

Amrutvahini Sheti and ShikshanVikas Sanstha's

**AMRUTVAHINI COLLEGE OF ENGINEERING, SANGAMNER**

Amrutnagar, Ghulewadi, Sangamner-422608



(An Autonomous Institute Approved by AICTE and Affiliated to SPPU, Pune)

## Curriculum Structure and Syllabus of Second Year B.Tech. Civil Engineering



(Effective from Academic Year 2026-27)

*Justin*

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## Abbreviation

AEC - Ability Enhancement Course  
AICTE - All India Council for Technical Education  
CEP - Community Engagement Project  
EEM - Entrepreneurship/Economics/Management Courses  
MDM - Multidisciplinary Minor  
MOOC - Massive Open Online Course  
NEP - National Education Policy  
NPTEL - National Programme on Technology Enhanced Learning  
OE - Open Elective  
PCC - Program Core Course  
CCC – Cocurricular Course  
PEO - Programme Educational Objectives  
PSO - Program Specific Outcomes  
SWAYAM - Study Webs of Active-learning for Young Aspiring Minds  
UGC - University Grants Commission  
VEC - Value Education Course  
VSE - Vocational and Skill Enhancement Course  
WK - Knowledge and Attitude Profile  
CCE - Comprehensive and Continuous Evaluation  
ISO - International Organization for Standardization  
EOMS - Educational Organization Management System

  
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## Institute Vision

To create opportunities for rural students to become able engineers and technocrats through continual excellence in engineering education.

## Institute Mission

Our mission is to create self-disciplined, physically fit, mentally robust and morally strong engineers and technocrats with high degree of integrity and sense of purpose who are capable to meet challenges of ever advancing technology for the benefit of mankind and nature.

We, the management, the faculty and staff, therefore promise to strive hard and commit ourselves to achieve this objective through a continuous process of learning and appreciation of needs of time.

## Department Vision

Knowledge center for rural students with continual excellence in technical education

## Department Mission

M1: To create self-disciplined, physically fit and competent Civil Engineers with high level of professional, moral and ethical values.

M2: To serve mankind and nature with high integrity and sense of purpose to meet challenges of ever advancing technology through research and development.

M3: To mentor students in pursuit of higher education, employability and entrepreneurship.

  
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## ISO 21001:2018 - EOMS Policy

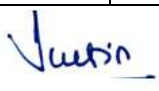
We, at AVCOE Sangamner, are committed to:

- Provide quality technical education to the rural students
- Provide conducive environment for all round development of the students.
- Develop as a premier institute for technical education & research as per the needs and expectations of all stakeholders.
- Comply all applicable requirements.
- Develop students into technocrat having social responsibility.
- Keep abreast about the advances in technology and innovation.
- Enhance industry-institute interaction.
- Managing intellectual property.
- Maintain hygiene, health and safety for applicable requirements.
- Achieve continual improvement in academic and administrative processes.
- We shall strive to maintain Educational Organizational Management System.

## Knowledge and Attitude Profile

A Knowledge and Attitude Profile (KAP), often represented as WK (Knowledge and Attitude Profile) in some contexts, is a framework or assessment tool used to evaluate an individual's knowledge and attitudes related to a specific area, topic, or domain.

|     |                                                                                                                                                                                                                      |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| WK1 | A systematic, theory-based understanding of the natural sciences applicable to the discipline and awareness of relevant social sciences.                                                                             |
| WK2 | Conceptually-based mathematics, numerical analysis, data analysis, statistics and formal aspects of civil and information science to support detailed analysis and modeling applicable to the discipline.            |
| WK3 | A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline.                                                                                                           |
| WK4 | Engineering specialist knowledge that provides theoretical framework and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline.              |
| WK5 | Knowledge, including efficient resource use, environmental impacts, whole-life cost, re-use of resources, net zero carbon, and similar Concepts, that supports engineering design and operations in a practice area. |

  
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|     |                                                                                                                                                                                                                                                                                                  |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| WK6 | Knowledge of engineering practice (technology) in the practice areas in the engineering discipline.                                                                                                                                                                                              |
| WK7 | Knowledge of the role of engineering in society and identified issues in engineering practice in the discipline, such as the professional responsibility of an engineer to public safety and sustainable development.                                                                            |
| WK8 | Engagement with selected knowledge in the current research literature of the discipline, awareness of the power of critical thinking and creative approaches to evaluate emerging issues.                                                                                                        |
| WK9 | Ethics, inclusive behavior and conduct. Knowledge of professional ethics, responsibilities, and norms of engineering practice. Awareness of the need for diversity by reason of ethnicity, gender, age, physical ability etc. with mutual understanding and respect, and of inclusive attitudes. |

  
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## Program Outcomes (POs)

|     |                                            |                                                                                                                                                                                                                                                                              |
|-----|--------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PO1 | Engineering knowledge                      | Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.                            |
| PO2 | Problem analysis                           | Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4)                                                                   |
| PO3 | Design / Development of Solutions          | complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)                             |
| PO4 | Conduct Investigations of Complex Problems | Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).                                                                     |
| PO5 | Engineering Tool Usage                     | Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6)                                                          |
| PO6 | The Engineer and The World                 | Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).                                |
| PO7 | Ethics                                     | Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9)                                                                                                                            |
| PO8 | Individual and Collaborative Team work     | Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.                                                                                                                                                                        |
| PO9 | Communication                              | Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences. |



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|      |                                |                                                                                                                                                                                                                                            |
|------|--------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| PO10 | Project Management and Finance | Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.     |
| PO11 | Life-Long Learning             | Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8) |

### Program Educational Objectives (PEOs):

**PEO1:**The graduate will have professional competence with moral and ethical values to enhance their skills related to entrepreneurship, employability and higher education.

**PEO2:**The graduate will have sense of commitment for integrated and sustainable socio-economic development of the nation.

**PEO3:**The graduate will have an ability and motivation to carry out research and development activities using modern engineering tools and techniques.

**PEO 4:** The graduate will have capability for critical thinking, engineering reasoning, problem solving, experimentation and teamwork.

### Program Specific Outcomes (PSOs):

**After successful completion of Civil Engineering program, the students will enable to**

**PSO1:** Develop knowledge of building planning constructions, concrete technology, surveying, fluid and hydraulics, structural analysis and design, geotechnical and foundation, construction management, transportation and infrastructure, quantity surveying, and environmental engineering to design, develop and manage the civil engineering structures considering safety, health, ethics and environment aspects.

**PSO2:** Apply professional skills and fundamentals of mathematics, basic sciences, numerical methods, computer programming and applied mechanics in civil engineering field for the betterment of society through sustainable development.

**PSO3:** Excel careers in government, public and private sectors in addition to entrepreneurship and consultancy in the field of civil engineering.

  
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## Preface

It gives me immense pleasure to present the autonomous syllabus of the Second Year B.Tech. in Civil Engineering, introduced for the first time by the department. This curriculum has been carefully designed to meet the changing needs of industry, higher education, and emerging technologies while strengthening the academic foundation of students.

The syllabus emphasizes conceptual understanding, practical learning, skill development, innovation, and problem-solving abilities. It includes modern and industry-relevant subjects that encourage students to explore advanced areas of Civil Engineering and interdisciplinary technologies. Special focus has been given to outcome-based education, hands-on learning, and project-oriented approaches to prepare students for professional challenges and lifelong learning.

I sincerely appreciate the valuable efforts of all faculty members, subject experts, and Board of Studies Civil Engineering members who contributed to the successful framing of this curriculum. I am confident that this syllabus will provide students with strong technical knowledge, professional competence, and opportunities for overall growth in the field of Civil Engineering.

I extend my best wishes to all students and faculty members for the successful implementation of this autonomous curriculum.

**Dr. S. B. Kandekar**

Head, Department of Civil Engineering

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## Program codes:

The institute has assigned a unique program code to each branch.

Table1–Program codes

| Sr. No.     | Program code                   | Code |
|-------------|--------------------------------|------|
| UG Programs |                                |      |
| 1           | Civil Engineering              | CE   |
| PG Programs |                                |      |
| 2           | M. Tech Structural Engineering | MSE  |

## Subject code nomenclature:

The following nomenclature demonstrates the subject codes:

- **R**-Year of designing/revising syllabus
- **Program code:** as given in Table-1
- **Course Type:** As per NEP
- **Course Number:**
  - 101 – FY B. Tech Subject 1
  - 201 - SY B. Tech Subject 1
  - 301 - TY B. Tech Subject 1,
  - 401 - B. Tech Subject 1 etc.



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| Sr. No.               | Name of the course                                             | Course Code    | Syllabus Design Teams                                                                                     |
|-----------------------|----------------------------------------------------------------|----------------|-----------------------------------------------------------------------------------------------------------|
| <b>Semester - III</b> |                                                                |                |                                                                                                           |
| 1                     | Mechanics of Structure                                         | R25-CE-PCC-201 | Er. A. R. Ghode        |
| 2                     | Surveying                                                      | R25-CE-PCC-202 | Er. V. R. Rahane       |
| 3                     | Architectural Planning and Design of Building                  | R25-CE-PCC-203 | Er. J. B. Sangale      |
| 4                     | Computational and Applied Mathematics                          | R25-CE-MDM-204 | Prof. D. N. Kalokhe    |
| 5                     | Open Elective I:<br>Mechanical, Electrical and Plumbing System | R25-CE-OEC-205 | Er. J. R. Gaikwad      |
| 6                     | Project Planning and Valuation                                 | R25-CE-EEM-206 | Er. A. C. Pemgirikar  |
| 7                     | Universal Human Values and Ethics                              | R25-CE-VEC-207 | Er. P. B. Vanave     |
| 8                     | Mechanics of Structure Lab                                     | R25-CE-PCC-208 | Er. T. R. More       |
| 9                     | Architectural Planning and Design of Building Lab              | R25-CE-PCC-209 | Er. M. D. Kokate     |
| 10                    | Community Engagement Project / Field Project                   | R25-CE-CEP-210 | Er. S. R. Wale       |

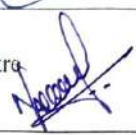
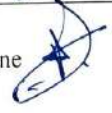


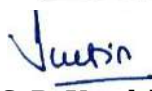
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| Sr. No.       | Name of the course                           | Course Code    | Syllabus Design Teams                                                                                    |
|---------------|----------------------------------------------|----------------|----------------------------------------------------------------------------------------------------------|
| Semester – IV |                                              |                |                                                                                                          |
| 1             | Fluid Mechanics                              | R25-CE-PCC-211 | Dr. R. T. Sahu        |
| 2             | Concrete Technology                          | R25-CE-PCC-212 | Dr. A. J. Meheta      |
| 3             | Structural Analysis                          | R25-CE-PCC-213 | Er. V. P. Kulkarni    |
| 4             | Digital Modelling and Visualization          | R25-CE-MDM-214 | Dr. V. B. Nawale      |
| 5             | Open Elective II: Interior Design            | R25-CE-OEC-215 | Er. C. M. Gunjal      |
| 6             | Revit Architecture Lab                       | R25-CE-VSC-216 | Er. M. A. Nawale      |
| 7             | Modern Indian Language and Technical Writing | R25-CE-AEC-217 | Er. A. P. Yadav      |
| 8             | Entrepreneurship & Contract Management       | R25-CE-EEM-218 | Dr. D. Debnath      |
| 9             | Concrete Technology Lab                      | R25-CE-PCC-219 | Er. A. C. Bochara   |
| 10            | Fluid Mechanics Lab                          | R25-CE-PCC-220 | Er. C. S. Kadlag    |
| 11            | Environmental Studies                        | R25-CE-VEC-221 | Er. P. R. Chandane  |

  
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 Head of Department

  
**Dr. M. A. Venkatesh**  
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## Guidelines for Examination Scheme:

The evaluation of students shall be based on continuous academic performance in a course based on Comprehensive Continuous Evaluation (CCE) and End Semester Examination (ESE). Components of the Examination System:

### 1. Comprehensive Continuous Evaluation (CCE):

- CCE of 40 marks based on all the Units of course.
- To design a Comprehensive Continuous Evaluation scheme for a theory subject of 40 marks with the specified parameters, the allocation of marks and the structure can be detailed as follows:

**Table3: Allocation of marks & structure**

| Sr.No. | Examination                                                                                        | Conduction Marks | Marks | Coverage of Units                |
|--------|----------------------------------------------------------------------------------------------------|------------------|-------|----------------------------------|
| 1      | <b>CCE–I</b><br>(Class test–1)                                                                     | 32               | 16    | Units1 & Unit2<br>(8 Marks/Unit) |
| 2      | <b>CCE–II</b><br>(Assessment tools: Case Study, presentation, Open book test etc.)                 | 32               | 16    | Units3 & Unit4<br>(8 Marks/Unit) |
| 3      | <b>CCE–III</b><br>(Assessment tools: Assignments, seminar, quiz, course project, field visit etc.) | 08               | 08    | Unit 5                           |

The distribution of marks across various assessment tools and their mapping to COs is detailed in the table below.

**Table 3: Allocation of marks & pattern for 3-Credit subjects**

| Exam         | Assessment                 | CO1       | CO2       | CO3       | CO4       | CO5       |
|--------------|----------------------------|-----------|-----------|-----------|-----------|-----------|
| <b>CCE1</b>  | Written Test (Units 1 & 2) | 8         | 8         | –         | –         | –         |
| <b>CCE2</b>  | Continuous Assessment*     | –         | –         | 8         | 8         | –         |
| <b>CCE3</b>  | Continuous Assessment*     | –         | –         | –         | –         | 8         |
| <b>ESE</b>   | Written Examination        | 12        | 12        | 12        | 12        | 12        |
| <b>Total</b> | <b>100 Marks</b>           | <b>20</b> | <b>20</b> | <b>20</b> | <b>20</b> | <b>20</b> |

**Table 4: Allocation of marks & pattern for 2-Credit subjects**

| Exam        | Assessment                 | CO1 | CO2 | CO3 | CO4 |
|-------------|----------------------------|-----|-----|-----|-----|
| <b>CCE1</b> | Written Test (Units 1 & 2) | 10  | 10  | –   | –   |



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|              |                        |           |           |           |           |
|--------------|------------------------|-----------|-----------|-----------|-----------|
| <b>CCE2</b>  | Continuous Assessment* | —         | —         | 10        | 10        |
| <b>CCE3</b>  | Continuous Assessment* | —         | —         | —         | —         |
| <b>ESE</b>   | Written Examination    | 15        | 15        | 15        | 15        |
| <b>Total</b> | <b>100 Marks</b>       | <b>25</b> | <b>25</b> | <b>25</b> | <b>25</b> |

#### **Timeline for conduction of CCE:**

- Weeks 1-4: Completion of Unit 1 and 2  
Week 5: Conduct CCE1 of (16 marks)
- Weeks 6-8: Completion of Unit 3 and 4  
Week 9: Conduct CCE2 of (16 marks)
- Weeks 10-12: Completion of Unit 5  
Week 13: Conduct Seminar/Course project/Presentation/Quiz/Open Book test (8marks)

#### **Evaluation and Feedback:**

- **Unit Test:** Student answer papers will be evaluated promptly, and constructive feedback will be provided highlighting strengths and areas for improvement.
- **Assignments / Case Study:** Student submissions will be assessed as per the given rubric, and meaningful feedback will be provided to help students understand their performance and scope for enhancement.
- **Seminar Presentation:** Students will be evaluated based on content accuracy, delivery, and responses during the Q&A session. Feedback will be shared on communication skills and conceptual understanding.
- **Open Book Test:** Evaluation will focus on the depth of analysis and the ability to apply concepts. Feedback will emphasize students' critical thinking and problem-solving skills.
- **Mini Project:** Students will be assessed on problem identification, design approach, implementation quality, and documentation. Innovation, teamwork, and practical application of concepts will be strongly considered.
- **Field Visit:** Evaluation will be based on the student's report and reflection, focusing on understanding of real-world practices and their relevance to the course outcomes. Marks will reflect clarity, insight, and active participation.

#### **2. End Semester Examination (ESE):**

The ESE is a compulsory examination for all students. The ESE examination will be conducted at the end of the semester by the institutes Department of Examination and Evaluation (DEE). The ESE will be based on 100% syllabus (Unit 1 to Unit5). The ESE shall be of 60marks (12Marks/Unit) conducted for all theory courses as mentioned in the programme structure.

  
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# Semester-I

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| Sr. No.      | Course Code    | Course Type                                           | Name of the Subject                                                       | Teaching Scheme (Hrs./week) |    |     |               |                     |       | Examination Scheme and Marks |     |     |    |    |       | Credit |    |     |       |
|--------------|----------------|-------------------------------------------------------|---------------------------------------------------------------------------|-----------------------------|----|-----|---------------|---------------------|-------|------------------------------|-----|-----|----|----|-------|--------|----|-----|-------|
|              |                |                                                       |                                                                           | TH                          | PR | TUT | Contact Hours | Self Learning Hours | Total | CCE                          | ESE | TW  | PR | OR | TOTAL | TH     | PR | TUT | TOTAL |
| Semester-III |                |                                                       |                                                                           |                             |    |     |               |                     |       |                              |     |     |    |    |       |        |    |     |       |
| 1            | R25-CE-PCC-201 | Program Core course - 1                               | Mechanics of Structure                                                    | 3                           | -  | -   | 45            | 45                  | 90    | 40                           | 60  | -   | -  | -  | 100   | 3      | -  | -   | 3     |
| 2            | R25-CE-PCC-202 | Program Core course - 2                               | Surveying                                                                 | 3                           | -  | -   | 45            | 45                  | 90    | 40                           | 60  | -   | -  | -  | 100   | 3      | -  | -   | 3     |
| 3            | R25-CE-PCC-203 | Program Core course - 3                               | Architectural Planning and Design of Building                             | 3                           | -  | -   | 45            | 45                  | 90    | 40                           | 60  | -   | -  | -  | 100   | 3      | -  | -   | 3     |
| 4            | R25-CE-MDM-204 | Multidisciplinary Minor-1                             | Computational and Applied Mathematics                                     | 3                           | -  | -   | 45            | 45                  | 90    | 40                           | 60  | -   | -  | -  | 100   | 3      | -  | -   | 3     |
| 5            | R25-CE-OEC-205 | Open Elective - 1                                     | To be chosen from a basket of Open Elective- I finalized at college level | 2                           | -  | -   | 30            | 30                  | 60    | 40                           | 60  | -   | -  | -  | 100   | 2      | -  | -   | 2     |
| 6            | R25-CE-EEM-206 | Entrepreneurship/Economics/ Management course         | Project Planning and Valuation                                            | 1                           | 2  | -   | 15            | 15                  | 60    | 25                           | -   | 25  | -  | -  | 50    | 1      | 1  | -   | 2     |
| 7            | R25-CE-VEC-207 | Value Education Course                                | Universal Human Values and Ethics                                         | 2                           | -  | -   | 30            | 30                  | 60    | 50                           | -   | -   | -  | -  | 50    | 2      | -  | -   | 2     |
| 8            | R25-CE-PCC-208 | Program Core Course-Lab                               | Mechanics of Structure Lab                                                | -                           | 2  | -   | 30            | -                   | 30    | -                            | -   | 25  | 25 | -  | 50    | -      | 1  | -   | 1     |
| 9            | R25-CE-PCC-209 | Program Core Course Lab / Multidisciplinary Minor-Lab | Architectural Planning and Design of Building Lab                         | -                           | 2  | -   | 30            | -                   | 30    | -                            | -   | 25  | 25 | -  | 50    | -      | 1  | -   | 1     |
| 10           | R25-CE-CEP-210 | Comunity Engagement Project / Field Project           | Community Engagement Project / Field Project                              | -                           | 4  | -   | 60            | -                   | 60    | -                            | -   | 50  | -  | -  | 50    | -      | 2  | -   | 2     |
|              |                |                                                       |                                                                           | 17                          | 10 | 0   | 375           | 255                 | 660   | 275                          | 300 | 125 | 50 | 0  | 750   | 17     | 5  | 0   | 22    |

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|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|----------|--------|--------------------|--------------|--------|----------------|----|
| Program:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | S.Y. B.Tech. Civil                                                                                         |          |        |                    | Semester:    |        | III            |    |
| Course:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Mechanics of Structure                                                                                     |          |        |                    | Course Code: |        | R25-CE-PCC-201 |    |
| Teaching Scheme (hrs. / week)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                            |          |        | Examination Scheme |              |        |                |    |
| Lecture                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Practical                                                                                                  | Tutorial | Credit | CCE                | ESE          | TW     | PR             | OR |
| 03                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | -                                                                                                          | -        | 03     | 40                 | 60           | -      | -              | -  |
| <b>Course Description and Relevance:</b><br>This course helps students to understand how structures like beams, columns, and shafts respond to different loads. It explores concepts such as stress and strain, shear force and bending moments, torsion, and column stability, connecting the theory of mechanics to real-world applications in structural design and civil engineering practice.                                                                                                                                                                                                                               |                                                                                                            |          |        |                    |              |        |                |    |
| <b>Prerequisite:</b><br>Engineering Mathematics, Engineering Mechanics and Civil Engineering Systems.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                            |          |        |                    |              |        |                |    |
| <b>Bridge Content:</b><br>Basic laws of statics, Calculation of centroid, and Moment of inertia, Differential calculus, Integration, and Derivatives                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                            |          |        |                    |              |        |                |    |
| <b>Course Objectives:</b><br>1. <b>UNDERSTAND</b> the fundamental concepts of stress, strain, and deformation in structural members under various loads.<br>2. <b>ANALYZE</b> internal forces and draw shear force and bending moment diagrams for different loading conditions.<br>3. <b>EVALUATE</b> bending, shear, and torsional stresses in beams and shafts of various cross-sections.<br>4. <b>ASSESS</b> the behavior of columns under axial and eccentric loading, and determine critical loads for stability.<br>5. <b>DETERMINE</b> slope and deflection in beams and analyze frame using standard analytical method. |                                                                                                            |          |        |                    |              |        |                |    |
| <b>Course Outcomes:</b> After learning the course, students will be able to                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                            |          |        |                    |              |        |                |    |
| CO                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Course Outcome                                                                                             |          |        |                    |              |        | Bloom's Level  |    |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | EXPLAIN and COMPUTE stresses, strains, and deformations in structural elements subjected to axial loading. |          |        |                    |              |        | 2              |    |
| CO2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | CONSTRUCT and INTERPRET shear force and bending moment diagrams for beams under different loadings.        |          |        |                    |              |        | 3              |    |
| CO3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | CALCULATE bending, shear, and torsional stresses in beams and shafts with various cross-sections.          |          |        |                    |              |        | 3              |    |
| CO4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | ANALYZE the stability of columns under axial and eccentric loads and determine critical buckling loads.    |          |        |                    |              |        | 4              |    |
| CO5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | EVALUATE slope and deflection in beams and analyze simple trusses using analytical methods.                |          |        |                    |              |        | 4              |    |
| Course Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                            |          |        |                    |              |        |                |    |
| Unit 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Title: Simple And Complex Stress, Strain                                                                   |          |        |                    |              | 9 Hrs. | CO1            |    |
| a) Overview of construction materials and their properties. Introduction to Hooke's Law, Explanation of axial stresses (compression and tension), and various types of strains (linear, lateral, shear, and volumetric). Discussion on elastic constants and their interrelationships.Stresses and strains due to a temperature                                                                                                                                                                                                                                                                                                  |                                                                                                            |          |        |                    |              |        |                |    |

  
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| <p>change.</p> <p>b) Analysis of stresses, strains, and deformations in determinate and indeterminate structures for homogeneous and composite materials, considering the effects of temperature changes.</p> <p>c) Principal Stresses and Strains: Concept of principal planes and principal stresses, Normal and shear stresses on a plane.</p>                                                                                                                                                                                                                                                                                                                                                                                             |                                              |               |            |
| <p><b>Exemplars / Practical Applications and usage:</b></p> <ul style="list-style-type: none"> <li>• Analysis of stresses in steel tie rods used in roof trusses and transmission towers.</li> <li>• Determination of thermal stresses in railway tracks, pipelines, and bridge members due to temperature variation.</li> <li>• Evaluation of deformation in reinforced concrete and composite structural members.</li> <li>• Application of principal stress theory in pressure vessels, shafts, and machine components.</li> </ul>                                                                                                                                                                                                         |                                              |               |            |
| <p><b>Assignments:</b></p> <p>A steel bar of 30 mm diameter and 2 m length carries a tensile load of 120 kN. Determine the stress, strain, and elongation if <math>E=200</math> GPa.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                              |               |            |
| <b>Unit 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>Title: Shear Force and Bending Moment</b> | <b>9 Hrs.</b> | <b>CO2</b> |
| <p>a) Concept of shear force and bending moment, Relationship between shear force, bending moment, and intensity of loading.</p> <p>b) Shear force, and bending moment diagrams for determinate beams under different loadings (concentrated, uniformly distributed, uniformly varying loads, and couples), Point of Contra-flexure,</p> <p>c) Deriving bending moment and loading diagrams from a given shear force diagram, analytical calculations and visualizing using Origin software( for point load and simply supported beam only)</p>                                                                                                                                                                                               |                                              |               |            |
| <p><b>Exemplars / Practical Applications and usage:</b></p> <ul style="list-style-type: none"> <li>• Determination of shear force and bending moment in beams used in buildings, bridges, and industrial structures.</li> <li>• Analysis of loading effects on floor beams, roof girders, and cantilever balconies.</li> <li>• Identification of critical sections in structural members for safe and economical design.</li> </ul>                                                                                                                                                                                                                                                                                                           |                                              |               |            |
| <p><b>Assignments:</b></p> <p>1. Draw the shear force and bending moment diagrams for a simply supported beam subjected to a central point load.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                              |               |            |
| <b>Unit 3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>Title: Stresses In Beams and Shafts</b>   | <b>9 Hrs.</b> | <b>CO3</b> |
| <p>a) Stresses in beams due to Bending: Theory of simple bending, assumptions, derivation of flexure formula, Bending stress distribution diagrams and the Moment of Resistance of cross-sections, application of the bending equation to different section.</p> <p>b) Shear Stresses in Beams:-Concept of shear, complementary shear, derivation of shear stress formula, Shear stress distribution for various cross-sections, maximum and average shear stress for circular and rectangular sections.</p> <p>c) Stresses in shafts due to Torsion:- Theory of torsion, assumptions, introductory equation of torsion, Brief idea of shear stress and shear strain in shafts. Introduction to angle of twist and deformation in shafts.</p> |                                              |               |            |

  
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**Exemplars / Practical Applications and usage:**

- Application of flexure theory in the design of machine components and structural members.
- Evaluation of shear stress distribution in rectangular, circular, and I-sections for safe beam design.
- Study of torsional behaviour in transmission shafts

**Assignments:**

Derive the flexure formula and explain the assumptions made in the theory of simple bending.

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                         |               |            |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------|---------------|------------|
| <b>Unit 4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>Title: Axially and Eccentrically Loaded Columns.</b> | <b>9 Hrs.</b> | <b>CO4</b> |
| <p>a) Columns and Struts, Definition, Short and Long columns, End conditions, Equivalent length / Effective length, Slenderness ratio, Axially loaded short and long column, theory of long columns, Critical load for Columns with different end conditions.</p> <p>b) Direct and bending stresses for eccentrically loaded short columns, Resultant stress diagrams due to axial loads, uniaxial, and biaxial bending.</p> <p>c) Concept of the core of a section for solid and hollow rectangular and circular sections.</p> |                                                         |               |            |
| <p><b>Exemplars / Practical Applications and usage:</b></p> <ul style="list-style-type: none"> <li>• Determination of buckling load and stability of long columns subjected to compressive forces.</li> <li>• Application of Euler's column theory in the design of steel and reinforced concrete compression members.</li> <li>• Evaluation of effective length and end conditions in structural frame systems. Study of eccentric loading in columns supporting beams, brackets, and crane girders.</li> </ul>                |                                                         |               |            |
| <p><b>Assignments:</b></p> <p>A hollow circular steel column of length 3 m with both ends hinged carries an axial load. Determine the critical buckling load using Euler's formula.</p>                                                                                                                                                                                                                                                                                                                                         |                                                         |               |            |
| <b>Unit 5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | <b>Title: Slope and Deflection of Beams and Frames</b>  | <b>9 Hrs.</b> | <b>CO5</b> |
| <p>a) Bending into a circular arc – Shape and nature of elastic curve (deflection curve); Relationship between slope, deflection, and curvature.</p> <p>b) Double integration and Macaulay's methods – Determination of slope and deflection for cantilever and simply supported beams and frames subjected to point loads, U.D.L., and moment.</p>                                                                                                                                                                             |                                                         |               |            |
| <p><b>Exemplars / Practical Applications and usage:</b></p> <ul style="list-style-type: none"> <li>• Application of double integration and Macaulay's methods in structural analysis and design of beams.</li> <li>• Analysis of elastic curves for beams subjected to point loads, uniformly distributed loads, and moments.</li> <li>• Study of truss systems used in roof structures, transmission towers, railway bridges, and industrial sheds.</li> </ul>                                                                 |                                                         |               |            |
| <p><b>Assignments:</b></p> <p>Compare double integration and Macaulay's methods for determining beam deflection with suitable examples.</p>                                                                                                                                                                                                                                                                                                                                                                                     |                                                         |               |            |
| <p><b>Course Projects:</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                         |               |            |
| <p>Analysis and preparation of Shear Force and Bending Moment Diagrams for beams subjected to different loading conditions using manual and software approaches.</p>                                                                                                                                                                                                                                                                                                                                                            |                                                         |               |            |
| <p><b>Textbooks:</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                         |               |            |

  
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1. R. K. Bansal “Strength of Materials”, Laxmi Publications, New Delhi, 7<sup>th</sup> edition (2024).
2. S. Ramamrutham, R. Narayan, “Strength of Materials”, Dhanpat Rai Publishing Company, New Delhi, 20<sup>th</sup> edition (2020).
3. B. C. Punmia & A. K. Jain, “Mechanics of Structures”, Laxmi Publications, New Delhi.

#### Reference Books:

1. S. S. Bhavikatti, “Strength of Materials”, S. Chand and Company Ltd., 5<sup>th</sup> edition, 2021.
2. Timoshenko & Gere, “Mechanics of Materials”, CBS Publishers & Distributors, 2<sup>nd</sup> edition, 2018.
3. R. C. Hibbeler, “Mechanics of Materials”, Pearson Education, 10<sup>th</sup> edition, 2022.

#### MOOCs Links and additional reading material:

- **NPTEL Course:** *Introduction to Mechanics of Solids* – Prof. U. C. Bose, IIT Madras  
<https://nptel.ac.in/courses/105/106/105106149>
- **NPTEL Course:** *Strength of Materials* – Prof. S. K. Mondal, IIT Roorkee  
<https://nptel.ac.in/courses/112/107/112107146>
- **MOOC:** *Mechanics of Materials I: Fundamentals of Stress and Strain* – Coursera (Georgia Institute of Technology)  
<https://www.coursera.org/learn/mechanics-of-materials-i>

#### Strength of CO-PO-PSO Mapping

| CO   | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1  | 3   | 2   | -   | -   |     | -   | -   | -   | -   | -    | -    | 2    | 1    | -    |
| CO2  | 3   | 3   | 2   | 1   | 1   | -   | -   | -   | -   | -    | -    | 2    | 2    | -    |
| CO3  | 3   | 3   | 2   | 2   | 1   | -   | -   | -   | -   | -    | -    | 3    | 2    | 1    |
| CO4  | 3   | 2   | 2   | 2   | 1   | -   | -   | -   | -   | -    | -    | 2    | 2    | 1    |
| CO5  | 3   | 3   | 2   | 2   | 1   | -   | -   | -   | -   | -    | -    | 3    | 2    | 1    |
| Avg. | 3   | 3   | 2   | 2   | 1   | -   | -   | -   | -   | -    | -    | 2    | 2    | 1    |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

#### Assessment Pattern

| BT Level | CCE |     |             |                |                             |                          | ESE |
|----------|-----|-----|-------------|----------------|-----------------------------|--------------------------|-----|
|          | CT1 | CT2 | Assignments | Course Project | Field Activity / Case Study | Quiz / presentation etc. |     |
| K1       | ✓   | -   | ✓           | -              | -                           | -                        | ✓   |
| K2       | ✓   | -   | ✓           | -              | -                           | -                        | ✓   |
| K3       | ✓   | -   | ✓           | -              | -                           | ✓                        | ✓   |
| K4       | -   | -   | ✓           | -              | -                           | ✓                        | ✓   |
| K5       | -   | -   | -           | -              | -                           | -                        | -   |
| K6       | -   | -   | -           | -              | -                           | -                        | -   |

This course serves as a prerequisite for / maps with the following future courses:

  
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- Structural Analysis
- Design of Steel Structures
- Design of Reinforced Concrete Structures

**Job Mapping:**

Job opportunities that one can get after learning this course:

- Structural Design Engineer
- Site Engineer
- Bridge Design Engineer
- CAD Drafting Engineer

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|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------|----------|--------|--------------------|--------------|--------|----------------|----|
| Program:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | S. Y. B. Tech (Civil)                                                                        |          |        |                    | Semester:    |        | III            |    |
| Course:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Surveying                                                                                    |          |        |                    | Course Code: |        | R25-CE-PCC-202 |    |
| Teaching Scheme (hrs. / week)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                              |          |        | Examination Scheme |              |        |                |    |
| Lecture                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Practical                                                                                    | Tutorial | Credit | CCE                | ESE          | TW     | PR             | OR |
| 03                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | -                                                                                            | -        | 03     | 40                 | 60           | -      | -              | -  |
| <b>Course Description and Relevance:</b><br>Surveying is the foundational science of determining the relative positions of points on, above, or beneath the Earth's surface. It combines mathematical precision with field-based exploration to create the maps and boundaries that define our physical world.                                                                                                                                                                                                |                                                                                              |          |        |                    |              |        |                |    |
| <b>Prerequisite:</b><br>Basic Civil Engineering systems of field Survey                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                              |          |        |                    |              |        |                |    |
| <b>Bridge Content:</b><br>Modernization of Field Survey to meet the need of mankind through Recent Techniques and Materials.                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                              |          |        |                    |              |        |                |    |
| <b>Course Objectives:</b><br>1. To <b>DEVELOP</b> ability in students to apply knowledge of mathematics, science, and engineering to understand the measurement techniques in surveying.<br>2. To <b>MAKE</b> student competent to use techniques, methods and equipment/tools necessary for linear and angular measurement in horizontal and vertical plane.<br>3. To <b>PREPARE</b> students for the fundamentals of Space Based Positioning System & Geographic Information System.                        |                                                                                              |          |        |                    |              |        |                |    |
| <b>Course Outcomes:</b> After learning the course, students will be able to                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                              |          |        |                    |              |        |                |    |
| CO                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Course Outcome                                                                               |          |        |                    |              |        | Bloom’s Level  |    |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | DRAW the traverse using compass or plane table and APPLY corrections if any.                 |          |        |                    |              |        | 2              |    |
| CO2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | PREPARE contour plan for an area and also ESTIMATE earthwork in road work by levelling.      |          |        |                    |              |        | 4              |    |
| CO3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | MEASURE horizontal and vertical angles after performing temporary adjustments on theodolite. |          |        |                    |              |        | 4              |    |
| CO4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | ANALYZE the distances by tacheometry and EXPLAIN fundamentals of SBPS system                 |          |        |                    |              |        | 3              |    |
| CO5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | PREPARE data for curve setting through various methods.                                      |          |        |                    |              |        | 3              |    |
| Course Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                              |          |        |                    |              |        |                |    |
| Unit 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Title: Compass and Plane Table Surveying                                                     |          |        |                    |              | 9 Hrs. | CO1            |    |
| a) Definition and scope of surveying, Surveying Principles, Importance of surveying Concept of ranging, chaining, offsetting and traversing.<br>b) Prismatic Compass: Concept of bearing, meridian and their types, construction and use of prismatic compass, local attraction and correction, dip, declination and calculation of true bearings.<br>c) Plane Table Surveying: Principle, accessories and their uses, advantages and disadvantages, methods- Radiation, intersection, traversing, resection. |                                                                                              |          |        |                    |              |        |                |    |

  
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| <b>Exemplars / Practical Applications and usage:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                              |               |            |
| <ul style="list-style-type: none"> <li>• Prismatic Compass is basic instrument for the determination of bearing/Direction of any survey line</li> <li>• Plane table survey provides knowledge for surveying and drawing of existing land surface / features</li> </ul>                                                                                                                                                                                                                                                                                                                  |                                                              |               |            |
| <b>Assignments:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                              |               |            |
| 1. Problems on finding local attraction and calculation of corrected bearing of traverse<br>2. Types, advantages and limitations of Plane Table Survey                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                              |               |            |
| <b>Unit 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>Title: Levelling and Contouring</b>                       | <b>9 Hrs.</b> | <b>CO2</b> |
| a) Levelling: Introduction, benchmarks, use of auto level, types-digital level and laser level in the construction industry, principal axes of dumpy level, testing and permanent adjustments, reciprocal levelling, curvature and refraction corrections, distance to the visible horizon.<br>b) Profile levelling and cross-sectioning and their applications.<br>c) Contouring – direct and indirect methods of contouring, uses of contour maps, characteristics and use of topo-sheets.                                                                                            |                                                              |               |            |
| <b>Exemplars / Practical Applications and usage:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                              |               |            |
| <ul style="list-style-type: none"> <li>• Determination of reduced level of ground points</li> <li>• Use of levelling for study of topography of ground surface</li> <li>• Calculate correction of Curvature, Refraction and Combined to find out altitude of ground</li> <li>• Methods of contouring, characteristics and applications of contour maps</li> </ul>                                                                                                                                                                                                                       |                                                              |               |            |
| <b>Assignments:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                              |               |            |
| 1. Explain different methods of Levelling and explain any one in detail.<br>2. Find the reduced level of ground points using auto Level<br>3. State characteristics and uses of contour maps                                                                                                                                                                                                                                                                                                                                                                                            |                                                              |               |            |
| <b>Unit 3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>Title: Theodolite Surveying</b>                           | <b>9 Hrs.</b> | <b>CO3</b> |
| a) 20" Vernier transit theodolite: uses of theodolite for angle measurement: horizontal angle, vertical angles, and deflection angles. Magnetic bearing, prolonging a line, lining in and setting out an angle with a theodolite. Fundamental axes of theodolite: testing and permanent adjustments of a transit theodolite.<br>b) Theodolite traversing – computation of consecutive and independent coordinates, adjustment of closed traverse by transit rule and Bowditch's rule, Gale's traverse table. Checks, omitted measurements, area calculation by independent coordinates. |                                                              |               |            |
| <b>Exemplars / Practical Applications and usage:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                              |               |            |
| <ul style="list-style-type: none"> <li>▪ Study angular measurements of different survey lines and traverse</li> <li>▪ Solve the traverse conditions by use of linear and angular measurements</li> <li>▪ Determination of consecutive coordinates and correction for the same</li> </ul>                                                                                                                                                                                                                                                                                                |                                                              |               |            |
| <b>Assignments:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                              |               |            |
| 1. Enlist different uses of 20" Vernier transit theodolite<br>2. Solve the traverse to compute corrected coordinates of the traverse<br>3. calculate consecutive and independent coordinates of traverse points<br>4. state different adjustments of theodolite                                                                                                                                                                                                                                                                                                                         |                                                              |               |            |
| <b>Unit 4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>Title: Tachometry &amp; Electronic Survey Techniques.</b> | <b>9 Hrs.</b> | <b>CO4</b> |
| a) Tachometry – Principle of stadia tachometry, fixed hair method with vertical staff to determine horizontal                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                              |               |            |

  
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distances and elevations of points, finding tacheometric constants. Tacheometric contouring.  
b) Modern Survey System – Study and use of Electronic Total Station (ETS), types, functions: and uses  
Introduction to SBPS systems – GPS Segments of SBPS (Space, Control and User), applications of SBPS in surveying. SBPS Co-ordinates & heights, DGPS System Applications of DGPS (Differential Global Positioning System) in surveying.

