                                                                                         |
|--------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|
| CO1                                                                | Explain the principles and components of remote sensing systems and satellite platforms.                |
| CO2                                                                | Perform visual and digital interpretation of remotely sensed data for terrain analysis.                 |
| CO3                                                                | Apply spatial database concepts and analysis techniques for data management and decision-making.        |
| CO4                                                                | Understand the fundamentals and operational principles of GIS, including data models and projections.   |
| CO5                                                                | Analyze and implement GIS applications in civil engineering, planning, hazard assessment, and business. |

## Course Contents

| Module 1                                                                                                                                                                                                                                                                                                                      | Concepts of Remote Sensing                                    | Hrs. 8 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|--------|
| Basics of remote sensing, elements involved, electromagnetic spectrum<br>Terminology & units, energy resources, energy interactions with Earth surface & atmosphere<br>Atmospheric effects, Remote sensing platforms and sensors, satellite orbits, sensor resolutions, types of sensors, IRS, and Landsat satellites series. |                                                               |        |
| Module 2                                                                                                                                                                                                                                                                                                                      | Remote Sensing Data Interpretation & Digital Image Processing | Hrs. 8 |
| Visual interpretation techniques, elements, converging evidence, Spectral signature, Spectral properties of soil, water, vegetation, Digital image and properties, Concepts of digital image processing, image enhancement, Pattern recognition, classification techniques, and accuracy estimation.                          |                                                               |        |
| Module 3                                                                                                                                                                                                                                                                                                                      | Spatial DBMS & Analysis                                       | Hrs. 8 |
| Spatial DBMS: data storage, DBMS structure models, Entity Relationship model, normalization.<br>Spatial Analysis: topology, vector & raster data analysis, network analysis, Data interpolation techniques, data input: keyboard, digitization, scanning, remotely sensed data.                                               |                                                               |        |

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|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|---------------|
| <b>Module 4</b>                                                                                                                                                                                                                                                                                                                                                        | <b>Introduction to GIS</b>                 | <b>Hrs. 8</b> |
| History and components of GIS, applications and integration of remote sensing, Nature of geographic data, types of maps and scales, Map projections, coordinate systems, geo-referencing, map transformation, Thematic mapping for various applications.                                                                                                               |                                            |               |
| <b>Module 5</b>                                                                                                                                                                                                                                                                                                                                                        | <b>Implementing a GIS and Applications</b> | <b>Hrs. 8</b> |
| Implementing a GIS: Awareness, developing system requirements, evaluation of alternative systems, decision making using GIS. Applications of GIS: GIS-based road network planning, Mineral mapping using GIS, Shortest path detection using GIS, Hazard Zonation using remote sensing and GIS, GIS for solving multi-criteria problems, GIS for business applications. |                                            |               |

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| <b>Text Books:</b>      |                                                                                                                                                         |
| <b>1</b>                | Remote Sensing and GIS by Basudeb Bhatta, Oxford University Press, 2 <sup>nd</sup> Edition, 2011.                                                       |
| <b>2</b>                | Introduction to Geographic Information Systems by Kang-Tsung Chang, McGraw-Hill Education (Indian Edition), 7 <sup>th</sup> Edition, 2015.              |
| <b>3</b>                | Fundamentals of Geographic Information Systems by Michael N. Demers, 4 <sup>th</sup> Edition, Wiley Publishers, 2012.                                   |
| <b>4</b>                | Textbook of Remote Sensing and Geographical Information Systems by M. Anji Reddy.                                                                       |
| <b>Reference Books:</b> |                                                                                                                                                         |
| <b>1</b>                | Remote Sensing and Image Interpretation by Thomas M. Lillesand and Ralph W. Kiefer, Wiley Publishers, 7 <sup>th</sup> Edition, 2015.                    |
| <b>2</b>                | Geographic Information systems – An Introduction by Tor Bernhardsen, Wiley India Publication, 3 <sup>rd</sup> Edition, 2010.                            |
| <b>3</b>                | Advanced Surveying: Total Station, GIS and Remote Sensing by Satheesh Gopi, R. Sathi Kumar, N. Madhu, Pearson Education, 1 <sup>st</sup> Edition, 2007. |

| SUBJECT CODE                   |          | OPEN ELECTIVE-III             |       |                            |     |     |       | CREDITS |
|--------------------------------|----------|-------------------------------|-------|----------------------------|-----|-----|-------|---------|
| 26AF1ARPOEM05P                 |          | Ground Improvement Techniques |       |                            |     |     |       | 3       |
| Teaching Work Load/week (Hrs.) |          |                               |       | Examination Scheme (Marks) |     |     |       |         |
| Theory                         | Tutorial | Laboratory                    | Total | ISE                        | MSE | ESE | Total |         |
| 3                              | 0        | 0                             | 3     | 20                         | 20  | 60  | 100   |         |

| Course Objectives |                                                                                                                                                                               |
|-------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| COBJ1             | Understand the Need for Ground Improvement: Recognize the necessity and scope of ground improvement in geotechnical engineering projects.                                     |
| COBJ2             | Explore Dewatering Techniques: Learn various methods for lowering groundwater and their applications in soil stabilization.                                                   |
| COBJ3             | Analyze Compaction Methods: Investigate in-situ compaction techniques for both granular and cohesive soils, and assess factors influencing compaction.                        |
| COBJ4             | Evaluate Drainage and Consolidation Aids: Study the function and design of sand drains, wick drains, and related methods for soil strengthening and settlement reduction.     |
| COBJ5             | Understand Reinforcement Techniques: Learn the principles of earth reinforcement, geotextiles, and their practical applications in filtration, drainage, and erosion control. |

| Course Outcomes: Students will be able to |                                                                                                                                                           |
|-------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO1                                       | Explain the principles and methods of dewatering and groundwater control in soil stabilization                                                            |
| CO2                                       | Identify and apply various compaction techniques and evaluate their effectiveness for different soil types.                                               |
| CO3                                       | Design stone columns, lime piles, root piles, and understand soil nailing techniques for slope stability and liquefaction mitigation.                     |
| CO4                                       | Apply the principles of reinforced earth design and select appropriate geosynthetics for engineering applications.                                        |
| CO5                                       | Distinguish between types of grout and grouting methods; design grouting systems for specific geotechnical issues including expansive soil stabilization. |

## Course Contents

| Module 1                                                                                                                                                                                                                                                                                                                                         | Dewatering: Introduction   | Hrs. 8 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|--------|
| Scope and necessity of ground improvement in Geotechnical engineering basic concepts. Drainage – Ground Water lowering by well points, deep wells, vacuum and electroosmotic methods. Stabilization by thermal and freezing techniques - Applications.                                                                                           |                            |        |
| Module 2                                                                                                                                                                                                                                                                                                                                         | Compaction and Sand Drains | Hrs. 6 |
| Insitu compaction of granular and cohesive soils, Shallow and Deep compaction methods – Sand piles – Concept, design, factors influencing compaction. Blasting and dynamic consolidation – Preloading with sand drains, fabric drains, wick drains etc. – Theories of sand drain – design and relative merits of various methods – Case studies. |                            |        |

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|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------|---------------|
| <b>Module 3</b>                                                                                                                                                                                                                                                                             | <b>Stone Column, Lime Piles and Soil Nailing</b> | <b>Hrs. 5</b> |
| Stone column, lime piles – Functions – Methods of installation– design, estimation of load carrying capacity and settlement. Root piles and soil nailing – methods of installation – Design and Applications - Soil liquefaction mitigation methods - case studies.                         |                                                  |               |
| <b>Module 4</b>                                                                                                                                                                                                                                                                             | <b>Earth Reinforcement</b>                       | <b>Hrs. 4</b> |
| Earth reinforcement – Principles and basic mechanism of reinforced earth, simple design: Synthetic and natural fiber-based Geotextiles and their applications. Filtration, drainage, separation, erosion control – case studies.                                                            |                                                  |               |
| <b>Module 5</b>                                                                                                                                                                                                                                                                             | <b>Grouting</b>                                  | <b>Hrs. 4</b> |
| Grouting – Types of grouts – Suspension and solution grouts – Basic requirements of grout. Grouting equipment – injection methods – jet grouting – grout monitoring – Electro – Chemical stabilization – Stabilization with cement, lime - Stabilization of expansive clays – case studies. |                                                  |               |

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|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Text Books:</b>      |                                                                                                                                                              |
| <b>1</b>                | Pappala, A.J., Huang,J., Han, J., and Hoyos, L.R., "Ground Improvement and Geosynthetics; Geotechnical special publication No.207, Geo Institute, ASCE, 2010 |
| <b>2</b>                | Cox, B.R., and Griffiths S.C., "Practical Recommendation for Evaluation and mitigation of Soil Liquefaction" in Arkansas, (Project Report), 2010.            |
| <b>3</b>                | Day, R.W., "Foundation Engineering Handbook, McGraw – Hill Companies, Inc. 2006.                                                                             |
| <b>4</b>                | Rowe, R.K., "Geotechnical and Geoenvironmental Engineering Handbook, Kluwer Academic Publishers, 2001.                                                       |
| <b>5</b>                | Das, B.M., "Principles of Foundation Engineering, Fourth Edition, PWS Publishing, 1999.                                                                      |
| <b>Reference Books:</b> |                                                                                                                                                              |
| <b>1</b>                | Moseley, M.P., "Ground Treatment, Blackie Academic and Professionals, 1998.                                                                                  |
| <b>2</b>                | Koerner, R.M., "Designing with Geosynthetics, Third Edition, Prentice Hall 1997.                                                                             |
| <b>3</b>                | Hehn, R.W., "Practical Guide to Grouting of Underground Structures, ASCE, 1996                                                                               |
| <b>4</b>                | Jewell, R.A., "Soil Reinforcement with Geotextiles, CIRIA, London, 1996.                                                                                     |
| <b>5</b>                | Koerner, R.M. and Welsh, J.P., "Construction and Geotechnical Engineering using Synthetic Fabrics”                                                           |

|                                |                                  |            |       |                            |     |     |         |
|--------------------------------|----------------------------------|------------|-------|----------------------------|-----|-----|---------|
| SUBJECT CODE                   | OPEN ELECTIVE-III                |            |       |                            |     |     | CREDITS |
| 26AF1ARPOEM05Q                 | Sustainable Construction Methods |            |       |                            |     |     | 3       |
| Teaching Work Load/week (Hrs.) |                                  |            |       | Examination Scheme (Marks) |     |     |         |
| Theory                         | Tutorial                         | Laboratory | Total | ISE                        | MSE | ESE | Total   |
| 3                              | 0                                | 0          | 3     | 20                         | 20  | 60  | 100     |

|                          |                                                                                   |
|--------------------------|-----------------------------------------------------------------------------------|
| <b>Course Objectives</b> |                                                                                   |
| COBJ1                    | To introduce the concepts of sustainability in the built environment.             |
| COBJ2                    | To familiarize students with sustainable and alternative building materials.      |
| COBJ3                    | To explore eco-friendly and cost-effective construction methods and technologies. |
| COBJ4                    | To understand green building standards and regulations.                           |
| COBJ5                    | To introduce digital and smart technologies for sustainable construction.         |

|                                                  |                                                                                    |
|--------------------------------------------------|------------------------------------------------------------------------------------|
| <b>Course Outcomes: Students will be able to</b> |                                                                                    |
| CO1                                              | Explain the fundamental concepts of sustainability.                                |
| CO2                                              | Describe the properties and uses of sustainable building materials.                |
| CO3                                              | Identify suitable construction techniques and practices for sustainable buildings. |
| CO4                                              | Discuss the standards and guidelines for sustainable buildings.                    |
| CO5                                              | Comment on the role of BIM and automation in sustainable construction.             |

## Course Contents

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                               |               |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|---------------|
| <b>Module 1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>Introduction to Sustainability</b>         | <b>Hrs. 8</b> |
| Impacts of global warming, sustainability indicators - Carbon foot print, Embodied energy and carbon, sustainability analysis - Lifecycle Analysis, EIA - Concept of Green Buildings.                                                                                                                                                                                                                                                                                                                                                                                                            |                                               |               |
| <b>Module 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>Sustainable building materials</b>         | <b>Hrs. 8</b> |
| Introduction to sustainable building materials, qualities, use, examples - Natural building materials, locally available and locally manufactured materials – wood, earth, stone and lime-based materials.<br>Alternative Building Materials - Overview and definition of alternative or appropriate building materials - Alternative materials developed and promoted by government organisations like CSIR labs: CBRI and SERC, GRIHA, ASTRA (IISc), BMTPC, HUDCO and its building centers - Alternative materials developed and promoted by non-government organisations DA, Auroville, TERI. |                                               |               |
| <b>Module 3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>Sustainable methods &amp; technologies</b> | <b>Hrs. 5</b> |
| Eco friendly and low-cost techniques - Different substitute, for wall construction - Flemish Bond - Rat Trap Bond – Arches – Panels - Cavity Wall – Ferro, Cement and Ferro Concrete constructions – different pre cast members using these materials -Alternate roofing systems - Filler Slab - Composite Beam and Panel Roof -Pre-engineered and ready to use building elements - wood products -steel and plastic –Mivan technique -Contributions of agencies - Costford - Nirmithi Kendra – Habitat                                                                                          |                                               |               |

|                                                                                                                                                                                                                                                                                                                                             |                                         |               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------|---------------|
| <b>Module 4</b>                                                                                                                                                                                                                                                                                                                             | <b>Green building rating systems</b>    | <b>Hrs. 4</b> |
| Green building rating systems – Guidelines from IGBC – LEED rating system, TERI-GRIHA rating system. Codes - Energy Conservation Building Code (BEE), National Building Code. Green Building Case studies – Residential, Institutional, and Commercial. Concept of Net Zero buildings – Use of BIPV and other renewable energy in buildings |                                         |               |
| <b>Module 5</b>                                                                                                                                                                                                                                                                                                                             | <b>ICT for Sustainable Construction</b> | <b>Hrs. 4</b> |
| Building Information modeling – Introduction to BIM, concepts and benefits, BIM for construction scheduling, cost estimation and construction management. Building Automation – Concepts, components of BA, applications of BA for functional efficiency of buildings.                                                                      |                                         |               |