**Exemplars / Practical Applications and usage:**

Determination of Horizontal, Vertical as well as sloping Distances without measuring by tape  
Calculate elevation and depression of ground surface points using tachometry.  
Study the different digital equipment for surveying having very small least count and high accuracy

**Assignments:**

1. Derive the formulae to calculate horizontal distance and vertical height of ground point with line of sight inclined and staff held Vertical
2. State the formulae to calculate horizontal distance and vertical height of ground point with line of sight inclined and staff held Normal
3. Enlist different modern surveying equipment, and state their uses to carry out survey.

| Unit 5 | Title : Curves | 9 Hrs. | CO5 |
|--------|----------------|--------|-----|
|--------|----------------|--------|-----|

a) Introduction to horizontal and vertical curves, different types and their applications, curves-elements / Components, Linear Methods of setting out of curve (Numerical on setting out simple curve)  
b) Angular methods: Rankine's method of deflection angles (one and two theodolite methods). (Numerical on simple circular curves), Transition curves: necessity and types.

**Exemplars / Practical Applications and usage:**

Setting out of curve for roads and railway alignment  
Components of different types of curves used for change of direction and alignments  
Different methods for setting out of simple circular curves

**Assignments:**

1. Enlist different types of curves explain them with neat sketches
2. State the methods of setting out of curves?
3. Derive the method for setting out of simple circular curve by method of Deflection angle.
4. Tabulate the data required for setting out of curve

**Course Projects:**

1. Contour Project
2. Road Project
3. Setting out of Building

**Textbooks:**

1. T. P. Kanetkar and S.V.Kulkarni, "Surveying and Levelling Vol. I and Vol. II", PVG Prakashan. Pune, 20<sup>th</sup> edition.
2. Dr. B. C. Punmia, Ashok K. Jain, Arun K.Jain, "Surveying, Vol. I & II", Laxmi Publications (P), Ltd, New Delhi.
3. S. K. Duggal, "Surveying, Vol. I & II", Tata McGraw Hill Publishing Co Ltd., New Delhi.
4. Subramanian, "Surveying and Levelling", Oxford University Press, 2<sup>nd</sup> edition, 2012.

  
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### Reference Books:

1. Dr. A. M. Chandra, "Plane Surveying", New Age International Publishers, 2006.
2. N. N. Basak, "Surveying and Levelling", Tata McGraw Hill, 2013.
3. Dr. K. R. Arora, "Surveying Vol. I & II", Standard Book House, 17<sup>th</sup> edition, 2019.
4. James M. Anderson, Edward M. Mikhail, "Surveying: Theory and Practice", Tata McGraw Hill, 7<sup>th</sup> edition, 2013.
5. David Clark, "Plane and Geodetic Surveying for Engineers Vol. I", Constable, 2013.

### MOOCs Links and additional reading material:

NPTel: <https://archive.nptel.ac.in/courses/105/104/105104101/>

### Strength of CO-PO-PSO Mapping

| CO   | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1  | 3   | 1   | 2   | 1   | 2   | 3   | 2   | 0   | 0   | 0    | 2    | 3    | 3    | 3    |
| CO2  | 3   | 1   | 2   | 1   | 2   | 3   | 2   | 0   | 0   | 0    | 0    | 3    | 3    | 3    |
| CO3  | 3   | 1   | 2   | 1   | 2   | 3   | 2   | 0   | 0   | 0    | 2    | 3    | 3    | 3    |
| CO4  | 3   | 1   | 2   | 1   | 2   | 3   | 2   | 0   | 0   | 0    | 2    | 3    | 3    | 3    |
| CO5  | 3   | 1   | 2   | 1   | 2   | 3   | 2   | 2   | 0   | 0    | 2    | 3    | 3    | 3    |
| Avg. | 3.0 | 1.0 | 2.0 | 1.0 | 2.0 | 3.0 | 2.0 | 0.1 | 0.0 | 0.0  | 1.6  | 3.0  | 3.0  | 3.0  |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

### Assessment Pattern

| BT Level | CCE |     |             |                |                             |                          | ESE |
|----------|-----|-----|-------------|----------------|-----------------------------|--------------------------|-----|
|          | CT1 | CT2 | Assignments | Course Project | Field Activity / Case Study | Quiz / presentation etc. |     |
| K1       | ✓   | -   | ✓           | -              | -                           | ✓                        | ✓   |
| K2       | ✓   | -   | ✓           | -              | -                           | ✓                        | ✓   |
| K3       | ✓   | -   | ✓           | -              | -                           | ✓                        | ✓   |
| K4       | ✓   | -   | ✓           | -              | -                           | ✓                        | ✓   |
| K5       | -   | -   | -           | -              | -                           | -                        | -   |
| K6       | -   | -   | -           | -              | -                           | -                        | -   |

This course serves as a prerequisite for / maps with the following future courses:

**Highway & Transportation Engineering:** Mapping horizontal and vertical curves for road alignment.

**Hydrology:** Determining drainage patterns and catchment areas via contouring.

**Urban Planning:** Utilizing GIS and Cadastral Law for land subdivision and zoning.

**Geotechnical Engineering:** Using site levels to analyze soil stability and topography

**Structural Design:** Ensuring precise positioning and "setting out" of building footprints and foundations.

**Job Mapping:**

  
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Job opportunities that one can get after learning this course:

**Civil Infrastructure:** As a **Site Engineer** or **Construction Surveyor**.

**Geospatial Data:** Roles in **GIS Analysis** and **Cartography** involve converting field data into intelligent maps for urban planning and disaster management.

**Energy & Mining:** **Mine Surveyors** map underground tunnels, while **Hydrographic Surveyors** support offshore wind and oil exploration.

**Technology:** Emerging roles in **LiDAR Scanning** focus on creating 3D "Digital Twins" for smart city development and autonomous vehicle navigation.

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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                       |          |        |                    |              |    |                |    |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|--------|--------------------|--------------|----|----------------|----|
| Program:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | S.Y. B.Tech. (Civil)                                                                                                                                                  |          |        |                    | Semester:    |    | III            |    |
| Course:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Architectural Planning and Design of Buildings                                                                                                                        |          |        |                    | Course Code: |    | R25-CE-PCC-203 |    |
| Teaching Scheme (hrs/week)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                       |          |        | Examination Scheme |              |    |                |    |
| Lecture                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Practical                                                                                                                                                             | Tutorial | Credit | CCE                | ESE          | TW | PR             | OR |
| 03                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | -                                                                                                                                                                     | -        | 03     | 40                 | 60           | -  | -              | -  |
| <b>Course Description:</b><br>This course introduces the foundational concepts of Architectural Planning and Design of Buildings using building byelaws for the planning and drafting of civil engineering structures. The Architectural Planning component covers the Architectural planning principles. The Design of Building component includes arrangements such as Plan, Elevation and Section drawings and AI Driven sustainable building features. The course also discusses town planning principles, village forms highlights, drawing approval guidelines, safety aspects and building services.                                                 |                                                                                                                                                                       |          |        |                    |              |    |                |    |
| <b>Course Relevance:</b><br>The course Architectural Planning and Design of Buildings is highly relevant for developing the fundamental skills required in the field of building planning and design. It provides students with essential knowledge of planning, functional requirements, building byelaws, creativity, imagination and the integration of structural and aesthetic considerations, AI driven sustainable building technique in real-world building planning projects.                                                                                                                                                                      |                                                                                                                                                                       |          |        |                    |              |    |                |    |
| <b>Prerequisite:</b><br>Fundamentals of Engineering Mechanics and Civil Engineering Systems and Engineering Graphics.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                       |          |        |                    |              |    |                |    |
| <b>Bridge Content:</b><br>Basics of building components and building types                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                       |          |        |                    |              |    |                |    |
| <b>Course Objectives:</b><br>1. To <b>STUDY</b> different types of structure and building components with their functional requirement.<br>2. To <b>LEARN</b> building bye-laws, regulations and Architectural and building planning.<br>3. To <b>UNDERSTAND</b> the functional planning, drafting of residential buildings and concepts of AI-driven sustainable building.<br>4. To <b>UNDERSTAND</b> the functional planning, dimensional requirements, drafting of various public buildings and the concept of Building Plan Management System (BPMS).<br>5. To <b>LEARN</b> Town planning parameters and different services, safety aspects of building |                                                                                                                                                                       |          |        |                    |              |    |                |    |
| <b>Course Outcomes:</b> After learning the course, students will be able to                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                       |          |        |                    |              |    |                |    |
| CO                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Course Outcome                                                                                                                                                        |          |        |                    |              |    | Bloom's Level  |    |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | IDENTIFY types of building and basic requirements of building construction.                                                                                           |          |        |                    |              |    | 2              |    |
| CO2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | EXPLAIN the use of Architectural Principles and Building byelaws for building planning.                                                                               |          |        |                    |              |    | 2              |    |
| CO3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | UNDERSTAND functional requirements, standard dimensions, and planning principles to plan residential buildings and AI Driven sustainable building.                    |          |        |                    |              |    | 3              |    |
| CO4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | UNDERSTAND functional requirements, standard dimensions and planning principles for various types of public buildings and concept of building plan management system. |          |        |                    |              |    | 3              |    |
| CO5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | EXPLAIN the concept of town planning and safety building aspects.                                                                                                     |          |        |                    |              |    | 2              |    |
| Course Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                       |          |        |                    |              |    |                |    |

  
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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                             |               |            |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|---------------|------------|
| <b>Unit 1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>Introduction to Building Technology</b>                                  | <b>9 Hrs.</b> | <b>CO1</b> |
| Definition and scope of building technology, fundamentals of building construction, classification of buildings as per NBC (National Building Code). Type of structures: load bearing & framed structure and their requirements, type of loads and their effects. Building components, types and their functions: foundation, plinth, wall, door, window, column, beam, lintels, arch, slab, precast panel, flooring, roofing. Concept of Autoclaved Aerated Concrete blocks, Types and function of formwork and scaffolding.                                                                                    |                                                                             |               |            |
| <b>Exemplars / Practical Applications and usage:</b> <ul style="list-style-type: none"> <li>The above content is demonstrating the various components of buildings with their function</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                             |               |            |
| <b>Assignments:</b> <ol style="list-style-type: none"> <li>Enlist the type of building according to the national building code &amp; discuss any one in brief.</li> <li>Difference between load bearing and RCC structure.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                            |                                                                             |               |            |
| <b>Unit 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>Building bye laws and introduction to Architectural drawing</b>          | <b>9 Hrs.</b> | <b>CO2</b> |
| Building Byelaws: Necessity of bye-laws, UDCPR (Unified Development Control and Promotion Regulations for Maharashtra State) - plot sizes, road width, open spaces, floor space index (F.S.I.), Marginal distances, building line, control line, height regulations, room sizes, Area calculations with examples (built-up area, carpet area etc.), Rules for ventilation, lighting, Vertical circulation, Sanitation and Parking of vehicles (Minimum Standard Dimensions), Scales, symbols and abbreviation used for building drawing. Principles of Building Planning and Principles of Architectural design. |                                                                             |               |            |
| <b>Exemplars / Practical Applications and usage:</b> <ul style="list-style-type: none"> <li>The concepts of building byelaws and UDCPR are practically used for approvals of civil engineering drawing through the Competent Authority</li> </ul>                                                                                                                                                                                                                                                                                                                                                                |                                                                             |               |            |
| <b>Assignments:</b> <ol style="list-style-type: none"> <li>Explain the necessity of building byelaws and Define Building line, FSI, Carpet area</li> <li>Distinguish between: i) Aspect and Prospect      ii) Grouping and Circulation</li> </ol>                                                                                                                                                                                                                                                                                                                                                                |                                                                             |               |            |
| <b>Unit 3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>Planning of Residential Buildings and AI Driven Sustainable building</b> | <b>9 Hrs.</b> | <b>CO3</b> |
| Functional requirements and standard dimensions, preparation of Line plan, Developed Plan, Elevation and Sectional Elevation of Residential Buildings. Design of staircase: Dog legged /Quarter turn. Fully Automated construction techniques, Concept and features of AI driven sustainable building.                                                                                                                                                                                                                                                                                                           |                                                                             |               |            |
| <b>Exemplars / Practical Applications and usage:</b> <ul style="list-style-type: none"> <li>The Knowledge of developed plan, elevation, and sectional elevation practically used for technical Supervision on construction site.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                      |                                                                             |               |            |
| <b>Assignments:</b> <ol style="list-style-type: none"> <li>What are the fundamental requirements for residential Building?</li> <li>Write a Short note on AI driven sustainable building.</li> </ol>                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                             |               |            |
| <b>Unit 4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>Planning of Public Buildings and BPMS Portal</b>                         | <b>9 Hrs.</b> | <b>CO4</b> |
| Functional requirements, dimensions, and preparation of line plan, Developed plan, Elevation and Sectional Elevation of commercial buildings, School, College, Hostel, Restaurant/ Hotel building, Primary Health Center/ Hospital, Shopping complex, Sports complex, Vegetable market, Post office, and Bank. Concept of Building Plan Management System (BPMS Portal)                                                                                                                                                                                                                                          |                                                                             |               |            |

  
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**Exemplars / Practical Applications and usage:**

- The concept of Functional requirements, dimensions, and planning of Public Buildings practically provide effective arrangement of different units in different public buildings

**Assignments:**

1. Draw Line plan of Post office Building with suitable scale
2. Write down the sanctioning procedure of building drawing on BPMS Portal.

| Unit 5 | Town planning and safety aspects | 9Hrs. | CO5 |
|--------|----------------------------------|-------|-----|
|--------|----------------------------------|-------|-----|

**Town Planning and legal aspects:** Necessity of town planning. Development plan and its importance, Introduction to different zones of land in town planning, 7/12 abstract, 8A abstract, Form 6 and its types, Concept of TDR. Introduction to RERA act. Introduction to Maharashtra Regional and Town Planning (MRTP) Act. Concept of safety aspects, Noise, Plumbing. Planning for good acoustics, Need for earthquake resistant structure.

**Exemplars / Practical Applications and usage:**

- The Knowledge of town planning and practical understanding of building services involve in planning of building.

**Assignments:**

1. Write a note on land use zoning and mention the requirements of each of them.
2. What do you understand by RERA act ?

**Course Projects:**

-

**Textbooks:**

1. Dr. B. C. Punmia, Er. Ashok K. Jain, Dr. Arun K. Jain, “Building Construction”, Laxmi Publication 12<sup>th</sup> edition, 2023.
2. S.V.Deodhar, “Building Materials”, Khanna Publication.
3. S. Y. Patki, M. G. Shah, C. M. Kale, “Building Drawing with an Integrated Approach to Build Environment” McGraw Hill Education, 6<sup>th</sup> Edition.

**Reference Books:**

1. S.K. Duggal, “Building Materials”, New Age International Publisher, 5<sup>th</sup> edition.
2. Charles Kibert, “Handbook on Green Building Design & Construction”, Wiley Publisher.
3. National Building Code (NBC) 2016, Volume I and II.
4. Unified Development Control and Promotion Regulations (UDCPR) for Maharashtra State, Updated as on 30<sup>th</sup> January, 2025.
5. Model Building Bye-Laws 2016.

**MOOCs Links and additional reading material:**

1. Unit 1 [https://onlinecourses.swayam2.ac.in/nou26\\_ce07/preview](https://onlinecourses.swayam2.ac.in/nou26_ce07/preview)
2. Unit 2 <https://dn790008.ca.archive.org/0/items/nationalbuilding01/nationalbuilding01.pdf>
3. Unit 3 [https://onlinecourses.nptel.ac.in/e-learning/preview/noc25\\_ar13](https://onlinecourses.nptel.ac.in/e-learning/preview/noc25_ar13)
4. Unit 4 <https://www.pmrda.gov.in/wp-content/uploads/2025/09/Updated-UDCPR-30.01.25.pdf>
5. Unit 5 <https://ia800909.us.archive.org/20/items/nationalbuilding02/nationalbuilding02.pdf>

  
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### Strength of CO-PO-PSO Mapping

| CO          | PO1        | PO2        | PO3        | PO4        | PO5         | PO6        | PO7        | PO8        | PO9        | PO10        | PO11       | PSO1       | PSO2       | PSO3       |
|-------------|------------|------------|------------|------------|-------------|------------|------------|------------|------------|-------------|------------|------------|------------|------------|
| CO1         | 3          | 2          | 2          | -          | -           | 2          | 2          | 1          | 2          | 1           | 2          | 3          | 3          | 3          |
| CO2         | 3          | 2          | 2          | -          | 2           | 2          | 2          | 1          | 1          | -           | 2          | 3          | 3          | 3          |
| CO3         | 3          | 3          | 3          | 3          | 3           | 2          | 2          | 1          | 2          | 2           | 2          | 3          | 3          | 3          |
| CO4         | 3          | 3          | 3          | 3          | 3           | 2          | 2          | 1          | 2          | 2           | 2          | 3          | 3          | 3          |
| CO5         | 3          | 2          | 1          | -          | -           | 2          | 2          | 1          | 1          | -           | 2          | 3          | 3          | 3          |
| <b>Avg.</b> | <b>3.0</b> | <b>2.4</b> | <b>2.4</b> | <b>3.0</b> | <b>2.67</b> | <b>2.0</b> | <b>2.0</b> | <b>1.0</b> | <b>1.6</b> | <b>1.66</b> | <b>2.0</b> | <b>3.0</b> | <b>3.0</b> | <b>3.0</b> |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

### Assessment Pattern

| BT Level | CCE |     |             |                |                             |                          | ESE |
|----------|-----|-----|-------------|----------------|-----------------------------|--------------------------|-----|
|          | CT1 | CT2 | Assignments | Course Project | Field Activity / Case Study | Quiz / presentation etc. |     |
| K1       | ✓   | -   | -           | -              | ✓                           | ✓                        | ✓   |
| K2       | ✓   | -   | -           | -              | ✓                           | ✓                        | ✓   |
| K3       | ✓   | -   | -           | -              | ✓                           | ✓                        | ✓   |
| K4       | -   | -   | -           | -              | ✓                           | -                        | ✓   |
| K5       | -   | -   | -           | -              | -                           | -                        | -   |
| K6       | -   | -   | -           | -              | -                           | -                        | -   |

This course serves as a prerequisite for / maps with the following future courses:

Architectural Planning and Design of Buildings course forms the foundation for several advanced and applied Engineering courses. Here is a list of future courses.

1. Structural Engineering: Understanding loads, stresses, and designing structural elements.
2. Project and Construction Management: Applies concepts of planning for real world civil engineering projects
3. Surveying: Architectural planning informs site layout
4. Estimation and costing: Early planning and design influence project budgeting and feasibility studies.

### Job Mapping:

Job opportunities that one can get after learning this course:

1. Drafting Engineer: With prior knowledge of engineering drawing and architectural drafting principles, you can prepare detailed building plans, sections, elevations, and construction drawings using AutoCAD.
2. Site Engineer: Responsible for executing construction work on-site, interpreting architectural drawings, coordinating with contractors, and ensuring that the building is constructed as per design.

  
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|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------|--------|--------------------|-----|----------------|---------------|
| Program:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                         | S.Y. B. Tech (Civil)                  |        | Semester:          |     | III            |               |
| Course:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                                                                                         | Computational and Applied Mathematics |        | Course Code:       |     | R25-CE-MDM-204 |               |
| Teaching Scheme(Hrs./Week)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                                         |                                       |        | Examination Scheme |     |                |               |
| Lecture                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Practical                                                                                                                                                                               | Tutorial                              | Credit | CCE                | ESE | TW             | PR            |
| 03                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | -                                                                                                                                                                                       | -                                     | 03     | 40                 | 60  | -              | -             |
| <b>Course Description</b><br>This course provides fundamental concepts of statistics, probability, numerical methods, vector algebra, and partial differential equations with applications in Civil Engineering. It develops analytical and computational skills for solving engineering problems and interpreting data used in design, analysis, and decision-making.                                                                                                                                                                                       |                                                                                                                                                                                         |                                       |        |                    |     |                |               |
| <b>Course Relevance</b><br>This course is essential for Civil Engineering as it provides tools for data analysis, uncertainty handling, and numerical problem-solving. It is applied in material testing, structural analysis, fluid mechanics, surveying, and infrastructure design for accurate engineering decisions.                                                                                                                                                                                                                                     |                                                                                                                                                                                         |                                       |        |                    |     |                |               |
| <b>Prerequisite:</b><br>1. Basic knowledge of mathematics - algebra, trigonometry, and calculus<br>2. Fundamental concepts of differentiation and integration.                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                         |                                       |        |                    |     |                |               |
| <b>Bridge Content</b><br>This course bridges higher secondary mathematics with advanced engineering mathematics required in Civil Engineering. It connects basic concepts of calculus and algebra to engineering applications through statistical analysis, probability, numerical methods, vector calculus, and partial differential equations. It prepares students to transition from fundamental mathematical techniques to problem-solving approaches used in structural analysis, fluid mechanics, surveying, and other civil engineering disciplines. |                                                                                                                                                                                         |                                       |        |                    |     |                |               |
| <b>Course Objectives:</b><br>To introduce statistical and mathematical tools used in Civil Engineering applications. To develop skills in data analysis using statistics and probability. To enable solving engineering problems using numerical methods. To understand vector calculus concepts for physical field analysis. To apply partial differential equations in engineering problem-solving.                                                                                                                                                        |                                                                                                                                                                                         |                                       |        |                    |     |                |               |
| <b>Course Outcomes:</b> On completion of the course, learner will be able to -:                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                         |                                       |        |                    |     |                |               |
| CO                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Course Outcome                                                                                                                                                                          |                                       |        |                    |     |                | Bloom's Level |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | APPLY measures of central tendency, dispersion, moments, skewness, and kurtosis to analyze and interpret statistical data in engineering problems.                                      |                                       |        |                    |     |                | 3             |
| CO2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | USE probability concepts, probability distributions, and Bayes theorem to solve engineering problems involving uncertainty.                                                             |                                       |        |                    |     |                | 3             |
| CO3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | SOLVE systems of linear equations and ordinary differential equations using numerical methods such as Gauss elimination, Jacobi, Gauss-Seidel, Euler's method, and Runge-Kutta methods. |                                       |        |                    |     |                | 3             |

  
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|     |                                                                                                                                              |              |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| CO4 | <b>APPLY</b> vector algebra concepts including divergence, curl, solenoidal and irrotational fields to analyze engineering physical systems. | <b>3</b>     |
| CO5 | <b>SOLVE</b> and interpret partial differential equations such as wave equations in one and two dimensions for engineering applications.     | <b>1,2,3</b> |

| Course Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                          |               |            |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------|---------------|------------|
| <b>Unit 1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>Statistics</b>        | <b>9 Hrs.</b> | <b>CO1</b> |
| Study of statistical measures including central tendency, dispersion, moments, skewness, kurtosis, correlation, regression, interpretation of statistical data.                                                                                                                                                                                                                                                                                                                                                                                |                          |               |            |
| <b>Exemplars / Practical Applications, Usage:</b> A civil engineering team analyzes concrete strength, traffic flow, and rainfall data using statistical methods. Students learn how statistics supports real-world applications such as quality control of materials, transportation planning, flood risk assessment, and structural reliability analysis.                                                                                                                                                                                    |                          |               |            |
| <b>Assignments:</b> <ul style="list-style-type: none"> <li>Problems based on skewness, kurtosis, correlation</li> <li>Problems based on dispersion, and interpretation of statistical data</li> </ul>                                                                                                                                                                                                                                                                                                                                          |                          |               |            |
| <b>Unit 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>Probability</b>       | <b>9 Hrs.</b> | <b>CO2</b> |
| Basic probability concepts, addition and multiplication theorems, Conditional probability, Bayes theorem, random variables (discrete and continuous), Probability distributions including binomial, Poisson and normal distribution, and their applications in engineering problems.                                                                                                                                                                                                                                                           |                          |               |            |
| <b>Exemplars / Practical Applications, Usage:</b> "A civil engineering team applies probability concepts to analyze material strength variability, traffic accident likelihood, and flood occurrence patterns. Students learn how probability distributions and reliability models are used in real-world applications such as quality assurance of construction materials, transportation safety planning, hydrological risk assessment, and structural performance evaluation under uncertain loads."                                        |                          |               |            |
| <b>Assignments:</b> <ul style="list-style-type: none"> <li>Problems based on skewness, kurtosis, correlation</li> <li>Problems based on dispersion, correlation, regression, and interpretation of statistical data.</li> </ul>                                                                                                                                                                                                                                                                                                                |                          |               |            |
| <b>Unit 3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>Numerical methods</b> | <b>9 Hrs.</b> | <b>CO3</b> |
| Numerical methods: Gauss elimination method, Cholesky decomposition method; Jacobi method and Gauss-Seidel method for solving system of linear equations; numerical solution of ordinary differential equations using Euler's method, Modified Euler's method, and Runge-Kutta method.                                                                                                                                                                                                                                                         |                          |               |            |
| <b>Exemplars / Practical Applications, Usage:</b> A civil engineering team applies numerical methods such as Gauss elimination, Jacobi iteration, and Runge-Kutta techniques to solve complex equations in structural analysis, fluid mechanics, and geotechnical modeling. Students learn how these computational approaches are used in real-world applications such as predicting stresses in high-rise buildings, simulating groundwater flow, optimizing dam design, and ensuring accurate solutions for large-scale engineering systems. |                          |               |            |
| <b>Assignments:</b> <ul style="list-style-type: none"> <li>Problems based on Gauss elimination; Jacobi method; Gauss-Seidel method.</li> <li>Problems based on using Euler's method, Modified Euler's method, and Runge-Kutta methods.</li> </ul>                                                                                                                                                                                                                                                                                              |                          |               |            |

  
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| Unit 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Vector Differentiation | 9 Hrs. | CO4 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|--------|-----|
| Vector algebra: operations on vectors, dot product, cross product, scalar triple product and vector triple product; divergence and curl of vector functions, solenoidal and irrotational vector fields and their physical interpretation.                                                                                                                                                                                                                                                                                                                                                                                              |                        |        |     |
| <b>Exemplars / Practical Applications, Usage:</b> A civil engineering team applies vector differentiation to study fluid flow, stress distribution, and velocity fields in structures and hydraulic systems. Students learn how vector calculus techniques are used in real-world applications such as analyzing groundwater movement, predicting load effects on bridges, modeling airflow around buildings, and optimizing structural design under varying forces.                                                                                                                                                                   |                        |        |     |
| <b>Assignments:</b> <ul style="list-style-type: none"> <li>Problems based on Vector algebra: operations on vectors, dot product, cross product, scalar triple product.</li> <li>Problems based on divergence and curl of vector functions, solenoidal and irrotational vector fields.</li> </ul>                                                                                                                                                                                                                                                                                                                                       |                        |        |     |
| Unit 5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Application of PDE     | 9 Hrs. | CO5 |
| Applications of partial differential equations: wave equation, one-dimensional and two-dimensional heat flow equations and their solutions with applications in engineering problems.                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                        |        |     |
| <b>Exemplars / Practical Applications, Usage:</b> A civil engineering team applies partial differential equations to model heat transfer in concrete, groundwater flow in soils, and stress distribution in structures. Students learn how PDEs are used in real-world applications such as predicting thermal effects on dams, analyzing seepage in foundations, simulating vibration of bridges, and ensuring stability of large infrastructure under complex environmental conditions.                                                                                                                                              |                        |        |     |
| <b>Assignments:</b> <ul style="list-style-type: none"> <li>Problems based on Applications of partial differential equations: wave equation, one-dimensional and two-dimensional</li> <li>Problems based on heat flow equations and their solutions with applications in engineering problems.</li> </ul>                                                                                                                                                                                                                                                                                                                               |                        |        |     |
| <b>Course Projects:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                        |        |     |
| <b>Textbooks:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                        |        |     |
| <ul style="list-style-type: none"> <li>Advanced Engineering Mathematics: Erwin Kreyszig, Wiley India.</li> <li>Higher Engineering Mathematics: B.S. Grewal, Khanna Publishers.</li> <li>Engineering Mathematics: H.K. Dass, S. Chand Publishing.</li> <li>Probability and Statistics: T. K. V. Iyengar and B. Krishna Gandhi, S. Chand Publishing.</li> <li>Introductory Methods of Numerical Analysis: S.S. Sastry, PHI Learning.</li> <li>Numerical Methods for Engineering and Science: Jain, Iyengar and Jain, New Age International.</li> <li>Advanced Differential Equations: M.D. Raisinghania, S. Chand Publishing.</li> </ul> |                        |        |     |
| <b>Reference Books:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                        |        |     |
| <ul style="list-style-type: none"> <li>Advanced Engineering Mathematics: Erwin Kreyszig, Wiley India.</li> <li>Higher Engineering Mathematics: B.S. Grewal, Khanna Publishers.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                              |                        |        |     |

  
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- Introductory Methods of Numerical Analysis: S.S. Sastry, PHI Learning.

#### MOOCs / NPTEL Links and additional reading material:

1. **Statistics** : By Prof. S. Dharmaraja , IIT Delhi.  
<https://youtu.be/1NPBMF2T8Iw?si=NFIZByxtxPgKlcM>
2. **Probability** : By Prof. Prof. S. Dharmaraja , IIT Delhi  
<https://youtu.be/Tbdj75ByDIU?si=kUR7ObER7G7F5Qij>
3. **Numerical methods**: By Prof.SaurabhBasu , IIT Guwahati.  
<https://youtu.be/pOtnzAXIXvI?si=oHNUDpbvTY8L5RCv>
4. **Vector Differentiation**: By Prof.Hari Shankar Mahato , IIT Kharagpur.  
<https://youtu.be/MPGPX7UkKsU?si=zzEUCSkLxQVUusr0g>
5. **Application of PDE**: By Prof.ShivajiGanesh , IIT Mumbai.  
<https://youtu.be/NL-nGACP3Ws?si=rSAS2sTweioApXsn>

#### Strength of CO-PO-PSO Mapping

| CO          | PO1         | PO2         | PO3 | PO4 | PO5 | PO6 | PO7         | PO8         | PO9         | PO10 | PO11        |
|-------------|-------------|-------------|-----|-----|-----|-----|-------------|-------------|-------------|------|-------------|
| CO1         | 2           | 2           | -   | -   | -   | -   | 2           | 2           | 1           | -    | 2           |
| CO2         | 3           | 3           | -   | -   | -   | -   | 2           | 2           | 1           | -    | 2           |
| CO3         | 2           | 2           | -   | -   | -   | -   | 2           | 2           | 1           | -    | 2           |
| CO4         | 3           | 3           | -   | -   | -   | -   | 2           | 2           | 1           | -    | 2           |
| CO5         | 3           | 3           | -   | -   | -   | -   | 2           | 2           | 1           | -    | 2           |
| <b>Avg.</b> | <b>2.60</b> | <b>2.60</b> | -   | -   | -   | -   | <b>2.00</b> | <b>2.00</b> | <b>1.00</b> | -    | <b>2.00</b> |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

#### Assessment Pattern

| BT Level | CCE |     |             |                |                             |                          | ESE |
|----------|-----|-----|-------------|----------------|-----------------------------|--------------------------|-----|
|          | CT1 | CT2 | Assignments | Course Project | Field Activity / Case Study | Quiz / presentation etc. |     |
| K1       | ✓   | -   | ✓           | -              | ✓                           | ✓                        | ✓   |
| K2       | ✓   | -   | ✓           | -              | ✓                           | -                        | ✓   |
| K3       | ✓   | -   | ✓           | -              | ✓                           | -                        | ✓   |
| K4       | -   | -   | -           | -              | -                           | -                        | -   |
| K5       | -   | -   | -           | -              | -                           | -                        | -   |
| K6       | -   | -   | -           | -              | -                           | -                        | -   |

  
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This course serves as a prerequisite for / maps with the following future courses:

1. Modeling and simulation
2. Real-world data analysis
3. Mechanical/electrical system design
4. Advanced software tools like MATLAB, ANSYS, CFD, and ML algorithms
5. GATE Exam/ CAT Exam /Aptitude Tests

**Job Mapping:**

Job opportunities that one can get after learning this course:

1. Applied Mathematician
2. Computational Scientist
3. Numerical Analyst
4. Data Analyst
5. Tool Design Engineer

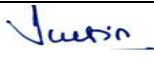
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|                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                    |          |        |                    |              |        |                |    |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|----------|--------|--------------------|--------------|--------|----------------|----|--|
| Program:                                                                                                                                                                                                                                                                                                                                                                                                            | S.Y. B.Tech. (Civil)                                                               |          |        |                    | Semester:    |        | III            |    |  |
| Course:                                                                                                                                                                                                                                                                                                                                                                                                             | Open Elective 1: Mechanical, Electrical and Plumbing System                        |          |        |                    | Course Code: |        | R25-CE-OEC-205 |    |  |
| Teaching Scheme (hrs/week)                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                    |          |        | Examination Scheme |              |        |                |    |  |
| Lecture                                                                                                                                                                                                                                                                                                                                                                                                             | Practical                                                                          | Tutorial | Credit | CCE                | ESE          | TW     | PR             | OR |  |
| 02                                                                                                                                                                                                                                                                                                                                                                                                                  | -                                                                                  | -        | 02     | 40                 | 60           | -      | -              | -  |  |
| <b>Course Description:</b> This course introduces the fundamental principles, design integration, and installation practices of Mechanical, Electrical, and Plumbing (MEP) systems. It bridges the gap between structural design and building services, focusing on water supply, sanitation, HVAC (Heating, Ventilation, and Air Conditioning), electrical distribution, and fire safety.                          |                                                                                    |          |        |                    |              |        |                |    |  |
| <b>Course Relevance:</b> For a Civil Engineer, MEP knowledge is crucial for coordinating site activities, avoiding structural-service conflicts (clashes), and ensuring sustainable building operations. As the industry moves toward BIM (Building Information Modeling), integrated MEP knowledge is a core competency.                                                                                           |                                                                                    |          |        |                    |              |        |                |    |  |
| <b>Prerequisite:</b> <ul style="list-style-type: none"><li>Basic Electrical &amp; Electronics Engineering: Understanding of voltage, current, and power,</li><li>Engineering Graphics: Ability to read and interpret 2D plan views and sections,</li><li>Fluid Mechanics: Basic concepts of pressure, flow, and head loss (for plumbing),</li><li>Physics (Thermodynamics): Basic heat transfer concepts.</li></ul> |                                                                                    |          |        |                    |              |        |                |    |  |
| <b>Bridge Content:</b> <ul style="list-style-type: none"><li>Review of fluid pressure and flow in pipes.</li><li>Fundamentals of thermal comfort.</li><li>Basic electrical circuits and safety grounding.</li></ul>                                                                                                                                                                                                 |                                                                                    |          |        |                    |              |        |                |    |  |
| <b>Course Objectives:</b> <ol style="list-style-type: none"><li>To <b>FAMILIARIZE</b> students with the essential Mechanical, Electrical, and Plumbing services required in modern buildings.</li><li>To <b>DEVELOP</b> the ability to coordinate civil structures with MEP service requirements.</li></ol>                                                                                                         |                                                                                    |          |        |                    |              |        |                |    |  |
| <b>Course Outcomes:</b> After learning the course, students will be able to                                                                                                                                                                                                                                                                                                                                         |                                                                                    |          |        |                    |              |        |                |    |  |
| CO                                                                                                                                                                                                                                                                                                                                                                                                                  | Course Outcome                                                                     |          |        |                    |              |        | Bloom's Level  |    |  |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                 | INTERPRET architectural drawings and NBC codes to plan service layouts.            |          |        |                    |              |        | 4              |    |  |
| CO2                                                                                                                                                                                                                                                                                                                                                                                                                 | EVALUATE HVAC and Fire Safety requirements for different building occupancies.     |          |        |                    |              |        | 3              |    |  |
| CO3                                                                                                                                                                                                                                                                                                                                                                                                                 | DESIGN basic electrical load distributions and lighting schemes for indoor spaces. |          |        |                    |              |        | 6              |    |  |
| CO4                                                                                                                                                                                                                                                                                                                                                                                                                 | CALCULATE water demand and design efficient plumbing and drainage networks.        |          |        |                    |              |        | 3              |    |  |
| Course Content                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                    |          |        |                    |              |        |                |    |  |
| Unit 1                                                                                                                                                                                                                                                                                                                                                                                                              | Title: Introduction to MEP and Building Standards                                  |          |        |                    |              | 8 Hrs. | CO1            |    |  |
| The Role of MEP: Importance of MEP services in modern infrastructure; lifecycle of a building project, Coordination and Integration: How Civil, Structural, and MEP engineers collaborate; Introduction to BIM                                                                                                                                                                                                      |                                                                                    |          |        |                    |              |        |                |    |  |

  
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|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------|---------------|------------|
| (Building Information Modeling) for clash detection, Regulations and Codes: Overview of the National Building Code (NBC), Design Process: Understanding architectural layouts and MEP symbolic representations.                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                             |               |            |
| <b>Exemplars / Practical Applications and usage:</b><br>Analysis of a high-rise "mixed-use" building project lifecycle.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                             |               |            |
| <b>Assignments:</b><br>1. Identify 20 standard MEP symbols used in professional architectural drawings.<br>2. Comparative study of a "Green Building" vs. a conventional building.                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                             |               |            |
| <b>Unit 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>Title: Mechanical Systems - HVAC and Fire Protection</b> | <b>8 Hrs.</b> | <b>CO2</b> |
| Fundamentals of HVAC: Principles of thermodynamics and heat transfer; Types of HVAC systems (Window, Split, VRF, And Centralized Chilled Water Systems), Ventilation: Natural vs. Mechanical ventilation; Duct design basics; Air Handling Units (AHU), Fire Safety Systems: Fire chemistry; Active vs. Passive fire protection; Fire hydrant systems, sprinklers, smoke detectors, and fire alarms, Mechanical Transportation: Elevators, Escalators, and Moving Walkways—design criteria and structural requirements. Smart Building Technology: Introduction to Building Management Systems (BMS); Automation for lighting and HVAC. |                                                             |               |            |
| <b>Exemplars / Practical Applications and usage:</b><br>Visit to a basement to see Ventilation fans (Jet fans) and Fire Sprinkler networks.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                             |               |            |
| <b>Assignments:</b><br>1. Calculate the Fire Load for a library vs. an office space.<br>2. Design a basic duct layout for a 1000 sq. ft. hall.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                             |               |            |
| <b>Unit 3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>Title: Electrical Systems and Lighting</b>               | <b>7 Hrs.</b> | <b>CO3</b> |
| Power Distribution: Introduction to High Tension (HT) and Low Tension (LT) power; Substation components (Transformers, Switchgears, Busbars), Wiring and Safety: Types of wiring; Circuit breakers (MCB, RCCB); Earthing and Lightning protection for structures. Illumination Design: Fundamentals of lighting; Types of lamps (LED, Fluorescent); Calculation of Lux levels; Emergency lighting systems, Backup Systems: UPS and Diesel Generators (DG set) sizing and placement considerations. Solar PV integration; Energy auditing basics for Civil Engineers.                                                                    |                                                             |               |            |
| <b>Exemplars / Practical Applications and usage:</b><br>Sizing a Diesel Generator for a residential apartment complex.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                             |               |            |
| <b>Assignments:</b><br>1. Perform a manual "Lux calculation" for a classroom using the Lumen Method.<br>2. Draw a Single Line Diagram (SLD) for a residential distribution board.                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                             |               |            |
| <b>Unit 4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>Title: Plumbing and Sanitary Systems</b>                 | <b>7 Hrs.</b> | <b>CO4</b> |
| Water Supply: Sources of water; Cold and Hot water distribution systems; Direct vs. Indirect pumping; Storage tank (UGWT and OHWT) capacity calculations, Sanitation and Drainage: Soil and Waste pipe systems (Single stack, One-pipe, Two-pipe); Traps, Gully, and Manholes, Fixture Technology: Selection of sanitary ware; Water-efficient fixtures, Rainwater Harvesting: Storm water drainage design; Recharge pits and storage systems for urban civil structures. Grey water recycling.                                                                                                                                         |                                                             |               |            |
| <b>Exemplars / Practical Applications and usage:</b><br>Design of a Rainwater Harvesting system for the college campus.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                             |               |            |

  
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### Assignments:

1. Size the Underground and Overhead water tanks for a family of 50 residents (as per NBC 135 LPCD).
2. Draft a plumbing section showing the "Double Stack" drainage system.

### Course Projects:

-

### Textbooks:

#### Journals & Standards

- **National Building Code (NBC) 2016:** Specifically Parts 4 (Fire), 8 (Building Services), and 9 (Plumbing).
- **ASHRAE Journal:** For latest trends in HVAC and thermal efficiency.
- **CIBSE (Chartered Institution of Building Services Engineers):** Guides on lighting and electrical safety.

#### Technical Handbooks

- Plumbing Design and Practice by S.G. Deolalikar.
- Modern Air Conditioning Practice by Norman C. Harris.
- Handbook of Electrical Design Details by Neil Sclater.

### Reference Books:

- **National Building Code of India (NBC) - Part 4, 8 & 9:** Bureau of Indian Standards.
- **Building Services:** S.M. Patil, 2nd Edition, Seema Publication.
- **Building Services and Equipment:** Fred Hall and Roger Greeno, Routledge.
- **Mechanical and Electrical Equipment for Buildings:** Walter T. Grondzik and Alison G. Kwok, Wiley.
- **Water Supply and Sanitary Engineering:** S.C. Rangwala, Charotar Publishing House.

### MOOCs Links and additional reading material:

Since MEP is a specialized intersection of mechanical, electrical, and civil engineering, these courses provide the necessary cross-disciplinary knowledge:

- **NPTEL:** [Energy Efficiency, Acoustics & Daylighting in Building](#)
- **Coursera:** [Autodesk Certified Professional: Revit for Structural Design](#) (For BIM context).
- **edX:** [Sustainable Building Design](#).
- 

### Strength of CO-PO-PSO Mapping

| CO   | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1  | 3   | 2   | 1   | -   | -   | 3   | 2   | 2   | -   | 2    | -    | 2    | 3    | 2    |
| CO2  | 3   | 3   | 3   | 2   | -   | 3   | 1   | -   | 1   | -    | 1    | 3    | 2    | 2    |
| CO3  | 3   | 2   | 3   | -   | -   | 2   | 2   | -   | -   | -    | -    | 2    | 2    | 2    |
| CO4  | 3   | 3   | 3   | 2   | -   | 2   | 3   | -   | 1   | -    | 1    | 3    | 2    | 2    |
| Avg. | 3   | 2.5 | 2.5 | 2   | -   | 2.5 | 2.0 | 1   | 1   | 2    | 1    | 2.5  | 2.25 | 2.0  |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

### Assessment Pattern

|          |     |     |
|----------|-----|-----|
| BT Level | CCE | ESE |
|----------|-----|-----|

  
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|    | CT1 | CT2 | Assignments | Course Project | Field Activity /<br>Case Study | Quiz /<br>presentation etc. |   |
|----|-----|-----|-------------|----------------|--------------------------------|-----------------------------|---|
| K1 | ✓   | -   | ✓           | -              | -                              | -                           | ✓ |
| K2 | ✓   | -   | ✓           | -              | -                              | ✓                           | ✓ |
| K3 | -   | -   | ✓           | -              | ✓                              | ✓                           | ✓ |
| K4 | -   | -   | ✓           | -              | ✓                              | ✓                           | ✓ |
| K5 | -   | -   | -           | -              | -                              | -                           | ✓ |
| K6 | -   | -   | -           | -              | -                              | -                           | ✓ |

This course serves as a prerequisite for / maps with the following future courses:

This Open Elective acts as a foundation for several advanced specializations and professional electives in your final years and post-graduation:

1. Building Information Modeling (BIM)

Connection: This course is the direct prerequisite for Revit MEP. While Civil Engineering teaches you the "Shell," BIM courses teach you how to populate that shell with data-rich MEP systems.

Key Skill: Virtual design and construction (VDC).

2. Construction Technology & Management (CTM)

Connection: You cannot manage a project schedule without understanding MEP lead times (e.g., HVAC chillers often have a 4-month lead time). This course maps to Project Scheduling & Resource Management.

3. Green Building & Sustainable Architecture

Connection: 70% of a building's energy is consumed by MEP. This course is the prerequisite for LEED/GRIHA Certification courses and Energy Auditing.

4. Advanced Structural Design

Connection: Maps to courses dealing with High-Rise Buildings. You will learn how to design "Service Floors" and "Structural Sleeves" to accommodate massive MEP loads without compromising stability.

**Job Mapping:**

Job opportunities that one can get after learning this course:

Completion of this course, especially if paired with the Course Project, opens doors to three distinct career "Buckets":

1. Design & Engineering Roles

MEP Design Engineer: Creating the blueprints for water, power, and air systems.

BIM Coordinator (MEP): Using software like Navisworks to perform "Clash Detection" (identifying where a pipe hits a beam before it happens on-site).

Public Health Engineer (PHE): Specializing specifically in large-scale water treatment and sanitation for townships.

2. Site & Execution Roles

MEP Site Engineer: Supervising the installation of conduits, ducts, and pipes. This is a high-demand role in high-rise residential and commercial mall projects.

  
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Quality Control (QC) Engineer - MEP: Ensuring that the materials used (pipes, wires, valves) meet the IS/NBC standards.

Billing & Quantity Surveyor (MEP): Managing the "MEP BOQ" (Bill of Quantities), which often accounts for 30% to 45% of the total project cost?

### 3. Specialized Industry Roles

Facility Manager: Overseeing the operations of completed buildings (hospitals, data centers, airports) where MEP uptime is critical.

Sustainability Consultant: Helping developers achieve "Net Zero" status by optimizing HVAC and lighting systems.

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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                  |          |        |                    |              |    |                |    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|--------|--------------------|--------------|----|----------------|----|
| Program:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | S. Y. B.Tech (Civil)                                                                                                                                             |          |        |                    | Semester:    |    | III            |    |
| Course:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Project Planning and Valuation                                                                                                                                   |          |        |                    | Course Code: |    | R25-CE-EEM-206 |    |
| Teaching Scheme (hrs. / week)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                  |          |        | Examination Scheme |              |    |                |    |
| Lecture                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Practical                                                                                                                                                        | Tutorial | Credit | CCE                | ESE          | TW | PR             | OR |
| 01                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 02                                                                                                                                                               | -        | 02     | 25                 | -            | 25 | -              | -  |
| <b>Course Description:</b><br>This subject introduces the fundamental principles of Project Management and Economic analysis in Civil Engineering. It covers topics such as project planning, scheduling. Students learn to apply management tools like CPM, PERT for effective project execution. The course also emphasizes the concepts of Engineering Economics, including time value of money, project evaluation techniques.                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                  |          |        |                    |              |    |                |    |
| <b>Course Relevance:</b><br>Civil Engineers are often responsible for planning, executing and managing infrastructure projects within financial and time constraints. Understanding project management techniques ensures efficient use of resources, timely completion and quality control. Similarly, knowledge of engineering economics enables engineers to make sound financial decisions.                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                                                                  |          |        |                    |              |    |                |    |
| <b>Prerequisite:</b><br>Fundamentals of management and economics.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                  |          |        |                    |              |    |                |    |
| <b>Bridge Content:</b> -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                  |          |        |                    |              |    |                |    |
| <b>Course Objectives:</b><br>1. To <b>DEVELOP</b> understanding of project management principles and application of WBS, LOB, CPM, PERT and network analysis techniques for effective project control.<br>2. To <b>APPLY</b> integrated project management techniques and economic principles for efficient, cost-effective and secure execution of a construction project.<br>3. To enable students to <b>ANALYZE</b> project economics, apply time value of money concepts, and evaluate projects using payback period, NPV and IRR methods for sound financial planning.<br>4. To <b>PERFORM</b> a complete financial appraisal of a construction project by identifying funding sources, calculating the time-value of project cash flows and using standard investment and depreciation methods to determine its overall profitability and economic value. |                                                                                                                                                                  |          |        |                    |              |    |                |    |
| <b>Course Outcomes:</b> After learning the course, students will be able to                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                  |          |        |                    |              |    |                |    |
| CO                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Course Outcome                                                                                                                                                   |          |        |                    |              |    | Bloom's Level  |    |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | PLAN, EXECUTE and CONTROL complex projects by balancing time, cost and quality.                                                                                  |          |        |                    |              |    | 1,2,3          |    |
| CO2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | MAKE financial decisions by comparing technical alternatives, calculating long-term profitability and ensuring that engineering projects are financially viable. |          |        |                    |              |    | 1,2,3          |    |
| CO3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | systematically ORGANIZE project scope into manageable components and PRIORITIZE material resources based on their economic value                                 |          |        |                    |              |    | 1,2            |    |
| CO4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | CALCULATE the ideal order size and timing for material procurement and to                                                                                        |          |        |                    |              |    | 2,3            |    |

  
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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>UNDERSTAND</b> the on site safety protocols                                                                                                                                                      |               |                |
| CO5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>IDENTIFY</b> the critical path using MSP, different funding options for construction projects and <b>APPLY</b> Time Value of Money principles to determine the true future worth of investments. |               | <b>1,2,3,6</b> |
| <b>Course Content</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                     |               |                |
| <b>Unit 1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>Title: Introduction to Project Management, Project Planning and Scheduling</b>                                                                                                                   | <b>7 Hrs.</b> | <b>CO1</b>     |
| <p>Project Management: definition, significance, objectives, functions, principles, Responsibilities of project manager<br/>                     Work Breakdown Structure (WBS), Line of Balance (LOB),<br/>                     Network Planning, Network Analysis, C.P.M. – Activity on Arrow (A.O.A.)<br/>                     Critical Path and Types of Floats, Precedence Network Analysis (A.O.N.)<br/>                     Types of Precedence Relationship, P.E.R.T. Analysis</p> <p><b>Exemplars / Practical Applications and usage:</b><br/>                     Project Management uses WBS to define scope and CPM/PERT to schedule tasks and manage uncertainty, LOB tracks repetitive work. CPM analyzes Critical Paths and Floats to optimize resources, ensuring projects finish on time and within budget.</p> <p><b>Assignments:</b></p> <ul style="list-style-type: none"> <li>What is the importance of management in case of construction industry?</li> <li>State differences between AOA and AON.</li> <li>How to calculate the earliest expected time and latest allowable occurrence time in PERT? Give an example and explain it.</li> </ul>                            |                                                                                                                                                                                                     |               |                |
| <b>Unit 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>Title: Project Economics and Appraisal</b>                                                                                                                                                       | <b>8 Hrs.</b> | <b>CO2</b>     |
| <p>Project Economics: Definition, Principles, Importance in Construction Industry,<br/>                     Law of Demand and Supply, Difference between cost, value, price, Annuities and its types,<br/>                     Time Value of Money: Introduction, Simple and Compound Interest.<br/>                     Project Evaluation Techniques: Payback Period Method, Net Present Value, Internal Rate of Return, Benefit Cost Ratio.</p> <p><b>Exemplars / Practical Applications and usage:</b><br/>                     Project Economics evaluates the financial viability of construction projects. Supply and Demand dictates material costs, while Time Value of Money accounts for inflation's impact on long-term investments. Project Managers use NPV and IRR to choose profitable bids, BCR for public infrastructure and Payback Period to assess risk and liquidity.</p> <p><b>Assignments:</b></p> <ul style="list-style-type: none"> <li>What is the importance of economics in Civil Engineering?</li> <li>What are demand and supply curves? Describe the elasticity of supply.</li> <li>Explain with an example, the 'Law of Diminishing Marginal Utility'.</li> </ul> |                                                                                                                                                                                                     |               |                |
| <b>Course Projects:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                     |               |                |
| -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                     |               |                |
| <b>Textbooks:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                     |               |                |

  
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1. Dr. B. C. Punmia and K. K. Khadelwal, "Project Planning and Control with PERT and CPM", Firewall Media, Laxmi Publication, New Delhi
2. B. B. Goel, "Project Management Principles and Techniques", Deep and Deep Publisher

#### Reference Books:

1. Khatua, "Project Management", Oxford University
2. K. K. Chitkara, "Construction Project Management- Planning, Scheduling and Controlling", Tata McGraw Hill Publishing Company, New Delhi
3. B. Sengupta and H. Guha, "Construction Management and Planning", Tata McGraw Hill Publishing Company, New Delhi
4. S. Seetharaman, "Construction Engineering and Management", Umesh Publication
5. R. Panneerselvam, "Engineering Economics", PHI Learning Pvt. Ltd.
6. M. Y. Khan and P. K. Jain, "Financial Management", McGraw Hill Education

#### MOOCs Links and additional reading material:

1. <https://nptel.ac.in/courses/110104073>
2. <https://nptel.ac.in/courses/105103023>

#### List of Practical:

| Experiment No.1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Work Breakdown Structure (WBS) for activities involved in a residential building construction project. | 2 hrs | CO3 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------|-------|-----|
| <p><b>Objective:</b> To systematically decompose a residential building construction project into hierarchical levels of work, ensuring that 100% of the project scope is defined, organized and assigned for effective planning and execution.</p> <p><b>Associated Tasks:</b><br/>To achieve the objective, the following tasks must be performed:</p> <ol style="list-style-type: none"> <li>1. Scope Definition</li> <li>2. Level 1 Breakdown (Major Phases)</li> <li>3. Decomposition (Lower Levels)</li> <li>4. Coding and Numbering</li> <li>5. Verification</li> </ol> <p><b>Exemplars and Utility:</b><br/>Exemplar:<br/>An example of typical hierarchy for a residential project:</p> <ul style="list-style-type: none"> <li>• Level 0: Residential Building Project</li> <li>• Level 1 (Phases): 1.0 Substructure   2.0 Superstructure   3.0 MEP (Mechanical, Electrical, Plumbing)</li> <li>• Level 2 (Work Packages): Under 1.0: 1.1 Earthwork, 1.2 Piling, 1.3 Foundation.<br/>Under 2.0: 2.1 Columns, 2.2 Slabs, 2.3 Walls/Masonry.</li> </ul> <p>Utility:</p> <ul style="list-style-type: none"> <li>• 100% Rule: Ensures no part of the project is forgotten.</li> <li>• Basis for Scheduling: The lowest level "work packages" are converted into activities for the construction schedule (Gantt Chart).</li> </ul> |                                                                                                        |       |     |

  
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- Cost Control: Allows for accurate budget allocation to specific components of the building.
- Accountability: Provides a clear structure to assign specific tasks to contractors or teams.

|                        |                                                                   |              |            |
|------------------------|-------------------------------------------------------------------|--------------|------------|
| <b>Experiment No.2</b> | <b>ABC Analysis for Classification of Construction Materials.</b> | <b>2 hrs</b> | <b>CO3</b> |
|------------------------|-------------------------------------------------------------------|--------------|------------|

**Objective:**

To classify construction materials into three categories (A, B, and C) based on their annual consumption value.

**Associated Tasks:**

1. Data Collection: Compile a list of all materials (cement, steel, sand, nails, etc.) with their estimated quantities and unit prices.
2. Calculate Annual Usage Value: Multiply the quantity by the unit cost for each item.
3. Ranking: Sort the items in descending order based on their total usage value.
4. Cumulative Calculation: Calculate the cumulative percentage of the number of items and the cumulative percentage of the total value.
5. Classification: Apply the Pareto Principle (80/20 rule) to group items into A, B, and C categories.

**Exemplars and Utility:**

Exemplars (The Classification):

In a typical residential project, the materials generally fall into following brackets:

| Category           | Value % | Item Quantity % | Example Materials                   |
|--------------------|---------|-----------------|-------------------------------------|
| A (High Value)     | 70–80%  | 10–20%          | Structural Steel, Cement, Elevators |
| B (Moderate Value) | 15–20%  | 20–30%          | Bricks, Plumbing Fixtures, Timber   |
| C (Low Value)      | 5–10%   | 50–60%          | Sand, Nails, Washers, Binding Wire  |

Utility (The Purpose):

- Major Control on "A" Items: Since Category A represents the bulk of the budget, these items require strict inventory control, frequent stock checks, and precise ordering.
- Reduced Waste: By focusing on high-value items, managers can implement better security and storage to prevent damage or theft of expensive materials like steel.
- Optimized Resource Allocation: It prevents "over-managing" low-value items (Category C). For example, it is more efficient to buy nails in bulk once than to spend administrative time tracking them daily.
- Working Capital Management: Helps in maintaining a lean inventory, ensuring that funds are not tied up in unnecessary stock, thereby improving the project's cash flow.

|                        |                                                                                                           |              |            |
|------------------------|-----------------------------------------------------------------------------------------------------------|--------------|------------|
| <b>Experiment No.3</b> | <b>Determination of Economic Order Quantity (EOQ) and Reorder Point (ROP) for Construction Materials.</b> | <b>2 hrs</b> | <b>CO4</b> |
|------------------------|-----------------------------------------------------------------------------------------------------------|--------------|------------|

**Objective:**

To determine the Economic Order Quantity (EOQ) and Reorder Point (ROP) to minimize total inventory costs and ensure materials are replenished before a stock out occurs.

**Associated Tasks:**

1. Data Collection: Gather annual demand, unit cost, ordering cost per order and holding cost per unit per year.

  
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2. EOQ Calculation: Apply the EOQ formula to find the most cost-effective quantity to order.
3. Lead Time Analysis: Determine the average time between placing an order and receiving materials.
4. Safety Stock & ROP Determination: Calculate the Reorder Point using formula.

**Exemplars and Utility:**

Exemplar: Cement Procurement

Imagine a project requiring 10,000 bags of cement annually.

- Ordering Cost: Rs. 2,000
- Holding Cost: Rs. 50/bag/year
- EOQ Result: Using the formula, the EOQ might be 895 bags. Instead of ordering 5,000 bags twice (high storage cost) or 100 bags 100 times (high delivery cost), ordering 895 bags at a time minimizes the total cost.
- ROP Result: If lead time is 5 days and daily usage is 30 bags, the ROP would be 150 bags (plus safety stock).

Utility (Importance in Construction):

- Cost Optimization
- Prevents Delays
- Waste Reduction
- Cash Flow Management

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                            |              |            |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|--------------|------------|
| <b>Experiment No.4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>Preparation of a Project Schedule and Identification of Critical Path using Microsoft Project (MSP)</b> | <b>2 hrs</b> | <b>CO5</b> |
| <p><b>Objective:</b><br/>To develop a logical sequence of construction activities and determine the Critical Path using MSP</p> <p><b>Associated Tasks:</b><br/>To successfully generate a schedule in MSP, the following steps are performed</p> <ol style="list-style-type: none"> <li>1. Project Configuration</li> <li>2. Task Entry</li> <li>3. Establishing Precedence</li> <li>4. Resource Allocation</li> <li>5. Critical Path Analysis</li> </ol> <p><b>Exemplars and Utility:</b></p> <ul style="list-style-type: none"> <li>• Time Management: MSP automatically calculates the project end date based on task links, removing manual errors.</li> <li>• Proactive Bottleneck Detection: By identifying the Critical Path, managers know exactly which activities require the most supervision to avoid delays.</li> <li>• Progress Tracking: It allows for the comparison of the Baseline (planned schedule) against the Actual progress to calculate variances.</li> </ul> |                                                                                                            |              |            |
| <b>Experiment No.5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>Safety Norms and Personal Protective Equipment (PPE) Used at Construction Sites</b>                     | <b>2 hrs</b> | <b>CO4</b> |

  
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### Objective:

To familiarize with the safety protocols and standards governing construction sites and to identify, select and demonstrate the correct use of Personal Protective Equipment (PPE) to mitigate workplace hazards.

### Associated Tasks:

To achieve the objective, the following tasks are performed:

1. Hazard Identification: Conducting a walkthrough to identify potential risks.
2. Selection of PPE: Matching specific equipment to the identified hazards based on safety standards.
3. Inspection and Maintenance: Checking gear for defects, cracks or expiration before use.
4. Demonstration: The correct procedure for putting on and taking off gear to ensure maximum protection.
5. Compliance Monitoring: Recording and enforcing safety norms through site safety audits or checklists.

### Exemplars and Utility:

Exemplars (The "What"):

Prepare the following table for PPE

| PPE Item | Protection Area | Construction Context |
|----------|-----------------|----------------------|
|          |                 |                      |
|          |                 |                      |

Utility (The "Why"):

The utility of these norms and equipment focuses on three pillars:

- Life Safety
- Legal & Regulatory Compliance
- Economic Efficiency

|                        |                                                                                   |              |            |
|------------------------|-----------------------------------------------------------------------------------|--------------|------------|
| <b>Experiment No.6</b> | <b>Study of Various Sources of Project Finance for Civil Engineering Projects</b> | <b>2 hrs</b> | <b>CO5</b> |
|------------------------|-----------------------------------------------------------------------------------|--------------|------------|

### Objective:

To analyze the various funding sources of finance available for Civil Engineering Projects.

### Associated Tasks:

Identifying and collecting information about available public, private and multilateral funding sources for Civil Engineering Projects.

### Exemplars and Utility:

Exemplars (Financial Sources):

Civil Engineering projects typically use the following financing sources:

| Source Category   | Name of Financing Source | Typical Application |
|-------------------|--------------------------|---------------------|
| Short term source |                          |                     |
|                   |                          |                     |
|                   |                          |                     |
| Long Term Source  |                          |                     |
|                   |                          |                     |
|                   |                          |                     |

  
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Utility (The "Why");

The study of these sources provides critical strategic advantages:

- Off-Balance Sheet Financing
- Risk Allocation
- Bankability
- Long-term Stability

**Experiment No.7**

**Study and Application of Time Value of Money  
Concepts in Civil Engineering Projects**

**2 hrs**

**CO5**

**Objective:**

To understand and apply the principle of Time Value of Money for evaluating the financial feasibility and profitability of Civil Engineering projects.

**Associated Tasks:**

1. Data Collection
2. Determining the Discount Rate
3. Calculating Present and Future Values

**Exemplars and Utility:**

Exemplars (The "What")

In Civil Engineering, Time Value of Money is typically applied using formulae of future value and present value.

Utility (The "Why")

The utility of TVM in civil engineering includes:

- Life Cycle Cost Analysis
- Inflation Adjustment
- Investment Justification
- Sinking Funds Calculation

**Experiment No.8**

**Evaluation of Construction Project using Average  
Rate of Return (ARR) method and Payback  
Period method**

**2 hrs**

**CO2**

**Objective:**

To evaluate the financial feasibility and profitability of a construction project by calculating the time required to recover the initial investment (Payback Period) and the expected annual percentage return on the capital invested (ARR).

**Associated Tasks:**

To perform this evaluation, the following tasks are required:

1. Estimate Initial Outlay
2. Forecast Annual Cash Inflows
3. Calculate Payback Period:
4. Calculate Average Rate of Return (ARR)
5. Decision Analysis

**Exemplars:**

  
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Explain the traditional techniques of capital budgeting by solving numerical.

**Utility:**

- Risk Assessment
- Profitability Benchmark
- Simplicity in Decision Making
- Project Ranking

|                        |                                                                                                              |              |            |
|------------------------|--------------------------------------------------------------------------------------------------------------|--------------|------------|
| <b>Experiment No.9</b> | <b>Evaluation of Construction Project using Net Present Value (NPV) method and Benefit Cost Ratio method</b> | <b>2 hrs</b> | <b>CO2</b> |
|------------------------|--------------------------------------------------------------------------------------------------------------|--------------|------------|

**Objective:**

To evaluate the financial feasibility and economic viability of a construction project by Net Present Value (NPV) method and Benefit Cost Ratio method.

**Associated Tasks:**

1. Estimation of Cash Flow
2. Selection of Discount Rate
3. NPV Calculation
4. BCR Calculation
5. Decision Analysis

**Exemplars and Utility:**

Exemplars (Practical Example):

Solve the various numerical based on the time adjusted techniques of capital budgeting i.e. Net Present Value method and Benefit Cost Ratio method.

Utility (The Purpose)

- Time Value Adjustment
- Objective Selection
- Budget Prioritization
- Risk Mitigation

|                         |                              |              |            |
|-------------------------|------------------------------|--------------|------------|
| <b>Experiment No.10</b> | <b>Depreciation Analysis</b> | <b>2 hrs</b> | <b>CO2</b> |
|-------------------------|------------------------------|--------------|------------|

**Objective:**

Calculate annual depreciation using the Straight-Line method, Declining Balance method and sinking fund method for a specific piece of construction equipment.

**Associated Tasks:**

1. Asset selection.
2. Determine the annual depreciation by using 3 methods.
3. Compare the values.

**Exemplars and Utility:**

Exemplars:

Solve the numerical by all the three methods

Utility:

- Tax Shielding

  
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- Asset Replacement Planning
- Financial Reporting
- Cost Recovery

### Strength of CO-PO-PSO Mapping

| CO   | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1  | 3   | 2   | 2   | 2   | 2   | -   | -   | -   | -   | 3    | 3    | 3    | 2    | 2    |
| CO2  | 3   | 2   | 2   | 2   | 2   | -   | -   | -   | -   | 3    | 3    | 3    | 2    | 2    |
| CO3  | 3   | 2   | 2   | 2   | 2   | -   | -   | -   | -   | 3    | 3    | 3    | 2    | 2    |
| CO4  | 3   | 2   | 2   | 2   | 2   | -   | -   | -   | -   | 3    | 3    | 3    | 2    | 2    |
| CO5  | 3   | 2   | 2   | 2   | 2   | -   | -   | -   | -   | 3    | 3    | 3    | 2    | 2    |
| Avg. | 3   | 2   | 2   | 2   | 2   | -   | -   | -   | -   | 3    | 3    | 3    | 2    | 2    |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

### Assessment Pattern

| BT Level | CCE |     |             |                |                             |                          | ESE |
|----------|-----|-----|-------------|----------------|-----------------------------|--------------------------|-----|
|          | CT1 | CT2 | Assignments | Course Project | Field Activity / Case Study | Quiz / presentation etc. |     |
| K1       | ✓   | -   | -           | -              | ✓                           | -                        | -   |
| K2       | ✓   | -   | -           | -              | ✓                           | -                        | -   |
| K3       | ✓   | -   | -           | -              | ✓                           | -                        | -   |
| K4       | -   | -   | -           | -              | -                           | -                        | -   |
| K5       | -   | -   | -           | -              | -                           | -                        | -   |
| K6       | -   | -   | -           | -              | -                           | -                        | -   |

Project Management and Engineering Economics course serves as a prerequisite for / maps with the following future Civil Engineering courses:

1. Construction Management
2. Quantity Surveying, Contracts and Tenders

### Job Mapping:

Job opportunities that one can get after learning this course:

Planning Engineer – prepares project schedules using tools like Primavera or MS Project, and monitors progress.

Site Engineer / Construction Manager – applies project management skills to plan, organize, and manage on-site activities.

Project Manager (after experience) – oversees entire construction or infrastructure projects ensuring timely completion within budget.

Entrepreneurship – enables graduates to start their own construction firms, consultancies or project management companies.

  
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|                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                           |                                                |        |                    |     |              |               |                |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|------------------------------------------------|--------|--------------------|-----|--------------|---------------|----------------|--|
| Program:                                                                                                                                                                                                                                                                                                                                                |                                                                                                                           | S.Y. B.Tech. (Civil)                           |        |                    |     | Semester:    |               | III            |  |
| Course:                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                           | Universal Human Values and Ethics              |        |                    |     | Course Code: |               | R25-CE-VEC-207 |  |
| Teaching Scheme (hrs. /week)                                                                                                                                                                                                                                                                                                                            |                                                                                                                           |                                                |        | Examination Scheme |     |              |               |                |  |
| Lecture                                                                                                                                                                                                                                                                                                                                                 | Practical                                                                                                                 | Tutorial                                       | Credit | CCE                | ESE | TW           | PR            | OR             |  |
| 02                                                                                                                                                                                                                                                                                                                                                      | -                                                                                                                         | -                                              | 02     | 50                 | -   | -            | -             | -              |  |
| Course Description:                                                                                                                                                                                                                                                                                                                                     |                                                                                                                           |                                                |        |                    |     |              |               |                |  |
| This course enables civil engineering students to develop ethical competence, human values, and professional responsibility required for safe, sustainable, and socially responsible engineering practice. It connects personal values with professional conduct, teamwork, environmental responsibility, and real-life engineering decision-making.    |                                                                                                                           |                                                |        |                    |     |              |               |                |  |
| Course Relevance:                                                                                                                                                                                                                                                                                                                                       |                                                                                                                           |                                                |        |                    |     |              |               |                |  |
| Civil engineering projects directly affect human life, safety, environment, and society. Engineers must ensure ethical practices, sustainability, quality, and social responsibility in planning, design, and construction activities. This course integrates AICTE Universal Human Values (UHV) with professional ethics and engineering applications. |                                                                                                                           |                                                |        |                    |     |              |               |                |  |
| Prerequisite:                                                                                                                                                                                                                                                                                                                                           |                                                                                                                           |                                                |        |                    |     |              |               |                |  |
| Basic understanding of engineering profession, communication skills, social responsibility, and environmental awareness.                                                                                                                                                                                                                                |                                                                                                                           |                                                |        |                    |     |              |               |                |  |
| Bridge Content:                                                                                                                                                                                                                                                                                                                                         |                                                                                                                           |                                                |        |                    |     |              |               |                |  |
| Introduction to professional roles and responsibilities, workplace ethics, social responsibility, communication practices, and environmental awareness related to engineering profession.                                                                                                                                                               |                                                                                                                           |                                                |        |                    |     |              |               |                |  |
| Course Objectives:                                                                                                                                                                                                                                                                                                                                      |                                                                                                                           |                                                |        |                    |     |              |               |                |  |
| 1. To <b>DEVELOP</b> understanding of human values and ethical behaviour in personal and professional life.                                                                                                                                                                                                                                             |                                                                                                                           |                                                |        |                    |     |              |               |                |  |
| 2. To <b>PROMOTE</b> self-awareness, self-discipline, and responsible conduct among engineering students.                                                                                                                                                                                                                                               |                                                                                                                           |                                                |        |                    |     |              |               |                |  |
| 3. To <b>DEVELOP</b> harmonious relationships in family, society, and professional environments.                                                                                                                                                                                                                                                        |                                                                                                                           |                                                |        |                    |     |              |               |                |  |
| 4. To <b>STRENGTHEN</b> professional ethics, teamwork, sustainability, and value-based decision-making in engineering practice.                                                                                                                                                                                                                         |                                                                                                                           |                                                |        |                    |     |              |               |                |  |
| Course Outcomes: After learning the course, students will be able to                                                                                                                                                                                                                                                                                    |                                                                                                                           |                                                |        |                    |     |              |               |                |  |
| CO                                                                                                                                                                                                                                                                                                                                                      | Course Outcome                                                                                                            |                                                |        |                    |     |              | Bloom's Level |                |  |
| CO1                                                                                                                                                                                                                                                                                                                                                     | EXPLAIN the importance of human values, self-exploration, and ethical behaviour in personal and professional life.        |                                                |        |                    |     |              | 2             |                |  |
| CO2                                                                                                                                                                                                                                                                                                                                                     | DEMONSTRATE self-awareness, self-discipline, and responsible behaviour in professional activities.                        |                                                |        |                    |     |              | 3             |                |  |
| CO3                                                                                                                                                                                                                                                                                                                                                     | APPLY values such as trust, respect, teamwork, and social responsibility in human relationships and engineering practice. |                                                |        |                    |     |              | 3             |                |  |
| CO4                                                                                                                                                                                                                                                                                                                                                     | APPLY professional ethics, sustainability principles, and value-based decision-making in engineering situations.          |                                                |        |                    |     |              | 4             |                |  |
| Course Content                                                                                                                                                                                                                                                                                                                                          |                                                                                                                           |                                                |        |                    |     |              |               |                |  |
| Unit 1                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                           | Title: Foundations of Human Values and Ethical |        |                    |     | 8 Hrs.       |               | CO1            |  |

  
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|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------|--------------|------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | <b>Engineering Practice</b>                                                      |              |            |
| Meaning, purpose, and importance of human values. Need for value education in engineering profession. Self-exploration and self-awareness. Ethical behaviour in construction practices. Professional responsibilities of civil engineers. Consequences of corruption, compromise in quality, and unsafe practices. Case-based understanding from real civil engineering situations. Development of personal and professional vision and conduct.                                                                                                                                            |                                                                                  |              |            |
| <b>Exemplars / Practical Applications and usage:</b><br>Ethical failures in construction projects, quality compromise cases, safety negligence examples.                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                  |              |            |
| <b>Assignments:</b><br>Short reflective notes and case analysis.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                  |              |            |
| <b>Unit 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Title: Personal Well-being and Professional Conduct</b>                       | <b>8Hrs.</b> | <b>CO2</b> |
| Understanding self: thoughts, emotions, habits, and actions. Balancing personal life and professional responsibilities. Stress, fatigue, and pressure management at construction sites. Importance of discipline, punctuality, accuracy, and responsibility. Handling deadlines, emergencies, and safety risks. Identifying strengths and limitations to improve professionalism. Time management and workplace ethics.                                                                                                                                                                     |                                                                                  |              |            |
| <b>Exemplars / Practical Applications and usage:</b><br>Site-based stress scenarios and professional conduct examples.                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                  |              |            |
| <b>Assignments:</b><br>Self-assessment and time-management exercises.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                  |              |            |
| <b>Unit 3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Title: Professional Relationships, Teamwork, and Social Responsibility</b>    | <b>7Hrs.</b> | <b>CO3</b> |
| Effective communication in engineering environments. Working with contractors, labour, clients, consultants, and government officials. Leadership, teamwork, coordination, and decision-making. Conflict management and dispute resolution. Social responsibility in infrastructure planning. Sensitivity to community needs, public welfare, and sustainable engineering practices.                                                                                                                                                                                                        |                                                                                  |              |            |
| <b>Exemplars / Practical Applications and usage:</b><br>Engineer–Contractor–Client coordination cases                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                  |              |            |
| <b>Assignments:</b><br>Role-play and teamwork-based activities.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                  |              |            |
| <b>Unit 4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Title: Harmony in Nature, Professional Ethics, and Universal Human Values</b> | <b>7Hrs.</b> | <b>CO4</b> |
| Understanding harmony in nature through coexistence and mutual fulfilment among the four orders of nature – material, plant, animal, and human order. Realizing existence as co-existence at all levels. Holistic perception of harmony in existence. Relationship between human values and harmony in nature. Professional ethics and code of conduct. Workplace safety and professional responsibility. Integrity, accountability, and quality in engineering work. Ethical decision-making and value-based leadership. Role of universal human values in personal and professional life. |                                                                                  |              |            |
| <b>Exemplars / Practical Applications and usage:</b><br>Observation and analysis of harmony in family, society, and nature. Safety management practices at construction sites.                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                  |              |            |

  
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### Assignments:

Prepare a reflective report on harmony in existence, professional ethics, and ethical responsibilities.