|                         |                                                                                                                                          |
|-------------------------|------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Text Books:</b>      |                                                                                                                                          |
| <b>1</b>                | Sustainable Building - Design Manual Pt 1 & 2, The Energy and Resources Institute, TERI, 2004                                            |
| <b>2</b>                | Automation Systems in Smart and Green Buildings (Modern Building Technology), Er. V K Jain, Khanna Publishers.                           |
| <b>3</b>                | Jagadish. K.S. Alternative Building Materials and Technologies, New age International Pvt Ltd Publishers, 2008                           |
| <b>4</b>                | Energy Conservation Building Code of India, User manual, 2007                                                                            |
| <b>5</b>                | P.K. Singh, Rainwater Harvesting: Low cost indigenous and innovative technologies, Macmillan Publishers India, 2008                      |
| <b>Reference Books:</b> |                                                                                                                                          |
| <b>1</b>                | Ross Spiegel.G, Green Building Materials A Guide to Product Selection and Specification,                                                 |
| <b>2</b>                | Traci Rose Rider, Stacy Glass, Jessica McNaughton, Understanding Green Building Materials, W.W.Norton and Company, 2011                  |
| <b>3</b>                | BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers and Contractors- Chuck Eastman, et al. |
| <b>4</b>                | Jagadish. K.S. Building with stabilised mud, I.K. International Publishing House Pvt. Limited, 2007                                      |

|                                |          |                                |       |                            |     |     |         |  |
|--------------------------------|----------|--------------------------------|-------|----------------------------|-----|-----|---------|--|
| SUBJECT CODE                   |          | Design of Steel Structures Lab |       |                            |     |     | CREDITS |  |
| 26AF1191PCL507                 |          |                                |       |                            |     |     | 1       |  |
| Teaching Work Load/week (Hrs.) |          |                                |       | Examination Scheme (Marks) |     |     |         |  |
| Theory                         | Tutorial | Laboratory                     | Total | ISE                        | MSE | ESE | Total   |  |
| 0                              | 0        | 2                              | 2     | 50                         | -   | 50  | 100     |  |

|                                                                           |                                                                                                                                                                                             |
|---------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course Outcomes:</b> On completion of course, students will be able to |                                                                                                                                                                                             |
| CO1                                                                       | Illustrate the geometric and dimensional characteristics of various structural steel sections, types of trusses, and types of structural connections through detailed engineering drawings. |
| CO2                                                                       | Analyze and design industrial shed structures using portal or gable frame systems with appropriate bracing, purlins, columns, and base plates, considering practical loading conditions.    |
| CO3                                                                       | Evaluate the structural behavior of trussed roof systems with bracing and perform detailed design of purlins, columns, and column bases for industrial applications.                        |
| CO4                                                                       | Design gantry girders along with supporting columns, bracings, and associated structural elements for industrial sheds subjected to moving loads from cranes.                               |
| CO5                                                                       | Analyze and design structural systems involving composite steel–RCC construction with emphasis on load-sharing behavior, member design, and detailing.                                      |

## Course Contents

Term work shall consist of detailed analytical report for structural design and drawing of any one of the following from Group A/B/C as per IS 800-2007/1984.

|                                                                                                                                                                                    |  |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| <b>Group A</b>                                                                                                                                                                     |  |
| 1) Drawing of structural steel sections, types of trusses, types of connections                                                                                                    |  |
| 2) Industrial Shed: Roof Truss with Necessary Bracing System, Purlins, Column and Column Bases                                                                                     |  |
| <b>Group B</b>                                                                                                                                                                     |  |
| 1) Drawing of structural steel sections, types of trusses, types of connections                                                                                                    |  |
| 2) Industrial Shed: Plate Girder, Purlins, Column and Column Bases                                                                                                                 |  |
| <b>Group C</b>                                                                                                                                                                     |  |
| 1) Drawing of structural steel sections, types of trusses, types of connections                                                                                                    |  |
| 2) Analysis and design of any structural steel building with Portal or Gable Frames of Solid or Open Web Sections with Necessary. Bracing System, Purlins, Column and Column Bases |  |

|                                |          |                                             |       |                            |     |     |       |         |  |
|--------------------------------|----------|---------------------------------------------|-------|----------------------------|-----|-----|-------|---------|--|
| SUBJECT CODE                   |          | Open Channel Flow & Hydraulics Machines Lab |       |                            |     |     |       | CREDITS |  |
| 26AF1191PCL508                 |          |                                             |       |                            |     |     |       | 1       |  |
| Teaching Work Load/week (Hrs.) |          |                                             |       | Examination Scheme (Marks) |     |     |       |         |  |
| Theory                         | Tutorial | Laboratory                                  | Total | ISE                        | MSE | ESE | Total |         |  |
| 0                              | 0        | 2                                           | 2     | 25                         | -   | 25  | 50    |         |  |

|                                                                           |                                                                                                       |
|---------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------|
| <b>Course Outcomes:</b> On completion of course, students will be able to |                                                                                                       |
| CO1                                                                       | Calculate coefficient of discharge for flow measuring equipment in open channels and closed conduits. |
| CO2                                                                       | Study mechanism of hydraulic jump.                                                                    |
| CO3                                                                       | Understand mechanism of pumps and turbines.                                                           |
| CO4                                                                       | Understand the impact of jets on various surfaces.                                                    |
| CO5                                                                       | Evaluate the performance characteristics of Pelton, Kaplan, and Francis turbines                      |

## Course Contents

Practical Work consists of at least six performances from list below and detailed reporting in form of journal.

|                                                                                               |                                                                        |
|-----------------------------------------------------------------------------------------------|------------------------------------------------------------------------|
| Experiment No 1                                                                               | Calibration of V notch / Rectangular notch.                            |
| Experiment No 2                                                                               | Calibration of Ogee Weir.                                              |
| Experiment No 3                                                                               | Velocity distribution in open channel in transverse direction of flow. |
| Experiment No 4                                                                               | Study of hydraulic jump                                                |
| Experiment No 5                                                                               | Impact of jet                                                          |
| Experiment No 6                                                                               | Study of Turbines                                                      |
| Experiment No 7                                                                               | Tests on Centrifugal Pump                                              |
| Experiment No 8                                                                               | Performance Characteristics of Pelton/ Kaplan/ Francis Turbine         |
| <b>Use of computer programs such as MS Excel is desirable for post-processing of results.</b> |                                                                        |

| SUBJECT CODE   |          | Geotechnical Engineering Lab |       |                            |     | CREDITS |       |
|----------------|----------|------------------------------|-------|----------------------------|-----|---------|-------|
| 26AF1191PCL509 |          |                              |       |                            |     | 1       |       |
| 2 hours / week |          |                              |       | Examination Scheme (Marks) |     |         |       |
| Theory         | Tutorial | Laboratory                   | Total | ISE                        | MSE | ESE     | Total |
| 0              | 0        | 2                            | 2     | 25                         | -   | 25      | 50    |

|                                                                           |                                                                         |
|---------------------------------------------------------------------------|-------------------------------------------------------------------------|
| <b>Course Outcomes:</b> On completion of course, students will be able to |                                                                         |
| CO1                                                                       | Determine basic physical properties of soils for classification.        |
| CO2                                                                       | Evaluate soil compaction characteristics using Proctor tests.           |
| CO3                                                                       | Measure in-situ density and bearing capacity of soils.                  |
| CO4                                                                       | Assess soil permeability and consolidation for drainage and settlement. |
| CO5                                                                       | Analyze soil shear strength parameters for stability analysis.          |

## Course Contents

Practical Work consists of at least eight performances from list below and detailed reporting in form of journal.

|                                                                                               |                                                                                                                                                                                                                                                                                            |
|-----------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Experiment No 1                                                                               | To find out specific gravity of soil solids by Pycnometer Method                                                                                                                                                                                                                           |
| Experiment No 2                                                                               | Determination of moisture content by oven drying method                                                                                                                                                                                                                                    |
| Experiment No 3                                                                               | To detect field density of the soil by core cutter method                                                                                                                                                                                                                                  |
| Experiment No 4                                                                               | To ensure grain size distribution by mechanical sieve analysis.                                                                                                                                                                                                                            |
| Experiment No 5                                                                               | To work out Atterberg's limits (LL, PL and SL)                                                                                                                                                                                                                                             |
| Experiment No 6                                                                               | To determine compaction properties by Standard Proctor Test                                                                                                                                                                                                                                |
| Experiment No 7                                                                               | To figure out of permeability of soil by using falling head test                                                                                                                                                                                                                           |
| Experiment No 8                                                                               | To decide shear strength parameters by direct shear test.                                                                                                                                                                                                                                  |
| Experiment No 9                                                                               | To find out shear strength by unconfined compressive strength test.                                                                                                                                                                                                                        |
| Experiment No 10                                                                              | To determine of shear strength parameters by Triaxial shear test.                                                                                                                                                                                                                          |
| Experiment No 11                                                                              | Determination of C.B.R. value by conducting laboratory CBR test. (soaked/unsoaked)                                                                                                                                                                                                         |
| Experiment No 12                                                                              | To decide Coefficient of consolidation by conducting consolidation test                                                                                                                                                                                                                    |
| Experiment No 13                                                                              | To work out Compaction properties of soil by modified proctor test                                                                                                                                                                                                                         |
| Experiment No 14                                                                              | To determine permeability of soil by using constant head method                                                                                                                                                                                                                            |
| Experiment No 15                                                                              | To analyze the stability of an earth slope using GEO5's Slope Stability module, determine the Factor of Safety (FOS) using Bishop's Simplified Method, and study the influence of soil shear strength parameters (cohesion $c$ and angle of internal friction $\phi$ ) on slope stability. |
| <b>Use of computer programs such as MS Excel is desirable for post-processing of results.</b> |                                                                                                                                                                                                                                                                                            |

|                                |                         |            |       |                            |     |     |         |
|--------------------------------|-------------------------|------------|-------|----------------------------|-----|-----|---------|
| SUBJECT CODE                   | Soft Skills Development |            |       |                            |     |     | CREDITS |
| 26AF1191HM510                  |                         |            |       |                            |     |     | AU      |
| Teaching Work Load/week (Hrs.) |                         |            |       | Examination Scheme (Marks) |     |     |         |
| Theory                         | Tutorial                | Laboratory | Total | ISE                        | MSE | ESE | Total   |
| 0                              | 2                       | 0          | 2     | -                          | -   | -   | GR      |

| Course Objectives |                                                                                                                                    |
|-------------------|------------------------------------------------------------------------------------------------------------------------------------|
| COBJ1             | To inculcate soft skills so that students can work efficiently in the corporate sector and government organisations.               |
| COBJ2             | To provide knowledge of conflict management while working in large organisations                                                   |
| COBJ3             | To develop management skills required in routine work environment                                                                  |
| COBJ4             | To polish the personality of the learners in order to make them good leaders and employees                                         |
| COBJ5             | To imbibe qualities like manners and etiquettes, coordination, mutual understanding for their colleagues while working in a group. |

| Course Outcomes: On completion of course, students will be able to |                                                                                              |
|--------------------------------------------------------------------|----------------------------------------------------------------------------------------------|
| CO1                                                                | Learners will acquire interpersonal communication skills                                     |
| CO2                                                                | Learners will develop the ability to work independently                                      |
| CO3                                                                | Learners will develop the qualities like self-discipline, self-criticism and self-management |
| CO4                                                                | Learners will have the qualities of time management and discipline                           |
| CO5                                                                | Learners would be able to present themselves as an inspiration for others                    |

## Course Contents

| Module 1                                                                                                                                                                                                                                                                                                                                                                                           | Introduction to Soft Skills and Personality Development | Hrs. 8 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|--------|
| Introduction to Soft Skills, Need of Soft Skills, New Approach to Learning, Human Perceptions: Understanding People, Types of Soft Skills: Self-Management Skills, Interpersonal Skills, what is Personality, Personality Development.                                                                                                                                                             |                                                         |        |
| Module 2                                                                                                                                                                                                                                                                                                                                                                                           | Self-Management & Self-Management Techniques            | Hrs. 8 |
| Self Management, Stress Management: Types of Stress: Self-Awareness about Stress, Regulating Stress: Making the Best out of Stress, Self-Evaluation, Self- discipline, Self-criticism, Recognition of one's own limits and deficiencies, dependency, etc. Self-Awareness, Self-Management, identifying one's strengths and weaknesses, Planning & Goal setting, Managing self-emotions, ego, pride |                                                         |        |
| Module 3                                                                                                                                                                                                                                                                                                                                                                                           | Interpersonal Skills Development                        | Hrs. 5 |
| Positive Relationship, Positive Attitudes, Empathies: comprehending others' opinions, points of views, and face them with understanding, Mutuality, Trust, Emotional Bonding, Handling Situations (Interview), Importance of interpersonal skills, Creative Thinking, Critical Thinking.                                                                                                           |                                                         |        |
| Module 4                                                                                                                                                                                                                                                                                                                                                                                           | Problem Solving Techniques                              | Hrs. 5 |

|                                                                                                                                                                                                                                                                    |                                                          |               |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|---------------|
| Conflict Resolution Skills: Seeking Win-Win Solution (Negotiation Skills), Inter-Personal Conflicts: Two Examples, Inter-Personal Conflicts: Two Solutions, Types of Conflicts: Becoming a Conflict Resolution Expert                                              |                                                          |               |
| <b>Module 5</b>                                                                                                                                                                                                                                                    | <b>Motivation/ Inspiration and Motivation Techniques</b> | <b>Hrs. 5</b> |
| Ability to shape and direct working methods according to self-defined criteria, Ability to think for oneself, apply oneself to a task independently with self-motivation, Motivation techniques based on needs and field situations, Leadership and Team Dynamics. |                                                          |               |