### Course Projects:

### Textbooks:

1. R. R. Gaur, R. Sangal and G. P. Bagaria, “A Foundation Course in Human Values and Professional Ethics”, Excel Books, New Delhi.
2. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, “Engineering Ethics – Concepts and Cases”, Cengage Learning.
3. B. S. Raghavan, “Human Values and Professional Ethics”, S. Chand Publications.
4. Govindarajan M., Natarajan S., Senthil Kumar V. S., “Professional Ethics and Human Values”, PHI Learning.

### Reference Books:

1. Mike Martin and Roland Schinzinger, “Ethics in Engineering”, McGraw Hill.
2. A. N. Tripathi, “Human Values”, New Age International Publishers.
3. M. Govindarajan, “Professional Ethics and Human Values”, PHI Publications.
4. S. K. Chakraborty, “Values and Ethics for Organizations”, Oxford University Press.
5. BIS Safety Standards and Environmental Protection Guidelines.

### MOOCs Links and additional reading material:

6. AICTE Universal Human Values Portal: <https://fdp-si.aicte-india.org/UHV-II.html>
7. NPTEL Course on Human Values and Ethics: <https://nptel.ac.in/courses/109106188>
8. SWAYAM Course – Human Values and Professional Ethics: <https://swayam.gov.in>
9. Engineering Ethics and Sustainability Resources: <https://onlineethics.org>

### Strength of CO-PO-PSO Mapping

| CO   | PO1  | PO2  | PO3  | PO4  | PO5  | PO6 | PO7 | PO8 | PO9  | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------|------|------|------|------|------|-----|-----|-----|------|------|------|------|------|------|
| CO1  | 2    | 1    | –    | –    | –    | 2   | 2   | 3   | 1    | 2    | –    | 1    | –    | 1    |
| CO2  | 1    | 2    | –    | –    | –    | 2   | 1   | 3   | 2    | 2    | –    | 1    | –    | 1    |
| CO3  | 2    | 2    | 1    | –    | –    | 3   | 2   | 3   | 3    | 2    | –    | 2    | 1    | 2    |
| CO4  | 2    | 2    | 2    | 1    | 1    | 3   | 3   | 3   | 3    | 2    | 2    | 2    | 2    | 3    |
| Avg. | 1.75 | 1.75 | 0.75 | 0.25 | 0.25 | 2.5 | 2.0 | 3.0 | 2.25 | 2.0  | 0.5  | 1.5  | 0.75 | 1.75 |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

### Assessment Pattern

| BT Level | CCE |     |             |                |                             |                          | ESE |
|----------|-----|-----|-------------|----------------|-----------------------------|--------------------------|-----|
|          | CT1 | CT2 | Assignments | Course Project | Field Activity / Case Study | Quiz / presentation etc. |     |
| K1       | ✓   | -   | ✓           | -              | -                           | -                        | -   |
| K2       | ✓   | -   | ✓           | -              | -                           | ✓                        | -   |

  
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|    |   |   |   |   |   |   |   |
|----|---|---|---|---|---|---|---|
| K3 | ✓ | - | ✓ | - | - | - | - |
| K4 | - | - | ✓ | - | ✓ | - | - |
| K5 | - | - | - | - | - | - | - |
| K6 | - | - | - | - | - | - | - |

This course serves as a prerequisite for / maps with the following future courses:

1. Construction Management
2. Project Planning and Control
3. Environmental Engineering
4. Professional Practice and Entrepreneurship
5. Sustainable Infrastructure Engineering

### Job Mapping:

Job opportunities that one can get after learning this course:

After learning this course, students can contribute effectively in the following roles:

1. Site Engineer
2. Project Engineer
3. Quality Control Engineer
4. Safety Engineer
5. Environmental and Sustainability Consultant
6. Construction Planning Engineer
7. Government Engineering Services
8. Infrastructure Project Coordinator
9. CSR and Community Development Roles
10. Ethical Compliance and Safety Management Roles

  
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|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------|--------|--------------------|--------------|----|----------------|----|
| Program:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                            | S.Y. B.Tech (Civil)        |        |                    | Semester:    |    | III            |    |
| Course:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                            | Mechanics of Structure Lab |        |                    | Course Code: |    | R25-CE-PCC-208 |    |
| Teaching Scheme (hrs / week)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                            |                            |        | Examination Scheme |              |    |                |    |
| Lecture                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Practical                                                                                                                                                                                                                  | Tutorial                   | Credit | CCE                | ESE          | TW | PR             | OR |
| -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 02                                                                                                                                                                                                                         | -                          | 01     | -                  | -            | 25 | 25             | -  |
| <b>Course Description:</b><br>The Mechanics of Structures Lab enables students to experimentally study the mechanical properties of materials such as steel, aluminum, copper, brass and timber under different loading conditions. Through various tests - tension, compression, torsion and impact - students learn to determine material behavior, strength parameters and failure characteristics.                                                                                                                                                                                                                                                                                 |                                                                                                                                                                                                                            |                            |        |                    |              |    |                |    |
| <b>Course Relevance:</b><br>This lab is fundamental for understanding how materials respond to applied forces in real-world structural applications. It strengthens the students’ ability to relate theoretical concepts with practical performance, which is essential for safe and efficient structural design and analysis in civil and mechanical engineering.                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                            |                            |        |                    |              |    |                |    |
| <b>Prerequisite:</b><br>Students should have a basic understanding of Engineering Mechanics and Strength of Materials theory, including concepts of stress, strain, elasticity, bending, and torsion.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                                                                                                            |                            |        |                    |              |    |                |    |
| <b>Bridge Content:</b> -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                                                                                                            |                            |        |                    |              |    |                |    |
| <b>Course Objectives:</b><br><div>1. To <b>STUDY</b> and determine the mechanical properties of various structural materials such as mild steel, TMT steel, timber, polymers, and masonry units through tension, compression, bending, shear, torsion, and impact tests.</div> <div>2. To <b>EVALUATE</b> the behavior and strength characteristics of construction materials under different loading conditions (tensile, compressive, flexural, shear, and impact) for use in structural applications.</div> <div>3. To <b>DEVELOP</b> analytical and computational skills by interpreting experimental data, applying theoretical principles, and using computational methods</div> |                                                                                                                                                                                                                            |                            |        |                    |              |    |                |    |
| <b>Course Outcomes:</b> After learning the course, students will be able to                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                            |                            |        |                    |              |    |                |    |
| CO                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Course Outcome                                                                                                                                                                                                             |                            |        |                    |              |    | Bloom’s Level  |    |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | PERFORM various mechanical tests such as tension, shear, torsion, and impact on different engineering materials to determine their mechanical properties and understand their behavior under different loading conditions. |                            |        |                    |              |    | 3              |    |
| CO2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | CONDUCT compression and bending tests on timber to evaluate their strength characteristics, study the effect of loading direction, and understand their structural behavior under axial and flexural loads.                |                            |        |                    |              |    | 3              |    |
| CO3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | PERFORM abrasion and flexural strength tests on flooring tiles to evaluate their surface wear resistance, bending strength. Also determine the compressive strength of bricks.                                             |                            |        |                    |              |    | 3              |    |

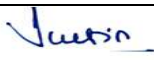
  
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|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|------------|
| CO4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>PREPARE</b> technical assignments and conduct a market survey of structural materials to analyze their properties, availability, and cost, thereby developing practical knowledge. | 2            |            |
| CO5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | <b>APPLY</b> computational methods and software tools to analyze experimental data.                                                                                                   | 2            |            |
| <b>A. List of Practical: (Any eight)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                                                                                       |              |            |
| <b>Experiment No.1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Tension test on Mild and TMT steel.</b>                                                                                                                                            | <b>2 Hrs</b> | <b>CO1</b> |
| <p><b>Objective:</b><br/>To determine the mechanical properties such as yield strength, ultimate tensile strength, Young's modulus, and percentage elongation.</p> <p><b>Associated Tasks:</b></p> <ul style="list-style-type: none"> <li>• Prepare the test specimen as per standard dimensions (mark gauge length).</li> <li>▪ Measure initial dimensions (diameter, area, gauge length).</li> <li>▪ Mount the specimen in the Universal Testing Machine (UTM).</li> <li>▪ Apply tensile load gradually and record load–extension readings.</li> <li>▪ Plot the stress–strain curve from the test data.</li> <li>▪ Calculate mechanical properties (yield strength, ultimate stress, E, elongation, reduction in area).</li> <li>▪ Observe and record the mode of failure (necking, fracture characteristics).</li> </ul> <p><b>Exemplars and Utility:</b><br/>Example of stress–strain relationship and mechanical property evaluation. <b>Used to</b> determine strength and ductility of structural steels.</p> |                                                                                                                                                                                       |              |            |
| <b>Experiment No.2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Tension test on Polymer Bar/FRP Rebar Material.</b>                                                                                                                                | <b>2 Hrs</b> | <b>CO1</b> |
| <p><b>Objective:</b><br/>To determine the mechanical properties such as yield strength, ultimate tensile strength (UTS), Young's modulus, and percentage elongation.</p> <p><b>Associated Tasks:</b></p> <ul style="list-style-type: none"> <li>• Prepare the test specimen as per standard dimensions (mark gauge length).</li> <li>▪ Measure initial dimensions (diameter, area, gauge length).</li> <li>▪ Mount the specimen in the Universal Testing Machine (UTM).</li> <li>▪ Apply tensile load gradually and record load–extension readings.</li> <li>▪ Plot the stress–strain curve from the test data.</li> <li>▪ Calculate mechanical properties (yield strength, ultimate stress, E, elongation, reduction in area).</li> <li>▪ Observe and record the mode of failure (fracture characteristics).</li> </ul> <p><b>Exemplars and Utility:</b><br/>Test helps in selecting suitable materials for construction and engineering.</p>                                                                       |                                                                                                                                                                                       |              |            |
| <b>Experiment No.3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | <b>Shear (Single &amp; Double) test on mild steel.</b>                                                                                                                                | <b>2 Hrs</b> | <b>CO1</b> |
| <p><b>Objective:</b><br/>To determine the <b>shear strength</b> of mild steel under <b>single and double shear</b> conditions.</p> <p><b>Associated Tasks:</b></p> <ul style="list-style-type: none"> <li>▪ Prepare specimen,</li> <li>▪ Fix in shear test fixture,</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                                                                                       |              |            |

  
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- Apply load using UTM
- Record failure load
- Calculate shear stress

**Exemplars and Utility:**

Used to design bolts, rivets, pins and steel connections, Helps understand shear failure behaviour in structural and mechanical components

|                        |                                                  |              |            |
|------------------------|--------------------------------------------------|--------------|------------|
| <b>Experiment No.4</b> | <b>Torsion test on mild steel /aluminum bar.</b> | <b>2 Hrs</b> | <b>CO1</b> |
|------------------------|--------------------------------------------------|--------------|------------|

**Objective:**

To determine the torsional strength, modulus of rigidity (G).

**Associated Tasks:**

- Prepare/cut the circular mild steel/Aluminium specimen
- Mount it in the torsion testing machine
- Apply torque gradually
- Measure angle of twist
- Plot torque vs. angle and calculate G and shear stress.

**Exemplars and Utility:**

The test essential for designing rotating shafts and torsional components, also helps understand mild steel's ductility and failure behaviour in torsion.

|                        |                                                                           |              |            |
|------------------------|---------------------------------------------------------------------------|--------------|------------|
| <b>Experiment No.5</b> | <b>Impact (Izod &amp; Charpy) test on mild steel, aluminum and brass.</b> | <b>2 Hrs</b> | <b>CO1</b> |
|------------------------|---------------------------------------------------------------------------|--------------|------------|

**Objective:**

To determine the impact toughness of mild steel, aluminium, copper and brass using Izod and Charpy tests. Also to study the energy absorbed during sudden loading.

**Associated Tasks:**

- Prepare/specify standard notched specimens
- Mount specimens in Izod/Charpy setup
- Release pendulum to fracture the specimen
- Note energy absorbed from the dial
- Compare materials and test types

**Exemplars and Utility:**

Useful for designing automotive parts, machine components, and structural members.

|                        |                                                                             |              |            |
|------------------------|-----------------------------------------------------------------------------|--------------|------------|
| <b>Experiment No.6</b> | <b>Compression test on timber (parallel &amp; perpendicular to grains).</b> | <b>2 Hrs</b> | <b>CO2</b> |
|------------------------|-----------------------------------------------------------------------------|--------------|------------|

**Objective:**

To determine the compressive strength of timber parallel and perpendicular to the grain.

**Associated Tasks:**

- Prepare standard timber specimens
- Place specimen in CTM (parallel/perpendicular orientation)
- Apply compressive load gradually
- Record load at failure

  
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|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|--------------|------------|
| <ul style="list-style-type: none"> <li>Calculate compressive stress and compare both directions</li> </ul> <p><b>Exemplars and Utility:</b></p> <ul style="list-style-type: none"> <li>Helps in designing timber columns, beams, joints, and load-bearing elements</li> <li>Shows that timber is stronger parallel to grain and weaker perpendicular.</li> </ul>                                                                                                                                                                                                                                                                                                                                 |                                                                   |              |            |
| <b>Experiment No.7</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>Bending test on timber.</b>                                    | <b>2 Hrs</b> | <b>CO2</b> |
| <p><b>Objective:</b></p> <ol style="list-style-type: none"> <li>To determine the flexural strength, modulus of elasticity, and bending behaviour of timber.</li> <li>To study how orthotropic (timber) materials behave under bending load.</li> </ol> <p><b>Associated Tasks:</b></p> <ul style="list-style-type: none"> <li>Prepare standard specimens</li> <li>Support specimen on two supports (simply supported)</li> <li>Apply central or two-point load</li> <li>Record load and deflection</li> <li>Calculate bending stress, modulus of rupture, and modulus of elasticity</li> </ul> <p><b>Exemplars and Utility:</b><br/>Test helps in designing beams and load-bearing elements.</p> |                                                                   |              |            |
| <b>Experiment No.8</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>Abrasion test of flooring tiles.</b>                           | <b>2 Hrs</b> | <b>CO3</b> |
| <p><b>Objective:</b><br/>To determine the abrasion resistance (wearing strength) of flooring tiles.</p> <p><b>Associated Tasks:</b></p> <ul style="list-style-type: none"> <li>Prepare tile specimen of standard size</li> <li>Place tile in the abrasion-testing machine (e.g., revolving disc type)</li> <li>Apply abrasive load with grit</li> <li>Run the machine for specified revolutions</li> <li>Measure loss of thickness or loss of weight</li> </ul> <p><b>Exemplars and Utility:</b><br/>e.g .Ceramic tiles, Vitrified tiles, Natural stone, Utility: Prevents premature surface wear and ensures long service life.</p>                                                             |                                                                   |              |            |
| <b>Experiment No.9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>Compressive strength test on bricks / aerated /AAC blocks.</b> | <b>2 Hrs</b> | <b>CO3</b> |
| <p><b>Objective:</b><br/>To determine the compressive strength of clay bricks, aerated blocks, and AAC blocks.</p> <p><b>Associated Tasks:</b></p> <ul style="list-style-type: none"> <li>Measure dimensions of the specimen and calculate area.</li> <li>Place specimen in compression-testing machine.</li> <li>Apply load gradually until failure.</li> <li>Record ultimate load and compute compressive strength.</li> </ul> <p><b>Exemplars and Utility:</b><br/>Determines suitability for load-bearing vs. non-load-bearing applications.</p>                                                                                                                                             |                                                                   |              |            |
| <b>Experiment No.10</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>Flexural strength of flooring tiles.</b>                       | <b>2 Hrs</b> | <b>CO3</b> |
| <b>Objective:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                   |              |            |

  
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To determine the flexural strength (modulus of rupture) of flooring tiles.

**Associated Tasks:**

- Prepare tile specimen of standard size
- Place it on two supports in the flexural test setup
- Apply load at the centre or two-point loading
- Record breaking load
- Calculate flexural strength using standard formula

**Exemplars and Utility:**

e.g. Ceramic tiles, Vitrified tiles, Cement concrete / mosaic tiles, Natural stone tiles (granite/marble) etc. helps classify tiles for structural and flooring applications

**B. Assignment Works**

|                              |                                                              |       |     |
|------------------------------|--------------------------------------------------------------|-------|-----|
| No.1                         | One Assignment of each unit.                                 |       |     |
| No.2                         | Market Survey of structural materials including its costing. | 2 Hrs | CO4 |
| <b>C. Computational Work</b> |                                                              |       |     |
| 1.                           | The above assignment to be solved using python programming.  | 2 Hrs | CO5 |

**Strength of CO-PO-PSO Mapping**

| CO   | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1  | 3   | 3   | 2   | 3   | 1   | 1   | 1   | 1   | 1   | 2    | 1    | 3    | 2    | 1    |
| CO2  | 3   | 2   | 2   | 3   | 1   | 1   | 2   | 1   | 1   | 2    | 1    | 3    | 2    | 1    |
| CO3  | 3   | 2   | 2   | 3   | 1   | 1   | 2   | 1   | 1   | 2    | 1    | 2    | 2    | 1    |
| CO4  | 2   | 2   | 1   | 2   | 2   | 3   | 2   | 1   | 2   | 3    | 2    | 2    | 2    | 3    |
| CO5  | 2   | 3   | 1   | 3   | 2   | 1   | 1   | 1   | 1   | 2    | 2    | 1    | 3    | 1    |
| Avg. | 2.6 | 2.4 | 1.6 | 2.8 | 1.4 | 1.4 | 1.6 | 1   | 1.2 | 2.9  | 1.4  | 2.2  | 2.2  | 1.4  |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

This course serves as a prerequisite for / maps with the following future courses:

It serves as a prerequisite for advanced courses in Structural Analysis and Design, Construction Materials, Reinforced Concrete Design, Steel and Timber Design, Infrastructure Engineering, and Experimental Stress Analysis. The skills and concepts learned here are directly applicable to future courses involving design; quality control, material selection, and structural performance evaluation, ensuring students are well-prepared for both theoretical and practical challenges in civil, mechanical, and materials engineering disciplines.

**Job Mapping:**

Material and Quality Control Engineers analyze metals and polymers, while Civil and Structural Engineers use results from timber, bricks, and tile tests for safe design. Lab Technicians prepare specimens and record data, and Mechanical Engineers focus on torsion and bending of components. These experiments link theory to practice, aiding design, material selection, and quality assurance across construction, industrial, and mechanical applications.

  
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|                 |                                                    |          |        |                    |     |              |                |    |
|-----------------|----------------------------------------------------|----------|--------|--------------------|-----|--------------|----------------|----|
| Program:        | Civil Engineering                                  |          |        |                    |     | Semester:    | III            |    |
| Course:         | Architectural Planning and Design of Buildings Lab |          |        |                    |     | Course Code: | R25-CE-PCC-209 |    |
| Teaching Scheme |                                                    |          |        | Examination Scheme |     |              |                |    |
| Lecture         | Practical                                          | Tutorial | Credit | CCE                | ESE | TW           | PR             | OR |
| -               | 02                                                 | -        | 01     |                    |     | 25           | 25             | -  |

**Course Description and Relevance:**

This course focuses on the principles and processes involved in designing functional, aesthetic, and sustainable buildings. It covers both the theoretical and practical aspects of architectural design and planning, as well as the use of AutoCAD and Google Sketch Up software, from conceptualization to detailed planning. Students will explore various types of brick bonds, foundations, and planning strategies, and enhance their knowledge by visiting professional consultancy sectors and construction sites. The course also helps students understand how to meet users' needs while considering technical, environmental, social, and cultural factors

**Prerequisite:**

Engineering Mechanics and Civil Engineering System and Engineering Graphics.

**Bridge Content:**

Fundamental concepts of building construction with advanced architectural planning and design practices, software's (AutoCAD, Google SketchUp)

**Course Objectives:**

1. To **UNDERSTAND** the types of brick bond and foundations.
2. To **IDENTIFY** functional spaces and their relationships in residential and public buildings.
3. To **DEVELOP** proficiency in using computer-aided design (CAD) software for building drawings.
4. To **PREPARE** building layout up to lintel level using Google SketchUp software.
5. To **EXPOSE** students to real-time construction activities and site conditions.

**Course Outcomes:** After learning the course, students will be able to

| CO  | Course Outcome                                                                                                                                                   | Bloom's Level |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| CO1 | <b>UNDERSTAND</b> different types of brick bonds and foundations                                                                                                 | 1             |
| CO2 | <b>PLAN</b> various types of residential and public building effectively, considering their utility and functions in accordance with the national building code. | 3             |
| CO3 | <b>DEMONSTRATE</b> proficiency in drafting building drawings using AutoCAD and infrastructure site layout using micro station software.                          | 2             |
| CO4 | <b>PREPARED</b> a layout plan of building up to lintel level using google sketch up software.                                                                    | 2             |
| CO5 | <b>UNDERSTAND</b> the construction site parameters, documentation and municipal rules for submission drawing approval.                                           | 1             |

**List of Practical:**

|                        |                                                         |               |            |
|------------------------|---------------------------------------------------------|---------------|------------|
| <b>Experiment No.1</b> | <b>Prepare drawings of at least four types of bonds</b> | <b>2 hrs.</b> | <b>CO1</b> |
|------------------------|---------------------------------------------------------|---------------|------------|

**Objective:**

To understand the concept and purpose of bonds in brick masonry.

**Associated Tasks:**

  
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Identify and list different types of bonds used in building construction.

- Study standard brick size and mortar thickness as per practice.
- Understand the arrangement of headers and stretchers in each bond.

**Exemplars and Utility:**

Neatly labeled drawings prepared as per standard civil engineering drawing practices.

- Improves visualization of masonry patterns used in buildings.
- Assists in identifying suitable bonds for different structural requirements.

|                        |                                                                          |               |            |
|------------------------|--------------------------------------------------------------------------|---------------|------------|
| <b>Experiment No.2</b> | <b>Prepare drawings of type of foundation (one shallow and one deep)</b> | <b>2 hrs.</b> | <b>CO1</b> |
|------------------------|--------------------------------------------------------------------------|---------------|------------|

**Objective:**

To identify different types of foundations used for various soil and load conditions.

**Associated Tasks:**

Study soil conditions and load considerations influencing foundation selection.

- Identify and list various types of shallow and deep foundations.

**Exemplars and Utility:**

Neatly drafted foundation drawings with correct dimensions and labels.

- Helps students understand the function and importance of foundations.
- Improves ability to select suitable foundation types for different site conditions.

|                        |                                                                                           |               |            |
|------------------------|-------------------------------------------------------------------------------------------|---------------|------------|
| <b>Experiment No.3</b> | <b>Prepare drawing of at least two types of doors and windows using AutoCAD software.</b> | <b>2 hrs.</b> | <b>CO3</b> |
|------------------------|-------------------------------------------------------------------------------------------|---------------|------------|

**Objective:**

To understand the functional and structural importance of doors, windows in buildings

**Associated Tasks:**

Collect reference material and standard drawings of doors, windows.

- Study functions, materials, and construction details of each element.

**Exemplars and Utility:**

Neatly drafted drawings with correct dimensions, symbols, and annotations.

- Helps students understand construction details of doors, windows.
- Improves drafting, technical drawing, and visualization skills.

|                        |                                                                                         |              |            |
|------------------------|-----------------------------------------------------------------------------------------|--------------|------------|
| <b>Experiment No.4</b> | <b>Draw at least one residential and one public building line plan (On Graph paper)</b> | <b>2 hrs</b> | <b>CO2</b> |
|------------------------|-----------------------------------------------------------------------------------------|--------------|------------|

**Objective:**

To identify functional spaces and their relationships in residential and public buildings.

**Associated Tasks:**

Collect reference drawings and standards for residential and public buildings.

- Study functional requirements of residential and public buildings.

**Exemplars and Utility: Residential Building Line Plan**

showing spaces such as living room, bedroom, Kitchen, dining, toilet, and circulation areas.

- **Public Building Line Plan** (school / hospital / office / community hall) showing functional spaces like classrooms, wards, offices, corridors, waiting areas, and services.

  
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|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|------------|
| <ul style="list-style-type: none"> <li>➤ Helps students understand space planning and functional relationships in buildings.</li> <li>➤ Develops ability to plan and organize residential and public building layouts.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                 |              |            |
| <b>Experiment No.5</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>Floor Plan/ Typical floor plan with construction notes, schedule of openings, of any type of building, Plan, Elevation and Section (Full Imperial sheet)</b> | <b>4 hrs</b> | <b>CO2</b> |
| <p><b>Objective:</b><br/>To understand the complete architectural drawing set of a building</p> <ul style="list-style-type: none"> <li>➤ To develop the ability to prepare a detailed <b>floor plan / typical floor plan</b></li> </ul> <p><b>Associated Tasks:</b><br/>Select an appropriate type of building for drawing</p> <ul style="list-style-type: none"> <li>➤ Collect reference drawings, standards, and by-laws related to the selected building</li> </ul> <p><b>Exemplars and Utility:</b><br/><b>Floor Plan / Typical Floor Plan</b> of a residential, commercial, or institutional building with room labels and dimensions.</p> <ul style="list-style-type: none"> <li>➤ Helps students understand complete working drawing preparation</li> <li>➤ Develops ability to integrate plan, elevation, and section in one drawing set</li> </ul> <p>Improves drafting accuracy, presentation, and professional drawing skills</p> |                                                                                                                                                                 |              |            |
| <b>Experiment No.6</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>Develop typical floor plan drawing exercise as completed in assignment number 5 using computer software and Printout of the same.</b>                        | <b>2 hrs</b> | <b>CO3</b> |
| <p><b>Objective:</b><br/>To develop proficiency in using computer-aided design (CAD) software for building drawings</p> <p><b>Associated Tasks:</b><br/>Review the manual floor plan prepared in Assignment 5.</p> <ul style="list-style-type: none"> <li>➤ Set up drawing sheet with proper scale, units, and layout.</li> </ul> <p><b>Exemplars and Utility:</b><br/><b>Digital Floor Plan</b> replicating the manual plan from Assignment 5 with walls, doors, windows, and furniture layout.</p> <ul style="list-style-type: none"> <li>➤ Helps students gain proficiency in CAD software for building drawings.</li> <li>➤ Improves accuracy, neatness, and professional presentation of floor plans.</li> </ul>                                                                                                                                                                                                                        |                                                                                                                                                                 |              |            |
| <b>Experiment No.7</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>Layout plan of building up to Lintel level using Google sketch up software.</b>                                                                              | <b>2 hrs</b> | <b>CO4</b> |
| <p><b>Objective:</b><br/>To understand the basic tools and commands of SketchUp software for building drawing preparation.</p> <ul style="list-style-type: none"> <li>➤ To prepare the layout plan of a building up to lintel level accurately using SketchUp.</li> </ul> <p><b>Associated Tasks:</b><br/>Prepare a layout plan of building up to lintel level.</p> <p><b>Exemplars and Utility:</b><br/><b>Layout plan</b> of a residential or public building block showing the 3D visualization.</p> <ul style="list-style-type: none"> <li>➤ Helps students to understand building planning</li> </ul>                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                                                 |              |            |

  
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|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|------------|
| ➤ Develops 3D Modeling Skills                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                             |              |            |
| <b>Experiment No.8</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>Designing Civil Infrastructure site layout using micro station</b>                                                                                                       | <b>2 hrs</b> | <b>CO3</b> |
| <p><b>Objective:</b> To prepare a digital site layout showing roads, buildings, parking areas, and utility services using MicroStation.</p> <p>➤ <b>Associated Tasks:</b> Prepare a civil infrastructure site layout using MicroStation by creating roads, buildings, parking areas, utility lines, and necessary annotations.</p> <p><b>Exemplars and Utility:</b> Civil Infrastructure Site Layout drawing showing roads, buildings, parking areas, drainage system, and utility lines.</p> <p>➤ Helps students gain proficiency in using MicroStation software for civil engineering drawings.</p> <p>➤ Improves accuracy, neatness, and professional presentation of site layout drawings.</p> <p>➤ Enhances understanding of the arrangement of various infrastructure components.</p> <p>➤ Provides practical exposure to computer-aided drafting techniques used in civil engineering projects.</p> |                                                                                                                                                                             |              |            |
| <b>Experiment No. 9</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>Site Visit: Any on-going Construction Site (visit report should contain: details of the project, stages of construction, sketches of components, material used etc.)</b> | <b>-</b>     | <b>CO5</b> |
| <p><b>Objective:</b><br/>To expose students to real-time construction activities and site conditions.</p> <p>➤ To understand the <b>details of an ongoing construction project</b></p> <p><b>Associated Tasks:</b><br/>Identify and select a suitable ongoing construction site for visit</p> <p>➤ Obtain necessary permission from site authority/engineer.</p> <p><b>Exemplars and Utility:</b><br/><b>Site Visit Report</b> containing project details (name, location, type, client, contractor)</p> <p>➤ Description of the <b>stage of construction</b> observed.</p> <p>➤ Provides practical exposure to real construction practices.</p> <p>Helps students understand the sequence and stages of construction.</p>                                                                                                                                                                                 |                                                                                                                                                                             |              |            |

### Strength of CO-PO-PSO Mapping

| CO  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1 | 3   | 2   | -   | -   | 1   | -   | 2   | 3   | 3   | -    | 3    | 3    | 3    | 3    |
| CO2 | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3    | 3    | 3    | 3    | 3    |
| CO3 | 3   | 2   | 2   | 1   | 3   | -   | 2   | 3   | 3   | -    | 3    | 3    | 3    | 3    |
| CO4 | 3   | 2   | 2   | 1   | 3   | -   | 2   | 3   | 3   | -    | 3    | 3    | 3    | 3    |
| CO5 | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 1   | 2   | 3    | 3    | 3    | 3    | 3    |
|     | 3   | 2.4 | 2.5 | 2   | 2.6 | 3   | 2.4 | 2.6 | 2.8 | 3    | 3    | 3    | 3    | 3    |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

**This course serves as a prerequisite for / maps with the following future courses:**

Architectural Planning and Design of Buildings course forms the foundation for several advanced and

  
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applied Engineering courses. Here is a list of future courses.

1. **Structural Engineering:** Understanding loads, stresses, and designing structural elements.
2. **Project and Construction Management:** Applies concepts of planning for real world civil engineering projects
3. **Surveying:** Architectural planning informs site layout
4. **Estimation and costing:** Early planning and design influence project budgeting and feasibility studies.
5. **Working Drawings & Detailing:** Creating detailed technical drawings and construction documents for execution.
6. **Computer-Aided Design (CAD) & Modeling:** Utilizing 2D and 3D software (AutoCAD, SketchUp) to create precise, detailed layouts.
7. **Interior Architecture & Space Programming:** Focused design of interior environments, including spatial planning and material specifications.
8. **Sustainable and Green Architecture:** Planning buildings with focus on energy efficiency, LEED standards, and climate-responsive design

#### **Job Mapping:**

Job opportunities that one can get after learning this course:

1. **Drafting Engineer:** With prior knowledge of engineering drawing and architectural drafting principles, you can prepare detailed building plans, sections, elevations, and construction drawings using AutoCAD.
2. **Site Engineer:** Responsible for executing construction work on-site, interpreting architectural drawings, coordinating with contractors, and ensuring that the building is constructed as per design.

  
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|                            |                                              |          |        |                    |              |    |                |    |
|----------------------------|----------------------------------------------|----------|--------|--------------------|--------------|----|----------------|----|
| Program:                   | Civil Engineering                            |          |        |                    | Semester:    |    | III            |    |
| Course:                    | Community Engagement Project (Field Project) |          |        |                    | Course Code: |    | R25-CE-CEP-210 |    |
| Teaching Scheme (hrs/week) |                                              |          |        | Examination Scheme |              |    |                |    |
| Lecture                    | Practical                                    | Tutorial | Credit | CCE                | ESE          | TW | PR             | OR |
| -                          | 04                                           | -        | 02     | -                  | -            | 50 | -              | -  |

**Course Description and Relevance:**

This practical course is designed to provide second-year Civil Engineering students with intensive, hands-on field experience in fundamental and modern surveying techniques. The practicals are structured as a continuous field project, simulating the initial surveying phase of a typical civil engineering construction site. Students will work in teams to execute various methods, including chaining and ranging, compass and theodolite traversing, leveling, contouring, and area/volume calculation. The course culminates in the preparation of a complete field report, including plans, profiles, and cross-sections, demonstrating the ability to transition from field measurement to professional drawing.

**Prerequisite:**

Basic Introduction to Civil Engineering

**Bridge Content:**

The core content to include for this gap-bridging practical focuses on a mix of traditional surveying techniques, modern instrumentation, data processing, and final output/reporting.

**Course Objectives:**

1. To **LEARN** the fundamental concepts and instruments used for compass.
2. To **STUDY** concepts of leveling, methods of leveling and contouring.
3. To **LEARN** the essentials of theodolite and theodolite traversing.
4. To **STUDY** Drone Survey.
5. To **STUDY** various types of curves and methods of setting out of curves.
6. To **STUDY** modern instruments like DGPS and Total Station.

**Course Outcomes:** After learning the course, students will be able to

| CO  | Course Outcome                                                                                                                                                                                                               | Bloom's Level |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| CO1 | <b>APPLY</b> conventional surveying instruments (Prismatic Compass, Transit Theodolite, and Nautical Sextant) to measure angular bearings, horizontal, and vertical angles while adjusting for errors like local attraction. | 3             |
| CO2 | <b>ANALYZE</b> ground terrain elevations and vertical profiles by executing differential and profile leveling using an Auto Level across multiple change points.                                                             | 4             |
| CO3 | <b>OPERATE</b> advanced electronic surveying technologies, including Total Stations and Differential GPS (DGPS), to capture precise spatial data, determine 3D coordinates, and compute land areas.                          | 3             |
| CO4 | <b>EXECUTE</b> the precise field setting-out of civil engineering layouts and geometric circular curves, using standard and modern instrumentation.                                                                          | 3             |
| CO5 | <b>DEVELOP</b> comprehensive engineering profiles, large-scale topographic maps, and digital contour models by integrating drone photogrammetry, field project data, and                                                     | 6             |

  
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|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | specialized mapping software.                                                                                                                               |              |            |
| <b>List of Practical:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                                             |              |            |
| <b>Experiment No. 01</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>Measurement of magnetic bearings of traverse, using prismatic compass and calculations of correction for local attraction and true bearings.</b>         | <b>2 Hrs</b> | <b>CO1</b> |
| <p><b>Objective:</b><br/>To identify and calculate the corrections for Local attraction at each station.</p> <p><b>Associated Tasks:</b><br/>Measure and record the Fore Bearing (FB) and Back Bearing (BB) of every traverse line using prismatic compass and make correction for local attraction.</p> <p><b>Exemplars:</b><br/>Establishing boundary lines; Orienting maps.<br/>Utility: Foundation for all initial property or topographical surveys.</p>                                                                                                                                                                                                                                      |                                                                                                                                                             |              |            |
| <b>Experiment No. 02</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>Determination of elevation difference between any two points in an area using Auto level by taking at least three change points.</b>                     | <b>2 Hrs</b> | <b>CO2</b> |
| <p><b>Objective:</b><br/>To accurately determine the elevation difference between a starting benchmark and a final point using an Auto Level by employing the Differential Levelling technique.</p> <p><b>Associated Tasks:</b><br/>Take and record Back Sight (BS) and Fore Sight (FS) readings at designated points, calculation of RLs.</p> <p><b>Exemplars:</b><br/>Establishing Benchmark networks for construction projects, determining foundation depths, conducting route surveys for roads/pipelines.</p> <p><b>Utility:</b><br/>Foundation for all vertical control in Civil Engineering; essential for ensuring gravitational flow (sewers, drains) and accurate grading of sites.</p> |                                                                                                                                                             |              |            |
| <b>Experiment No. 03</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>Measurement of horizontal angles (by repetition method) and vertical angles using 1" Digital Theodolite or 20" Vernier Transit Theodolite.</b>           | <b>2 Hrs</b> | <b>CO1</b> |
| <p><b>Objective:</b> To master the setup, temporary adjustments, and precise measurement of horizontal angles (using the Method of Repetition) and vertical angles using a Vernier Transit Theodolite.</p> <p><b>Associated Tasks:</b> Centering, Measuring a horizontal and vertical angle</p> <p><b>Exemplars:</b> Establishing a high-precision control traverse; accurately determining the direction for the laying out of structures.</p> <p><b>Utility:</b> Fundamental skill for all traverse surveying, triangulation networks, road/rail alignment, and setting out major civil engineering projects. It is the core basis for determining the plan position of points.</p>              |                                                                                                                                                             |              |            |
| <b>Experiment No. 04</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <b>Determination of horizontal, vertical, sloping distance and height of building using Total Station, and Setting out of building using Total Station.</b> | <b>2 Hrs</b> | <b>CO3</b> |

  
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**Objective:**

To master the fundamental and advanced operational capabilities of the Total Station instrument for precise geometric measurement and spatial layout tasks in civil engineering.

**Associated Tasks:**

Setup instrument, Measurement of horizontal angle, vertical angle, and slope distance , Remote Distance Measurement (RDM) Vertical Measurement and Setting Out of building

**Exemplars:**

Determining the 3D position of survey control points.

**Utility:**

Traversing and Topographic Mapping for site plan generation.

|                          |                                                                 |              |            |
|--------------------------|-----------------------------------------------------------------|--------------|------------|
| <b>Experiment No. 05</b> | <b>Farmland Boundary Survey and Area Computation Using DGPS</b> | <b>2 Hrs</b> | <b>CO3</b> |
|--------------------------|-----------------------------------------------------------------|--------------|------------|

**Objective:**

The primary goal of this practical project is to accurately delineate the geographic boundaries of a designated agricultural land parcel using high-precision DGPS and to compute its exact surface area.

**Associated Tasks:**

Site Inspection, Mission Planning, Base Station Setup, Rover Setup, Boundary Mapping, Point Capture, Data Export, Software Import, Polygon Creation, Area Computation

**Exemplars:**

Establishing a high-precision control traverse; accurately determining the area of traverse.

**Utility:**

Boundary Dispute Resolution, Precision Agriculture, Financial & Subsidies etc.

|                          |                                                                               |              |            |
|--------------------------|-------------------------------------------------------------------------------|--------------|------------|
| <b>Experiment No. 06</b> | <b>Drone Surveying and Photogrammetric Mapping for Large-Scale Topography</b> | <b>2 Hrs</b> | <b>CO3</b> |
|--------------------------|-------------------------------------------------------------------------------|--------------|------------|

**Objective:**

To introduce students to autonomous flight planning, aerial image acquisition, and photogrammetric processing to generate high-resolution orthomosaics, Digital Elevation Models (DEMs), and 3D point clouds for large scale engineering projects.

**Associated Tasks:**

Ground Control Point (GCP) Establishment, Flight Mission Planning, Autonomous Flight Execution, Data Processing & Photogrammetry, Analysis & Export.

**Exemplars:**

Preliminary survey for a large scale projects.

**Utility:**

Unmatched Speed and Cost Efficiency, High-Precision Deliverables for Modern Infrastructure, Safety in Hazardous Terrains

|                          |                                                |              |            |
|--------------------------|------------------------------------------------|--------------|------------|
| <b>Experiment No. 07</b> | <b>Setting out a circular curve on ground.</b> | <b>2 Hrs</b> | <b>CO4</b> |
|--------------------------|------------------------------------------------|--------------|------------|

**Objective:**

To accurately fix the position of points (pegs) along a pre-designed simple circular curve on the ground using theodolite and tape, starting from the point of curve.

  
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**Associated Tasks:**

Preliminary Calculation, Instrument Setup, Angular Measurement, Linear Measurement.

**Exemplars:**

Setting out road centerlines for turns, laying out railway track curves, and establishing the boundaries of canals or pipeline routes.

**Utility:**

It is an accurate and versatile method used for important, large curves where the ground is relatively rough or long chords are involved, as each point is fixed independently from the tangent point.

|                          |                                                                               |              |            |
|--------------------------|-------------------------------------------------------------------------------|--------------|------------|
| <b>Experiment No. 08</b> | <b>Study and use of nautical sextant and measurement of horizontal angles</b> | <b>2 Hrs</b> | <b>CO1</b> |
|--------------------------|-------------------------------------------------------------------------------|--------------|------------|

**Objective:**

Determine the Horizontal Sextant Angle (HSA) between two fixed, known objects ashore. **Associated Tasks:** Index Error Check, Instrument Setup, Sighting and Alignment, Reading and Recording

**Exemplars:**

Position Fixing (Three-Point Fix) in coastal navigation. By measuring the HSAs between three known shore objects, a navigator can plot two intersecting position circles to get a highly accurate vessel location, especially when GPS signals are unavailable or distrusted.

**Utility:**

It is a reliable, non-electronic back-up for GPS/electronic navigation. In surveying, it's useful for taking rapid angles between shore points from a boat or for establishing a control network in specialized hydrographic work.

|                          |                                                                                                                                                                                                                                                                                                           |              |            |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|------------|
| <b>Experiment No. 09</b> | <b>Road project using Auto level or DGPS for minimum length of 200 meters including fixing of alignment, profile leveling, cross-sectioning, plotting of Longitudinal section and Cross Section. (One full imperial sheet including plan, Longitudinal section and any three typical Cross-sections).</b> | <b>2 Hrs</b> | <b>CO3</b> |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|------------|

**Objective:**

To apply fundamental and advanced surveying principles to design and map a proposed linear civil engineering structure (road) from field data acquisition to final engineering drawing output.

**Associated Tasks:**

Reconnaissance of the site. Fixing the horizontal alignment (straight sections and curves). Conducting Profile Levelling along the centerline. Executing Cross-Sectioning at regular intervals, Calculation and adjustment of Reduced Levels (RLs). Computation of horizontal and vertical curve data (if applicable). Earthwork Volume calculations. Plotting the plan, Longitudinal Section (L-Section), and Cross-Sections.

**Exemplars:**

Preliminary Survey Report and Engineering Drawing.

**Utility:**

Foundation for Design, Quantity Estimation and Skill Bridging

|                          |                                                                                                              |              |            |
|--------------------------|--------------------------------------------------------------------------------------------------------------|--------------|------------|
| <b>Experiment No. 10</b> | <b>Contouring project on hilly area with DGPS instrument and generating contours using Qualcon software.</b> | <b>2 Hrs</b> | <b>CO5</b> |
|--------------------------|--------------------------------------------------------------------------------------------------------------|--------------|------------|

**Objective:**

  
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To Generate an accurate and detailed Topographic Map (including contour lines) of a designated hilly area by executing a Differential Global Positioning System (DGPS) survey and processing the resulting 3D coordinate data using appropriate geospatial software.

**Associated Tasks:**

Field Reconnaissance, DGPS Setup, Data Acquisition, Data Processing, GIS/CAD Processing, Digital Terrain Model (DTM) Creation and Contour Generation.

**Exemplars:**

Preliminary survey for a reservoir, a hill road alignment, or a landslide analysis site.

**Utility:**

Hydrology & Drainage: Determining watershed boundaries and drainage paths. Earthwork: Calculating cut and fill volumes for road/site grading. Site Selection: Identifying suitable areas for infrastructure placement.

**Textbooks:**

1. T. P. Kanetkar and S.V.Kulkarni, "Surveying and Levelling Vol. I and Vol. II", PVG Prakashan. Pune, 20<sup>th</sup> edition.
2. Dr. B. C. Punmia, Ashok K. Jain, Arun K.Jain, "Surveying, Vol. I & II", Laxmi Publications (P), Ltd, New Delhi.
3. S. K. Duggal, "Surveying, Vol. I & II", Tata McGraw Hill Publishing Co Ltd., New Delhi.
4. Subramanian, "Surveying and Levelling", Oxford University Press, 2<sup>nd</sup> edition, 2012.

**Reference Books:**

1. Dr. A. M. Chandra, "Plane Surveying", New Age International Publishers, 2006.
2. N. N. Basak, "Surveying and Levelling", Tata McGraw Hill, 2013.
3. Dr. K. R. Arora, "Surveying Vol. I & II", Standard Book House, 17<sup>th</sup> edition, 2019.
4. James M. Anderson, Edward M. Mikhail, "Surveying: Theory and Practice", Tata McGraw Hill, 7<sup>th</sup> edition, 2013.
5. David Clark, "Plane and Geodetic Surveying for Engineers Vol. I", Constable, 2013.

**MOOCs Links and additional reading material:**

1. MOOC: "Digital Land Surveying and Mapping" (NPTEL - IIT Roorkee)
2. MOOC: "Surveying" (NPTEL - IIT Kanpur/IIT Roorkee)
3. Handbook: "The Surveying Handbook" by Russell C. Brinker and Roy Minnick

**Strength of CO-PO-PSO Mapping**

| CO  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1 | 3   | 2   | —   | 2   | —   | 1   | —   | 1   | 2   | 2    | —    | 2    | 3    | 2    |
| CO2 | 3   | 2   | 1   | 2   | 1   | 1   | —   | 1   | 3   | 2    | 2    | 2    | 3    | 2    |
| CO3 | 3   | 2   | 2   | 3   | 3   | 1   | 1   | 1   | 3   | 2    | 2    | 3    | 3    | 3    |
| CO4 | 3   | 2   | 3   | 2   | 2   | 2   | —   | 1   | 3   | 2    | 2    | 3    | 3    | 3    |

  
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|-------------|----------|------------|------------|------------|------------|------------|----------|----------|------------|------------|------------|------------|----------|------------|
| CO5         | 3        | 3          | 3          | 3          | 3          | 2          | 1        | 1        | 3          | 3          | 3          | 3          | 3        | 3          |
| <b>Avg.</b> | <b>3</b> | <b>2.2</b> | <b>2.3</b> | <b>2.4</b> | <b>2.3</b> | <b>1.4</b> | <b>1</b> | <b>1</b> | <b>2.8</b> | <b>2.2</b> | <b>2.3</b> | <b>2.6</b> | <b>3</b> | <b>2.6</b> |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

This course serves as a prerequisite for / maps with the following future courses:

Advanced Surveying

Remote Sensing and GIS.

**Job Mapping:**

**Civil Infrastructure:** As a **Site Engineer** or **Construction Surveyor**.

**Geospatial Data:** Roles in **GIS Analysis** and **Cartography** involve converting field data into intelligent maps for urban planning and disaster management.

**Energy & Mining:** **Mine Surveyors** map underground tunnels, while **Hydrographic Surveyors** support offshore wind and oil exploration.

**Technology:** Emerging roles in **LiDAR Scanning** focus on creating 3D "Digital Twins" for smart city development and autonomous vehicle navigation.

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# Semester-II

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| Course Code    | Course Type                                  | Name of the Subject                                                       | Teaching Scheme (Hrs./week) |    |     |               |               |       | Examination Scheme and Marks |     |    |    |    |       | Credit |    |     |       |
|----------------|----------------------------------------------|---------------------------------------------------------------------------|-----------------------------|----|-----|---------------|---------------|-------|------------------------------|-----|----|----|----|-------|--------|----|-----|-------|
|                |                                              |                                                                           | TH                          | PR | TUT | Contact Hours | Self-Learning | Total | CCE                          | ESE | TW | PR | OR | TOTAL | TH     | PR | TUT | TOTAL |
|                | SEMESTER IV                                  |                                                                           |                             |    |     |               |               |       |                              |     |    |    |    |       |        |    |     |       |
| R25-CE-PCC-211 | Program Core course - 4                      | Fluid Mechanics                                                           | 3                           | .. | ..  | 45            | 45            | 90    | 40                           | 60  | .. | .. | .. | 100   | 3      | .. | ..  | 3     |
| R25-CE-PCC-212 | Program Core course - 5                      | Concrete Technology                                                       | 2                           | .. | ..  | 30            | 30            | 60    | 40                           | 60  | .. | .. | .. | 100   | 2      | .. | ..  | 2     |
| R25-CE-PCC-213 | Program Core course - 6                      | Structural Analysis                                                       | 3                           | .. | ..  | 45            | 45            | 90    | 40                           | 60  | .. | .. | .. | 100   | 3      | .. | ..  | 3     |
| R25-CE-MDM-214 | Multidisciplinary Minor-2                    | Digital Modelling and Visualization                                       | 2                           | .. | ..  | 30            | 30            | 60    | 40                           | 60  | .. | .. | .. | 100   | 2      | .. | ..  | 2     |
| R25-CE-OEC-215 | Open Elective-2                              | To be chosen from a basket of Open Elective- I finalized at college level | 2                           | .. | ..  | 30            | 30            | 60    | 40                           | 60  | .. | .. | .. | 100   | 2      | .. | ..  | 2     |
| R25-CE-VSC-216 | Vocational Skill Course                      | Revit Architecture Lab                                                    | 1                           | 2  | ..  | 15            | 15            | 60    | ..                           | ..  | 25 | 25 | .. | 50    | 1      | 1  | ..  | 2     |
| R25-CE-AEC-217 | Ability Enhancement Course                   | Modern Indian Language and Technical Writing                              | 1                           | 2  | ..  | 15            | 15            | 60    | ..                           | ..  | 50 | .. | .. | 50    | 1      | 1  | ..  | 2     |
| R25-CE-EEM-218 | Entrepreneurship/Economics/Management course | Entrepreneurship & Contract Management                                    | 2                           | .. | ..  | 30            | 30            | 60    | 50                           | ..  | .. | .. | .. | 50    | 2      | .. | ..  | 2     |
| R25-CE-PCC-219 | Program Core Course- Lab                     | Concrete Technology Lab                                                   | ..                          | 2  | ..  | 30            | ..            | 30    | ..                           | ..  | .. | .. | 25 | 25    | ..     | 1  | ..  | 1     |
| R25-CE-PCC-220 | Program Core Course- Lab                     | Fluid Mechanics Lab                                                       | ..                          | 2  | ..  | 30            | --            | 30    | ..                           | ..  | .. | .. | 25 | 25    | ..     | 1  | ..  | 1     |
| R25-CE-VEC-221 | Value Education Course                       | Environmental Studies                                                     | 2                           | .. | ..  | 30            | 30            | 60    | 50                           | ..  | .. | .. | .. | 50    | 2      | .. | ..  | 2     |
|                |                                              |                                                                           | 18                          | 8  | 0   | 330           | 270           | 660   | 300                          | 300 | 75 | 25 | 50 | 750   | 18     | 4  | 0   | 22    |

  
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|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|----------------------------|---------------|---------------------------|---------------------|---------------|-----------------------|-----------|
| <b>Program:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                             | <b>S.Y. B.Tech (Civil)</b> |               |                           | <b>Semester:</b>    |               | <b>IV</b>             |           |
| <b>Course:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                             | <b>Fluid Mechanics</b>     |               |                           | <b>Course Code:</b> |               | <b>R25-CE-PCC-211</b> |           |
| <b>Teaching Scheme (hrs / week)</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                             |                            |               | <b>Examination Scheme</b> |                     |               |                       |           |
| <b>Lecture</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>Practical</b>                                                                                                            | <b>Tutorial</b>            | <b>Credit</b> | <b>CCE</b>                | <b>ESE</b>          | <b>TW</b>     | <b>PR</b>             | <b>OR</b> |
| 03                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | -                                                                                                                           | -                          | 03            | 40                        | 60                  | -             | -                     | -         |
| <b>Course Description and Relevance:</b><br>This course introduces the fundamental principles of Fluid Mechanics, including properties of fluids, fluid statics, kinematics, and dynamics. It covers flow measurements, dimensional analysis, flow through pipes, and open channel flow. The course emphasizes analytical and practical approaches for solving real-world civil and hydraulic engineering problems.                                                                                                                                                                                                                                                                                |                                                                                                                             |                            |               |                           |                     |               |                       |           |
| <b>Prerequisite:</b><br>Engineering Mathematics and Engineering Mechanics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                             |                            |               |                           |                     |               |                       |           |
| <b>Bridge Content:</b><br>Review of basic calculus (differentiation, integration), units and dimensions, elementary mechanics (force, mass, acceleration),                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                                             |                            |               |                           |                     |               |                       |           |
| <b>Course Objectives:</b><br>1. To <b>STUDY</b> fluid properties, fluid statics.<br>2. To <b>STUDY</b> fluid kinematics.<br>3. To <b>STUDY</b> & apply fluid dynamics equations.<br>4. To <b>CALCULATE</b> different types of losses in pipes.<br>5. To <b>STUDY</b> open channel flow with reference to energy – depth relationship and uniform flow.                                                                                                                                                                                                                                                                                                                                             |                                                                                                                             |                            |               |                           |                     |               |                       |           |
| <b>Course Outcomes:</b> After learning the course, students will be able to                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                             |                            |               |                           |                     |               |                       |           |
| <b>CO</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>Course Outcome</b>                                                                                                       |                            |               |                           |                     |               | <b>Bloom’s Level</b>  |           |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>UNDERSTAND</b> fluid properties and concepts of fluid statics and <b>SOLVE</b> problems based on practical applications. |                            |               |                           |                     |               | 2,3                   |           |
| CO2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>UNDERSTAND</b> fundamentals of fluid kinematics and <b>APPLY</b> it to solve fluid flow problems.                        |                            |               |                           |                     |               | 2,3                   |           |
| CO3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>SOLVE</b> fluid flow problems using Bernoulli’s equation.                                                                |                            |               |                           |                     |               | 3                     |           |
| CO4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>CALCULATE</b> major and minor losses in the pipe network.                                                                |                            |               |                           |                     |               | 3                     |           |
| CO5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | <b>APPLY</b> the knowledge of uniform flow and depth-energy to <b>SOLVE</b> problems on open channel flow                   |                            |               |                           |                     |               | 3                     |           |
| <b>Course Content</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                             |                            |               |                           |                     |               |                       |           |
| <b>Unit 1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>Properties of Fluids and Fluid Statics</b>                                                                               |                            |               |                           |                     | <b>9 Hrs.</b> | <b>CO1</b>            |           |
| Properties of fluids: basic definitions - fluid, fluid mechanics, ideal fluids, real fluids, mass density, specific weight, specific volume, specific gravity; viscosity- dynamic and kinematic, classification of fluids based on newton’s law of viscosity (rheological diagram), surface tension, capillarity, vapour pressure, compressibility and elasticity.<br>Fluid statics: pressure and its measurement, fluid pressure at a point, pascal’s law, hydrostatic law; concept of atmospheric, absolute, gauge and negative pressure; pressure measuring devices. Total pressure, intensity of pressure, center of pressure. Pressure on horizontal, vertical, inclined and curved surfaces. |                                                                                                                             |                            |               |                           |                     |               |                       |           |
| <b>Exemplars / Practical Applications and usage:</b><br>These fundamental fluid properties and statics principles are practically applied in Civil Engineering to design hydraulic structures (like dams, weirs, and retaining walls), calculate hydrostatic forces on submerged gates,                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                             |                            |               |                           |                     |               |                       |           |

  
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design water supply piping systems, and select pressure gauges or manometers for accurate fluid monitoring.

**Assignments:**

1. Explain in details all the physical properties of fluid.
2. Explain and derive the basic equation of Hydrostatics.
3. Explain the concept of Pascals Law.

|               |                         |               |            |
|---------------|-------------------------|---------------|------------|
| <b>Unit 2</b> | <b>Fluid Kinematics</b> | <b>9 Hrs.</b> | <b>CO2</b> |
|---------------|-------------------------|---------------|------------|

Eulerian and Lagrangian approach, velocity and acceleration, and their components in Cartesian co-ordinates, Classification of flows, streamline, stream tube, path line, streak line, control volume. Equation of continuity for 3-D flow in Cartesian coordinates, components of rotation, velocity potential, stream function, flow net and its use.

**Exemplars / Practical Applications and usage:**

These fluid mechanics concepts are used in civil engineering to design hydraulic structures like dams, spillways, and pipe networks. They model water flow patterns, predict velocity and pressure changes, track pollutant dispersion, and analyze seepage under foundations via flow nets.

**Assignments:**

1. Explain and derive the Eulerian and Lagrangian approach of describing the fluid motion.
2. Explain and derive the continuity equation based on stream tube concept.
3. Explain and derive the continuity equation in 3D-Cartesian coordinates.

|               |                       |               |            |
|---------------|-----------------------|---------------|------------|
| <b>Unit 3</b> | <b>Fluid Dynamics</b> | <b>9 Hrs.</b> | <b>CO3</b> |
|---------------|-----------------------|---------------|------------|

Forces acting on fluid mass in motion, Euler's equation of motion along a streamline and its integration to get Bernoulli's equation and its limitations, Modified Bernoulli's equation, concept of HGL and TEL, Application of Bernoulli's equation: Venturimeter, Orifice meter, Rota-meter and Pitot tube.

**Exemplars / Practical Applications and usage:**

These concepts are used to design and analyze pipe networks, water supply systems, and open channels. They allow engineers to calculate pressure variations, account for energy losses (via HGL/TEL), and precisely measure flow rates using devices like venturimeters and pitot tubes.

**Assignments:**

1. Derive the Euler's equation and significance of each term in Bernoulli's equation.
2. Explain the concept of HGL & TEL.
3. Explain with neat sketch Venturimeter, Orifice meter, Rota-meter and Pitot tube.

|               |                           |               |            |
|---------------|---------------------------|---------------|------------|
| <b>Unit 4</b> | <b>Flow Through Pipes</b> | <b>9 Hrs.</b> | <b>CO4</b> |
|---------------|---------------------------|---------------|------------|

Characteristics of laminar flow, laminar flow through a circular pipe: Hagen Poiseuille equation, Hazen-Williams formula. Characteristics of turbulent flow, Darcy-Weisbach Equation, Moody's diagram, Major and minor losses of energy in pipes, flow through pipes in simple and compound pipe, pipes in series, parallel, Dupit's equation, Introduction to pipe network and design: Hardy cross method.

**Exemplars / Practical Applications and usage:**

Used to design and analyze water supply networks, oil pipelines, and sewage systems by calculating friction losses, pressure drops, and determining optimal pipe sizes for efficient fluid transport.

**Assignments:**

1. Explain and derive the Hagen Poiseuille equations
2. Explain the concept of (1) Simple & Compound pipes; (2) Pipe in series; (3) Dupit's equations; (4) Hardy Cross Method.

  
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3. What is Energy loss in pipe flow and explain Major and Minor losses.

**Unit 5**

**Open Channel Flow**

**9 Hrs.**

**CO5**

Introduction to Open channel flow:

Classification of channels, channel flows and geometric elements of channel, Velocity distribution in open channel flow and hydraulic jump.

Uniform flow in open channels: Uniform flow formulae:

Chezy's and Manning's formulae; Factors affecting Manning's roughness coefficient. Most efficient channel sections: rectangular, trapezoidal. Depth-Energy Relationships in Open Channel Flow: Specific energy and Specific force diagram, Depth discharge diagram, Critical depth, Conditions for occurrence of critical flow; Froude's number, flow classification based on it, Introduction to channel transition.

**Exemplars / Practical Applications and usage:**

These open-channel flow principles are crucial for designing efficient drainage systems, irrigation canals, and flood control structures. Standardizing channel geometry, utilizing Chezy's/Manning's formulas for optimal cross-sections, and analyzing critical depth/hydraulic jumps allow engineers to control water flow, prevent erosion, and safely manage energy dissipators in spillways.

**Assignments:**

1. Explain the concept of velocity distribution in Open channel.
2. Explain Depth-Energy relationship in Open Channel flow.
3. Explain the most efficient channel sections for rectangular, triangular, and trapezoidal.

**Course Projects:**

-

**Textbooks:**

Dr. R.K. Bansal, "Fluid Mechanics and Hydraulic Machines", Laxmi Publications (P), Ltd. New Delhi.

Dr. R.K. Rajput, "Fluid Mechanics and Hydraulic Machines", S Chand and Co Ltd. New Delhi.

Sukumar Pati, "Fluid Mechanics and Hydraulic Machines", McGraw Hill, New Delhi.

**Reference Books:**

Dr. P.N. Modi & S.M. Seth, "Hydraulics and Fluid Mechanics including Hydraulic Machine", Standard book house, Delhi.

K. Subramanya, "Flow in Open Channels", Tata McGraw Hill, New Delhi.

R.J. Garde and A.J. Mirajgaonkar, "Engineering Fluid Mechanics", SCI TECH Publications (India) Pvt. Ltd, Chennai.

Vijay Gupta, Santosh K. Gupta, "Fluid Mechanics and its Applications", New Age international Pvt.Ltd, New Delhi.

Yunus. A Cengel and John0. M. Cimbala, "Fluid Mechanics, Fundamentals and applications", McGraw Hill International, New Delhi.

Streeter, Wylie and Bedford, "Fluid Mechanics", McGraw Hill International, New Delhi.

Ven Tee Chow, "Open Channel Hydraulics", McGraw-Hill Book Company-Koga.

**MOOCs Links and additional reading material:**

1. SWAYAM-NPTEL: [https://onlinecourses.nptel.ac.in/noc23\\_me42/preview](https://onlinecourses.nptel.ac.in/noc23_me42/preview)
2. SWAYAM-NPTEL: [https://onlinecourses.nptel.ac.in/noc25\\_ce66/preview](https://onlinecourses.nptel.ac.in/noc25_ce66/preview)
3. SWAYAM-NPTEL: [https://onlinecourses.nptel.ac.in/noc25\\_me41/preview](https://onlinecourses.nptel.ac.in/noc25_me41/preview)
4. SWAYAM-NPTEL: <https://nptel.ac.in/courses/105101082>

  
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5. **SWAYAM-NPTEL:** <https://nptel.ac.in/courses/105103095>
6. **SWAYAM-NPTEL:** <https://nptel.ac.in/courses/112106768>

### Strength of CO-PO-PSO Mapping

| CO          | PO1      | PO2        | PO3         | PO4         | PO5      | PO6      | PO7      | PO8      | PO9      | PO10     | PO11     | PSO1     | PSO2       | PSO3     |
|-------------|----------|------------|-------------|-------------|----------|----------|----------|----------|----------|----------|----------|----------|------------|----------|
| CO1         | 3        | 2          | -           | -           | -        | -        | 2        | 3        | 3        | 3        | 3        | 3        | 2          | 2        |
| CO2         | 3        | 3          | 2           | -           | 2        | -        | 2        | 3        | 3        |          |          | 3        | 3          | 2        |
| CO3         | 3        | 3          | 3           | 2           | 2        | -        | 2        | 3        | 3        | 3        | 3        | 3        | 2          | 2        |
| CO4         | 3        | 3          | 3           | 3           | 2        | -        | 2        | 3        | 3        |          |          | 3        | 3          | 2        |
| CO5         | 3        | 3          | 3           | 2           | 2        | -        | 2        | 3        | 3        | 3        | 3        | 3        | 3          | 2        |
| <b>Avg.</b> | <b>3</b> | <b>2.8</b> | <b>2.75</b> | <b>2.33</b> | <b>2</b> | <b>-</b> | <b>2</b> | <b>3</b> | <b>3</b> | <b>3</b> | <b>3</b> | <b>3</b> | <b>2.6</b> | <b>2</b> |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

### Assessment Pattern

| BT Level | CCE |     |             |                |                             |                          | ESE |
|----------|-----|-----|-------------|----------------|-----------------------------|--------------------------|-----|
|          | CT1 | CT2 | Assignments | Course Project | Field Activity / Case Study | Quiz / presentation etc. |     |
| K1       | ✓   | -   | ✓           | -              | -                           | -                        | ✓   |
| K2       | ✓   | -   | ✓           | -              | -                           | -                        | ✓   |
| K3       | ✓   | -   | ✓           | -              | -                           | ✓                        | ✓   |
| K4       | -   | -   | -           | -              | -                           | -                        | -   |
| K5       | -   | -   | -           | -              | -                           | -                        | -   |
| K6       | -   | -   | -           | -              | -                           | -                        | -   |

This course serves as a prerequisite for / maps with the following future courses:

1. Hydrology and Water Resource Engineering
2. Open Channel Flow
3. Dams and Hydraulics Structure

### Job Mapping:

Job opportunities that one can get after learning this course:

1. WRD (Water Resources Department)
2. PWD (Public Works Department)
3. CWC (Central Water Commission)
4. CWRB (Central Groundwater Board)
5. NHPC (National Hydroelectric Power Corporation)

  
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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                  |          |        |                    |                |        |               |    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------|----------|--------|--------------------|----------------|--------|---------------|----|
| Program:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | S.Y.B.Tech. (Civil)                                                                                                              |          |        | Semester:          | IV             |        |               |    |
| Course:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Concrete Technology                                                                                                              |          |        | Course Code:       | R25-CE-PCC-212 |        |               |    |
| Teaching Scheme (hrs/week)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |                                                                                                                                  |          |        | Examination Scheme |                |        |               |    |
| Lecture                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Practical                                                                                                                        | Tutorial | Credit | CCE                | ESE            | TW     | PR            | OR |
| 02                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | -                                                                                                                                | -        | 02     | 40                 | 60             | -      | -             | -  |
| <b>Course Description:</b><br>A concrete technology course provides a comprehensive exploration of the materials, science, and practical engineering involved in the production and use of concrete, which is the world's most widely consumed man-made material. A modified concrete technology course shifts the focus from traditional portland cement concrete to advanced composites, sustainable materials, and "modified" mixes that use polymers or chemical additives to enhance performance.       |                                                                                                                                  |          |        |                    |                |        |               |    |
| <b>Course Relevance:</b><br>The relevance of a concrete technology course stems from its status as the "backbone" of modern infrastructure. It translates theoretical material science into the practical ability to build safe, durable, and sustainable structures.                                                                                                                                                                                                                                        |                                                                                                                                  |          |        |                    |                |        |               |    |
| <b>Prerequisite:</b><br>Engineering Mathematics, Engineering Chemistry, Engineering Mechanics                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                  |          |        |                    |                |        |               |    |
| <b>Bridge Content:</b><br>high-performance materials, specialized construction techniques, and long-term durability                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                                  |          |        |                    |                |        |               |    |
| <b>Course Objectives:</b><br>1. To <b>KNOW</b> properties of various ingredients of concrete and concept of mix design.<br>2. To <b>LEARN</b> the behavior and properties of concrete in fresh and hardened state.<br>3. To <b>UNDERSTAND</b> special concrete and their applications.<br>4. To <b>UNDERSTAND</b> the durability aspects and preventive measures to enhance the life of concrete                                                                                                             |                                                                                                                                  |          |        |                    |                |        |               |    |
| <b>Course Outcomes:</b> After learning the course, students will be able to                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                                                                  |          |        |                    |                |        |               |    |
| CO                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Course Outcome                                                                                                                   |          |        |                    |                |        | Bloom's Level |    |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | REMEMBER the various ingredients of concrete and its suitable proportion to achieved desired strength.                           |          |        |                    |                |        | 1             |    |
| CO2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | UNDERSTAND standard tests on fresh and hardened concrete and INTERPRET results related to workability, strength, and durability. |          |        |                    |                |        | 2             |    |
| CO3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | DESIGN concrete mix with desired strength.                                                                                       |          |        |                    |                |        | 3             |    |
| CO4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | ANALYZE durability concerns in concrete and RECOMMEND suitable preventive or mitigation measures.                                |          |        |                    |                |        | 4             |    |
| Course Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                                  |          |        |                    |                |        |               |    |
| Unit 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Title: Introduction to Concrete as a Construction Material: General Perspective.                                                 |          |        |                    |                | 8 Hrs. | CO1           |    |
| a) Cement: Manufacturing of Portland cement, basic chemistry of cement, chemical composition, hydration of cement, types of cement, test on cement.<br>b) Aggregates and water: Types of aggregate, physical and mechanical properties, soundness, alkali-aggregate reaction, sieve analysis. Water: Quality requirements and its role.<br>c) Admixtures: Types: mineral and chemical, IS specification (9103 & 456) functions, and modern admixtures (alccofine, metakaolin). Fibers: types, and functions. |                                                                                                                                  |          |        |                    |                |        |               |    |

  
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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                   |               |            |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------|---------------|------------|
| <b>Exemplars / Practical Applications and usage:</b> <ul style="list-style-type: none"> <li>Concrete serves as the "backbone" of modern infrastructure, with applications ranging from residential homes to massive engineering projects.</li> </ul>                                                                                                                                                                                                                                                                                                                                                   |                                                                                   |               |            |
| <b>Assignments:</b> <ol style="list-style-type: none"> <li>Explain dry and wet process of manufacturing of Portland cement</li> <li>Explain sieve analysis of coarse and fine aggregate</li> <li>Enlist the various types admixtures</li> </ol>                                                                                                                                                                                                                                                                                                                                                        |                                                                                   |               |            |
| <b>Unit 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>Title: Production, Properties and placement of Fresh and Hardened Concrete</b> | <b>8 Hrs.</b> | <b>CO2</b> |
| <ol style="list-style-type: none"> <li>Fresh Concrete: Workability and factors affecting workability. Workability tests on fresh concrete. Setting time, mixing- batching, placing and compaction of concrete, segregation and bleeding of concrete, curing methods. Pumping of concrete, under water concreting, ready mixed concrete.</li> <li>Hardened concrete: Strength development: compressive, tensile, flexural strength. Factors affecting strength of concrete. Stress-strain relationship, Relation between tensile and compression strengths, elasticity and creep, shrinkage.</li> </ol> |                                                                                   |               |            |
| <b>Exemplars / Practical Applications and usage:</b> <ul style="list-style-type: none"> <li>Concrete is a versatile construction material whose effectiveness depends on careful management across its three primary stages: production, fresh (plastic) state, and hardened state.</li> </ul>                                                                                                                                                                                                                                                                                                         |                                                                                   |               |            |
| <b>Assignments:</b> <ol style="list-style-type: none"> <li>Define workability and explain various tests on workability.</li> <li>State and explain relation between tensile and compression strengths.</li> <li>Explain elasticity and creep of concrete.</li> </ol>                                                                                                                                                                                                                                                                                                                                   |                                                                                   |               |            |
| <b>Unit 3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>Title: Concrete Mix Design</b>                                                 | <b>7 Hrs.</b> | <b>CO3</b> |
| <ol style="list-style-type: none"> <li>Principles of mix design. Design mix, nominal mix, Factors for proportioning of concrete. Factors to be considered, various methods of mix proportioning.</li> <li>IS 10262 method of concrete mix design. Case studies of concrete failure due to improper mix design.</li> <li>Introduction and mix design of High Strength Concrete, using IS 10262 &amp; 456. Ultra High Performance concrete (UHPC) using IS 10262&amp;456.</li> </ol>                                                                                                                     |                                                                                   |               |            |
| <b>Exemplars / Practical Applications and usage:</b> <ul style="list-style-type: none"> <li>Concrete mix design is the scientific process of determining the exact proportions of cement, water, and aggregates to achieve specific structural goals. It moves beyond simple "recipes" to ensure every batch of concrete is optimized for its unique environment and load requirements.</li> </ul>                                                                                                                                                                                                     |                                                                                   |               |            |
| <b>Assignments:</b> <ol style="list-style-type: none"> <li>Enlist the various methods of mix proportioning.</li> <li>Design a concrete mix of M<sub>40</sub> grade using IS code methods</li> <li>Differentiate between IS code and DOE methods of mix design.</li> </ol>                                                                                                                                                                                                                                                                                                                              |                                                                                   |               |            |
| <b>Unit 4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <b>Title: Durability and Sustainability of Concrete</b>                           | <b>7 Hrs.</b> | <b>CO4</b> |
| <ol style="list-style-type: none"> <li>Importance of durability. Causes and mechanisms of deterioration: Sulphate attack, chloride ingress, corrosion of reinforcement: mechanism and prevention. Porosity, permeability, and water absorption.</li> <li>Sustainable concrete: Use of recycled aggregates, industrial by-products, and green cements. Bendable concrete</li> <li>Introduction to life cycle analysis of concrete. Non-destructive testing of concrete: Rebound hammer,</li> </ol>                                                                                                      |                                                                                   |               |            |

  
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ultrasonic pulse velocity, penetration resistance, pull-out test. 3D printed concrete and digital fabrication techniques.