|                    |                                                                                                                              |
|--------------------|------------------------------------------------------------------------------------------------------------------------------|
| <b>Text Books:</b> |                                                                                                                              |
| <b>1</b>           | Mitra, Barun. Personality Development and Soft Skills. Oxford University Press, 2016.                                        |
| <b>2</b>           | Ramesh, Gopalswamy. The Ace of Soft Skills: Attitude, Communication and Etiquette for Success. Pearson Education, 2013.      |
| <b>3</b>           | Covey, Stephen R. Seven Habits of Highly Effective People: Powerful Lessons in Personal Change. Simon & Schuster Ltd., 2013. |
| <b>4</b>           | Rosenberg, Marshall B. Nonviolent Communication: A Language of Life. Puddle Dancer Press, 2015.                              |

|                                |                                                   |            |       |                            |     |     |         |
|--------------------------------|---------------------------------------------------|------------|-------|----------------------------|-----|-----|---------|
| SUBJECT CODE                   | Construction Equipment and Site Safety Management |            |       |                            |     |     | CREDITS |
| 26AF1191VS511                  |                                                   |            |       |                            |     |     | 2       |
| Teaching Work Load/week (Hrs.) |                                                   |            |       | Examination Scheme (Marks) |     |     |         |
| Theory                         | Tutorial                                          | Laboratory | Total | ISE                        | MSE | ESE | Total   |
| 2                              | 0                                                 | 0          | 2     | 50                         | -   | 25  | 75      |

| Course Objectives |                                                                                           |
|-------------------|-------------------------------------------------------------------------------------------|
| 1                 | To understand the classification, selection, and cost analysis of construction equipment. |
| 2                 | To study earthmoving and material handling equipment used in construction projects.       |
| 3                 | To learn road construction and concreting equipment and their applications.               |
| 4                 | To understand construction site safety practices and hazard control measures.             |
| 5                 | To study safety laws, regulations, and safety management systems in construction.         |

| Course Outcomes: On completion of course, students will be able to |                                                                                         |
|--------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| CO1                                                                | Explain the types, selection criteria, and cost aspects of construction equipment.      |
| CO2                                                                | Describe the operation and applications of earthmoving and material handling equipment. |
| CO3                                                                | Understand the use of road construction and concreting equipment in projects.           |
| CO4                                                                | Apply construction safety measures and emergency response procedures.                   |
| CO5                                                                | Understand safety regulations, risk assessment, and safety management systems.          |

## Course Contents

|                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                    |               |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|---------------|
| <b>Module 1</b>                                                                                                                                                                                                                                                                                                                                                                                                         | <b>Introduction to Construction Equipment</b>      | <b>Hrs. 8</b> |
| The classification of construction equipment, the fundamental criteria for selecting appropriate machinery based on productivity, cost-effectiveness, project suitability, The estimation of ownership and operating costs, understanding equipment depreciation, replacement policies, introduction to automation trends in construction equipment.                                                                    |                                                    |               |
| <b>Module 2</b>                                                                                                                                                                                                                                                                                                                                                                                                         | <b>Earthmoving and Material Handling Equipment</b> | <b>Hrs. 8</b> |
| Types of earthmoving machinery such as excavators, bulldozers, backhoe loaders, and scrapers, along with compacting equipment like rollers and rammers, material handling tools including different types of cranes, hoists, conveyors, forklifts. Emphasis is placed on equipment used for foundation works, the importance of safety protocols and inspection routines for all these machines.                        |                                                    |               |
| <b>Module 3</b>                                                                                                                                                                                                                                                                                                                                                                                                         | <b>Road Construction and Concreting Equipment</b>  | <b>Hrs. 8</b> |
| The equipment used in road construction including pavers, graders, and milling machines. Equipment for concrete-related operations such as batching plants, transit mixers, concrete pumps, and slip-forming machines, advanced techniques such as shotcreting, the use of asphalt mixing and laying equipment, practical case studies to illustrate the effective deployment of such equipment in real-world projects. |                                                    |               |
| <b>Module 4</b>                                                                                                                                                                                                                                                                                                                                                                                                         | <b>Construction Site Safety Management</b>         | <b>Hrs. 8</b> |

|                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                         |               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|---------------|
| The concept of construction safety, common hazards, and accident trends in the industry, safety measures such as proper signage, the use of personal protective equipment (PPE), the role of site layout in enhancing safety, risks associated with working at heights, excavation, trenching, fire hazards, and electrical safety, emergency planning and basic first aid procedures.                           |                                                         |               |
| <b>Module 5</b>                                                                                                                                                                                                                                                                                                                                                                                                  | <b>Safety Laws, Regulations, and Management Systems</b> | <b>Hrs. 8</b> |
| The legal and regulatory framework governing construction safety, relevant national standards and international benchmarks such as OSHA and ISO 45001. Statutory compliance, conducting safety audits and inspections, preparation of safety reports, risk assessment methods, job hazard analysis (JHA), the implementation of comprehensive Safety Management Systems (SMS), behavior-based safety approaches. |                                                         |               |

|                                               |                                                                                                                                                                                        |
|-----------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Guidelines for Assignments/Assessment:</b> |                                                                                                                                                                                        |
| <b>1</b>                                      | The candidate shall perform minimum five assignments consisting aspects of the Course.                                                                                                 |
| <b>2</b>                                      | Faculty member can do the (internal & external) assessment through Quiz/ Exam. (MCQ/descriptive) /PPT/ Poster/Drawing/small project activity and must maintain the record of the same. |

|                         |                                                                                                        |
|-------------------------|--------------------------------------------------------------------------------------------------------|
| <b>Text Books:</b>      |                                                                                                        |
| <b>1</b>                | Sharma, S.C., Construction Equipment and Management, Khanna Publishers.                                |
| <b>2</b>                | Hinze, J., Construction Safety, Prentice Hall.                                                         |
| <b>3</b>                | Peurifoy, R.L., Construction Planning, Equipment, and Methods, McGraw-Hill.                            |
| <b>4</b>                | Goetsch, D.L., Construction Safety and Health, Pearson                                                 |
| <b>5</b>                | Mahesh Varma, Construction Equipment and Its Planning and Application, Metropolitan Book Co. Pvt. Ltd. |
| <b>Reference Books:</b> |                                                                                                        |
| <b>1</b>                | IS Codes and OSHA Construction Safety Manuals.                                                         |
| <b>2</b>                | CPWD Safety Code and Manuals.                                                                          |

# Dr. Babasaheb Ambedkar Technological University, Lonere

## Teaching & Evaluation Scheme for Third Year B. Tech. Civil Engineering

| Sr. No.     | Course Code    | Course Title                      | Teaching Scheme |   |    | Evaluation Scheme |     |     |       | Credits |
|-------------|----------------|-----------------------------------|-----------------|---|----|-------------------|-----|-----|-------|---------|
|             |                |                                   | L               | T | P  | ISE               | MSE | ESE | Total |         |
| Semester-VI |                |                                   |                 |   |    |                   |     |     |       |         |
| 1           | 26AF1191PC601  | Design of Concrete Structures     | 3               | 0 | 0  | 20                | 20  | 60  | 100   | 3       |
| 2           | 26AF1191PE602  | Program Elective-I                | 3               | 0 | 0  | 20                | 20  | 60  | 100   | 3       |
| 3           | 26AF1191PE603  | Program Elective -II              | 3               | 0 | 0  | 20                | 20  | 60  | 100   | 3       |
| 4           | 26AF1191PE604  | Program Elective-III              | 3               | 0 | 0  | 20                | 20  | 60  | 100   | 3       |
| 5           | 26AF1191PC605  | Foundation Engineering            | 3               | 0 | 0  | 20                | 20  | 60  | 100   | 3       |
| 6           | Refer Bucket   | Multi-Disciplinary Minor-IV       | 3               | 0 | 0  | 20                | 20  | 60  | 100   | 3       |
| 7           | 26AF1191PCL607 | Design of Concrete Structures Lab | 0               | 0 | 2  | 50                | -   | 50  | 100   | 1       |
| 8           | 26AF1191PEL608 | Program Elective-II- Lab          | 0               | 0 | 2  | 25                | -   | 25  | 50    | 1       |
| 9           | 26AF1191PEL609 | Program Elective-III- Lab         | 0               | 0 | 2  | 25                | -   | 25  | 50    | 1       |
| 10          | 26AF1191EL610  | Seminar                           | 0               | 0 | 2  | 25                | -   | 25  | 50    | 1       |
| 11          | 27AF1191EL711  | Project Phase-I                   | 0               | 0 | 4  | 50                | -   | 50  | 100   | 2       |
| TOTAL       |                |                                   | 18              | 0 | 12 | 295               | 120 | 535 | 950   | 24      |

| Course Type          | Course Code    | Course Name                        | Course Type                  | Course Code    | Course Name                      |
|----------------------|----------------|------------------------------------|------------------------------|----------------|----------------------------------|
| Program Elective-I   | 26AF1191PE602A | Hydraulics Structures              | Open elective-III            | 26AF1ARPOEM05O | Geomatics Engineering            |
|                      | 26AF1191PE602B | Dams and Reservoirs                |                              | 26AF1ARPOEM05P | Ground Improvement Techniques    |
| Program Elective-II  | 26AF1191PE603A | Water Quality Engineering          |                              | 26AF1ARPOEM05Q | Sustainable Construction Methods |
|                      | 26AF1191PE603B | Environment Health and Safety      | Multi-Disciplinary Minor-III | Refer Bucket   | Refer Bucket                     |
| Program Elective-III | 26AF1191PE604A | Highway & Railway Engineering      | Multi-Disciplinary Minor-IV  | Refer Bucket   | Refer Bucket                     |
|                      | 26AF1191PE604B | Intelligent Transportation Systems |                              |                |                                  |
|                      | 26AF1191PE604C | Traffic Engineering & Management   |                              |                |                                  |

### Type of course:

|                                                          |                                                          |
|----------------------------------------------------------|----------------------------------------------------------|
| Basic Science: <b>BS</b>                                 | Engineering Science: <b>ES</b>                           |
| Program Elective: <b>PE</b>                              | Program Core: <b>PC</b>                                  |
| Modern Indian Language: <b>MIL</b>                       | Indian Knowledge System: <b>IK</b>                       |
| Value Education Course: <b>VEC</b>                       | Ability Enhancement Course: <b>AE</b>                    |
| Vocational and Skill Enhancement: <b>VS</b>              | Audit Course: <b>AU</b>                                  |
| Open Elective: <b>OE</b> (Other than particular program) | Co-curricular & Extracurricular Activities: <b>CC</b>    |
| Multidisciplinary Courses: <b>MD</b>                     | Humanities, Management, language and Commerce: <b>HM</b> |

|                                |                               |            |       |                            |     |     |         |
|--------------------------------|-------------------------------|------------|-------|----------------------------|-----|-----|---------|
| SUBJECT CODE                   | Design of Concrete Structures |            |       |                            |     |     | CREDITS |
| 26AF1191PC601                  |                               |            |       |                            |     |     | 3       |
| Teaching Work Load/week (Hrs.) |                               |            |       | Examination Scheme (Marks) |     |     |         |
| Theory                         | Tutorial                      | Laboratory | Total | ISE                        | MSE | ESE | Total   |
| 3                              | 0                             | 0          | 3     | 20                         | 20  | 60  | 100     |

**Pre-requisite: Engineering Mechanics, Mechanics of Solids, Structural Mechanics**

| Course Objectives |                                                                                     |
|-------------------|-------------------------------------------------------------------------------------|
| COBJ1             | To understand the fundamentals and philosophies of reinforced concrete design.      |
| COBJ2             | To study analysis and design of RC structural elements using Working Stress Method. |
| COBJ3             | To learn limit state design concepts for shear, bond, and flexure.                  |
| COBJ4             | To understand the design and detailing of beams, slabs, and staircases using LSM.   |
| COBJ5             | To study the design of columns and footings under different loading conditions.     |

| Course Outcomes: On completion of course, students will be able to |                                                                                    |
|--------------------------------------------------------------------|------------------------------------------------------------------------------------|
| CO1                                                                | Explain the behavior and design philosophies of reinforced concrete structures.    |
| CO2                                                                | Design RC beams, columns, and footings using Working Stress Method.                |
| CO3                                                                | Apply limit state concepts for shear, bond, and flexural design.                   |
| CO4                                                                | Design and detail beams, slabs, and staircases using Limit State Method.           |
| CO5                                                                | Analyze and design compression members and isolated footings using LSM principles. |