#### Exemplars / Practical Applications and usage:

Durability and sustainability in concrete are interconnected concepts that transform it from a simple building material into a long-term asset for resilient infrastructure. While **durability** focuses on extending the structure's lifespan against environmental decay, **sustainability** emphasizes reducing the environmental footprint throughout its life cycle.

#### Assignments:

1. Define durability of concrete and explain factors affecting durability of concrete.
2. Write a short note on recycled aggregates.
3. Enlist the various Non-destructive testing of concrete, explain any one in details.

#### Course Projects:

-

#### Textbooks:

1. Concrete Technology, Adam M. Neville, J. J. Brooks, Pearson Education
2. Concrete Technology, M. Gambhir, Tata McGraw-Hill Publishing Company
3. Concrete Technology by M. S. Shetty, S Chand, New Delhi-110055

#### Reference Books:

1. Properties of Concrete, A. M. Neville, Pearson Education.
2. Concrete: Microstructure, Properties, and Materials, P. Kumar Mehta and Paulo J.M. Monteiro, McGraw Hill Education.
3. Concrete Mix Design by A. P. Remideos, Himalaya Publishing House.
4. Concrete Technology by A. R. Shantakumar, Oxford University Press.
5. Concrete Technology by R.S. Varshney, Oxford and IBH.
6. Durability Design of Concrete Structures, by A. Sarja and E. Vesari, E & FN Spon Publication.

#### IS Codes:

Latest revised editions of IS codes: IS 456, IS 269, IS 1489, IS 4031, IS 383, IS 2386, IS 9103, IS 516, IS 1199, IS 10262, SP 23, IS 13311.

#### MOOCs Links and additional reading material:

10. [https://www.researchgate.net/publication/294104534\\_Sustainable\\_Concrete\\_Technology](https://www.researchgate.net/publication/294104534_Sustainable_Concrete_Technology)
11. <https://www.researchgate.net/topic/Concrete-Technologies/publications>
12. <https://www.sciencegate.app/keyword/177216>
13. <https://onlinelibrary.wiley.com/doi/toc/10.1155/7074.si.985807>

**You Tube:** [https://onlinecourses.nptel.ac.in/noc25\\_ce10/preview](https://onlinecourses.nptel.ac.in/noc25_ce10/preview)

**Website:** <https://www.indianconcreteinstitute.org/>

#### Strength of CO-PO-PSO Mapping

| CO  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1 | 1   | 1   | 2   | -   | -   | 1   | -   | -   | -   | -    | 2    | 2    | 2    | 2    |
| CO2 | 1   | 1   | 2   | -   | -   | 1   | -   | -   | -   | -    | 2    | 2    | 2    | 2    |
| CO3 | 1   | 1   | 2   | -   | -   | 1   | -   | -   | -   | -    | 2    | 2    | 2    | 2    |

  
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|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO4  | 1 | 1 | 2 | - | - | 1 | - | - | - | - | 2 | 2 | 2 | 2 |
| Avg. | 1 | 1 | 2 | - | - | 1 | - | - | - | - | 2 | 2 | 2 | 2 |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

### Assessment Pattern

| BT Level | CCE |     |             |                |                             |                          | ESE |
|----------|-----|-----|-------------|----------------|-----------------------------|--------------------------|-----|
|          | CT1 | CT2 | Assignments | Course Project | Field Activity / Case Study | Quiz / presentation etc. |     |
| K1       | ✓   | -   | ✓           | -              | -                           | -                        | ✓   |
| K2       | ✓   | -   | ✓           | -              | -                           | ✓                        | ✓   |
| K3       | ✓   | -   | ✓           | ✓              | ✓                           | ✓                        | ✓   |
| K4       | -   | -   | ✓           | ✓              | ✓                           | -                        | ✓   |
| K5       | -   | -   | -           | -              | -                           | -                        | -   |
| K6       | -   | -   | -           | -              | -                           | -                        | -   |

This course serves as a prerequisite for / maps with the following future courses:

A **Concrete Technology** course is a fundamental building block in civil engineering, serving as a critical prerequisite or mapping directly to several advanced and specialized fields of study.

A)Core Prerequisite Mapping

1. Design of Reinforced Concrete (RC) Structures
2. Design of Prestressed Concrete (PSC)
3. Structural Analysis & Design

B)Advanced& Specialized Future Courses

1. **Advanced Concrete Technology (ACT)**
2. Specialized Materials Technology
3. Sustainable & Green Building Design

### Job Mapping:

Job opportunities that one can get after learning this course:

Learning concrete technology opens up a wide range of specialized roles within the construction and manufacturing industries, focusing on quality, design, and production.

  
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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                         |          |        |                    |              |        |                |    |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------|----------|--------|--------------------|--------------|--------|----------------|----|
| Program:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | S.Y. B.Tech. (Civil)                                                                                    |          |        |                    | Semester:    |        | IV             |    |
| Course:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Structural Analysis                                                                                     |          |        |                    | Course Code: |        | R25-CE-PCC-213 |    |
| Teaching Scheme (hrs/week)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                         |          |        | Examination Scheme |              |        |                |    |
| Lecture                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Practical                                                                                               | Tutorial | Credit | CCE                | ESE          | TW     | PR             | OR |
| 03                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | -                                                                                                       | -        | 03     | 40                 | 60           | -      | -              | -  |
| <b>Course Description:</b><br>This subject will build on the concepts from Engineering Mechanics and Mechanics of Structures.                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                         |          |        |                    |              |        |                |    |
| <b>Course Relevance:</b><br>The course is relevant to all mechanics knowledge required for Structural Engineering.                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                                                         |          |        |                    |              |        |                |    |
| <b>Prerequisite:</b><br>Basic Concepts of Engineering Mechanics                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                         |          |        |                    |              |        |                |    |
| <b>Bridge Content:</b><br>--                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                         |          |        |                    |              |        |                |    |
| <b>Course Objectives:</b><br>1. To <b>UNDERSTAND</b> basic concept of static and kinematic indeterminacy and analysis of indeterminate beams.<br>2. To <b>GAIN</b> the knowledge of redundant trusses and able to perform approximate analysis of multi-story multi-bay frames.<br>3. To <b>LEARN</b> the basic of Slope-Deflection Method and Stiffness method in beams and frames.<br>4. To <b>UNDERSTAND</b> analysis of beams and frames by Moment distribution method.<br>5. To <b>EXPLAIN</b> the basic concept of Plastic analysis. |                                                                                                         |          |        |                    |              |        |                |    |
| <b>Course Outcomes:</b> After learning the course, students will be able to                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                         |          |        |                    |              |        |                |    |
| CO                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Course Outcome                                                                                          |          |        |                    |              |        | Bloom's Level  |    |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | UNDERSTAND the basic concept of static and kinematic indeterminacy and ANALYSIS of indeterminate beams. |          |        |                    |              |        | 2,4            |    |
| CO2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | ANALYZE redundant trusses and able to perform approximate analysis of multi-story multi-bay frames.     |          |        |                    |              |        | 4              |    |
| CO3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | UNDERSTAND the basic of Slope-Deflection Method and Stiffness method in beams and frames.               |          |        |                    |              |        | 2              |    |
| CO4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | ANALYZE the beams and frames by Moment distribution method.                                             |          |        |                    |              |        | 4              |    |
| CO5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | UNDERSTAND the basic concept of Plastic analysis.                                                       |          |        |                    |              |        | 2              |    |
| Course Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                         |          |        |                    |              |        |                |    |
| Unit 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Title: Fundamentals of structure and analysis of redundant beams                                        |          |        |                    |              | 9 Hrs. | CO1            |    |
| Types and classification of structures based on structural forms, concept of indeterminacy<br>Static degree of indeterminacy. Kinematics degree of indeterminacy Analysis of propped cantilever up to second degree by strain energy method. Analysis of continuous beams with indeterminacy up to second degree by strain energy method.                                                                                                                                                                                                  |                                                                                                         |          |        |                    |              |        |                |    |
| <b>Exemplars / Practical Applications and usage:</b><br>Will be useful in Analysis of Beams and frames                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                                                                         |          |        |                    |              |        |                |    |

  
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**Assignments:**

1. Explain Static Indeterminacy with examples.
2. Explain kinematic Indeterminacy with examples.

|               |                                                                    |               |            |
|---------------|--------------------------------------------------------------------|---------------|------------|
| <b>Unit 2</b> | <b>Title: Analysis of redundant pin jointed Trusses and Frames</b> | <b>9 Hrs.</b> | <b>CO2</b> |
|---------------|--------------------------------------------------------------------|---------------|------------|

Analysis of redundant trusses by unit load method for external loading, lack of fit and sinking of support. Approximate methods of analysis of multi-storied multi-bay 2-D rigid jointed frames by Cantilever method and Portal method.

**Exemplars / Practical Applications and usage:**

Useful for software program for ETABS and STAAD-Pro.

**Assignments:**

4. Explain redundant truss with figure.
5. A Pratt type truss with 5m span and 3m height is Point loaded at apex 10kN analyzed the truss by unit load method .

|               |                                                 |               |            |
|---------------|-------------------------------------------------|---------------|------------|
| <b>Unit 3</b> | <b>Title: Stiffness and Flexibility Method.</b> | <b>9 Hrs.</b> | <b>CO3</b> |
|---------------|-------------------------------------------------|---------------|------------|

Fundamental concepts of flexibility and stiffness method, Stiffness method: Application to beams and Frames. Formation of  $2 \times 2$  matrices. Flexibility method for redundant beams.

**Exemplars / Practical Applications and usage:**

- Useful in design practices of Beam and Columns.

**Assignments:**

1. Analyze the beam 6m span and Centre point load by Slope deflection method and draw BMD. Assume uniform flexural rigidity.
2. Analyze the beam 5m span with complete UDL by stiffness matrix method and draw BMD. Assume uniform flexural rigidity.

|               |                                          |               |            |
|---------------|------------------------------------------|---------------|------------|
| <b>Unit 4</b> | <b>Title: Moment Distribution Method</b> | <b>9 Hrs.</b> | <b>CO4</b> |
|---------------|------------------------------------------|---------------|------------|

Stiffness factor, carry over factor, distribution factor, Application of Moment distribution method of analysis to beams and frames with and without joint translation and yielding of support

**Exemplars / Practical Applications and usage:**

Useful in Continuous beam design with complex staging situations

**Assignments:**

1. Analyze the beam 3m span and Centre point load by MDM and draw BMD. Assume uniform flexural rigidity.
2. Analyze the beam 5m span with UDL up to 3m by MDM and draw BMD. Assume uniform flexural rigidity.

|               |                                             |               |            |
|---------------|---------------------------------------------|---------------|------------|
| <b>Unit 5</b> | <b>Title :Plastic Analysis of Structure</b> | <b>9 Hrs.</b> | <b>CO5</b> |
|---------------|---------------------------------------------|---------------|------------|

Introduction to Plastic analysis. Assumptions in Plastic analysis with idealized curves, formation of plastic hinges, elastic, elasto plastic, plastic stages, collapse mechanism. Calculation of plastic moments for I section, T section and Circular solid section.

**Exemplars / Practical Applications and usage:**

Useful in design of steel and RC structures.

**Assignments:**

1. Assignment on Basic of Plastic Analysis and theorem of Plastic
2. Calculate the  $M_p$  of Circular Pipe 1.5m diameter complete solid section

  
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3. Calculate  $M_p$  of I section flange 200mm x 100mm top and bottom and web 300mm x 20mm

### Course Projects:

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### Textbooks:

1. Vazirani and Ratwani, "Analysis of Structures Vol II", Khanna publication.
2. S. Ramamrutham, "Theory of Structures", Dhanpat Rai Publication.
3. Pandit and Gupta, "Structural Analysis: A Matrix approach", Tata McGraw Hill Publication.
4. B C Punmia, A K Jain, "Theory of Structures", Laxmi Publication.

### Reference Books:

1. C. K. Wang, "Intermediate Structural Analysis", Tata McGraw Hill Education Pvt. Ltd.
2. Dr. H. J. Shah and S. B. Junnarkar, "Mechanics of Structures Vol. II (Theory and Analysis of Structures)", Charotar Publishing House Pvt. Ltd.
3. C. S. Reddy, "Basic Structural Analysis", Tata McGraw Hill Education Pvt. Ltd.
4. Gere and Weaver, "Matrix Method of Structural Analysis", CBS Publishers.
5. R. C. Hibbler, "Structural Analysis", Pearson Education.
6. B. G. Neal, Chapman & Hall, "The Plastic Methods of Structural Analysis".

### MOOCs Links and additional reading material:

1. <http://nptel.iitm.ac.in/courses-contents/IIT Kanpur and IIT Madras>.
2. <http://edx.org>
3. <https://www.thestructuralengineer.info/online-library>
4. <https://www.udemy.com/course/statics-for-engineering-undergrads/>
5. <https://www.classcentral.com/course/swayam-structural-analysis-i-14313>

### Strength of CO-PO-PSO Mapping

| CO   | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1  | 3   | 3   | 1   | 3   | 1   | 3   | 2   | 3   | 2   | 3    | -    | 3    | 3    | 3    |
| CO2  | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 2   | 3    | 2    | 3    | 3    | 3    |
| CO3  | 2   | 2   | 3   | 3   | 3   | 3   | 3   | 3   | 2   | 3    | 1    | 3    | 3    | 3    |
| CO4  | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 2   | 3    | 2    | 3    | 3    | 3    |
| CO5  | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 3   | 2   | 3    | 2    | 3    | 3    | 3    |
| Avg. | 2.8 | 2.8 | 2.6 | 3   | 2.6 | 3   | 2.8 | 3   | 2   | 3    | 1.4  | 3    | 3    | 3    |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

### Assessment Pattern

| BT Level | CCE |     |             |                |                             |                          | ESE |
|----------|-----|-----|-------------|----------------|-----------------------------|--------------------------|-----|
|          | CT1 | CT2 | Assignments | Course Project | Field Activity / Case Study | Quiz / presentation etc. |     |
| K1       | ✓   | -   | ✓           | -              | -                           | -                        | ✓   |
| K2       | ✓   | -   | ✓           | -              | -                           | -                        | ✓   |

  
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|    |   |   |   |   |   |   |   |
|----|---|---|---|---|---|---|---|
| K3 | ✓ | - | ✓ | - | - | ✓ | ✓ |
| K4 | ✓ | - | ✓ | - | - | ✓ | ✓ |
| K5 | - | - | - | - | - | - | - |
| K6 | - | - | - | - | - | - | - |

This course serves as a prerequisite for / maps with the following future courses:

- 1.Design of Steel Structures
- 2.Design of RC Elements
- 3.Design of Prestressed members

**Job Mapping:**

Job opportunities will be in Design Engineering field

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|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------|----------|--------|--------------------|--------------|----|----------------|---------------|
| Program:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | S. Y. B. Tech (Civil)                                        |          |        |                    | Semester:    |    | IV             |               |
| Course:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Open Elective 2: Interior Design                             |          |        |                    | Course Code: |    | R25-CE-OEC-215 |               |
| Teaching Scheme (hrs / week)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                                                              |          |        | Examination Scheme |              |    |                |               |
| Lecture                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Practical                                                    | Tutorial | Credit | CCE                | ESE          | TW | PR             | OR            |
| 02                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | -                                                            | -        | 02     | 40                 | 60           | -  | -              | -             |
| <b>Course Description:</b><br>Interior Design is an important interdisciplinary subject that combines aesthetics, functionality, ergonomics, building materials, and construction techniques to create efficient and comfortable indoor spaces. For Civil Engineering students, knowledge of interior design helps in understanding space utilization, building services integration, material selection, lighting, ventilation, and user-oriented planning.                                                                                                                                                                     |                                                              |          |        |                    |              |    |                |               |
| <b>CourseRelevance:</b><br>This course introduces students to the principles of interior design, space planning, furniture layout, color schemes, lighting systems and modern interior materials. It also develops the ability to prepare interior layouts and basic design concepts for buildings.                                                                                                                                                                                                                                                                                                                              |                                                              |          |        |                    |              |    |                |               |
| <b>Prerequisite:</b> <ul style="list-style-type: none"><li>Basics of Building Construction</li><li>Engineering Drawing and Drafting</li><li>Building Planning Concepts</li><li>Knowledge of Civil Engineering Materials</li><li>Basics of Building Byelaws and Green building knowledge</li><li>Basics of AutoCAD and interior knowledge planning</li></ul>                                                                                                                                                                                                                                                                      |                                                              |          |        |                    |              |    |                |               |
| <b>Bridge Content:</b> <ul style="list-style-type: none"><li>Introduction to Interior Design</li><li>Basics of Space Planning</li><li>Architectural Drawing Reading</li><li>Ergonomics and Human Dimensions</li><li>Basics of Color Theory and Lighting</li><li>Introduction to Interior Materials and Finishes</li><li>Basic Auto CAD Commands for Interior Drafting</li><li>Fundamentals of Building Services in Interiors</li><li>Sustainable Interior Concepts</li></ul>                                                                                                                                                     |                                                              |          |        |                    |              |    |                |               |
| <b>Course Objectives:</b><br>After completion of the course, students will be able to: <ol style="list-style-type: none"><li><b>To UNDERSTAND</b> the fundamentals and principles of interior design.</li><li><b>To LEARN</b> properties of interior finishing materials, color theory, internal air quality principles for functional, aesthetic space design.</li><li><b>To DEVELOP</b> concepts for modular furniture, decorative elements and green, sustainable interior accessories that create positive environmental impact.</li><li><b>To TRAIN</b> students in innovative trends and professional practices.</li></ol> |                                                              |          |        |                    |              |    |                |               |
| <b>Course Outcomes:</b> After learning the course, students will be able to                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                              |          |        |                    |              |    |                |               |
| CO                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Course Outcome                                               |          |        |                    |              |    |                | Bloom's Level |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | UNDERSTAND basic principles and elements of interior design. |          |        |                    |              |    |                | 1,2           |

  
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|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------|-------------------|
| CO2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>SELECT</b> appropriate finishing materials and apply color schemes effectively in interior design projects.              | 3                 |
| CO3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>APPLY</b> green and sustainable interior planning concept for interior design.                                           | 1,2,3             |
| CO4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | <b>LEARN</b> innovative trends and professional practices and create functional, aesthetical, sustainable interior layouts. | 2                 |
| <b>Course Content</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                             |                   |
| <b>Unit 1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>Title: Fundamentals of Interior Design</b>                                                                               | <b>7 Hrs. CO1</b> |
| <ul style="list-style-type: none"> <li>Interior design: Definition, concept, Elements (Space, Line, Form, Light, Color, Texture, Pattern), Principles (Balance, Unity, Rhythm, Emphasis, Scale and Proportion, Contrast, Details), Composition, Golden Ratio.</li> <li>Concept of space and place, varied spaces.</li> <li>Interior architecture: concept and importance, Stages of an interior project design.</li> </ul>                                                                       |                                                                                                                             |                   |
| <b>Exemplars / Practical Applications and usage:</b> <ul style="list-style-type: none"> <li>Planning of living room, bedroom, and kitchen layouts.</li> <li>Furniture arrangement based on human movement.</li> <li>Space utilization in small apartments.</li> </ul>                                                                                                                                                                                                                            |                                                                                                                             |                   |
| <b>Assignments:</b> <ol style="list-style-type: none"> <li>Prepare a scaled furniture interior layout for a 1BHK residential unit.</li> <li>Explain the concept of interior architecture.</li> <li>Visit an interior office and analyze space planning.</li> </ol>                                                                                                                                                                                                                               |                                                                                                                             |                   |
| <b>Unit 2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>Title: Creative space planning elements and materials</b>                                                                | <b>7 Hrs. CO2</b> |
| <ul style="list-style-type: none"> <li>Space making elements: wall, column, partition screen, floor, furniture, interior landscaping.</li> <li>Trends, concept, Types and function of Lighting, Color, Furnishing, Finishes, material (wood, paint, stone, tiles), surface treatment.</li> <li>Heating, Ventilation and Air Conditioning system (HVAC), Volatile Organic Compounds limits (VOC), Min Indoor Air and Environment Quality requirement (IAQ, IEQ)</li> </ul>                        |                                                                                                                             |                   |
| <b>Exemplars / Practical Applications and usage:</b> <ul style="list-style-type: none"> <li>Selection of flooring materials for commercial / residential buildings</li> <li>Incorporate daylighting to reduce energy consumption.</li> <li>Different types of paints used for buildings.</li> </ul>                                                                                                                                                                                              |                                                                                                                             |                   |
| <b>Assignments:</b> <ol style="list-style-type: none"> <li>Prepare a comparative study of flooring materials.</li> <li>Collect samples / photos of interior finishes and prepare a presentation.</li> <li>Identify minimum requirements of internal air and environmental quality.</li> </ol>                                                                                                                                                                                                    |                                                                                                                             |                   |
| <b>Unit 3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | <b>Title: Green and sustainable interior planning</b>                                                                       | <b>8 Hrs. CO3</b> |
| <ul style="list-style-type: none"> <li>Space making crafts and Surface narrative craft, Concept of Modular furniture, Interior accessories and decorative elements, Concept of Virtual Reality (VR) and Augmented Reality (AR).</li> <li>Interior Architecture drawing, Drafting standards and symbols, Acoustics and sound control.</li> <li>Sustainable interior design concept, Concept of green interior, Policies and incentives, Green product- Rating standards for furniture.</li> </ul> |                                                                                                                             |                   |
| <b>Exemplars / Practical Applications and usage:</b> <ul style="list-style-type: none"> <li>Creating feature walls and decorative partitions.</li> <li>Prepare floor plans, reflected ceiling plans, elevations, sections, and furniture layouts.</li> <li>Use standard architectural symbols for doors, windows, furniture, lighting, electrical fixtures, and plumbing.</li> </ul>                                                                                                             |                                                                                                                             |                   |
| <b>Assignments:</b> <ol style="list-style-type: none"> <li>Explain the concept of VR and AR in interior designing.</li> <li>Explain the concepts green interior, sustainable interior, modular furniture with suitable examples.</li> </ol>                                                                                                                                                                                                                                                      |                                                                                                                             |                   |

  
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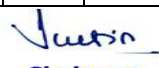
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|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|---------------|------------|
| 3. Visit or study <b>any</b> residential house, office, café, hotel, or educational institution and prepare a report on interior designing.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                            |               |            |
| <b>Unit 4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | <b>Title: Innovative trends and professional practices</b> | <b>8 Hrs.</b> | <b>CO4</b> |
| <ul style="list-style-type: none"> <li>Innovative Trends and Technology in interior design, Origami application in interior architecture, Electrical, plumbing and fire safety services and their functional importance. Concept of luxury interior and Tiny house.</li> <li>Avenues of Pedagogy in interior design. Professional Practice in Interior Design, Factors for cost calculation, methods to compute costing. Agreement and contracts for interior design.</li> <li>Prepare case of BHK interior residential project including Questionnaire, plan building services and interior services.</li> </ul>                                                                                                                                                  |                                                            |               |            |
| <b>Exemplars / Practical Applications and usage:</b> <ul style="list-style-type: none"> <li>Creating decorative wall panels, ceilings, and lighting fixtures inspired by origami patterns.</li> <li>Ensuring electrical safety through proper wiring and circuit protection.</li> <li>Managing client meetings and design documentation.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                |                                                            |               |            |
| <b>Assignments:</b> <ol style="list-style-type: none"> <li>Collecting client requirements regarding budget, lifestyle, family size, interior requirement, preferences, and functional needs.</li> <li>Choose any <b>one room</b> (Living Room, Bedroom, Office Cabin, Classroom, or Café). Prepare the following drawings:<br/>Furniture Layout Plan, Interior Elevation of one wall, Lighting Layout, Flooring Pattern, Indicate standard architectural symbols for furniture, lighting, doors, and windows.</li> <li>Prepare Innovative Trends and Technology comparison table highlighting their benefits and limitations.</li> </ol>                                                                                                                           |                                                            |               |            |
| <b>Textbooks:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                            |               |            |
| <ol style="list-style-type: none"> <li>Francis D. K. Ching, “Interior Design Illustrated”, John Wiley and Sons, Inc. 3<sup>rd</sup> edition.</li> <li>John F. Pile, “Interior Design”, Pearson, 3<sup>rd</sup> edition.</li> <li>S. C. Rangwala, “Building Construction”, Charotar Publishing House Pvt. Ltd., 35<sup>th</sup> edition.</li> <li>Premavathy Seetharaman and Parveen Pannu, “Interior Design and Decoration”, CBS Publisher and distributors 1<sup>st</sup> edition, 2017.</li> <li>Satish Chandra and R. Aggarwal, “Interior Design and Architecture”, Dhanpat Rai and Co.</li> </ol>                                                                                                                                                              |                                                            |               |            |
| <b>Reference Books:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                            |               |            |
| <ol style="list-style-type: none"> <li>Joseph De Chiara, Julius Panero and Martin Zelnik, “Time Saver Standards for Interior Design and Space Planning”, McGraw Hill Publication, 2<sup>nd</sup> edition.</li> <li>Julius Panero and Martin Zelnik, “Human Dimension and Interior Space”, Whitney Library of Design.</li> <li>Rosemary Kilmer and W. Otie Kilmer, “Designing Interiors”, Wiley, 2<sup>nd</sup> edition.</li> <li>Corky Binggeli, “Interior Graphic Standards”, John Wiley and Sons Inc., 2<sup>nd</sup> edition.</li> <li>Ahmed Kasu, “Interior Design”, Ashish Book Centre.</li> <li>National Building Code of India (NBC), 2016.</li> <li>Sam Kubba, “LEED Practices, Certification and Accreditation Handbook”, Butterworth Heinman.</li> </ol> |                                                            |               |            |
| <b>MOOCs Links and additional reading material:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                            |               |            |
| NPTEL Online Course: Interior Design                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                            |               |            |

### Strength of CO-PO-PSO Mapping

| CO  | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1 | 3   | 3   | 3   | -   | -   | 2   | -   | -   | -   | 1    | -    | 3    | 2    | 1    |
| CO2 | 3   | 1   | 2   | 3   | -   | -   | -   | -   | -   | -    | 2    | 2    | 3    | 1    |
| CO3 | 2   | 2   | 3   | 2   | -   | 3   | -   | 3   | 3   | 1    | 1    | 3    | 2    | 2    |
| CO4 | 2   | 2   | 3   | 1   | 3   | 2   | 3   | 1   | -   | 3    | 1    | 3    | 2    | 2    |

  
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|------|-----|---|------|---|---|------|---|---|---|------|------|------|------|-----|
| Avg. | 2.5 | 2 | 2.75 | 2 | 3 | 2.33 | 3 | 2 | 3 | 1.67 | 1.33 | 2.75 | 2.25 | 1.5 |
|------|-----|---|------|---|---|------|---|---|---|------|------|------|------|-----|

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

### Assessment Pattern

| BT Level |     |     |             |                |                             |                          | ESE |
|----------|-----|-----|-------------|----------------|-----------------------------|--------------------------|-----|
|          | CT1 | CT2 | Assignments | Course Project | Field Activity / Case Study | Quiz / presentation etc. |     |
| K1       | ✓   | -   | -           | -              | -                           | -                        | ✓   |
| K2       | ✓   | -   | -           | -              | -                           | ✓                        | ✓   |
| K3       | -   | -   | -           | -              | ✓                           | ✓                        | ✓   |
| K4       | -   | -   |             | -              |                             |                          | ✓   |
| K5       | -   | -   | -           | -              | -                           | -                        | -   |
| K6       | -   | -   | -           | -              | -                           | -                        | -   |

This course serves as a prerequisite for / maps with the following future courses:

Advanced Building services

Sustainable Architecture

### Job Mapping:

Job opportunities that one can get after learning this course:

An Interior Design course maps to roles like Residential/Commercial Interior Designer, Space Planner, Lighting Consultant, and Visual Merchandiser. It equips professionals to create functional layouts, select sustainable materials, coordinate with MEP teams, and produce technical CAD drawings for design firms, real estate developers, and corporate clients.

  
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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                           |                                     |        |                    |     |              |               |                |  |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------|-------------------------------------|--------|--------------------|-----|--------------|---------------|----------------|--|
| Program:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                           | S.Y. B.Tech. (Civil)                |        |                    |     | Semester:    |               | IV             |  |
| Course:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                           | Digital Modelling and Visualization |        |                    |     | Course Code: |               | R25-CE-MDM-214 |  |
| Teaching Scheme (hrs/week)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                                                           |                                     |        | Examination Scheme |     |              |               |                |  |
| Lecture                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Practical                                                                                                                 | Tutorial                            | Credit | CCE                | ESE | TW           | PR            | OR             |  |
| 02                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | -                                                                                                                         | -                                   | 02     | 40                 | 60  | -            | -             | -              |  |
| Course Description:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                           |                                     |        |                    |     |              |               |                |  |
| This course introduces the fundamentals of BIM, focusing on the transition from 2D CAD drafting to parametric 3D modeling using tools like Revit. It covers creation of building components, levels, families, and extraction of drawings, schedules, and documentation from a single intelligent model.                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                           |                                     |        |                    |     |              |               |                |  |
| Course Relevance:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                                                           |                                     |        |                    |     |              |               |                |  |
| BIM is essential in the AEC industry for improving coordination, reducing errors, and enabling efficient project planning, design, and execution. It equips students with industry-relevant skills such as 3D modeling, quantity takeoff, documentation, and collaboration used in modern construction projects.                                                                                                                                                                                                                                                                                                                                              |                                                                                                                           |                                     |        |                    |     |              |               |                |  |
| Prerequisite:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                                                           |                                     |        |                    |     |              |               |                |  |
| Basic knowledge of Engineering Drawing principles and familiarity with 2D drafting using AutoCAD, including commands, layers, and drawing standards.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                           |                                     |        |                    |     |              |               |                |  |
| Bridge Content:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                           |                                     |        |                    |     |              |               |                |  |
| This course bridges the gap between traditional CAD and BIM by shifting the focus from simple line-based drafting to intelligent object-based modeling. Students will learn the transition from lines and layers (CAD) to parametric objects and relationships (BIM), along with understanding the spatial coordination between plan, elevation, and section views within a unified 3D environment.                                                                                                                                                                                                                                                           |                                                                                                                           |                                     |        |                    |     |              |               |                |  |
| Course Objectives:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                                                           |                                     |        |                    |     |              |               |                |  |
| <div>1. To <b>UNDERSTAND</b> the fundamental differences between CAD and BIM workflows in the construction industry.</div> <div>2. To <b>DEVELOP</b> skills in cleaning, organizing, and integrating 2D legacy drawings into a structured 3D BIM environment.</div> <div>3. To <b>CREATE</b> a parametric 3D building model using intelligent components such as walls, floors, doors, and windows.</div> <div>4. To <b>DESIGN</b> and model vertical circulation elements (stairs) and roof systems using BIM tools.</div> <div>5. To <b>GENERATE</b> professional-quality visualizations, schedules, and construction documentation from a BIM model.</div> |                                                                                                                           |                                     |        |                    |     |              |               |                |  |
| Course Outcomes: After learning the course, students will be able to                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                           |                                     |        |                    |     |              |               |                |  |
| CO                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Course Outcome                                                                                                            |                                     |        |                    |     |              | Bloom's Level |                |  |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | EXPLAIN the concepts of BIM and differentiate between CAD and BIM workflows, including BIM dimensions and lifecycle.      |                                     |        |                    |     |              | 1,2           |                |  |
| CO2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | APPLY techniques to clean, import, and convert 2D CAD drawings into a structured 3D BIM model using levels and grids.     |                                     |        |                    |     |              | 3             |                |  |
| CO3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | DEVELOP a parametric 3D building model using Revit tools, including walls, floors, doors, windows, and families.          |                                     |        |                    |     |              | 6             |                |  |
| CO4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | CREATE and document building components such as staircases and roof systems, along with generating views and annotations. |                                     |        |                    |     |              | 6             |                |  |

  
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| Course Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                               |        |     |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------|--------|-----|
| Unit 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Title: Fundamentals of BIM and Revit          | 7 Hrs. | CO1 |
| <p>Definition of BIM (Building Information Modelling), Evolution from CAD to BIM, Differences between CAD and BIM (2D vs Intelligent Model), BIM dimensions (3D, 4D, 5D concept), Features and capabilities of Autodesk Revit Advantages of BIM in construction industry, Limitations and challenges of BIM. Revit user interface: Ribbon, Project Browser, Properties Palette, View Control Bar. BIM dimensions (3D, 4D, 5D), BIM Levels (Level 0 to Level 3), BIM lifecycle (design to facility management), Interoperability concept, File formats (RVT, IFC, DWG), Limitations of BIM.</p> <p><b>Exemplars / Practical Applications and usage:</b><br/>           Compare same building drawn in AutoCAD vs Revit (highlight intelligence vs drafting)<br/>           Demonstrate 3D model automatically generating plans, sections and elevations<br/>           Case study: Residential vs Commercial BIM workflow (Level of Development-LOD difference)<br/>           Show 4D simulation concept (timeline linking) using sample project<br/>           Demonstrate file interoperability (DWG → Revit → IFC-Industry Foundation Classes) workflow</p> <p><b>Assignments:</b><br/>           Prepare a comparison chart: AutoCAD vs Revit vs BIM<br/>           Draw a simple 2D plan in CAD and convert conceptually into BIM workflow steps<br/>           Identify and explain BIM Levels (0–3) with real examples<br/>           Short report on BIM lifecycle (Design → Construction → Facility Management)<br/>           Create a Revit interface labeling diagram with functions</p> |                                               |        |     |
| Unit 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Title: Parametric Modeling and Basic Elements | 7 Hrs. | CO2 |
| <p>Concept of parametric modelling, Constraints and relationships in Revit, Levels and grids (importance in building design), Types of walls (structural, architectural), Doors and windows as parametric components, editing tools: Move, Copy, Rotate, Mirror, Trim, Constraints (dimensional &amp; geometric), Types of walls (basic, stacked, curtain wall), Wall properties (height, thickness, material), Selection methods (filter, tab), Snapping and alignment tools.</p> <p><b>Exemplars / Practical Applications and usage:</b><br/>           Demonstrate parametric wall changing height/thickness automatically<br/>           Show grid and level setup for multi-story building<br/>           Live example: aligning imported CAD plan to BIM origin<br/>           Demonstrate constraints (lock, align, dimension-based control)<br/>           Show difference between basic wall, stacked wall and curtain wall</p> <p><b>Assignments:</b><br/>           Set up levels for G+1 building with proper naming<br/>           Create grid system for a rectangular building layout<br/>           Model different wall types with materials and thickness variation<br/>           Clean a messy CAD plan and align properly in Revit<br/>           Practice editing tools (Move, Rotate, Mirror) on building elements</p>                                                                                                                                                                                                                                                        |                                               |        |     |
| Unit 3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Title: Building Components and Families       | 8 Hrs. | CO3 |
| <p>Concept of families in Revit, Types of families: System families, Loadable families, In-place families, Floors, roofs, and ceilings (types and uses), Stairs and railings (basic concept), Materials and their properties (appearance, structure), In-place families, Type vs Instance parameters, Material take-off concept, Work sets (basic teamwork concept), Hosting of components (wall-hosted, face-hosted)</p> <p><b>Exemplars / Practical Applications and usage:</b></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                               |        |     |

  
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Model load-bearing vs partition wall (material + thickness difference)  
 Demonstrate family types (system vs loadable vs in-place)  
 Show door/window parametric resizing  
 Demonstrate material change impact on model appearance  
 Example of hosted elements (window in wall, face-based objects)

**Assignments:**

Convert 2D 2BHK plan into basic 3D model (walls + floors)  
 Insert and modify doors/windows using family parameters  
 Create floor and roof for residential building  
 Assign and modify materials for walls, floors, roofs  
 Prepare basic material takeoff table (manual or software)

| Unit 4 | Title: Views, Annotation and Documentation | 8 Hrs. | CO4 |
|--------|--------------------------------------------|--------|-----|
|--------|--------------------------------------------|--------|-----|

Types of views: Plan, Elevation, Section, 3D view, View properties and visibility control, annotation tools: Dimensions, Text, Tags, Sheet creation and layout, Printing and exporting drawings, Basics of rendering and visualization, View control (scale, detail level, visibility), View templates, Tagging and scheduling relation, Detailing tools (detail lines, regions), Camera view and walkthrough.