## Course Contents

| Module 1                                                                                                                                                                                                                                                                                                                                                                                | Fundamentals and Working Stress Method                       | Hrs. 6  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|---------|
| Basic aspects of structural design, design philosophies (WSM, ULM, LSM), Stress-strain behavior of concrete and steel, Comparison of WSM, ULM, and LSM, factor of safety, load estimation, Introduction to Working Stress Method, permissible stresses, assumptions, Basic design of RC sections using WSM principles.                                                                  |                                                              |         |
| Module 2                                                                                                                                                                                                                                                                                                                                                                                | Structural Design Using WSM                                  | Hrs. 10 |
| Stress block parameters and section classification (under/over-reinforced, balanced), Flexural design of singly and doubly reinforced beams, Shear design principles and detailing of reinforcement, Design of axially and uniaxially eccentrically loaded short columns, Design of isolated column footings, WSM as per IS:456-2000 Annexure B.                                        |                                                              |         |
| Module 3                                                                                                                                                                                                                                                                                                                                                                                | Limit State Method - Philosophy, Shear, and Bond             | Hrs. 8  |
| Limit State approach: definition, types, and classifications of limit states, Characteristic loads and strengths, partial safety factors, Strain variation and stress distribution diagrams, serviceability requirements, Design for shear: types of shear failure, reinforcement types, minimum shear steel, Design for bond: development length, anchorage, detailing as per IS code. |                                                              |         |
| Module 4                                                                                                                                                                                                                                                                                                                                                                                | Limit State Design in Flexure - Beams, Slabs, and Staircases | Hrs. 8  |
| Design of singly and doubly reinforced beams using LSM, Design of flanged beams (L and T sections), Design and detailing of one-way and two-way slabs under various loading/supports, Deflection and crack control criteria, Design of staircases: dog-legged and open-well, effective span, and load distribution.                                                                     |                                                              |         |

|                                                                                                                                                                                                                                                                                                                                                                                 |                                                              |               |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|---------------|
| <b>Module 5</b>                                                                                                                                                                                                                                                                                                                                                                 | <b>Compression Members and Footings - Limit State Design</b> | <b>Hrs. 8</b> |
| <b>Design</b> of axially and eccentrically loaded short columns (rectangular and circular), Construction of interaction diagrams for uni-axial bending, Concept of bi-axial bending and interaction surface (theoretical introduction), Design and detailing of isolated footings for axial and uniaxial loads, Practical considerations in reinforcement layout and anchorage. |                                                              |               |

|                         |                                                                                    |
|-------------------------|------------------------------------------------------------------------------------|
| <b>Text Books:</b>      |                                                                                    |
| <b>1</b>                | Varghese, P. C. Limit State Design of Reinforced Concrete, PHI Learning.           |
| <b>2</b>                | Pillai, S. U., & Menon, D. Reinforced Concrete Design, McGraw-Hill.                |
| <b>3</b>                | Jain, A. K. Limit State Design of RCC, Nem Chand & Bros.                           |
| <b>4</b>                | Subramanian, N. Design of Reinforced Concrete Structures, Oxford University Press. |
| <b>5</b>                | Punmia, B. C. Reinforced Concrete Structures, Laxmi Publications.                  |
| <b>Reference Books:</b> |                                                                                    |
| <b>1</b>                | IS:456-2000 – Code of Practice for Plain and Reinforced Concrete, BIS.             |
| <b>2</b>                | Handoo, B. L. Concrete Structures, Satya Prakashan.                                |

|                                  |                                             |            |       |                                |     |     |         |
|----------------------------------|---------------------------------------------|------------|-------|--------------------------------|-----|-----|---------|
| SUBJECT CODE                     | Program Elective -I<br>Hydraulic Structures |            |       |                                |     |     | CREDITS |
| 26AF1191PE602A                   |                                             |            |       |                                |     |     | 3       |
| Teaching Work Load/week (3 Hrs.) |                                             |            |       | Examination Scheme (100 Marks) |     |     |         |
| Theory                           | Tutorial                                    | Laboratory | Total | ISE                            | MSE | ESE | Total   |
| 3                                | 0                                           | 0          | 3     | 20                             | 20  | 60  | 100     |

**Pre-requisite: Knowledge of Applied Mechanics, Fluid Mechanics**

| Course Objectives |                                                                                                             |
|-------------------|-------------------------------------------------------------------------------------------------------------|
| COBJ1             | To understand the fundamentals, classification, and design considerations of hydraulic structures and dams. |
| COBJ2             | To study the design and stability aspects of dams, reservoirs, and diversion headworks.                     |
| COBJ3             | To learn the functions and design concepts of spillways and energy dissipators.                             |
| COBJ4             | To understand the design principles of weirs, barrages, and canal structures.                               |
| COBJ5             | To study dam safety and instrumentation techniques used in hydraulic structures.                            |

| Course Outcomes: On completion of course, students will be able to |                                                                                                  |
|--------------------------------------------------------------------|--------------------------------------------------------------------------------------------------|
| CO1                                                                | Explain the classification, site selection, and design aspects of hydraulic structures and dams. |
| CO2                                                                | Analyze stability, seepage, and reservoir-related aspects of dams and diversion headworks.       |
| CO3                                                                | Describe spillway types, gates, and energy dissipation arrangements.                             |
| CO4                                                                | Apply design concepts of weirs, barrages, and lined and unlined canals.                          |
| CO5                                                                | Understand dam safety measures and the working of instrumentation systems.                       |

## Course Contents

| Module 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Fundamentals of Hydraulic Structures | Hrs.8  |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|--------|
| Introduction and classification of hydraulic structures, Site selection and design parameters, Factors governing selection of type of dam, Classification of dams, Classification based on purpose, Classification based on materials, Classification based on size of project, Classification based on hydraulic action, Classification based on structural action, Dams and earthquakes, Dams and social issues, Large dams verses small dams, Displacement and rehabilitation, Dams and climate change ,Overview of hydrological and geological considerations, Introduction to IS code practices. |                                      |        |
| Module 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Dams and Reservoirs                  | Hrs. 8 |
| Types and classification of dams: Gravity, Arch, Earth-fill, Rock-fill, Design of gravity dams: Stability, stress analysis, practical profiles, Seepage and slope stability in earth dams, Reservoir planning, sedimentation, and control. Introduction, Function of diversion headworks, Selection of site for diversion headworks, Layout of diversion headworks, Components of diversion headworks, Design of weir on permeable foundation,                                                                                                                                                        |                                      |        |
| Module 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Spillways and Energy Dissipators     | Hrs. 8 |
| Spillway: Necessity and function, components of spillway, different types, Energy dissipation arrangements, gates for spillway, Elementary design of an ogee spillway Outlets in Dams: Outlets through concrete and earth dams,                                                                                                                                                                                                                                                                                                                                                                       |                                      |        |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                       |               |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|---------------|
| different types, Trash racks.<br>Spillway Gates -Introduction of Spillway gates, Classification of spillway crest gates, Classification based on function, Classification based on movement of gates, Classification based on special features, Introduction to automatic gates, Maintenance of gates, Inspection of gates.                                                                                                                                                                                                 |                                       |               |
| <b>Module 4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>Canal and River Structures</b>     | <b>Hrs. 8</b> |
| Design of weirs and barrages on permeable foundations: Introduction, causes of failure of weirs, creep theory, Khosla's theory.<br>Design of canal sections: Design of unlined canals- introduction, design formulae. Kennedy's theory and Lacey's theory, drawbacks and comparison. Design of lined canals, design parameters, design procedures, types of lining                                                                                                                                                          |                                       |               |
| <b>Module 5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>Dam Safety and Instrumentation</b> | <b>Hrs. 8</b> |
| Significance of Instrumentation: introduction, objectives of dam safety and instrumentation. Working principles and functions of instruments: piezometer, porous tube piezometer, pneumatic piezometer, vibrating wire piezometer, vibrating wire settlement cell, inclinometer, joint meter, pendulums, inverted pendulum, hanging pendulum, automatic pendulum coordinator, vibrating wire pressure cell, extensometer, embedment strain gauge, temperature gauge, distributed fiber optics temperature tool, seismograph |                                       |               |

|                         |                                                                                                                  |
|-------------------------|------------------------------------------------------------------------------------------------------------------|
| <b>Text Books:</b>      |                                                                                                                  |
| <b>1</b>                | Arora, K.R., "Irrigation, Water Power and Water Resources Engineering", Standard Publishers Distributors, Delhi. |
| <b>2</b>                | Modi, P.N., "Introduction to Water Resources and Waterpower Engineering", Standard Publication, Delhi            |
| <b>3</b>                | Garg, S.K., "Irrigation Engineering and Hydraulic Structures" Khanna Publishers                                  |
| <b>4</b>                | Asawa, G, L "Irrigation and Water Resources Engineering", New Age Int. Ltd.                                      |
| <b>5</b>                | "Hydraulic Engineering", J. A. Roberson, J. J. Cassidy, M. N. Chaudhry, John Wiley & Sons, New York, 1998.       |
| <b>Reference Books:</b> |                                                                                                                  |
| <b>1</b>                | Water Resources Engineering by R.K. Linsley & J.L.H. Paulhus, McGraw Hill.                                       |
| <b>2</b>                | Open channel hydraulics by Ven Te Chow Mc Graw Hill Book Co. International Students Edition                      |

|                                |                                                   |            |       |                            |     |     |         |
|--------------------------------|---------------------------------------------------|------------|-------|----------------------------|-----|-----|---------|
| SUBJECT CODE                   | Program Elective -I<br><b>Dams and Reservoirs</b> |            |       |                            |     |     | CREDITS |
| 26AF1191PE602B                 |                                                   |            |       |                            |     |     | 3       |
| Teaching Work Load/week (Hrs.) |                                                   |            |       | Examination Scheme (Marks) |     |     |         |
| Theory                         | Tutorial                                          | Laboratory | Total | ISE                        | MSE | ESE | Total   |
| 3                              | 0                                                 | 0          | 3     | 20                         | 20  | 60  | 100     |

| Course Objectives |                                                                                     |
|-------------------|-------------------------------------------------------------------------------------|
| COBJ1             | To understand the fundamentals and classification of dams and hydraulic structures. |
| COBJ2             | To study different canal structures and their functions in irrigation systems.      |
| COBJ3             | To learn river behavior and river training methods.                                 |
| COBJ4             | To understand the principles and components of diversion head works.                |
| COBJ5             | To study the types and design considerations of cross drainage works.               |

| Course Outcomes: On completion of course, students will be able to |                                                                                       |
|--------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| CO1                                                                | Explain the classification, selection, and features of dams and hydraulic structures. |
| CO2                                                                | Describe different canal structures, falls, outlets, and regulators.                  |
| CO3                                                                | Understand river training structures and their applications.                          |
| CO4                                                                | Apply basic design concepts of diversion head works and weirs.                        |
| CO5                                                                | Describe the types, functions, and design considerations of cross drainage works.     |

## Course Contents

| Module 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Fundamentals of Hydraulic Structures | Hrs. 6 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------|--------|
| Introduction, historical development of dams, different terms related to dams, selection of site of dam, factors governing selection of type of dam, classifications of dam, classification based on purpose, classification based on material, classification based on size of project, classification based on hydraulic action, classification based on structural action, introduction of arch dam and buttress dam including classification, advantages and limitations.                                                                                                  |                                      |        |
| Module 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Canal Structures                     | Hrs. 6 |
| Canal falls Introduction, Necessity of canal fall, Selection of site for canal fall, Classification of canal fall, Types of falls, Free fall or open fall, Notch fall, Ogee Fall, Rapid Stepped fall, Straight glacis fall, Sarda fall, Semi pressure fall, Baffle or Englis Fall, Montague fall Siphon well or cylinder fall, Pressure or closed conduit fall, Shaft or Pipe fall, Selection of type of fall, Canal outlets- Introduction of Canal outlet or module, Canal escapes- Introduction of Escapes, Significance of canal escape, Canal regulators—Canal regulators. |                                      |        |
| Module 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | River Training Structures            | Hrs. 6 |
| Introduction, Classification of rivers, Classification based on topography, regime, alignment, source, Behaviour of rivers, River training, Objectives of river training, Classification of river training, purpose, orientation, River training structures, Embankment or Levee, Guide banks, Groynes or spurs, Artificial cut off, Pitched Island, submerged sill or dykes, Closing dykes                                                                                                                                                                                    |                                      |        |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                             |               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|---------------|
| <b>Module 4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>Diversion head works</b> | <b>Hrs. 6</b> |
| Introduction, function of diversion head works, selection of sites for diversion head works, components of diversion head works, design of weir on permeable foundation, criteria for safe design of weir floor, brief introduction to Bligh and Lane's theory, Khosla's theory based on potential theory approach, Khosla's theory on independent variables, design of weirs on permeable foundations.                                              |                             |               |
| <b>Module 5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>Cross Drainage Works</b> | <b>Hrs. 6</b> |
| Introduction, Necessity of Cross Drainage works, Selection of site for Cross Drainage work, Selection of suitable type of C. D. works, data required for design of cross drainage work, classification of cross drainage works. Drain over canal: siphon, super passage. Canal over drain: aqueduct, siphon aqueduct. Canal and drain water meeting at same level: level crossing, inlet and outlet, design considerations for cross drainage works. |                             |               |

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|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Text Books:</b>      |                                                                                                                                           |
| <b>1</b>                | Irrigation and Water Resources Engineering, Asawa G. L., New Age International (P) Ltd.                                                   |
| <b>2</b>                | Irrigation Engineering and Hydraulic Structures, Garg S. K, Khanna Publication.                                                           |
| <b>3</b>                | Irrigation Water Power Engineering, Punmia B. C., Laxmi Publication.                                                                      |
| <b>4</b>                | Design Textbook in Civil Engineering: Volume Six: Dams- Leliavsky, Serge – Oxford and IBH Publishing Co. Pvt. Ltd., 1981.                 |
| <b>Reference Books:</b> |                                                                                                                                           |
| <b>1</b>                | Design of Small Dams, United States Department of the Interior, Bureau of Reclamation revised reprint 1974, Oxford and IBH Publishing Co. |
| <b>2</b>                | Design Textbook in Civil Engineering, Volume Six, Leliavsky, Serge-Oxford and IBH Publishing Co.Pvt. Ltd.                                 |
| <b>3</b>                | Irrigation, Water Resources and Water Power Engineering, Modi P. N., Standard Book House, New Delhi.                                      |

| SUBJECT                       | Program Elective -II      |            |       |                            |     |     | CREDITS |
|-------------------------------|---------------------------|------------|-------|----------------------------|-----|-----|---------|
| 26AF1191PE603A                | Water Quality Engineering |            |       |                            |     |     | 3       |
| Teaching Workload/week (Hrs.) |                           |            |       | Examination Scheme (Marks) |     |     |         |
| Theory                        | Tutorial                  | Laboratory | Total | ISE                        | MSE | ESE | Total   |
| 3                             | 0                         | 0          | 3     | 20                         | 20  | 60  | 100     |

| Course Objectives |                                                                                   |
|-------------------|-----------------------------------------------------------------------------------|
| COBJ1             | To understand the fundamentals of water quality and water pollution.              |
| COBJ2             | To study water quality parameters and analytical instruments.                     |
| COBJ3             | To learn water and wastewater treatment technologies and processes.               |
| COBJ4             | To understand the design and operation of water and wastewater treatment systems. |
| COBJ5             | To study water quality index, pollution impacts, and water quality modeling.      |

| Course Outcomes: On completion of course, students will be able to |                                                                                                                                                        |
|--------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| CO1                                                                | Identify and classify different sources of water pollutants and explain the chemical and biological processes affecting water quality.                 |
| CO2                                                                | Perform laboratory analysis of key water quality parameters and interpret results using appropriate instrumentation and techniques.                    |
| CO3                                                                | Compare Indian and international water quality standards and assess the suitability of water for drinking, agricultural, industrial, and aquatic uses. |
| CO4                                                                | Design basic components of water treatment plants and evaluate the performance of conventional and advanced treatment systems.                         |
| CO5                                                                | Analyze the impact of pollution on surface and groundwater bodies.                                                                                     |