**Exemplars / Practical Applications and usage:**

Generate plan, elevation, section automatically from model  
 Show difference in view scale and detail level  
 Demonstrate annotation (dimensioning, tagging live)  
 Create sheet layout with multiple views  
 Walkthrough example: camera view inside building

**Assignments:**

Generate 2 floor plans + 2 elevations from model  
 Add dimensions, tags, and text annotations properly  
 Create sheet with title block and view arrangement  
 Model and document staircase + roof with proper views  
 Create basic walkthrough (5–10 sec animation)

**Course Projects:**

**Course Project: “The Digital Twin”**

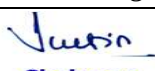
Students will develop a complete BIM-based project by converting a 2D PDF drawing of a residential villa into a clean CAD base and then creating a parametric 3D model using BIM tools. The project includes modelling all building components such as walls, floors, doors, windows, staircase, and roof, followed by generating plans, elevations, sections, schedules (BOQ), and rendered views, along with a short walkthrough visualization for final presentation.

**Textbooks:**

BIM Handbook: A Guide to Building Information Modeling by Eastman, Teicholz, et al.  
 Autodesk Revit Architecture: No Experience Required by Eric Wing.  
 Autodesk Revit Architecture Basics – Autodesk Official  
 BIM Handbook – Chuck Eastman  
 Mastering Autodesk Revit – Wiley Publications  
 Introduction to BIM – Ar. Kymmell

**Reference Books:**

Design Integration Using Autodesk Revit by Daniel John Stine.

  
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### Massive Open Online Courses (MOOCs) Links and additional reading material:

Unit 1: [Coursera - BIM Fundamentals]  
 Unit 2: [LinkedIn Learning - Revit: Importing CAD]  
 Unit 3: [Autodesk Learning - Modeling Walls]  
 Unit 4: [YouTube - Mastering Stairs in BIM]  
 [Enscape/V-Ray - Basic Rendering for Engineers]

### Strength of CO-PO-PSO Mapping

| CO   | PO1 | PO2  | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------|-----|------|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1  | 2   | 1    | -   | -   | 3   | -   | -   | -   | -   | 1    | -    | 2    | 1    | 1    |
| CO2  | 2   | 2    | 2   | -   | 3   | -   | -   | -   | -   | 2    | -    | 3    | 2    | 1    |
| CO3  | 3   | 2    | 3   | 1   | 3   | 1   | 1   | -   | 1   | 2    | 1    | 3    | 3    | 2    |
| CO4  | 3   | 2    | 3   | 1   | 3   | 1   | 1   | -   | 1   | 2    | 1    | 3    | 3    | 2    |
| Avg. | 2.5 | 1.75 | 2.6 | 1   | 3   | 1   | 1   | -   | 1   | 1.75 | 1    | 2.75 | 2.25 | 1.5  |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

### Assessment Pattern

| BT Level | CCE |     |             |                |                             |                          | ESE |
|----------|-----|-----|-------------|----------------|-----------------------------|--------------------------|-----|
|          | CT1 | CT2 | Assignments | Course Project | Field Activity / Case Study | Quiz / presentation etc. |     |
| K1       | ✓   | -   | ✓           | -              | -                           | -                        | ✓   |
| K2       | ✓   | -   | ✓           | -              | -                           | ✓                        | ✓   |
| K3       | ✓   | -   | ✓           | ✓              | ✓                           | ✓                        | ✓   |
| K4       | -   | -   | -           | -              | -                           | -                        | -   |
| K5       | -   | -   | -           | -              | -                           | -                        | -   |
| K6       | -   | -   | -           | -              | -                           | -                        | ✓   |

This course provides a strong foundation for several advanced subjects by integrating concepts from all five units of BIM:

- Project Management & Scheduling:**  
 Knowledge from BIM fundamentals and applications (Units 1 & 5) enables students to use BIM models for **4D scheduling**, where construction activities are linked with time for better project planning and monitoring.
- Quantity Surveying & Estimation:**  
 Skills developed in parametric modelling and documentation (Units 2, 3 & 5) support **5D cost estimation**, allowing automated generation of quantities, BOQ, and material take-offs directly from the BIM model.
- Structural Design & Analysis:**  
 Understanding of building components and modelling (Units 2 & 3) provides a base for exporting BIM models to structural analysis software such as **STAAD. Pro and ETABS** for further design and analysis.

  
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**Job Mapping:**

Job opportunities that one can get after learning this course:

Revit Modeler (BIM Modeler)

Junior BIM Engineer

2D/3D Design Technician and Site Planning / Drawing Engineer

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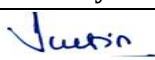


**Objective:** Import/link AutoCAD file (DWG)

  
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|                                                                                                                                                                                                                                                                                                                                                              |                                           |              |            |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|--------------|------------|
| <b>Associated Tasks:</b> Clean unnecessary layers, scale, and align drawing.                                                                                                                                                                                                                                                                                 |                                           |              |            |
| <b>Exemplars and Utility:</b> Set project units and positioning                                                                                                                                                                                                                                                                                              |                                           |              |            |
| <b>Experiment No.3</b>                                                                                                                                                                                                                                                                                                                                       | <b>Title: Level &amp; Grid Creation</b>   | <b>2 Hrs</b> | <b>CO2</b> |
| <b>Objective:</b><br>Create levels (Plinth, Floor and Roof)<br><b>Associated Tasks:</b><br>Develop grid system for building layout<br><b>Exemplars and Utility:</b><br>Creation of levels and grids in Autodesk Revit provides a reference framework for accurate building layout, alignment, and coordination of all structural and architectural elements. |                                           |              |            |
| <b>Experiment No.4</b>                                                                                                                                                                                                                                                                                                                                       | <b>Title: Wall Modeling (Parametric)</b>  | <b>2 Hrs</b> | <b>CO3</b> |
| <b>Objective:</b><br>Create different wall types (basic and structural)<br><b>Associated Tasks:</b><br>Apply thickness, height, and material<br><b>Exemplars and Utility:</b><br>Use editing tools (Move, Trim and Align)                                                                                                                                    |                                           |              |            |
| <b>Experiment No.5</b>                                                                                                                                                                                                                                                                                                                                       | <b>Title: Door &amp; Window Placement</b> | <b>2 Hrs</b> | <b>CO3</b> |
| <b>Objective:</b><br>Insert parametric door and window families<br><b>Associated Tasks:</b><br>Modify sizes, sill height, and placement<br><b>Exemplars and Utility:</b><br>Understand hosted components                                                                                                                                                     |                                           |              |            |
| <b>Experiment No.6</b>                                                                                                                                                                                                                                                                                                                                       | <b>Title: Floor &amp; Slab Modeling</b>   | <b>2 Hrs</b> | <b>CO3</b> |
| <b>Objective:</b><br>Create floor using boundary tools<br><b>Associated Tasks:</b><br>Apply materials and thickness<br><b>Exemplars and Utility:</b><br>Model multi-level floors                                                                                                                                                                             |                                           |              |            |
| <b>Experiment No.7</b>                                                                                                                                                                                                                                                                                                                                       | <b>Title: Staircase Modeling</b>          | <b>2 Hrs</b> | <b>CO4</b> |
| <b>Objective:</b><br>Create stair from ground to upper floor<br><b>Associated Tasks:</b><br>Adjust riser, tread, and landing<br><b>Exemplars and Utility:</b><br>Add railings                                                                                                                                                                                |                                           |              |            |
| <b>Experiment No.8</b>                                                                                                                                                                                                                                                                                                                                       | <b>Title: Roof Modeling</b>               | <b>2 Hrs</b> | <b>CO3</b> |
| <b>Objective:</b><br>Create roof by footprint<br><b>Associated Tasks:</b><br>Attach walls to roof<br><b>Exemplars and Utility:</b>                                                                                                                                                                                                                           |                                           |              |            |

  
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| Explore flat and sloped roof options                                                                                                                                                                                                           |                                             |              |            |
| <b>Experiment No.9</b>                                                                                                                                                                                                                         | <b>Title: Views &amp; Documentation</b>     | <b>2 Hrs</b> | <b>CO5</b> |
| <b>Objective:</b><br>Generate plans, elevations, and sections<br><b>Associated Tasks:</b><br>Add dimensions, tags, and annotations<br><b>Exemplars and Utility:</b><br>Create sheets and layouts                                               |                                             |              |            |
| <b>Experiment No.10</b>                                                                                                                                                                                                                        | <b>Title: Schedules &amp; Visualization</b> | <b>2 Hrs</b> | <b>CO5</b> |
| <b>Objective:</b><br>Generate door/window schedules<br><b>Associated Tasks:</b><br>Prepare quantity takeoff (area, volume)<br><b>Exemplars and Utility:</b><br>Apply materials and render views<br>Create short walkthrough animation          |                                             |              |            |
| <b>Textbooks:</b>                                                                                                                                                                                                                              |                                             |              |            |
| 1. Autodesk Revit 2026 Architecture Basics by Elise Moss (SDC Publications).<br>2. Residential Design Using Autodesk Revit 2027 by Daniel John Stine.                                                                                          |                                             |              |            |
| <b>Reference Books:</b>                                                                                                                                                                                                                        |                                             |              |            |
| 1. BIM Handbook: A Guide to Building Information Modeling by Chuck Eastman, et al.<br>2. The BIM Manager's Handbook by Dominik Holzer.                                                                                                         |                                             |              |            |
| <b>MOOCs Links and additional reading material:</b>                                                                                                                                                                                            |                                             |              |            |
| 1. <b>Coursera:</b> BIM Fundamentals for Engineers (National Taiwan University).<br>2. <b>LinkedIn Learning:</b> Revit Essential Training (Architecture).<br>3. <b>Autodesk Learning:</b> "AEC Standardized Workflows" (Self-paced tutorials). |                                             |              |            |

### Strength of CO-PO-PSO Mapping

| CO   | PO1 | PO2  | PO3  | PO4 | PO5  | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------|-----|------|------|-----|------|-----|-----|-----|-----|------|------|------|------|------|
| CO1  | 2   | 1    | -    | -   | 2    | -   | -   | -   | -   | 1    | -    | 1    | 1    | 2    |
| CO2  | 2   | 2    | 1    | -   | 3    | -   | -   | -   | -   | 1    | -    | 3    | 2    | 1    |
| CO3  | 3   | 2    | 3    | 1   | 3    | 1   | 1   | -   | 1   | 2    | 1    | 3    | 3    | 2    |
| CO4  | 3   | 2    | 3    | 1   | 3    | 1   | 1   | -   | 1   | 2    | 1    | 3    | 3    | 2    |
| Avg. | 2.5 | 1.75 | 2.33 | 1   | 2.75 | 1   | 1   |     | 1   | 1.5  | 1    | 2.5  | 2.25 | 1.75 |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

### Assessment Pattern

| BT Level | CCE |     |             |                |                             |                          | ESE |
|----------|-----|-----|-------------|----------------|-----------------------------|--------------------------|-----|
|          | CT1 | CT2 | Assignments | Course Project | Field Activity / Case Study | Quiz / presentation etc. |     |
| K1       | -   | -   | -           | -              | -                           | -                        | -   |
| K2       | -   | -   | -           | -              | -                           | -                        | -   |

  
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|    |   |   |   |   |   |   |   |
|----|---|---|---|---|---|---|---|
| K3 | - | - | - | - | - | - | - |
| K4 | - | - | - | - | - | - | - |
| K5 | - | - | - | - | - | - | - |
| K6 | - | - | - | - | - | - | - |

This course serves as a prerequisite for / maps with the following future courses:

- 1. Project Management & Scheduling:**  
Enables use of BIM models for **4D scheduling**, linking construction activities with time for effective planning and monitoring.
- 2. Quantity Surveying & Estimation:**  
Supports **5D cost estimation** through automated quantity takeoffs, BOQ preparation, and material scheduling from BIM models.
- 3. Structural Design & Analysis:**  
Provides a base for exporting BIM models to structural software such as **STAAD.Pro and ETABS** for analysis and design.

#### Job Mapping:

This course equips students with practical BIM skills that align with the following entry-level job roles in the AEC industry:

- 1. BIM Modeler (Architecture/Civil):**  
Responsible for developing 3D building models, including walls, floors, doors, windows, stairs, and roofs using Revit.
- 2. Revit Technician / Draftsman:**  
Prepares detailed drawings, plans, sections, and elevations, and converts 2D CAD drawings into BIM models.
- 3. Junior BIM Coordinator:**  
Assists in model coordination, basic clash detection, and collaboration between different disciplines.
- 4. Quantity Take-off Engineer (Junior Level):**  
Extracts quantities, prepares BOQs, and supports cost estimation using BIM-generated schedules.
- 5. Visualization Assistant:**  
Creates 3D views, renders, and walkthroughs for presentations and client communication.

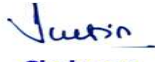
  
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|                                                                                                                     |                                                                   |          |        |                    |              |         |                |    |
|---------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|----------|--------|--------------------|--------------|---------|----------------|----|
| Program:                                                                                                            | S. Y. B.Tech (Civil)                                              |          |        |                    | Semester:    |         | IV             |    |
| Course:                                                                                                             | Modern Indian Languages and Technical Writing                     |          |        |                    | Course Code: |         | R25-CE-AEC-217 |    |
| Teaching Scheme (hrs / week)                                                                                        |                                                                   |          |        | Examination Scheme |              |         |                |    |
| Lecture                                                                                                             | Practical                                                         | Tutorial | Credit | CCE                | ESE          | TW      | PR             | OR |
| 01                                                                                                                  | 02                                                                | -        | 02     | -                  | -            | 50      | -              | -  |
| Course Description:                                                                                                 |                                                                   |          |        |                    |              |         |                |    |
| 1. प्रगत भाषिक कौशल्यांची क्षमता विकसित करणे.                                                                       |                                                                   |          |        |                    |              |         |                |    |
| 2. प्रसार माध्यमांतील संप्रेषणातील स्वरूप आणि स्थान स्पष्ट करणे.                                                    |                                                                   |          |        |                    |              |         |                |    |
| 3. व्यक्तिमत्त्व विकास आणि भाषा यांतील सहसंबंध स्पष्ट करणे.                                                         |                                                                   |          |        |                    |              |         |                |    |
| 4. प्रशासनातील पत्रव्यवहार आणि सरकारी दरबारी वापरल्या जाणाऱ्या भाषेचा अभ्यास करणे.                                  |                                                                   |          |        |                    |              |         |                |    |
| 5. प्रसारमाध्यमांसाठी लेखनक्षमता विकसित करणे.                                                                       |                                                                   |          |        |                    |              |         |                |    |
| 6. निविदा तयार करणे.                                                                                                |                                                                   |          |        |                    |              |         |                |    |
| Course Relevance:                                                                                                   |                                                                   |          |        |                    |              |         |                |    |
| विद्यार्थ्यांना उद्योग क्षेत्रात प्रभावी संवाद साधण्यासाठी व मुलाखतींमध्ये आत्मविश्वास वाढवण्यासाठी हा घटक मदत करतो |                                                                   |          |        |                    |              |         |                |    |
| Prerequisite:                                                                                                       |                                                                   |          |        |                    |              |         |                |    |
| 1. विद्यार्थ्यांना मूलभूत मराठी वाचन, लेखन आणि संभाषणाचे ज्ञान असणे आवश्यक आहे.                                     |                                                                   |          |        |                    |              |         |                |    |
| 2. माध्यमिक किंवा उच्चमाध्यमिक स्तरावरील मराठी व्याकरणाचे प्राथमिक ज्ञान असावे.                                     |                                                                   |          |        |                    |              |         |                |    |
| 3. मूलभूत संगणकीय ज्ञान आणि ई-मेल / डिजिटल संवादाची ओळख असावी.                                                      |                                                                   |          |        |                    |              |         |                |    |
| Bridge Content:                                                                                                     |                                                                   |          |        |                    |              |         |                |    |
| 1. तांत्रिक व शैक्षणिक लेखनाबद्दल प्राथमिक समज असणे अपेक्षित आहे.                                                   |                                                                   |          |        |                    |              |         |                |    |
| 2. गटचर्चा, सादरीकरण आणि संवाद प्रक्रियेत सहभागी होण्याची तयारी असावी.                                              |                                                                   |          |        |                    |              |         |                |    |
| Course Objectives:                                                                                                  |                                                                   |          |        |                    |              |         |                |    |
| 1. विद्यार्थ्यांच्या मराठी भाषिक कौशल्यांचा विकास करणे.                                                             |                                                                   |          |        |                    |              |         |                |    |
| 2. तांत्रिक, प्रशासकीय व व्यावसायिक लेखन कौशल्ये विकसित करणे.                                                       |                                                                   |          |        |                    |              |         |                |    |
| 3. अभियांत्रिकी क्षेत्रातील संवाद कौशल्ये सुधारणा करणे.                                                             |                                                                   |          |        |                    |              |         |                |    |
| 4. मराठी भाषेच्या माध्यमातून सामाजिक व व्यावसायिक मूल्यांची जाणीव निर्माण करणे.                                     |                                                                   |          |        |                    |              |         |                |    |
| 5. सादरीकरण, अहवाल लेखन व पत्रव्यवहार यामध्ये प्रावीण्य निर्माण करणे.                                               |                                                                   |          |        |                    |              |         |                |    |
| Course Outcomes:                                                                                                    |                                                                   |          |        |                    |              |         |                |    |
| CO                                                                                                                  | Course Outcome                                                    |          |        |                    |              |         | Bloom's Level  |    |
| CO1                                                                                                                 | विद्यार्थी शुद्ध आणि प्रभावी मराठी लेखन करू शकतील                 |          |        |                    |              |         | 3              |    |
| CO2                                                                                                                 | विद्यार्थी तांत्रिक आणि व्यावसायिक अहवाल तयार करू शकतील           |          |        |                    |              |         | 6              |    |
| CO3                                                                                                                 | विद्यार्थी प्रभावी मौखिक संवाद आणि सादरीकरण करू शकतील.            |          |        |                    |              |         | 3              |    |
| CO4                                                                                                                 | विद्यार्थी भाषांतर आणि द्विभाषिक संवाद कौशल्ये आत्मसात करतील.     |          |        |                    |              |         | 4              |    |
| CO5                                                                                                                 | विद्यार्थी नैतिक मूल्ये, नेतृत्व आणि टीमवर्क कौशल्य विकसित करतील. |          |        |                    |              |         | 5              |    |
| Course Content                                                                                                      |                                                                   |          |        |                    |              |         |                |    |
| Unit 1                                                                                                              | भाषा कौशल्ये आणि व्याकरण                                          |          |        |                    |              | 07 Hrs. | CO1            |    |
| मराठी भाषेची वैशिष्ट्ये, शुद्धलेखन नियम, शब्द संपत्ती विकास, वाक्यरचना व विराम चिन्हे, भाषाशैली व अभिव्यक्ती कौशल्य |                                                                   |          |        |                    |              |         |                |    |

  
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**Exemplars / Practical Applications and usage:**

हा घटक विद्यार्थ्यांना शुद्ध व प्रभावी मराठी लेखन आणि संभाषण कौशल्य विकसित करण्यास मदत करतो.

**Assignments:**

**Assignment 1:** दिलेल्या परिच्छेदातील शुद्धलेखन व व्याकरणाच्या चुका शोधून दुरुस्त करा.

**Assignment 2 :** अभियांत्रिकी शिक्षणातील मातृभाषेचे महत्त्व या विषयावर 500 शब्दांचा निबंध लिहा.

**Assignment 3:** तांत्रिक शब्दसंग्रह तयार करून त्यांचे अर्थ लिहा.

| Unit 2                                                                                                            | तांत्रिक व व्यावसायिक लेखन | 08 Hrs. | CO2 |
|-------------------------------------------------------------------------------------------------------------------|----------------------------|---------|-----|
| तांत्रिक अहवाल लेखन, प्रयोग अहवाल, प्रकल्प अहवाल लेखन, कार्यालयीन पत्रव्यवहार, ई-मेल लेखन, निवेदन, सूचना परिपत्रक |                            |         |     |

**Exemplars / Practical Applications and usage:**

अभियांत्रिकी क्षेत्रात प्रकल्प अहवाल, कार्यालयीन संवाद आणि तांत्रिक दस्तऐवजी करणासाठी हा घटक अत्यंत उपयुक्त आहे.

**Assignment 1:** एखाद्या प्रयोगाचा तांत्रिक अहवाल तयार करा.

**Assignment 2:** औद्योगिक भेटीवर आधारित प्रकल्प अहवाल लिहा.

**Assignment 3:** खालील प्रकारचे पत्रव्यवहार तयार करा:

- कार्यालयीन पत्र
- ई-मेल
- सूचना
- परिपत्रक

**Course Projects: -**

**Textbooks:**

1. डॉ. अशोक केळकर, डॉ. अशोक केळकर, Continental Prakashan, Pune.
2. महाराष्ट्र राज्य साहित्य संस्कृती मंडळ, तांत्रिक मराठी, Maharashtra Rajya Sahitya Sanskruti Mandal, Mumbai.
3. डॉ. सुहासिनी इलेंकर, संवादकौशल्ये, Diamond Publications, Pune.
4. महाराष्ट्र शासन प्रकाशन, कार्यालयीन मराठी, Government of Maharashtra Publication.
5. डॉ. मो. रा. वाळिंबे, मराठी व्याकरण आणि लेखन कौशल्य, Nirali Prakashan, Pune.
6. Alok Jain, Professional Communication Skills, s.chand Publishing.

**Reference Books:**

7. डॉ. अरविंद मंगरूळकर, आधुनिक मराठी व्याकरण, Venus Prakashan, Pune.
8. डॉ. मिलिंद मालशे, भाषा आणि संवाद कौशल्ये, Saket Publication, Aurangabad.
9. व्यक्तिमत्त्व विकास, शिवखेडा, Macmillan Publishers.
10. Sunita Mishra & C. Muralikrishn, Communication Skills for Engineers, Bloomsbury Publishing India.
11. B. N. Ghosh, Soft Skills for Engineers, Cengage Learning.

**MOOCs Links and additional reading material:**

3. <https://nptel.ac.in/courses/121107451?utm>
4. <https://archive.nptel.ac.in/course.html>
5. <https://elearn.nptel.ac.in/category/all-products>

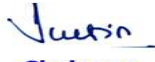
  
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| List of Practical: (Conduct any 8)                                                                                                                                                                                                                                                                                                                                               |                               |       |     |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------|-------|-----|
| Experiment No.1                                                                                                                                                                                                                                                                                                                                                                  | शुद्धलेखन आणि व्याकरण सराव    | 2 hrs | CO1 |
| <b>Objective:</b> विद्यार्थ्यांचे शुद्धलेखन व व्याकरण कौशल्य विकसित करणे.<br><b>Associated Tasks:</b> दिलेल्या परिच्छेदातील व्याकरण व शुद्धलेखनाच्या चुका ओळखून दुरुस्ती करणे<br><b>Exemplars and Utility:</b><br>Exemplar:<br><b>चुकीचा परिच्छेद दुरुस्त करणे.</b><br>Utility:<br><ul style="list-style-type: none"> <li>योग्य आणि प्रभावी लेखनासाठी उपयुक्त.</li> </ul>        |                               |       |     |
| Experiment No.2                                                                                                                                                                                                                                                                                                                                                                  | तांत्रिक शब्दसंग्रह तयार करणे | 2 hrs | CO1 |
| <b>Objective:</b><br>तांत्रिक मराठी संज्ञांची ओळख करून देणे.<br><b>Associated Tasks:</b><br>अभियांत्रिकी शाखेशी संबंधित मराठी – इंग्रजी तांत्रिक शब्दसंग्रह तयार करणे<br><b>Exemplars and Utility:</b><br>Exemplars :Civil Engineering शब्दसंग्रह तयार करणे<br>Utility (The Purpose):<br><ul style="list-style-type: none"> <li>तांत्रिक अहवाल आणि प्रकल्पलेखनात मदत.</li> </ul> |                               |       |     |
| Experiment No.3                                                                                                                                                                                                                                                                                                                                                                  | कार्यालयीन पत्रलेखन           | 2 hrs | CO2 |
| <b>Objective:</b><br>औपचारिक पत्रव्यवहार कौशल्य विकसित करणे<br><b>Associated Tasks:</b><br>रजा अर्ज, विनंती पत्र लिहिणे<br><b>Exemplars and Utility:</b><br>Exemplar: रजा अर्ज, विनंती पत्र लिहिणे.<br>Utility: सरकारी आणि औद्योगिक कार्यालयीन कामासाठी आवश्यक.                                                                                                                  |                               |       |     |
| Experiment No.4                                                                                                                                                                                                                                                                                                                                                                  | ई-मेल लेखन                    | 2 hrs | CO3 |
| <b>Objective:</b> व्यावसायिक ई-मेल लेखनाचे प्रशिक्षण देणे.<br><b>Associated Tasks:</b><br>Internship साठी ई-मेल लिहिणे<br><b>Exemplars and Utility:</b><br><ul style="list-style-type: none"> <li>उद्योग क्षेत्रातील डिजिटल संवादासाठी उपयुक्त</li> </ul>                                                                                                                        |                               |       |     |
| Experiment No.5                                                                                                                                                                                                                                                                                                                                                                  | तांत्रिक अहवाल लेखन           | 2 hrs | CO2 |
| <b>Objective:</b><br>अहवाल लेखनाची रचना आणि पद्धत समजावणे<br><b>Associated Tasks:</b><br>औद्योगिक भेट अहवाल तयार करणे<br><b>Exemplars and Utility:</b><br>Exemplars :<br>Utility :                                                                                                                                                                                               |                               |       |     |

  
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|                                                                                                                                                                                                                                                                                                                   |                                     |              |            |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|--------------|------------|
| प्रकल्प, प्रयोग आणि सर्वेक्षण दस्तऐवजीकरणासाठी आवश्यक                                                                                                                                                                                                                                                             |                                     |              |            |
| <b>Experiment No.6</b>                                                                                                                                                                                                                                                                                            | <b>PPT सादरीकरण कौशल्य</b>          | <b>2 hrs</b> | <b>CO4</b> |
| <b>Objective:</b><br><b>प्रभावी सादरीकरण कौशल्य विकसित करणे</b><br><b>Associated Tasks:</b><br>“Renewable Energy” विषयावर <b>PPT</b> तयार करणे<br><b>Exemplars and Utility:</b><br>Exemplars :<br>“Renewable Energy” विषयावर <b>PPT तयार करणे</b><br>Utility :<br>Seminar, Viva आणि Job Presentation साठी उपयुक्त |                                     |              |            |
| <b>Experiment No.7</b>                                                                                                                                                                                                                                                                                            | <b>गटचर्चा (Group Discussion)</b>   | <b>2 hrs</b> | <b>CO4</b> |
| <b>Objective:</b><br>संवाद, नेतृत्व आणि टीमवर्क वाढवणे.<br><b>Associated Tasks:</b><br>“Online Education” विषयावर <b>GD</b><br><b>Exemplars and Utility:</b><br>Exemplars<br>Campus Placement आणि व्यावसायिक चर्चेसाठी उपयुक्त<br>Utility :<br>Campus Placement आणि व्यावसायिक चर्चेसाठी उपयुक्त.                 |                                     |              |            |
| <b>Experiment No.8</b>                                                                                                                                                                                                                                                                                            | <b>मुलाखत कौशल्य सराव</b>           | <b>2 hrs</b> | <b>CO5</b> |
| <b>Objective:</b><br>मुलाखतीसाठी आत्मविश्वास आणि उत्तर देण्याची पद्धत विकसित करणे<br><b>Associated Tasks:</b><br><b>Mock Interview</b> घेणे<br><b>Exemplars and utility:</b><br>Job Interview आणि Personality Development साठी उपयुक्त                                                                            |                                     |              |            |
| <b>Experiment No.9</b>                                                                                                                                                                                                                                                                                            | <b>भाषांतरसराव</b>                  | <b>2 hrs</b> | <b>CO5</b> |
| <b>Objective:</b><br>द्विभाषिक संवाद आणि भाषांतर कौशल्य विकसित करणे<br><b>Associated Tasks:</b><br>इंग्रजी परिच्छेदाचे मराठीत भाषांतर<br><b>Exemplars and Utility:</b><br>Exemplars (Practical Example):<br><b>Technical Documentation</b> आणि प्रशासनिक कार्यासाठी उपयुक्त                                       |                                     |              |            |
| <b>Experiment No.10</b>                                                                                                                                                                                                                                                                                           | <b>डिजिटल माध्यमातील मराठी वापर</b> | <b>2 hrs</b> | <b>CO5</b> |

  
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**Objective:** डिजिटल प्लॅटफॉर्मवर प्रभावी मराठी वापरणे शिकवणे

**Associated Tasks:**

**ब्लॉग किंवा सोशल Media पोस्ट तयार करणे**

**Exemplars and Utility:**

Exemplars:

Utility:-Digital Communication आणि Content Creation मध्ये उपयुक्त

### Strength of CO-PO-PSO Mapping

| CO/PO | PO1  | PO2 | PO3 | PO4 | PO5 | PO6  | PO7 | PO8 | PO9 | PO10 | PO11 |
|-------|------|-----|-----|-----|-----|------|-----|-----|-----|------|------|
| CO1   | 1    | -   | -   | -   | -   | -    | -   | -   | 3   | -    | 2    |
| CO2   | 2    | 1   | 1   | 1   | 2   | -    | -   | 1   | 3   | 2    | 2    |
| CO3   | -    | -   | -   | -   | -   | 1    | 1   | 3   | 3   | 1    | 2    |
| CO4   | 1    | 1   | -   | -   | 2   | 1    | -   | 1   | 3   | -    | 2    |
| CO5   | -    | -   | -   | -   | -   | 2    | 3   | 3   | 2   | 1    | 3    |
| Avg   | 1.33 | 1   | 1   | 1   | 2   | 1.33 | 2   | 2   | 2.8 | 1.33 | 2.2  |

### Mapping Level

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

### Assessment Pattern

| BT Level | CCE |     |             |                |                             |                          | ESE |
|----------|-----|-----|-------------|----------------|-----------------------------|--------------------------|-----|
|          | CT1 | CT2 | Assignments | Course Project | Field Activity / Case Study | Quiz / presentation etc. |     |
| K1       | -   | -   | -           | -              | -                           | -                        | -   |
| K2       | -   | -   | -           | -              | -                           | -                        | -   |
| K3       | -   | -   | -           | -              | -                           | -                        | -   |
| K4       | -   | -   | -           | -              | -                           | -                        | -   |
| K5       | -   | -   | -           | -              | -                           | -                        | -   |
| K6       | -   | -   | -           | -              | -                           | -                        | -   |

This course serves as a prerequisite for / maps with the following future courses:

-

### Job Mapping:

हा अभ्यासक्रम विद्यार्थ्यांना उद्योग, प्रशासन, माध्यमे आणि व्यावसायिक क्षेत्रात प्रभावी संवाद, तांत्रिक लेखन आणि सादरीकरण कौशल्ये विकसित करण्यास मदत करतो. मुलाखत, प्रकल्प सादरीकरण, कार्यालयीन संवाद आणि डिजिटल कम्युनिकेशनसाठी हा अभ्यासक्रम अत्यंत उपयुक्त आहे.

  
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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                |          |        |                    |              |         |                |    |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------|----------|--------|--------------------|--------------|---------|----------------|----|
| Program:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | S. Y. B.Tech (Civil)                                                                                           |          |        |                    | Semester:    |         | IV             |    |
| Course:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Entrepreneurship and Contract Management                                                                       |          |        |                    | Course Code: |         | R25-CE-EEM-218 |    |
| Teaching Scheme                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                                                |          |        | Examination Scheme |              |         |                |    |
| Lecture                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | Practical                                                                                                      | Tutorial | Credit | CCE                | ESE          | TW      | PR             | OR |
| 02                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | -                                                                                                              | -        | 02     | 50                 | -            | -       | -              | -  |
| <b>Course Description:</b><br>This course introduces the fundamentals of entrepreneurship and contract management in civil engineering. It focuses on identifying business opportunities in construction, developing startup ideas, understanding tendering processes, contract administration, and dispute resolution. Students gain practical exposure to preparing business models, tender documents, and analyzing contracts used in infrastructure projects.                                                                                                                                                    |                                                                                                                |          |        |                    |              |         |                |    |
| <b>Course Relevance:</b><br>Civil engineers often engage in contracting, consulting, and infrastructure development. Knowledge of entrepreneurship enables them to establish and manage ventures, while contract management ensures proper execution of projects within legal and financial frameworks. This course bridges technical knowledge with business and legal aspects essential for professional success.                                                                                                                                                                                                  |                                                                                                                |          |        |                    |              |         |                |    |
| <b>Prerequisite:</b><br>Fundamentals of Management, Basics of Civil Engineering, Construction Practices                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                                                                                                |          |        |                    |              |         |                |    |
| <b>Bridge Content:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                                                |          |        |                    |              |         |                |    |
| <b>Course Objectives:</b><br>1. To <b>INTRODUCE</b> the fundamentals of entrepreneurship, innovation and business opportunities in civil engineering and allied sectors.<br>2. To <b>DEVELOP</b> entrepreneurial skills related to business planning, financial management and enterprise development.<br>3. To <b>PROVIDE</b> knowledge of various construction contracts, tendering procedures and contractual provisions used in civil engineering projects.<br>4. To <b>DEVELOP</b> understanding of contract administration, risk management and dispute resolution mechanisms for effective project execution. |                                                                                                                |          |        |                    |              |         |                |    |
| <b>Course Outcomes:</b> After learning the course, students will be able to                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |                                                                                                                |          |        |                    |              |         |                |    |
| CO                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Course Outcome                                                                                                 |          |        |                    |              |         | Bloom's Level  |    |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | IDENTIFY entrepreneurial opportunities and PREPARE basic business plans for startups and small enterprises.    |          |        |                    |              |         | 1,2,3          |    |
| CO2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | APPLY management, marketing and financial principles for establishing and managing entrepreneurial ventures    |          |        |                    |              |         | 1,2,3          |    |
| CO3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | SELECT suitable contract types and EVALUATE tendering procedures for different construction project scenarios. |          |        |                    |              |         | 1,2,3          |    |
| CO4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | APPLY principles of contract administration, claim management and dispute resolution in construction projects. |          |        |                    |              |         | 1,2,3          |    |
| Course Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                                                |          |        |                    |              |         |                |    |
| Unit 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Fundamentals of Entrepreneurship and Business Development                                                      |          |        |                    |              | 08 Hrs. | CO1            |    |

  
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Concepts and importance of entrepreneurship, types of entrepreneurships, and characteristics of successful entrepreneurs. Entrepreneurial traits, ethics and social responsibilities. Entrepreneurial opportunities in civil engineering including construction firms, consultancy services, project management, sustainable materials and infrastructure development. Idea generation, opportunity identification, innovation and creativity, startup development process, business models and basic sources of finance including loans, investors, venture capital and bootstrapping.

**Exemplar / Practical Application and Usage:**

These concepts enable civil engineers to launch and fund construction, consulting, or sustainable infrastructure startups, turning technical ideas into profitable, ethical businesses that solve urbanization challenges.

**Assignments:**

1. Why are ethics and social responsibilities considered critical traits for a civil engineering entrepreneur?
2. Where do the greatest entrepreneurial opportunities lie within urban infrastructure development for a civil engineering startup?

| Unit 2 | Business Planning and Enterprise Management | 08 Hrs. | CO2 |
|--------|---------------------------------------------|---------|-----|
|--------|---------------------------------------------|---------|-----|

Business planning and preparation of project reports for startups and small enterprises. Market survey, feasibility analysis, cost estimation, budgeting and resource planning. Basics of marketing, branding, leadership, team management and communication skills for entrepreneurs. Government schemes and support for startups, legal requirements for business registration, risk management and challenges in entrepreneurship with case studies related to civil engineering enterprises and construction businesses.

**Exemplar / Practical Application and Usage:**

These concepts allow civil engineers to systematically plan, finance, and launch construction ventures. By mastering feasibility analysis, budgeting, and legal registration alongside marketing and leadership skills, engineers can successfully leverage government support, manage project risks, and scale resilient, market-ready enterprises.