## Course Contents

| Module 1                                                                                                                                                                                                                                                                                                                                                                                         | Fundamentals of Water Quality and Pollution | Hrs. 8 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------|--------|
| Terminology related to water quality and pollution, Sources of water pollutants, Natural and anthropogenic pollution, Pollution kinetics including zero-order, first-order and second-order reactions, Reaction mechanisms in aquatic environments, International water quality standards (WHO), Indian water quality standards (IS 10500) for drinking, irrigation, industrial and aquatic use. |                                             |        |
| Module 2                                                                                                                                                                                                                                                                                                                                                                                         | Water Quality Analysis and Instrumentation  | Hrs.8  |
| Water quality parameters including pH, TDS, BOD, COD, DO, turbidity, alkalinity, hardness, nitrates, metals, Analytical methods such as titrimetric, gravimetric, spectrophotometric, electrometric, Instruments used in analysis including pH meter, turbidity meter, DO meter, spectrophotometer, flame photometer, Working principles and applications of each instrument                     |                                             |        |
| Module 3                                                                                                                                                                                                                                                                                                                                                                                         | Water and Wastewater Treatment Technologies | Hrs.8  |
| Water purification methods including mechanical filters, biological filters and membrane filters, Reverse osmosis principle and applications, RO membranes and related instruments, Water treatment processes such as aeration,                                                                                                                                                                  |                                             |        |

|                                                                                                                                                                                                                                                                                                                                                                            |                                                             |               |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|---------------|
| nitrogen removal, pH control, removal of solids and gases, Disinfection methods using chlorine, bromine, iodine, potassium permanganate, Ion exchange process                                                                                                                                                                                                              |                                                             |               |
| <b>Module 4</b>                                                                                                                                                                                                                                                                                                                                                            | <b>Water and Wastewater Treatment Systems</b>               | <b>Hrs. 6</b> |
| Components of water treatment plants, Design and working principles of treatment units, Wastewater treatment methods including primary, secondary and tertiary treatments, Activated sludge process, Trickling filters, UASB reactor, Membrane bioreactor (MBR), Instrumentation in wastewater treatment, Sludge management and disposal techniques.                       |                                                             |               |
| <b>Module 5</b>                                                                                                                                                                                                                                                                                                                                                            | <b>Water Quality Index, Pollution Impacts and Modeling.</b> | <b>Hrs. 6</b> |
| Water Quality Index (WQI) concept and principles, Parameters used in WQI calculation, Indian and international WQI standards, Water pollution due to pesticides and toxic metals, Sources and control of arsenic, lead, cadmium and mercury, Water quality modeling concepts, Introduction to QUAL2K and WASP models, Model inputs, calibration and result interpretation. |                                                             |               |

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|-------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Text Books:</b>      |                                                                                                                                                 |
| <b>1</b>                | Groundwater Hydrology by David Keith Todd- John Wiley & Sons.                                                                                   |
| <b>2</b>                | Water quality assessments by Chapman- D.- (Ed.)- 2nd Ed.- E&FNSPON (Imprint of Chapman & Hall- USA)- Pub. on behalf of UNESCO- WHO- UNEP- 1992. |
| <b>3</b>                | Metcalf & Eddy (Wastewater Engineering: Treatment and Resource Recovery McGraw-Hill Education                                                   |
| <b>4</b>                | Water Supply Engineering. By Dr. B.C. Punmia, Ashok Kr. Jain, Arun Kr. Jain                                                                     |
| <b>5</b>                | Surface Water-Quality Modeling - Steven C. Chapra                                                                                               |
| <b>Reference Books:</b> |                                                                                                                                                 |
| <b>1</b>                | Water Supply Engineering By SK Garg.                                                                                                            |
| <b>2</b>                | Environmental Pollution Control Engineering - C. S. Rao                                                                                         |

| SUBJECT                       |          | Program Elective -II          |       |                            |     |     | CREDITS |
|-------------------------------|----------|-------------------------------|-------|----------------------------|-----|-----|---------|
| 26AF1191PE603B                |          | Environment Health and Safety |       |                            |     |     | 3       |
| Teaching Workload/week (Hrs.) |          |                               |       | Examination Scheme (Marks) |     |     |         |
| Theory                        | Tutorial | Laboratory                    | Total | ISE                        | MSE | ESE | Total   |
| 3                             | 0        | 0                             | 3     | 20                         | 20  | 60  | 100     |

| Course Objectives |                                                                                            |
|-------------------|--------------------------------------------------------------------------------------------|
| COBJ1             | To introduce the necessity and framework of Environment, Health, and Safety (EHS) systems. |
| COBJ2             | To impart knowledge of occupational health and hygiene                                     |
| COBJ3             | To develop understanding of workplace safety systems.                                      |
| COBJ4             | To equip students with risk assessment and hazard control skills.                          |
| COBJ5             | To familiarize learners with Environmental Health and Safety Management Systems.           |

| Course Outcomes: On completion of course, students will be able to |                                                                                |
|--------------------------------------------------------------------|--------------------------------------------------------------------------------|
| CO1                                                                | Need for EHS in industries and related Indian regulations.                     |
| CO2                                                                | Various types of Health hazards, effect, assessment and control methods.       |
| CO3                                                                | Various safety systems in working environments.                                |
| CO4                                                                | The methodology for preparation of Emergency Plans and Accident investigation. |
| CO5                                                                | EHS Management System and its elements                                         |

## Course Contents

| Module 1                                                                                                                                                                                                                                                                                                       | Introduction                      | Hrs. 6 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------|--------|
| Need for developing Environment, Health and Safety systems in work places- International initiatives, National Policy and Legislations on EHS in India – Regulations and Codes of Practice -Role of trade union safety representatives – Ergonomics.                                                           |                                   |        |
| Module 2                                                                                                                                                                                                                                                                                                       | Occupational Health & Hygiene     | Hrs.8  |
| Definition of occupational health and hygiene – Categories of health hazards – Exposure pathways and human responses–Exposure Assessment-occupational exposure limits Hierarchy of control measures – Role of personal protective equipment and the selection criteria.                                        |                                   |        |
| Module 3                                                                                                                                                                                                                                                                                                       | Workplace Safety & Safety Systems | Hrs. 8 |
| Features of Satisfactory and Safe design of work premises – good housekeeping – lighting and color, Ventilation and Heat Control, Noise, Chemical and Radiation Safety – Electrical Safety – Fire Safety – Safety at Construction sites, ETP – Machine guarding – Process Safety, Working at different levels. |                                   |        |
| Module 4                                                                                                                                                                                                                                                                                                       | Hazards & Risk Management         | Hrs. 6 |
| Safety appraisal – Job Safety Analysis-Control techniques – plant safety inspection – Accident investigation – Analysis and Reporting – Hazard and Risk Management Techniques –Onsite and Offsite emergency Plans. Employee Participation- Education and Training- Case Studies.                               |                                   |        |

|                                                                                                                                                                                                     |                                                     |               |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|---------------|
| <b>Module 5</b>                                                                                                                                                                                     | <b>Environmental Health &amp; Safety Management</b> | <b>Hrs. 6</b> |
| Concept of Environmental Health and Safety Management – Elements of Environmental Health and Safety Management Policy and implementation and review – ISO 45001-Structure and Clauses-Case Studies. |                                                     |               |

|                         |                                                                                                                                                              |
|-------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Text Books:</b>      |                                                                                                                                                              |
| <b>1</b>                | The Beginner's Guide to the Environmental, Health and Safety Profession, Chance Roberts.                                                                     |
| <b>2</b>                | Environmental Safety and Health Regulations, Joel M. Haight, Feb 4, 2013.                                                                                    |
| <b>3</b>                | Safety, Health and Environmental Auditing, Simon Watson Pain, May 31, 2023.                                                                                  |
| <b>4</b>                | Industrial Health and Safety Acts and Amendments, by Ministry of Labour and Employment, Government of India.                                                 |
| <b>5</b>                | The Facility Manager's Guide to Environmental Health and Safety by Brian Gallant, Government Inst Publ., 2007.                                               |
| <b>Reference Books:</b> |                                                                                                                                                              |
| <b>1</b>                | Fundamentals of Industrial Safety and Health by Dr.K.U.Mistry, Siddharth Prakashan, 2012.                                                                    |
| <b>2</b>                | Effective Environmental, Health, and Safety Management Using the Team Approach by Bill Taylor, Culinary and Hospitality Industry Publications Services, 2005 |

|                                |                               |            |       |                            |     |     |         |
|--------------------------------|-------------------------------|------------|-------|----------------------------|-----|-----|---------|
| SUBJECT CODE                   | Program Elective -III         |            |       |                            |     |     | CREDITS |
| 26AF1191PE604A                 | Highway & Railway Engineering |            |       |                            |     |     | 3       |
| Teaching Work Load/week (Hrs.) |                               |            |       | Examination Scheme (Marks) |     |     |         |
| Theory                         | Tutorial                      | Laboratory | Total | ISE                        | MSE | ESE | Total   |
| 3                              | 0                             | 0          | 3     | 20                         | 20  | 60  | 100     |

| Course Objectives |                                                                                            |
|-------------------|--------------------------------------------------------------------------------------------|
| COBJ1             | To understand the classification of highways and the institutional frameworks.             |
| COBJ2             | To impart knowledge on the design principles of various highway geometric elements.        |
| COBJ3             | To introduce students to the selection and testing of highway construction materials.      |
| COBJ4             | To provide an overview of railway infrastructure components.                               |
| COBJ5             | To educate students on the design, construction, and maintenance of railway track systems. |

| Course Outcomes: On completion of course, students will be able to |                                                                                                                              |
|--------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| CO1                                                                | Classify different types of highways and explain their functions, identify the institutions involved in highway development. |
| CO2                                                                | Describe the various cross-sectional and geometric elements of highways.                                                     |
| CO3                                                                | Suitable materials for highway construction and evaluate their properties.                                                   |
| CO4                                                                | Identify and explain the components of railway.                                                                              |
| CO5                                                                | Explain the layout and working principles of railway operations.                                                             |

## Course Contents

| Module 1                                                                                                                                                                                                                                                                                                                                                                            | Highway Engineering                | Hrs. 8 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|--------|
| Classification of highways – Institutions for Highway planning, design and construction at different levels – factors influencing highway alignment -Typical cross sections of Urban and Rural roads – Engineering surveys for alignment- Conventional and Modern method.                                                                                                           |                                    |        |
| Module 2                                                                                                                                                                                                                                                                                                                                                                            | Design of Highway Elements         | Hrs. 8 |
| Cross sectional elements – Horizontal curves, super elevation, transition curves, widening of curves – Sight distances – Vertical curves, gradients- pavement components and their role – Design practice for flexible and rigid pavements (IRC methods only).                                                                                                                      |                                    |        |
| Module 3                                                                                                                                                                                                                                                                                                                                                                            | Highway Construction & Maintenance | Hrs. 8 |
| Highway construction materials, properties, testing methods – Construction practice of flexible and concrete pavement- Highway drainage – Evaluation and Maintenance of pavements.                                                                                                                                                                                                  |                                    |        |
| Module 4                                                                                                                                                                                                                                                                                                                                                                            | Railway Planning & Construction    | Hrs. 8 |
| Elements of permanent way – Rails, Sleepers, Ballast, rail fixtures and fastenings, Selection of gauges – Track Stress, coning of wheels, creep in rails, defects in rails – Route alignment surveys, conventional and modern methods- Geometric design of railway, gradient, super elevation, widening of gauge on curves (Problems)-Railway drainage- Level Crossings-Signalling. |                                    |        |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                               |               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------|---------------|
| <b>Module 5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>Railway Track Construction Maintenance &amp; Operation</b> | <b>Hrs. 8</b> |
| Railway Track Construction Maintenance and Operation Points and Crossings – Design of Turnouts, Working Principle-Track Circuiting – Construction & Maintenance – Conventional, Modern methods and Materials, Layouts of Railway Stations and Yards, Rolling Stock, Tractive Power, Track Resistance – Role of Indian Railways in National Development – Railways for Urban Transportation – LRT & MRTS Feasibility study, Planning and construction |                                                               |               |

|                         |                                                                                                                                                                                 |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Text Books:</b>      |                                                                                                                                                                                 |
| <b>1</b>                | Khanna.S. K., Justo. C.E.G and Veeraragavan A. “Highway Engineering”, Nemchand Publishers.                                                                                      |
| <b>2</b>                | Subramanian K.P., “Highways, Railways, Airport and Harbour Engineering”, Scitech Publications (India).                                                                          |
| <b>3</b>                | Kadiyali.L.R. “Principles and Practice of Highway Engineering”, Khanna Technical Publications.                                                                                  |
| <b>4</b>                | C. Venkatramaiah., Transportation Engineering-Vol. 2 Railways, Airports, Docks and Harbours, Bridges and Tunnels., Universities Press (India) Private Limited, Hyderabad, 2015. |
| <b>5</b>                | Indian Road Congress (IRC), Guidelines for the Design of Flexible Pavements, (Third Revision), IRC:37-2012.                                                                     |
| <b>Reference Books:</b> |                                                                                                                                                                                 |
| <b>1</b>                | Indian Road Congress (IRC), Guidelines for the Design of Plain Jointed Rigid Pavements for Highways, ( Third Revision), IRC:58-2012                                             |
| <b>2</b>                | Yang H. Huang, “Pavement Analysis and Design”, Pearson Education Inc, Nineth Impression, South Asia, 2012.                                                                      |

|                                |          |                                                             |  |                            |  |     |     |         |     |  |       |
|--------------------------------|----------|-------------------------------------------------------------|--|----------------------------|--|-----|-----|---------|-----|--|-------|
| SUBJECT CODE                   |          | Program Elective -III<br>Intelligent Transportation Systems |  |                            |  |     |     | CREDITS |     |  |       |
| 26AF1191PE604B                 |          |                                                             |  |                            |  |     |     | 3       |     |  |       |
| Teaching Work Load/week (Hrs.) |          |                                                             |  | Examination Scheme (Marks) |  |     |     |         |     |  |       |
| Theory                         | Tutorial | Laboratory                                                  |  | Total                      |  | ISE | MSE |         | ESE |  | Total |
| 3                              | 0        | 0                                                           |  | 3                          |  | 20  | 20  |         | 60  |  | 100   |

| Course Objectives |                                                                                     |
|-------------------|-------------------------------------------------------------------------------------|
| COBJ1             | To introduce the concept and scope of Intelligent Transportation Systems (ITS).     |
| COBJ2             | To provide knowledge of various ITS data collection and communication technologies. |
| COBJ3             | To explore the functional areas of ITS.                                             |
| COBJ4             | To analyze user needs and service requirements.                                     |
| COBJ5             | To understand the role of information management in ITS.                            |

| Course Outcomes: Students will be able to |                                                                                              |
|-------------------------------------------|----------------------------------------------------------------------------------------------|
| CO1                                       | Explain ITS & ATIS.                                                                          |
| CO2                                       | Explain about Advanced Transportation Management System.                                     |
| CO3                                       | Explain about APTS, CVO, new technology and ETC.                                             |
| CO4                                       | Discuss about regional architecture, integration of infrastructure and operational planning. |
| CO5                                       | Summarizes about ITS issues in terms of various factors and emerging issues.                 |

## Course Contents

| Module 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Introduction to Intelligent Transportation Systems (ITS) | Hrs. 8 |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|--------|
| <p>Definition of ITS and Identification of ITS Objectives, Historical Background, Benefits of ITS- safety, mobility, environmental sustainability, efficiency, Overview of ITS components and architecture, ITS stakeholders: Government, public, private sector, enforcement authorities</p> <p>ITS Data collection techniques –Roadside sensors and detectors (loop, video, infrared, microwave), Automatic Vehicle Location (AVL) systems, Automatic Vehicle Identification (AVI) systems, Role of Geographic Information Systems (GIS) and Remote Sensing, Data quality, integrity, and fusion techniques, vehicle Positioning System.</p> |                                                          |        |
| Module 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Telecommunications in ITS                                | Hrs. 6 |
| <p>Types of communications: wired vs wireless, analog vs digital, vehicle-to-Infrastructure (V2I), vehicle-to-Vehicle (V2V), and vehicle to everything (V2X) communications, role of highspeed internet, DSRC (Dedicated Short-Range Communications), and satellite-based communications, video-based data collection and analytics, role and architecture of Traffic Management Centres (TMCs), Information dissemination technologies: Variable Message Signs (VMS), web-based and mobile systems, Data storage and retrieval systems for ITS, road side communication.</p>                                                                  |                                                          |        |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                    |               |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|---------------|
| <b>Module 3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>ITS functional areas</b>        | <b>Hrs. 8</b> |
| Advanced Traffic Management Systems (ATMS)-Real-time traffic monitoring and control, Adaptive signal control and ramp metering, Advanced Traveler Information Systems (ATIS)-Route guidance and navigation systems, Real-time traffic and transit information for users, Advanced Vehicle Control Systems (AVCS):Collision avoidance, adaptive cruise control, lane keeping systems, Advanced Public Transportation Systems (APTS):Smart fare collection, passenger information systems, real-time fleet management, Commercial Vehicle Operations (CVO):Electronic clearance, weigh-in-motion systems, freight tracking, Advanced Rural Transportation Systems (ARTS):ITS solutions in low-density, remote areas.                              |                                    |               |
| <b>Module 4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>ITS User Needs and Services</b> | <b>Hrs. 6</b> |
| Framework of user needs: safety, efficiency, equity, convenience, Incident detection, congestion management, dynamic rerouting, Transit Signal Priority (TSP), scheduling, predictive arrival systems, Electronic Payment Systems: Toll collection (ETC), smart card systems, digital wallets for transit, Commercial Vehicle Operations (CVO):Fleet monitoring, route optimization, driver behaviour analysis, Emergency Management Systems: Dispatch optimization, crash notification systems (eCall), emergency vehicle signal pre-emption, Advanced Vehicle Safety Systems, Blind spot detection, driver alertness monitoring, autonomous braking, Accessibility and equity in ITS design                                                   |                                    |               |
| <b>Module 5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>Information Management</b>      | <b>Hrs. 8</b> |
| Automated Highway Systems - Vehicles in Platoons, autonomous vehicle convoys – Integration of Automated Highway Systems, ITS in developing countries, institutional and organizational issues in ITS deployment, ITS architecture and standards (e.g., ISO, IEEE, NTCIP), evaluation and performance measurement of ITS, ITS in Developed Countries: ITS Programs in the World – Overview of ITS implementations in developed countries-Case studies from USA (ITS America), Japan (VICS), Europe (ERTICO), South Korea<br>ITS in Developing Countries: Challenges and opportunities, Indian ITS policies and initiatives (e.g., MoRTH, NHAI projects, Smart Cities, Delhi Integrated Multi-Modal Transit System (DIMTS), FASTag, BRTS systems) |                                    |               |

|                         |                                                                                                                      |
|-------------------------|----------------------------------------------------------------------------------------------------------------------|
| <b>Text Books:</b>      |                                                                                                                      |
| <b>1</b>                | Ghosh, S., Lee, T.S., “Intelligent Transportation Systems: New Principles and Architectures”, CRC Press, 2000.       |
| <b>2</b>                | Mashrur A. Chowdhury, and Adel Sadek, “Fundamentals of Intelligent Transportation Systems Planning”, Artech          |
| <b>3</b>                | Urban Transportation: Planning, Operation and Management" – G.R. Rajasekhar                                          |
| <b>4</b>                | "Intelligent Transport Systems" – M.G. Lay & Indian adaptations                                                      |
| <b>Reference Books:</b> |                                                                                                                      |
| <b>1</b>                | Sussman, J.M., “Perspectives on Intelligent Transportation Systems”, Springer, Berlin, 2010.                         |
| <b>2</b>                | R.P Roess, E.S. Prassas, W.R. McShane., “Traffic Engineering”, Pearson Educational International, 3rd Edition, 2004. |

|                                |                                  |            |       |                            |     |     |         |
|--------------------------------|----------------------------------|------------|-------|----------------------------|-----|-----|---------|
| SUBJECT CODE                   | Program Elective -III            |            |       |                            |     |     | CREDITS |
| 26AF1191PE604C                 | Traffic Engineering & Management |            |       |                            |     |     | 3       |
| Teaching Work Load/week (Hrs.) |                                  |            |       | Examination Scheme (Marks) |     |     |         |
| Theory                         | Tutorial                         | Laboratory | Total | ISE                        | MSE | ESE | Total   |
| 3                              | 0                                | 0          | 3     | 20                         | 20  | 60  | 100     |

| Course Objectives |                                                             |
|-------------------|-------------------------------------------------------------|
| COBJ1             | To learn the fundamentals of traffic engineering.           |
| COBJ2             | To learn the methods of intersection design.                |
| COBJ3             | To learn the skills of traffic control.                     |
| COBJ4             | To be introduced to the different theories of traffic flow. |
| COBJ5             | To be aware of the importance of traffic safety.            |

| Course Outcomes: Students will be able to |                                       |
|-------------------------------------------|---------------------------------------|
| CO1                                       | Carry out traffic studies.            |
| CO2                                       | Design intersections.                 |
| CO3                                       | Implement traffic system management.  |
| CO4                                       | Aware of traffic flow theory.         |
| CO5                                       | Enhance safety in all design aspects. |

## Course Contents

|                                                                                                                                                                                                                                                                                          |                                          |               |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|---------------|
| <b>Module 1</b>                                                                                                                                                                                                                                                                          | <b>Introduction</b>                      | <b>Hrs. 6</b> |
| Significance and scope, Characteristics of Vehicles and Road Users, Skid Resistance and Braking Efficiency (Problems), Components of Traffic Engineering- Road, Traffic and Land Use Characteristics                                                                                     |                                          |               |
| <b>Module 2</b>                                                                                                                                                                                                                                                                          | <b>Traffic Surveys &amp; Analysis</b>    | <b>Hrs. 6</b> |
| Surveys and Analysis - Volume, Journey time, Capacity, Speed and Delays, Origin and Destination, Parking Survey, Pedestrian Studies, Accident analysis and Safety Level of Services applications and significance.                                                                       |                                          |               |
| <b>Module 3</b>                                                                                                                                                                                                                                                                          | <b>Traffic Control</b>                   | <b>Hrs. 6</b> |
| Traffic signs, Road markings, Design of Traffic signals and Signal co-ordination (Problems), Traffic control aids and Street furniture, Street Lighting, Computer applications in Signal design                                                                                          |                                          |               |
| <b>Module 4</b>                                                                                                                                                                                                                                                                          | <b>Geometric Design of Intersections</b> | <b>Hrs. 8</b> |
| Conflicts at Intersections, Classification of Intersections at Grade, - Chanallised and Unchanallised Intersection - Grade Separators (Concepts only), Principles of Intersection Design, Elements of Intersection Design, Chanallisation and Rotary design (Problems), Grade Separators |                                          |               |

|                                                                                                                                                                                                                                                                                                                                                             |                           |               |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------|---------------|
| <b>Module 5</b>                                                                                                                                                                                                                                                                                                                                             | <b>Traffic Management</b> | <b>Hrs. 8</b> |
| Area traffic Management system- Traffic System Management (TSM) and Travel Demand, Management (TDM), Traffic Forecasting techniques, Restrictions on turning movements, One-way Streets, Traffic Segregation, Traffic Calming, Tidal flow operations, Exclusive Bus Lanes - Introduction to Intelligence, Transport System (ITS)- enforcement and education |                           |               |

|                         |                                                                                                                                                                                                                                                                                                         |
|-------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Text Books:</b>      |                                                                                                                                                                                                                                                                                                         |
| <b>1</b>                | Highway Engineering, Khanna K and Justo C E G, Khanna Publishers, Roorkee, 2001                                                                                                                                                                                                                         |
| <b>2</b>                | Traffic Engineering and Transport Planning Kadiyali L, Khanna Technical Publications, Delhi 2000                                                                                                                                                                                                        |
| <b>3</b>                | Principles of Transportation Engineering" – Partha Chakroborty & Animesh Das                                                                                                                                                                                                                            |
| <b>4</b>                | Urban Transportation: Planning, Operation and Management" – G.R. Rajasekhar                                                                                                                                                                                                                             |
| <b>Reference Books:</b> |                                                                                                                                                                                                                                                                                                         |
| <b>1</b>                | <b>RC Codes</b> from Indian Roads Congress (essential for design references): IRC: 93 – Design of Traffic Signals, IRC: 106 – Guidelines for Capacity of Urban Roads, IRC: 65 – Traffic Signs, IRC: SP:90 – Manual for Road Safety Audit, IRC: SP:99- – Guidelines for Traffic Management in Work Zones |
| <b>2</b>                | "Highway Traffic Analysis and Design" – R.J. Salter and N.B. Hounsell.                                                                                                                                                                                                                                  |
| <b>3</b>                | "Traffic and Highway Engineering" – Nicholas J. Garber & Lester A. Hoel                                                                                                                                                                                                                                 |

| SUBJECT CODE          |          | Foundation Engineering |       |                            |     |     |       | CREDITS |  |
|-----------------------|----------|------------------------|-------|----------------------------|-----|-----|-------|---------|--|
| 26AF1191PC605         |          |                        |       |                            |     |     |       | 3       |  |
| 3 Lectures hours/week |          |                        |       | Examination Scheme (Marks) |     |     |       |         |  |
| Theory                | Tutorial | Laboratory             | Total | ISE                        | MSE | ESE | Total |         |  |
| 3                     | 0        | 0                      | 3     | 20                         | 20  | 60  | 100   |         |  |

| Course Objectives |                                                                                          |
|-------------------|------------------------------------------------------------------------------------------|
| COBJ1             | To introduce soil exploration techniques and their importance in foundation engineering. |
| COBJ2             | To understand and apply bearing capacity and settlement analysis theories.               |
| COBJ3             | To address challenges in designing foundations for problematic soils.                    |
| COBJ4             | To study the design and analysis of shallow and deep foundations.                        |
| COBJ5             | To examine slope stability and methods for its analysis and improvement.                 |

| Course Outcomes: On completion of course, students will be able to |                                                                           |
|--------------------------------------------------------------------|---------------------------------------------------------------------------|
| CO1                                                                | To identify and apply appropriate soil exploration and sampling methods.  |
| CO2                                                                | Analyze the stability of slope by theoretical and graphical methods.      |
| CO3                                                                | To compute bearing capacity and settlements using standard methods.       |
| CO4                                                                | To design foundations for expansive, collapsible, and compressible soils. |
| CO5                                                                | To evaluate and design various foundation systems per IS codes.           |

## Course Contents

| Module 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Introduction                    | Hrs. 8  |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------|---------|
| General requirements to be satisfied for satisfactory performance of foundations, Soil exploration: Necessity, Planning, Exploration Methods, Soil Sampling Disturbed and undisturbed, Rock Drilling and Sampling, Core Barrels, Core Boxes, Core Recovery, Field Tests for Bearing Capacity evaluation, Test Procedure & Limitations                                                                                                                                                                                                                                                                                                                                             |                                 |         |
| Module 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Bearing Capacity Analysis       | Hrs. 10 |
| Failure Modes, Terzaghi's Analysis, Specialization of Terzaghi's Equations, Skempton Values for $N_c$ , Meyerhof's Analysis, I.S. Code Method of Bearing Capacity Evaluation, Effect of Water Table, Eccentricity of load, Safe Bearing Capacity and Allowable Bearing Pressure, Settlement Analysis: Immediate Settlement - Consolidation Settlement, Differential Settlement, Tolerable Settlement, Angular distortion                                                                                                                                                                                                                                                          |                                 |         |
| Module 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Foundations for Difficult Soils | Hrs. 10 |
| Guidelines for Weak and Compressible Soils, Expansive soil, Parameters of Expansive Soils, Collapsible Soils and Corrosive Soils, Causes of Moisture changes in Soils, Effects of Swelling on Buildings, Preventative measures for Expansive Soils, Design of Foundation on Swelling Soils, Ground Improvement Methods: for general considerations, for Cohesive Soils, for Cohesionless Soils,<br>Shallow Foundations: Assumptions & Limitations of Rigid Design Analysis, Safe Bearing Pressure, Settlement of Footings, Design of isolated, Combined, Strap Footing (Rigid analysis), Raft Foundation (Elastic Analysis), I. S. Code of Practice for Design of Raft Foundation |                                 |         |

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|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------|---------------|
| <b>Module 4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>Deep foundations</b> | <b>Hrs. 8</b> |
| Pile Foundation: Classification, Pile Driving, Load Carrying Capacity of Piles, Single Pile Capacity, Dynamic Formulae, Static Formulae, Pile Load Tests, Penetration Tests, Negative skin Friction, Under Reamed Piles, Group Action of Piles, Caissons Foundations: Box, Pneumatic, Open Caissons, Forces, Grip Length, Well Sinking, Practical Difficulties and Remedial Measures Sheet Piles: Classification, Design of Cantilever Sheet Pile in Cohesionless and Cohesive soils. Design of Anchored Sheet Pile by Free Earth Support Method, Cellular Cofferdams: Types, Cell Fill Stability Considerations |                         |               |
| <b>Module 5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>Slope Stability</b>  | <b>Hrs. 8</b> |
| Different Definitions of Factors of Safety, Types of Slope Failures, Stability of an Infinite Slope of Cohesionless Soils, Stability Analysis of an Infinite Slope of Cohesive Soils, Stability of Finite Slopes- Slip Circle Method, Semi Graphical and Graphical Methods, Friction Circle Method, Stability Number: Concept and its use                                                                                                                                                                                                                                                                        |                         |               |

|                         |                                                                                        |
|-------------------------|----------------------------------------------------------------------------------------|
| <b>Text Books:</b>      |                                                                                        |
| <b>1</b>                | Kasamalkar, B.J., “Foundation Engineering”, Pittsburgh vintage Grand Prix              |
| <b>2</b>                | Murthy V.N.S., “Soil Mechanics and Foundation Engineering”, CRC Press 2002             |
| <b>3</b>                | Arora K.R., “Soil Mechanics and Foundation Engineering”, Standard publication 2009     |
| <b>4</b>                | Punmia B. C., “Soil Mechanics and Foundation Engineering”, Laxmi publication 16th 2017 |
| <b>5</b>                | Nayak N.V., “Foundation Design Manual”, Dhanpat Rai and Son                            |
| <b>6</b>                | Brahma S.P., “Foundation Engineering”, Tata McGraw-Hill 5th Edition                    |
| <b>7</b>                | Bowles J.E., “Foundation analysis & Design”, McGraw-Hill Higher Education 5th edition  |
| <b>Reference Books:</b> |                                                                                        |
| <b>1</b>                | Teng W.C., “Foundation Design”, Prentice-Hall Inc                                      |
| <b>2</b>                | Tomlinson M.J., “Foundation Design & Construction”, Prentice-Hall; 7th edition         |
| <b>3</b>                | Lee, “Sheet Piles” Concrete Publication, 1961                                          |
| <b>4</b>                | Relevant Publications by Bureau of Indian Standards, New Delhi                         |
| <b>5</b>                | IS 6403:1981, IS 1904:1986, IS 4091:1979                                               |

| SUBJECT CODE                   |          | Design of Concrete Structures Lab |       |                            |     |     |       | CREDITS |  |
|--------------------------------|----------|-----------------------------------|-------|----------------------------|-----|-----|-------|---------|--|
| 26AF1191PCL607                 |          |                                   |       |                            |     |     |       | 1       |  |
| Teaching Work Load/week (Hrs.) |          |                                   |       | Examination Scheme (Marks) |     |     |       |         |  |
| Theory                         | Tutorial | Laboratory                        | Total | ISE                        | MSE | ESE | Total |         |  |
| 0                              | 0        | 2                                 | 2     | 50                         | -   | 50  | 50    |         |  |

|                                                                           |                                                                                                    |
|---------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|
| <b>Course Outcomes:</b> On completion of course, students will be able to |                                                                                                    |
| CO1                                                                       | Identify and interpret design requirements of RCC structural elements. (Remembering/Understanding) |
| CO2                                                                       | Analyze structural behavior under various loading conditions. (Analyzing)                          |
| CO3                                                                       | Design RCC components as per IS 456 provisions. (Applying/Creating)                                |
| CO4                                                                       | Create detailed structural drawings using manual and CAD tools. (Creating)                         |
| CO5                                                                       | Justify design choices and evaluate structural safety and serviceability. (Evaluating)             |

## Course Contents

Term work shall consist of detailed analytical report for structural design and drawing of the following RC structures:

|                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-----------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A<br>(Compulsory)                                                                             | Design and detailing of G+1 RCC framed structure.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| B<br>(Any one of the listed)                                                                  | <p>The introduction, analysis and design of these topics shall be studied in self-study mode. If required the subject teacher should address the student's queries during tutorials).</p> <ol style="list-style-type: none"> <li>1) Retaining wall</li> <li>2) Elevated water tank: analysis and design of staging and tank body.</li> <li>3) Staircase of special form such as helicoidal stair</li> <li>4) Shell roofs: simple cylindrical, conical shells</li> <li>5) Special foundation type such as combined footing, raft, pile foundation</li> </ol> |
| <b>Use of computer programs such as MS Excel is desirable for post-processing of results.</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |

| SUBJECT CODE                   |          | Program Elective -II<br>Water Quality Engineering Lab |       |                            |     | CREDITS |       |
|--------------------------------|----------|-------------------------------------------------------|-------|----------------------------|-----|---------|-------|
| 26AF1191PEL608A                |          |                                                       |       |                            |     | 1       |       |
| Teaching Work Load/week (Hrs.) |          |                                                       |       | Examination Scheme (Marks) |     |         |       |
| Theory                         | Tutorial | Laboratory                                            | Total | ISE                        | MSE | ESE     | Total |
| 0                              | 0        | 2                                                     | 2     | 25                         | -   | 25      | 50    |

|                                                                           |                                                                                                                         |
|---------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| <b>Course Outcomes:</b> On completion of course, students will be able to |                                                                                                                         |
| CO1                                                                       | Determine key physical and chemical water quality parameters such as pH, turbidity, and TDS using standard instruments. |
| CO2                                                                       | Analyze alkalinity and hardness of water samples to evaluate buffering capacity and scaling potential.                  |
| CO3                                                                       | Perform BOD and COD tests to assess organic pollution levels in water and wastewater.                                   |
| CO4                                                                       | Interpret the working of a reverse osmosis (RO) unit.                                                                   |

## Course Contents

Practical Work consists of at least eight performances from list below and detailed reporting in form of journal.

|                                                                                               |                                                       |
|-----------------------------------------------------------------------------------------------|-------------------------------------------------------|
| Experiment No 1                                                                               | Determination of pH of Water Sample                   |
| Experiment No 2                                                                               | Determination of Turbidity                            |
| Experiment No 3                                                                               | Estimation of Total Dissolved Solids (TDS)            |
| Experiment No 4                                                                               | Determination of Alkalinity of Water.                 |
| Experiment No 5                                                                               | Determination of Total Hardness and Calcium Hardness. |
| Experiment No 6                                                                               | Estimation of Chlorides.                              |
| Experiment No 7                                                                               | Estimation of Dissolved Oxygen (DO)                   |
| Experiment No 8                                                                               | Determination of Biochemical Oxygen Demand (BOD)      |
| Experiment No 9                                                                               | Determination of Chemical Oxygen Demand (COD)         |
| Experiment No 10                                                                              | Demonstration of Reverse Osmosis (RO) Unit            |
| Experiment No 11                                                                              | Visit to a Water or Wastewater Treatment Plant.       |
| <b>Use of computer programs such as MS Excel is desirable for post-processing of results.</b> |                                                       |

|                                |          |                                                           |       |                            |     |     |       |         |  |
|--------------------------------|----------|-----------------------------------------------------------|-------|----------------------------|-----|-----|-------|---------|--|
| SUBJECT CODE                   |          | Program Elective -II<br>Environment Health and Safety Lab |       |                            |     |     |       | CREDITS |  |
| 26AF1191PEL608B                |          |                                                           |       |                            |     |     |       | 1       |  |
| Teaching Work Load/week (Hrs.) |          |                                                           |       | Examination Scheme (Marks) |     |     |       |         |  |
| Theory                         | Tutorial | Laboratory                                                | Total | ISE                        | MSE | ESE | Total |         |  |
| 0                              | 0        | 2                                                         | 2     | 25                         | -   | 25  | 50    |         |  |

|                                                                           |                                                                                                                         |
|---------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| <b>Course Outcomes:</b> On completion of course, students will be able to |                                                                                                                         |
| CO1                                                                       | Determine key physical and chemical water quality parameters such as pH, turbidity, and TDS using standard instruments. |
| CO2                                                                       | Analyze alkalinity and hardness of water samples to evaluate buffering capacity and scaling potential.                  |
| CO3                                                                       | Perform BOD and COD tests to assess organic pollution levels in water and wastewater.                                   |
| CO4                                                                       | Interpret the working of a reverse osmosis (RO) unit.                                                                   |

## Course Contents

Practical Work consists of at least eight performances from list below and detailed reporting in form of journal.

|                                                                                               |                                                       |
|-----------------------------------------------------------------------------------------------|-------------------------------------------------------|
| Experiment No 1                                                                               | Determination of pH of Water Sample                   |
| Experiment No 2                                                                               | Determination of Turbidity                            |
| Experiment No 3                                                                               | Estimation of Total Dissolved Solids (TDS)            |
| Experiment No 4                                                                               | Determination of Alkalinity of Water.                 |
| Experiment No 5                                                                               | Determination of Total Hardness and Calcium Hardness. |
| Experiment No 6                                                                               | Estimation of Chlorides.                              |
| Experiment No 7                                                                               | Estimation of Dissolved Oxygen (DO)                   |
| Experiment No 8                                                                               | Determination of Biochemical Oxygen Demand (BOD)      |
| Experiment No 9                                                                               | Determination of Chemical Oxygen Demand (COD)         |
| Experiment No 10                                                                              | Demonstration of Reverse Osmosis (RO) Unit            |
| Experiment No 11                                                                              | Visit to a Water or Wastewater Treatment Plant.       |
| <b>Use of computer programs such as MS Excel is desirable for post-processing of results.</b> |                                                       |

| SUBJECT CODE                   |          | Program Elective-III<br>Highway & Railway Engineering Lab |       |                            |     |     | CREDITS |
|--------------------------------|----------|-----------------------------------------------------------|-------|----------------------------|-----|-----|---------|
| 26AF1191PEL609A                |          |                                                           |       |                            |     |     | 1       |
| Teaching Work Load/week (Hrs.) |          |                                                           |       | Examination Scheme (Marks) |     |     |         |
| Theory                         | Tutorial | Laboratory                                                | Total | ISE                        | MSE | ESE | Total   |
| 0                              | 0        | 2                                                         | 2     | 25                         | -   | 25  | 50      |

|                                                                           |                                                                                                                                                                |
|---------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Course Outcomes:</b> On completion of course, students will be able to |                                                                                                                                                                |
| CO1                                                                       | Conduct and interpret results from aggregate crushing, impact, abrasion, and shape tests to assess their suitability for use in road construction.             |
| CO2                                                                       | Perform penetration, softening point, ductility, flash & fire point, and viscosity tests to determine the performance characteristics of bituminous materials. |
| CO3                                                                       | Assess binder content and stripping value to evaluate mix stability and moisture susceptibility in bituminous mixtures.                                        |
| CO4                                                                       | Conduct and analyze Marshall stability tests to evaluate the strength and deformation characteristics of bituminous mixes.                                     |
| CO5                                                                       | Gain hands-on experience in executing laboratory tests on aggregates and bitumen, and interpreting results as per relevant IS/ASTM standards.                  |

## Course Contents

Practical Work consists of at least eight performances from list below and detailed reporting in form of journal.

|                                                                                               |                                                                                                         |
|-----------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|
| Experiment No 1                                                                               | Aggregate crushing value test                                                                           |
| Experiment No 2                                                                               | Aggregate impact value test                                                                             |
| Experiment No 3                                                                               | Los Angeles abrasion test                                                                               |
| Experiment No 4                                                                               | Aggregate shape test                                                                                    |
| Experiment No 5                                                                               | Penetration test of bitumen                                                                             |
| Experiment No 6                                                                               | Softening point test of bituminous material                                                             |
| Experiment No 7                                                                               | (a) Flash and fire point test of bituminous material<br>(b) Viscosity test of bituminous material       |
| Experiment No 8                                                                               | Ductility test of bitumen                                                                               |
| Experiment No 9                                                                               | (a) Determination of binder content of asphalt mix<br>(b) Determination of stripping value of aggregate |
| Experiment No 10                                                                              | Marshall stability test of bituminous mix                                                               |
| <b>Use of computer programs such as MS Excel is desirable for post-processing of results.</b> |                                                                                                         |

| SUBJECT CODE                   |          | Program Elective-III<br>Intelligent Transportation Systems Lab |       |                            |     | CREDITS |       |
|--------------------------------|----------|----------------------------------------------------------------|-------|----------------------------|-----|---------|-------|
| 26AF1191PEL609B                |          |                                                                |       |                            |     | 1       |       |
| Teaching Work Load/week (Hrs.) |          |                                                                |       | Examination Scheme (Marks) |     |         |       |
| Theory                         | Tutorial | Laboratory                                                     | Total | ISE                        | MSE | ESE     | Total |
| 0                              | 0        | 2                                                              | 2     | 25                         | -   | 25      | 50    |

| Course Outcomes: On completion of course, students will be able to |                                                                                                                       |
|--------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|
| CO1                                                                | Explain the principles, objectives, and historical development of urban and town planning.                            |
| CO2                                                                | Interpret land use classifications, zoning regulations, and apply development control rules in planning exercises.    |
| CO3                                                                | Analyze the components of Master Plans and evaluate the legal and institutional framework of planning in India        |
| CO4                                                                | Apply basic concepts to plan urban infrastructure such as roads, water supply, sewerage, and drainage.                |
| CO5                                                                | Assess planning strategies for sustainable development and smart cities with a focus on environmental considerations. |

## Course Contents

Practical Work consists of at least eight performances from list below and detailed reporting in form of journal.

|                 |                                                                                                                                                                                                                                               |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Experiment No 1 | Introduction to Urban Base Maps & Survey Tools-<br>a) Understanding toposheets, satellite imagery, and municipal base maps<br>b) Introduction to GIS/AutoCAD/Google Earth for basic mapping                                                   |
| Experiment No 2 | Land Use Mapping of a Locality-<br>a) Field visit or remote mapping of a ward or neighborhood<br>b) Categorize plots into residential, commercial, public/semi-public, green, etc.<br>c) Prepare a land use map (manual or using GIS)         |
| Experiment No 3 | Plot Layout and Subdivision Planning-<br>a) Design a residential layout with proper plot sizes, roads, and amenities<br>b) Apply development control norms: FAR, setbacks, open space, etc.                                                   |
| Experiment No 4 | Zoning Map Preparation-<br>a) Create a basic zoning plan for a small urban area based on surveyed data<br>b) Apply compatible zoning: residential, commercial, institutional, recreational                                                    |
| Experiment No 5 | Master Plan Case Study-<br>a) Review an existing Master Plan of a city (e.g., Delhi, Pune, Indore, etc.)<br>b) Identify key land use proposals, transport networks, and growth areas<br>c) Submit a summary report with maps and observations |
| Experiment No 6 | Development Control Rules (DCR) Exercise-<br>a) Analyze local building bye-laws and DCR (e.g., height limits, plot coverage)<br>b) Prepare a report on compliance of a building with DCR norms                                                |
| Experiment No 7 | Urban Transportation Planning Exercise-<br>a) Map a road network hierarchy (arterial, collector, local roads)<br>b) Suggest basic traffic control measures, intersection design or BRT corridor.                                              |
| Experiment No 8 | Infrastructure Planning Mini-Project-<br>a) Plan water supply/sewerage for a residential block (20–30 plots).<br>b) Basic pipe sizing, layout sketching as per CPHEEO guidelines.                                                             |
| Experiment No 9 | Smart City Component Mapping-<br>a) Identify and mark ICT-based services (e-governance, smart lighting, surveillance)<br>b) Case study of a smart city implementation in India.                                                               |

|                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Experiment<br>No 10                                                                                                                                                                                                                                                                                                                          | Slum Redevelopment Plan<br>a) Create a simple layout showing redevelopment of a slum area<br>b) Include resettlement housing, basic amenities, and green space |
| <b>Project Title: Preparation of a Land Use Plan for a Small Urban Area / Neighborhood (2–5 sq.km)</b><br>Components: Site analysis and land use survey, Base map preparation, Proposed zoning plan, Infrastructure layout (roads, water, sewage), Development control norms, Sustainability or smart city elements, Presentation and Report |                                                                                                                                                                |

| SUBJECT CODE                   |          | Program Elective-III<br>Traffic Engineering & Management Lab |       |                            |     | CREDITS |       |
|--------------------------------|----------|--------------------------------------------------------------|-------|----------------------------|-----|---------|-------|
| 25AF1191PEL609C                |          |                                                              |       |                            |     | 1       |       |
| Teaching Work Load/week (Hrs.) |          |                                                              |       | Examination Scheme (Marks) |     |         |       |
| Theory                         | Tutorial | Laboratory                                                   | Total | ISE                        | MSE | ESE     | Total |
| 0                              | 0        | 2                                                            | 2     | 25                         | -   | 25      | 50    |

|                                                                           |                                                                            |
|---------------------------------------------------------------------------|----------------------------------------------------------------------------|
| <b>Course Outcomes:</b> On completion of course, students will be able to |                                                                            |
| CO1                                                                       | Collect and analyze real-world traffic data (speed, volume, O–D, parking). |
| CO2                                                                       | Design traffic signals and interpret LOS of urban roads.                   |
| CO3                                                                       | Apply IRC guidelines in traffic management decisions.                      |
| CO4                                                                       | Suggest basic improvements for safety and traffic efficiency.              |
| CO5                                                                       | Prepare technical reports and graphical presentations of traffic studies.  |

## Course Contents

Practical Work consists of at least eight performances from list below and detailed reporting in form of journal.

|                                                                              |                                                                                         |
|------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|
| Experiment No 1                                                              | Spot Speed Study – Measurement of vehicle speed using stopwatch or radar gun.           |
| Experiment No 2                                                              | Volume Count Study – Classified traffic volume count using manual or video method.      |
| Experiment No 3                                                              | Traffic Density and Flow Analysis – Compute traffic flow parameters (q, k, v).          |
| Experiment No 4                                                              | Origin–Destination (O–D) Survey – Using license plate matching / roadside interviews.   |
| Experiment No 5                                                              | Parking Study – Parking accumulation and turnover study for on-street/off-street areas. |
| Experiment No 6                                                              | Delay and Queue Length Study – At uncontrolled or signalized intersections.             |
| Experiment No 7                                                              | Traffic Signal Design – Design a fixed-time signal using Webster’s method.              |
| Experiment No 8                                                              | Saturation Flow and Level of Service (LOS) estimation based on IRC:106 guidelines.      |
| Experiment No 9                                                              | Intersection Capacity Analysis – Determine capacity of a four-arm intersection.         |
| Experiment No 10                                                             | Road Accident Data Analysis – Using sample police reports or traffic survey data.       |
| Experiment No 11                                                             | Installation & Study of Traffic Signs/Markings – Interpretation using IRC:67 & IRC:35.  |
| Project – Propose traffic improvement measures for a selected junction/area. |                                                                                         |

|                                |          |            |       |                            |     |     |         |  |
|--------------------------------|----------|------------|-------|----------------------------|-----|-----|---------|--|
| SUBJECT CODE                   |          | Seminar    |       |                            |     |     | CREDITS |  |
| 26AF1191EL610                  |          |            |       |                            |     |     | 1       |  |
| Teaching Work Load/week (Hrs.) |          |            |       | Examination Scheme (Marks) |     |     |         |  |
| Theory                         | Tutorial | Laboratory | Total | ISE                        | MSE | ESE | Total   |  |
| 0                              | 0        | 2          | 1     | 25                         | -   | 25  | 50      |  |

| Course Objectives |                                                                                                                       |
|-------------------|-----------------------------------------------------------------------------------------------------------------------|
| COBJ1             | Identify technical and practical challenges within the field of civil engineering.                                    |
| COBJ2             | Develop the ability to interpret, analyze, and communicate technical information effectively.                         |
| COBJ3             | Strengthen skills in technical report writing and presentation through critical thinking and structured documentation |
| COBJ4             | Learn referencing and plagiarism avoidance techniques.                                                                |

| Course Outcomes: On completion of course, students will be able to |                                                                                                                                    |
|--------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------|
| CO1                                                                | Understand and evaluate ongoing research, advancements, and interdisciplinary applications in civil engineering.                   |
| CO2                                                                | Conduct and organize a comprehensive literature survey using scholarly resources such as journals, books, and technical documents. |
| CO3                                                                | Analyze and derive conclusions from the selected technical topic.                                                                  |
| CO4                                                                | Prepare and present a structured technical report demonstrating critical analysis.                                                 |
| CO5                                                                | Enhance their technical writing and oral communication skills                                                                      |

| Guidelines for seminar work                                                                                                                                                                                                                                                           |                                                                                                                                                                                             |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1                                                                                                                                                                                                                                                                                     | <i>The seminar report should include the following elements. Internal guides may use a continuous evaluation sheet for each student, which will contribute to the term work assessment.</i> |
| 2                                                                                                                                                                                                                                                                                     | <b>Introduction:</b> Background of the selected topic, its relevance to civil engineering, the need for the study, objectives, and scope along with any limitations.                        |
| 3                                                                                                                                                                                                                                                                                     | <b>Literature Review:</b> Summary and analysis of literature from books, journals, conference papers, technical reports, and other scholarly documents—preferably from the last five years. |
| 4                                                                                                                                                                                                                                                                                     | <b>Theoretical Content:</b> Core subject matter related to the topic, including models, equations, methods, or relevant case studies.                                                       |
| 5                                                                                                                                                                                                                                                                                     | <b>Conclusion:</b> Final observations, outcomes of the study, and potential future scope.                                                                                                   |
| 6                                                                                                                                                                                                                                                                                     | <b>References:</b> Properly cited sources used throughout the seminar report.                                                                                                               |
| Guidelines for Assessment                                                                                                                                                                                                                                                             |                                                                                                                                                                                             |
| Panel of staff members along with a guide will assess the seminar work based on these parameters- Topic, Contents and Presentation, regularity, Punctuality and Timely Completion, Question and Answers, Report, Paper presentation/Publication, Attendance and Active Participation. |                                                                                                                                                                                             |

| SUBJECT CODE                   |          | Project Phase-I |       |                            |     |     |       | CREDITS |
|--------------------------------|----------|-----------------|-------|----------------------------|-----|-----|-------|---------|
| 27AF1191EL711                  |          |                 |       |                            |     |     |       | 2       |
| Teaching Work Load/week (Hrs.) |          |                 |       | Examination Scheme (Marks) |     |     |       |         |
| Theory                         | Tutorial | Laboratory      | Total | ISE                        | MSE | ESE | Total |         |
| 0                              | 0        | 4               | 2     | 50                         | -   | 50  | 100   |         |

| Course Objectives |                                                                      |
|-------------------|----------------------------------------------------------------------|
| COBJ1             | To identify a real-world civil engineering problem.                  |
| COBJ2             | To conduct detailed literature review and problem formulation.       |
| COBJ3             | To define project objectives, methodology, and expected outcomes.    |
| COBJ4             | To develop preliminary design / experimental / analytical framework. |
| COBJ5             | To prepare a comprehensive project proposal report.                  |

| Course Outcomes: On completion of course, students will be able to |                                                                                |
|--------------------------------------------------------------------|--------------------------------------------------------------------------------|
| CO1                                                                | Identify and define a research/industry problem in Civil Engineering.          |
| CO2                                                                | Conduct critical literature review using reputed journals (Scopus, SCI, etc.). |
| CO3                                                                | Develop methodology and work plan for the project.                             |
| CO4                                                                | Perform preliminary analysis/design/experimental planning.                     |
| CO5                                                                | Prepare and present a technical project proposal.                              |

| Guidelines for Project Phase-I                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                        |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Project work can be done in a group of students. (Min 2-Max.4.)                                                                                                                                                                                                                   |                                                                                                                                                                                                                                                                        |
| 1                                                                                                                                                                                                                                                                                 | <b>Problem Identification:</b><br>Students shall select a suitable project topic from any specialization of Civil Engineering and obtain approval of the topic and project title from the allotted guide. A clear and well-defined problem statement must be prepared. |
| 2                                                                                                                                                                                                                                                                                 | <b>Literature Review:</b><br>A comprehensive review of at least <b>10–15 research papers</b> from reputed journals shall be conducted. Based on the review, research gaps must be identified and a comparative analysis table should be prepared.                      |
| 3                                                                                                                                                                                                                                                                                 | <b>Project Planning:</b><br>The objectives and scope of the project shall be finalized. An appropriate methodology (Experimental / Analytical / Numerical / Field-based) must be defined along with a detailed work schedule.                                          |
| 4                                                                                                                                                                                                                                                                                 | <b>Preliminary Work:</b><br>Preliminary activities such as pilot study, experimental setup design, software modelling framework, and material procurement planning shall be carried out as applicable.                                                                 |
| 5                                                                                                                                                                                                                                                                                 | <b>Documentation and Presentation:</b><br>The synopsis/report and presentation must be completed within the stipulated time.                                                                                                                                           |
| <p><i>Internal guides may use a continuous evaluation sheet for each student, which will contribute to the term work assessment.</i></p> <p><b><i>Project diary must be maintained with guide to keep the records of students-guide interactions during the semester.</i></b></p> |                                                                                                                                                                                                                                                                        |

## Guidelines for Assessment

Panel of staff members along with a guide will assess the project phase -I work based on these parameters- Topic, Contents and Presentation, regularity, Punctuality and Timely Completion, Question and Answers, Report, Paper presentation/Publication, Attendance and Active Participation.

Following evaluation criteria can be used as a guideline

| <b>Component</b>       | <b>Marks</b> |
|------------------------|--------------|
| Literature Review      | 20           |
| Problem Formulation    | 15           |
| Methodology & Planning | 20           |
| Project Presentation   | 20           |
| Report Quality         | 25           |
| <b>Total</b>           | <b>100</b>   |