**Assignments:**

1. What are the essential components that must be included in a technical project report?
2. What are the key legal requirements and business registration steps a civil engineer?

| Unit 3 | Fundamentals of Contracts and Tendering | 07 Hrs. | CO3 |
|--------|-----------------------------------------|---------|-----|
|--------|-----------------------------------------|---------|-----|

Introduction to contract management, legal aspects and essential elements of contracts as per Indian Contract Act, 1872. Characteristics of good contracts, breach and termination of contracts, stakeholders in construction contracts and overview of contract management activities. Types of construction contracts including lump sum, fixed price, cost-plus, turnkey, BOT and design-build contracts. Tendering process including EOI, RFQ, RFP, bid security, prequalification, bidding strategy, tender evaluation, performance guarantee, contract documents, delays, penalties, liquidated damages and force majeure.

**Exemplar / Practical Application and Usage:**

Contract management enables civil engineers to legally safeguard projects under the Indian Contract Act, structure appropriate procurement methods (like BOT or Turnkey), handle bidding transparently, and manage risks like delays, penalties, and unforeseen disruptions during construction.

**Assignments:**

1. Why would a government authority choose a Build-Operate-Transfer (BOT) contract over a traditional Lump Sum contract for a mega-highway project?
2. What is the legal distinction between standard penalties and liquidated damages when a contractor causes extensive project delays?

  
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| Unit 4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Contract Administration & Dispute Resolution | 07 Hrs. | CO4 |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|---------|-----|
| General and special conditions of contracts, payment conditions, scope changes, extra claims, subcontracting and termination provisions. Contract administration, duties and responsibilities of parties, stakeholder agreements, contract risk management and management reporting. Change requests, extension of time, delay analysis and handling contractual claims. Dispute resolution mechanisms including negotiation, mediation and arbitration with administrative measures to avoid disputes and practical case studies related to construction contracts. |                                              |         |     |
| <b>Exemplar / Practical Application and Usage:</b><br>In civil engineering, these contract administration principles protect projects from financial and legal ruin when changes occur. They guide engineers in managing scope variations, analyzing delays for extensions of time, and handling extra claims. By utilizing structured dispute resolution like arbitration, engineers mitigate risks and ensure steady project completion despite inevitable site conflicts.                                                                                         |                                              |         |     |
| <b>Assignments:</b><br>What is the operational difference between the general and special conditions of a contract during a major infrastructure project?                                                                                                                                                                                                                                                                                                                                                                                                            |                                              |         |     |
| <b>Course Projects:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                              |         |     |
| -                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                              |         |     |
| <b>Textbooks:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                              |         |     |
| 1. Vasant Desai, "Entrepreneurship Development", Himalaya Publishing House, New Delhi<br>2. K. K. Chitkara, "Construction Project Management: Planning, Scheduling and Controlling", McGraw Hill Publishing Company                                                                                                                                                                                                                                                                                                                                                  |                                              |         |     |
| <b>Reference Books:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |                                              |         |     |
| 1. S. Anil Kumar, <i>Entrepreneurship Development</i> , New Age International Publishers.<br>2. Geoff Powell, <i>Construction Contract Preparation and Management: From Concept to Completion</i> , Bloomsbury Publishing.<br>3. B. Sengupta and H. Guha, <i>Construction Management and Planning</i> , Tata McGraw Hill Publishing Company.<br>4. M. N. Gangrade, <i>Contracts and Accounts in Civil Engineering</i> , Nirali Prakashan.<br>5. Will Hughes and Ronan Champion, <i>Construction Contracts: Law and Management</i> , Wiley-Blackwell.                 |                                              |         |     |
| <b>MOOCs Links and additional reading material:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                              |         |     |
| 6. <a href="https://nptel.ac.in/courses/1101061413">https://nptel.ac.in/courses/1101061413</a><br>7. <a href="https://nptel.ac.in/courses/129106006">https://nptel.ac.in/courses/129106006</a>                                                                                                                                                                                                                                                                                                                                                                       |                                              |         |     |

### Strength of CO-PO-PSO Mapping

| CO   | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1  | 3   | 2   | 2   | 1   | 1   | -   | -   | -   | 1   | 2    | 3    | 3    | 2    | 2    |
| CO2  | 3   | 2   | 2   | 1   | 1   | -   | -   | -   | 1   | 2    | 3    | 3    | 2    | 2    |
| CO3  | 3   | 2   | 2   | 2   | 2   | -   | -   | -   | 1   | 2    | 3    | 3    | 2    | 2    |
| CO4  | 3   | 2   | 2   | 2   | 2   | -   | -   | -   | 1   | 2    | 3    | 3    | 2    | 2    |
| Avg. | 3   | 2   | 2   | 1.5 | 1.5 | -   | -   | -   | 1   | 2    | 3    | 3    | 2    | 2    |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

  
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### Assessment Pattern

| BT Level | CCE |     |             |                |                             |                          | ESE |
|----------|-----|-----|-------------|----------------|-----------------------------|--------------------------|-----|
|          | CT1 | CT2 | Assignments | Course Project | Field Activity / Case Study | Quiz / presentation etc. |     |
| K1       | ✓   | -   | ✓           | -              | -                           | ✓                        | -   |
| K2       | ✓   | -   | ✓           | -              | -                           | ✓                        | -   |
| K3       | ✓   | -   | ✓           | -              | -                           | ✓                        | -   |
| K4       | -   | -   | -           | -              | -                           | -                        | -   |
| K5       | -   | -   | -           | -              | -                           | -                        | -   |
| K6       | -   | -   | -           | -              | -                           | -                        | -   |

Entrepreneurship and Contract Management serves as a prerequisite for / maps with the following future Civil Engineering courses:

Quantity Surveying, Contracts and Tenders

#### Job Mapping:

Entrepreneur – starts and manages construction firms, consultancy services, or material supply businesses.

Business Development Executive – identifies business opportunities, develops client networks, and supports startup growth.

Startup Founder – develops innovative solutions and technology-based ventures in civil engineering and infrastructure sectors.

Tendering Engineer – prepares tender documents, BOQs, and participates in bidding and procurement processes.

Contract Engineer – manages contract documentation, compliance, variations, and coordination between stakeholders.

Billing and Planning Engineer – handles interim bills, payment procedures, project scheduling, and contract administration activities.

Contract Manager – oversees contract execution, claims management, dispute resolution, and legal compliance in construction projects.

  
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|                              |                         |          |        |                    |                |    |    |    |
|------------------------------|-------------------------|----------|--------|--------------------|----------------|----|----|----|
| Program:                     | S. Y. B.Tech. (Civil)   |          |        | Semester:          | IV             |    |    |    |
| Course:                      | Concrete Technology Lab |          |        | Course Code:       | R25-CE-PCC-219 |    |    |    |
| Teaching Scheme (hrs / week) |                         |          |        | Examination Scheme |                |    |    |    |
| Lecture                      | Practical               | Tutorial | Credit | CCE                | ESE            | TW | PR | OR |
| -                            | 02                      | -        | 01     | -                  | -              | -  | -  | 25 |

**Course Description:**

Concrete Technology Laboratory provides practical knowledge of cement, aggregates, fresh concrete and hardened concrete testing. The course emphasizes laboratory experimentation, concrete mix design, quality control, durability evaluation and non-destructive testing methods used in modern construction practices.

**Course Relevance:**

The course helps students understand practical aspects of concrete technology and quality control in construction engineering. It develops laboratory skills, interpretation of experimental data and understanding of material behavior required in construction industry, RMC plants and structural engineering applications.

**Prerequisite:**

Engineering Chemistry , Building Materials

**Bridge Content:****Course Objectives:**

1. To **STUDY** properties of cement, fine aggregate and coarse aggregate through laboratory testing.
2. To **PERFORM** concrete mix design as per IS 10262 guidelines.
3. To **EVALUATE** properties of fresh and hardened concrete.
4. To **CONDUCT** durability and non-destructive testing on concrete.
5. To **DEVELOP** experimental skills and technical report preparation ability.

**Course Outcomes:** After learning the course, students will be able to

| CO  | Course Outcome                                                                       | Bloom's Level |
|-----|--------------------------------------------------------------------------------------|---------------|
| CO1 | <b>PERFORM</b> laboratory tests on cement and aggregates and interpret results.      | 3             |
| CO2 | <b>DESIGN</b> concrete mix using IS 10262 provisions.                                | 3             |
| CO3 | <b>CONDUCT</b> tests on fresh and hardened concrete and analyze strength properties. | 4             |
| CO4 | <b>EVALUATE</b> durability and non-destructive characteristics of concrete.          | 4             |
| CO5 | <b>ANALYZE</b> experimental data and prepare structured technical reports.           | 5             |

**List of Practical:**

|                        |                        |              |            |
|------------------------|------------------------|--------------|------------|
| <b>Experiment No.1</b> | <b>Tests on Cement</b> | <b>2 Hrs</b> | <b>CO1</b> |
|------------------------|------------------------|--------------|------------|

**Objective:**

To determine physical properties of cement.

**Associated Tasks:**

- Fineness test
- Standard consistency test
- Initial and final setting time
- Soundness test
- Compressive strength test

**Exemplars and Utility:**

Understanding quality and suitability of cement for construction works.

|                        |                                |              |            |
|------------------------|--------------------------------|--------------|------------|
| <b>Experiment No.2</b> | <b>Tests on Fine Aggregate</b> | <b>2 Hrs</b> | <b>CO1</b> |
|------------------------|--------------------------------|--------------|------------|

  
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**Objective:**

To determine physical properties of fine aggregate.

**Associated Tasks:**

- Sieve analysis
- Specific gravity
- Water absorption
- Bulking test

**Exemplars and Utility:**

Selection and grading of sand for concrete production.

|                        |                                  |              |            |
|------------------------|----------------------------------|--------------|------------|
| <b>Experiment No.3</b> | <b>Tests on Coarse Aggregate</b> | <b>2 Hrs</b> | <b>CO1</b> |
|------------------------|----------------------------------|--------------|------------|

**Objective:**

To determine engineering properties of coarse aggregate.

**Associated Tasks:**

- Aggregate impact value
- Aggregate crushing value
- Specific gravity and water absorption

**Exemplars and Utility:**

Assessment of aggregate strength and durability.

|                        |                                        |              |            |
|------------------------|----------------------------------------|--------------|------------|
| <b>Experiment No.4</b> | <b>Concrete Mix Design by IS 10262</b> | <b>2 Hrs</b> | <b>CO2</b> |
|------------------------|----------------------------------------|--------------|------------|

**Objective:**

To design concrete mix as per IS recommendations.

**Associated Tasks:**

- Selection of materials
- Mix proportion calculation
- Water-cement ratio determination

**Exemplars and Utility:**

Practical understanding of mix proportioning for required strength

|                        |                                |              |            |
|------------------------|--------------------------------|--------------|------------|
| <b>Experiment No.5</b> | <b>Tests on Fresh Concrete</b> | <b>2 Hrs</b> | <b>CO3</b> |
|------------------------|--------------------------------|--------------|------------|

**Objective:**

To determine workability of fresh concrete.

**Associated Tasks:**

- Slump test
- Compaction factor test
- Vee-Bee test
- Flow table test

**Exemplars and Utility:**

Evaluation of concrete workability for field applications.

|                        |                                   |              |            |
|------------------------|-----------------------------------|--------------|------------|
| <b>Experiment No.6</b> | <b>Tests on Hardened Concrete</b> | <b>2 Hrs</b> | <b>CO3</b> |
|------------------------|-----------------------------------|--------------|------------|

  
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**Objective:**

To prepare concrete specimens using standard procedures and determine their structural strength properties.

**Associated Tasks:**

- Batching of materials,
- Mixing of concrete, Casting and Curing of cubes/cylinders,
- Compressive strength test,
- Split tensile strength test,
- Flexural strength test.

**Exemplars and Utility:**

Assessment of structural performance of concrete.

|                        |                                     |              |            |
|------------------------|-------------------------------------|--------------|------------|
| <b>Experiment No.7</b> | <b>Durability Tests on Concrete</b> | <b>2 Hrs</b> | <b>CO4</b> |
|------------------------|-------------------------------------|--------------|------------|

**Objective:**

To study durability characteristics of concrete.

**Associated Tasks:**

- Water absorption test
- Permeability test
- Shrinkage test

**Exemplars and Utility:**

Understanding long-term performance of concrete structures.

|                        |                                            |              |            |
|------------------------|--------------------------------------------|--------------|------------|
| <b>Experiment No.8</b> | <b>Non-Destructive Testing on Concrete</b> | <b>2 Hrs</b> | <b>CO4</b> |
|------------------------|--------------------------------------------|--------------|------------|

**Objective:**

To evaluate concrete quality using NDT methods.

**Associated Tasks:**

- Rebound hammer test
- Ultrasonic Pulse Velocity test

**Exemplars and Utility:**

Assessment of in-situ concrete quality without damaging structure.

|                        |                                  |              |            |
|------------------------|----------------------------------|--------------|------------|
| <b>Experiment No.9</b> | <b>Study of Special Concrete</b> | <b>2 Hrs</b> | <b>CO5</b> |
|------------------------|----------------------------------|--------------|------------|

**Objective:**

To understand the properties and applications of modern and advanced concretes.

**Associated Tasks:**

Study of special concrete types (e.g., High-performance concrete, Self-compacting concrete, Fiber-reinforced concrete).

**Exemplars and Utility:**

Theoretical and practical understanding of advanced concrete technology and material behavior.

|                         |                                     |              |            |
|-------------------------|-------------------------------------|--------------|------------|
| <b>Experiment No.10</b> | <b>Technical Visit to RMC Plant</b> | <b>2 Hrs</b> | <b>CO5</b> |
|-------------------------|-------------------------------------|--------------|------------|

  
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**Objective:**

To understand modern concrete production at an industrial scale.

**Associated Tasks:**

Observation of RMC plant operations, automated batching processes, and plant-level quality control testing.

**Exemplars and Utility:**

Industrial exposure to large-scale ready-mix concrete production and logistics.

**Textbooks:**

1. Concrete Technology by M. S. Shetty
2. Concrete Technology by A. M. Neville
3. Properties of Concrete by A. M. Neville

**Reference Books:**

1. Gambhir M. L., Concrete Technology
2. IS 10262 – Concrete Mix Proportioning Guidelines
3. IS 456 – Plain and Reinforced Concrete Code
4. IS 516 – Methods of Tests for Strength of Concrete

**MOOCs Links and additional reading material:**

1. NPTEL – Concrete Technology
2. SWAYAM Courses on Construction Materials
3. IIT Lectures on Concrete Engineering
4. BIS Codes and Standards

**Strength of CO-PO-PSO Mapping**

| CO   | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1  | 3   | 2   | -   | 1   | 1   | -   | -   | -   | -   | -    | -    | 3    | 2    | 1    |
| CO2  | 3   | 3   | 2   | 2   | 1   | -   | -   | -   | -   | -    | -    | 3    | 2    | 1    |
| CO3  | 3   | 3   | 2   | 2   | 1   | -   | -   | -   | -   | -    | -    | 3    | 2    | 1    |
| CO4  | 3   | 2   | 1   | 2   | 1   | 1   | 1   | -   | -   | -    | -    | 3    | 2    | 1    |
| CO5  | 2   | 2   | 1   | 2   | 1   | -   | -   | 1   | 1   | 1    | -    | 2    | 1    | 1    |
| Avg. | 3   | 3   | 2   | 2   | 1   | 1   | 1   | 1   | 1   | 1    | -    | 3    | 2    | 1    |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

This course serves as a prerequisite for / maps with the following future courses:

- Design of Concrete Structures
- Advanced Concrete Technology
- Construction Engineering and Management
- Repair and Rehabilitation of Structures
- Quality Control and Assurance Engineering

**Job Mapping:**

- Site Engineer
- Quality Control Engineer
- RMC Plant Engineer
- Laboratory Testing Engineer
- Structural Design Assistant
- Research Assistant

  
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|------------------------------|-----------------------|----------|--------|--------------------|--------------|----|----------------|----|
| Program:                     | S. Y. B.Tech. (Civil) |          |        |                    | Semester:    |    | IV             |    |
| Course:                      | Fluid Mechanics Lab   |          |        |                    | Course Code: |    | R25-CE-PCC-220 |    |
| Teaching Scheme (hrs / week) |                       |          |        | Examination Scheme |              |    |                |    |
| Lecture                      | Practical             | Tutorial | Credit | CCE                | ESE          | TW | PR             | OR |
| -                            | 02                    | -        | 01     | -                  | -            | -  | -              | 25 |

**Course Description:**

The Fluid Mechanics laboratory disseminates students with the experimental determination of fluid properties and the verification of fundamental laws governing fluid statics and fluid flow. The laboratory provides hands-on experience in measuring discharge, pressure, velocity, head loss, and identifying flow regimes using standard hydraulic apparatus. It also develops students' skills in experimentation, observation, data analysis, and interpretation of results while understanding practical limitations in fluid flow systems.

**Course Relevance:**

This course is highly relevant to Civil Engineering applications such as pipe flow systems, hydraulic structures, water supply networks, irrigation systems, and environmental engineering projects. The practical knowledge gained through experimentation helps students understand real-life fluid behavior and strengthens the theoretical concepts learned in Fluid Mechanics. The laboratory also enhances problem-solving ability, technical competency, and preparedness for professional engineering practice and advanced studies in hydraulics and water resources engineering.

**Prerequisite:**

Physics, Engineering Mathematics and Engineering Mechanics

**Bridge Content:****Course Objectives:**

**UNDERSTAND** the physical properties of fluids, as well as the **USE** of pressure measuring devices and the concept of fluid statics.

To **STUDY** the fluid dynamics and use of various flow measuring devices.

To **EXAMINE** different losses in a pipe flow.

To **IMPART** knowledge of open channel flow and hydraulic machines.

To **DEVELOP** experimental and analytical skills for interpreting hydraulic phenomena and solving practical fluid engineering problems.

**Course Outcomes:** After learning the course, students will be able to

| CO  | Course Outcome                                                                                                                                                                                                    | Bloom's Level |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|
| CO1 | <b>EXPLAIN</b> the concept of viscosity as a fluid property, <b>MEASURE</b> the fluid pressure, and use various devices to measure fluid pressure.                                                                | 2             |
| CO2 | <b>APPLY</b> the buoyancy principle to determine the stability of a floating body using ship model.                                                                                                               | 3             |
| CO3 | <b>APPLY</b> Bernoulli's equation to fluid flow problems and <b>DISCOVER</b> the basic concepts of discharge determination employing flow measuring devices.                                                      | 3             |
| CO4 | <b>CLASSIFY</b> different types of flow based on Reynold's number, <b>DETERMINING</b> the major/minor losses in a pipe flow experimentally, <b>ANALYSE</b> velocity distribution and uniform flow in open channel | 3             |
| CO5 | <b>PERFORM</b> fluid mechanics laboratory experiments, <b>ANALYZE</b> experimental data, interpret results, and <b>PREPARE</b> structured technical                                                               | 3             |

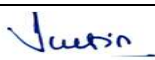
  
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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                           |              |                 |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|--------------|-----------------|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | reports with relevance to real-world hydraulic systems and site observations.             |              |                 |
| <b>List of Practical:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                           |              |                 |
| <b>Experiment No.1</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>Measurement of viscosity of fluid by using Redwood Viscometer.</b>                     | <b>2 Hrs</b> | <b>CO1, CO5</b> |
| <p><b>Objective:</b><br/>To determine the dynamic viscosity of a given fluid by measuring its resistance to flow using a standard viscometer.</p> <p><b>Associated Tasks:</b><br/>Calibration of the viscometer, observation of flow time under controlled conditions, and calculation of viscosity using relevant empirical relations.</p> <p><b>Exemplars and Utility:</b><br/>Demonstrates fluid resistance characteristics and has practical applications in hydraulic design, lubrication systems, and industrial fluid handling.</p> |                                                                                           |              |                 |
| <b>Experiment No.2</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>Experimental verification of Bernoulli's theorem with reference to loss of energy.</b> | <b>2 Hrs</b> | <b>CO3, CO5</b> |
| <p><b>Objective:</b><br/>To experimentally verify Bernoulli's theorem for fluid flow and evaluate the loss of energy between two sections of a flow system.</p> <p><b>Associated Tasks:</b><br/>Measurement of pressure head, velocity head, and elevation head at different sections and computation of total head and head loss.</p> <p><b>Exemplars and Utility:</b><br/>Illustrates energy transformation in flowing fluids and is useful in the analysis and design of pipes, nozzles, and hydraulic systems.</p>                     |                                                                                           |              |                 |
| <b>Experiment No.3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>Calibration of Venturimeter meter.</b>                                                 | <b>2 Hrs</b> | <b>CO3, CO5</b> |
| <p><b>Objective:</b><br/>To calibrate a venturimeter meter by determining its coefficient of discharge through experimental measurement of flow rate.</p> <p><b>Associated Tasks:</b><br/>Measurement of pressure difference and actual discharge, comparison with theoretical discharge, and evaluation of the coefficient of discharge.</p> <p><b>Exemplars and Utility:</b><br/>Provides practical understanding of flow measurement devices and their application in pipelines, water supply systems, and industrial flow control.</p> |                                                                                           |              |                 |
| <b>Experiment No.4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | <b>Calibration of Orifice meter.</b>                                                      | <b>2 Hrs</b> | <b>CO3, CO5</b> |
| <p><b>Objective:</b><br/>To calibrate a orifice meter by determining its coefficient of discharge through experimental measurement of flow rate.</p> <p><b>Associated Tasks:</b><br/>Measurement of pressure difference and actual discharge, comparison with theoretical discharge, and evaluation of the coefficient of discharge.</p> <p><b>Exemplars and Utility:</b></p>                                                                                                                                                              |                                                                                           |              |                 |

  
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Provides practical understanding of flow measurement devices and their application in pipelines, water supply systems, and industrial flow control.

|                        |                                                         |              |                     |
|------------------------|---------------------------------------------------------|--------------|---------------------|
| <b>Experiment No.5</b> | <b>Study of Uniform Flow Formulae for Open channel.</b> | <b>2 Hrs</b> | <b>CO4,<br/>CO5</b> |
|------------------------|---------------------------------------------------------|--------------|---------------------|

**Objective:**

To study and verify uniform flow conditions in an open channel using standard uniform flow formulae such as Chezy's and Manning's equations.

**Associated Tasks:**

Measurement of channel dimensions, slope, hydraulic radius, velocity, and discharge, followed by computation using uniform flow equations.

**Exemplars and Utility:**

Enhances understanding of open channel hydraulics and is applicable in the design and analysis of canals, drains, and irrigation channels.

|                        |                                                       |              |                     |
|------------------------|-------------------------------------------------------|--------------|---------------------|
| <b>Experiment No.6</b> | <b>Calibration of Rectangular / Triangular Notch.</b> | <b>2 Hrs</b> | <b>CO3,<br/>CO5</b> |
|------------------------|-------------------------------------------------------|--------------|---------------------|

**Objective:**

To calibrate a rectangular/triangular notch by determining the coefficient of discharge through experimental measurement of flow rate.

**Associated Tasks:**

Measurement of head over the notch, calculation of theoretical discharge, and comparison with actual discharge to evaluate performance.

**Exemplars and Utility:**

Demonstrates principles of open channel flow measurement and is widely used in laboratory testing, irrigation channels, and wastewater flow measurement.

|                        |                                                |              |                     |
|------------------------|------------------------------------------------|--------------|---------------------|
| <b>Experiment No.7</b> | <b>Determination of Minor Losses in pipes.</b> | <b>2 Hrs</b> | <b>CO4,<br/>CO5</b> |
|------------------------|------------------------------------------------|--------------|---------------------|

**Objective:**

To determine head losses due to pipe fittings such as bends, valves, and sudden expansions or contractions in a pipe flow system.

**Associated Tasks:**

Measurement of pressure drop across fittings, calculation of loss coefficients, and comparison of experimental and theoretical losses.

**Exemplars and Utility:**

Provides insight into energy losses in pipeline systems and supports efficient design of water supply, irrigation, and industrial piping networks.

|                        |                                                                       |              |                     |
|------------------------|-----------------------------------------------------------------------|--------------|---------------------|
| <b>Experiment No.8</b> | <b>Determination of Stability of Floating Bodies using Ship Model</b> | <b>2 Hrs</b> | <b>CO2,<br/>CO5</b> |
|------------------------|-----------------------------------------------------------------------|--------------|---------------------|

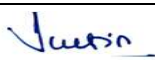
**Objective:**

To determine the metacentric height and assess the stability of a floating body using a ship model under different loading conditions.

**Associated Tasks:**

Measurement of heel angle, shift of load, calculation of metacentric height, and observation of restoring moments.

**Exemplars and Utility:**

  
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Demonstrates principles of buoyancy and stability, with applications in the design and safety analysis of ships, boats, and floating structures.

|                        |                                                        |              |                 |
|------------------------|--------------------------------------------------------|--------------|-----------------|
| <b>Experiment No.9</b> | <b>Measurement of point velocity using pitot tube.</b> | <b>2 Hrs</b> | <b>CO4, CO5</b> |
|------------------------|--------------------------------------------------------|--------------|-----------------|

**Objective:**

To measure the point velocity of flowing fluid at a specific location in a pipe or channel using a Pitot tube based on Bernoulli's principle.

**Associated Tasks:**

Installation of Pitot tube in the flow section, measurement of stagnation and static pressure head, recording differential head readings, calculation of point velocity, and analysis of flow characteristics.

**Exemplars and Utility:**

Demonstrates the application of Bernoulli's theorem and fluid flow measurement techniques, with applications in hydraulic laboratories, pipe flow analysis, ventilation systems, aircraft speed measurement, and industrial fluid transport systems.

|                         |                                                            |              |                 |
|-------------------------|------------------------------------------------------------|--------------|-----------------|
| <b>Experiment No.10</b> | <b>Determine the Reynold's Number and the Type of Flow</b> | <b>2 Hrs</b> | <b>CO4, CO5</b> |
|-------------------------|------------------------------------------------------------|--------------|-----------------|

**Objective:**

To determine the Reynolds number of fluid flowing through a pipe and identify the nature of flow as laminar, transitional, or turbulent.

**Associated Tasks:**

Measurement of discharge, determination of flow velocity, calculation of Reynolds number using fluid properties and pipe dimensions, observation of flow pattern using dye injection, and classification of flow regime.

**Exemplars and Utility:**

Demonstrates the principles of fluid flow behavior and transition of flow regimes, with applications in pipe network design, hydraulic engineering, water supply systems, chemical processing industries, and fluid transport analysis.

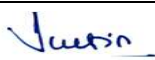
### Strength of CO-PO-PSO Mapping

| CO   | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1  | 3   | 2   | —   | —   | —   | —   | —   | —   | —   | —    | —    | 3    | —    | —    |
| CO2  | 3   | —   | —   | 1   | —   | —   | —   | —   | —   | —    | —    | 3    | 2    | —    |
| CO3  | 3   | 3   | —   | 2   | —   | —   | —   | —   | —   | —    | —    | 3    | 2    | —    |
| CO4  | 3   | 3   | 2   | 2   | —   | —   | —   | —   | —   | —    | —    | 3    | —    | —    |
| CO5  | 2   | 2   | 2   | 1   | 1   | —   | —   | 1   | 1   | 1    | —    | 2    | 1    | —    |
| Avg. | 3   | 3   | 2   | 2   | 1   | —   | —   | 1   | 1   | 1    | —    | 3    | 2    | —    |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

### Textbooks:

1. Dr P. N. Modi & S. M.Seth, "Hydraulics and Fluid Mechanics including Hydraulic Machine", Standard book house, Delhi-6
2. K Subramanya, "Flow in Open Channels", Tata McGraw Hill, New Delhi.
3. Sukumar Pati, "Fluid Mechanics and Hydraulic Machines", McGraw Hill, New Delhi.

  
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### Reference Books:

1. R. J. Garde and A.J Mirajgaonkar, “Engineering Fluid Mechanics”, SCITECH Publications (India) Pvt. Ltd, Chennai.
2. Vijay Gupta, Santosh K Gupta, “Fluid Mechanics and its Applications”, New Age International Pvt. Ltd, New Delhi.
3. Yunus A Cengel and John M Cimbala, “Fluid Mechanics, Fundamentals and applications”, Mc Graw Hill International, New Delhi.
4. Streeter, Wylie and Bedford, “Fluid Mechanics”, McGraw Hill International, New Delhi.
5. Ven Tee Chow, “Open Channel Hydraulics”, McGraw- Hill Book Company- Koga.
6. Dr. R K Rajput, “Fluid Mechanics and Hydraulic Machines”, S Chand and Co Ltd. New Delhi 7th edition, Pearson.

### MOOCs Links and additional reading material:

7. SWAYAM-NPTEL: [https://onlinecourses.nptel.ac.in/noc23\\_me42/preview](https://onlinecourses.nptel.ac.in/noc23_me42/preview)
8. SWAYAM-NPTEL: [https://onlinecourses.nptel.ac.in/noc25\\_ce66/preview](https://onlinecourses.nptel.ac.in/noc25_ce66/preview)
9. SWAYAM-NPTEL: [https://onlinecourses.nptel.ac.in/noc25\\_me41/preview](https://onlinecourses.nptel.ac.in/noc25_me41/preview)
10. SWAYAM-NPTEL: <https://nptel.ac.in/courses/105101082>
11. SWAYAM-NPTEL: <https://nptel.ac.in/courses/105103095>
12. SWAYAM-NPTEL: <https://nptel.ac.in/courses/112106768>

This course serves as a prerequisite for / maps with the following future courses:

- **Hydrology and Water Resources Engineering**  
– Application of fluid properties, flow measurement, pipe flow losses, and open channel flow concepts.
  - **Irrigation Engineering**  
– Understanding of canal flow, discharge measurement, hydraulic structures, and energy dissipation mechanisms.
  - **Design of Hydraulic Structures**  
– Use of Bernoulli’s principle, pressure distribution, hydraulic jump, and stability concepts in structural design.
  - **Water Supply Engineering**  
– Analysis of pipe networks, pressure measurement, losses in pipes, and flow measurement devices.
- Environmental Engineering (Water & Wastewater Engineering)
- Flow measurement, velocity distribution, and hydraulic behavior in treatment units and conveyance systems.
  - **Advanced Fluid Mechanics / Computational Fluid Dynamics (Elective)**  
– Experimental understanding of flow regimes, Reynolds number, and validation of analytical and numerical models.

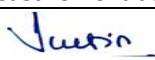
### Job Mapping:

#### 1. Graduate Civil Engineer / Site Engineer

Measurement and interpretation of fluid pressure, discharge, and flow conditions on construction sites.  
Application of Bernoulli’s principle, pipe losses, and open channel flow concepts in water supply and drainage works.  
Understanding stability of floating structures, tanks, and hydraulic elements

#### 2. Water Resources / Irrigation Engineer (Junior Level)

Discharge measurement using Venturimeter, Orificemeter, and Notches

  
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Analysis of open channel flow, uniform flow, and velocity distribution  
Practical understanding of hydraulic structures such as canals, spillways, and energy dissipators

**3. Hydraulic Design & Analysis Engineer (Entry Level)**

Estimation of major and minor losses in pipelines  
Use of Reynolds number for flow regime classification  
Application of Hardy Cross method for pipe network analysis

**4. Quality Control / Testing Engineer (Hydraulics & Infrastructure)**

Experimental testing of flow parameters and pressure systems  
Calibration of flow-measuring devices  
Data recording, result validation, and preparation of technical test reports

**5. Research Assistant / Higher Studies (M.Tech / PhD Aspirant)**

Experimental verification of fluid mechanics theories  
Data analysis, error estimation, and interpretation of results  
Exposure to laboratory practices and hydraulic research facilities through site visits

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|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------|----------|--------|--------------------|--------------|---------|----------------|----|
| Program:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | S.Y. B.Tech. (Civil)                                                           |          |        |                    | Semester:    |         | IV             |    |
| Course:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Environmental Studies                                                          |          |        |                    | Course Code: |         | R25-CE-VEC-221 |    |
| Teaching Scheme (hrs/week)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                |          |        | Examination Scheme |              |         |                |    |
| Lecture                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Practical                                                                      | Tutorial | Credit | CCE                | ESE          | TW      | PR             | OR |
| 02                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | -                                                                              | -        | 02     | 50                 | -            | -       | -              | -  |
| <b>Course Description:</b><br>This course provides a comprehensive, multidisciplinary exploration of Environment. It integrates perspectives from the physical sciences, social sciences, and humanities to analyze the complex causes Environmental issues.                                                                                                                                                                                                                                                                                      |                                                                                |          |        |                    |              |         |                |    |
| <b>Course Relevance:</b><br>Public health and safety, Environment awareness                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                |          |        |                    |              |         |                |    |
| <b>Prerequisite:</b> Fundamentals of Surveying, Building Planning                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                                                                                |          |        |                    |              |         |                |    |
| <b>Bridge Content:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                |          |        |                    |              |         |                |    |
| <b>Course Objectives:</b><br>1.To <b>MAKE</b> students understand importance of Environmental studies and Natural Resources<br>2. To <b>UNDERSTAND</b> the ecosystem & Biodiversity.<br>3. To <b>UNDERSTAND</b> Cause, effects and control measures of various Environmental Pollutions.<br>4. To <b>ANALYZE</b> the various Environmental Social issues.                                                                                                                                                                                         |                                                                                |          |        |                    |              |         |                |    |
| <b>Course Outcomes:</b> After learning the course, students will be able to                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |                                                                                |          |        |                    |              |         |                |    |
| CO                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Course Outcome                                                                 |          |        |                    |              |         | Bloom's Level  |    |
| CO1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | DEFINE identify, scope of Environmental Studies.                               |          |        |                    |              |         | 1              |    |
| CO2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | UNDERSTAND structure and function of ecosystem                                 |          |        |                    |              |         | 2              |    |
| CO3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | ASCERTAIN the various Environmental pollution and solid waste management       |          |        |                    |              |         | 1              |    |
| CO4                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | ASSESS Social Issues related to the Environment                                |          |        |                    |              |         | 1              |    |
| Course Content                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                |          |        |                    |              |         |                |    |
| Unit 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Title: Multidisciplinary nature of environmental studies and Natural Resources |          |        |                    |              | 08 Hrs. | CO1            |    |
| Definition, scope and importance, Need for public awareness, Renewable and non-renewable resources :<br>Natural resources and associated problems, Mining, dams and their effects on forest. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. Energy resources: Growing energy needs renewable and non-renewable energy sources. |                                                                                |          |        |                    |              |         |                |    |
| <b>Exemplars / Practical Applications and usage:</b><br>Use of Renewable and non-renewable resources in day today life                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                |          |        |                    |              |         |                |    |
| <b>Assignments:</b><br>1. Explain scope and Importance of Environmental Studies<br>2. State and explain various Renewable and non-renewable resources<br>3. Write for growing energy needs.                                                                                                                                                                                                                                                                                                                                                       |                                                                                |          |        |                    |              |         |                |    |
| Unit 2                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Title: Ecosystems & Biodiversity                                               |          |        |                    |              | 08 Hrs. | CO2            |    |
| Concept of an ecosystem, Structure and function of an ecosystem, Producers, consumers and decomposers, Energy flow in the ecosystem. Ecological succession, Food chains, food webs and ecological pyramids,Introduction, types, characteristic features, structure and function of the ecosystem, <b>Automated Biodiversity Net Gain (BNG)</b>                                                                                                                                                                                                    |                                                                                |          |        |                    |              |         |                |    |

  
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|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|----------------|------------|
| Introduction – Definition : genetic, species and ecosystem diversity, Biogeographically classification of India, Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and option values, Biodiversity at global, National and local level                                                                                                                                                                                                                      |                                                                    |                |            |
| <b>Exemplars / Practical Applications and usage:</b><br>Structure and function of various eco systems                                                                                                                                                                                                                                                                                                                                                                                         |                                                                    |                |            |
| <b>Assignments:</b><br>1. Explain Structure and function of an ecosystem.<br>2. Explain Biogeographically classification of India<br>3. Explain Biodiversity at global.                                                                                                                                                                                                                                                                                                                       |                                                                    |                |            |
| <b>Unit 3</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>Title: Environmental Pollution &amp; solid waste Management</b> | <b>07 Hrs.</b> | <b>CO3</b> |
| Cause, effects and control measures of: - a. Air pollution b. Soil pollution c. Marine pollution d. Noise pollution f. Thermal pollution, Environment Protection Act, Air (Prevention and Control of Pollution) Act, Water (Prevention and control of Pollution) Act. <b>Urban particulate matter trapping (Optical PM 2.5 Sensor nodes)</b><br>Solid waste Management: Causes, effects and control measures of urban and industrial wastes, Role of an individual in prevention of pollution |                                                                    |                |            |
| <b>Exemplars / Practical Applications and usage:</b><br>Municipal solid waste management, Environmental Pollutions                                                                                                                                                                                                                                                                                                                                                                            |                                                                    |                |            |
| <b>Assignments:</b><br>1. Explain the effect of Air pollution<br>2. Write a short not on industrial waste management<br>3. Write a short note on Nuclear hazards                                                                                                                                                                                                                                                                                                                              |                                                                    |                |            |
| <b>Unit 4</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | <b>Title: Social Issues</b>                                        | <b>07 Hrs.</b> | <b>CO4</b> |
| From Unsustainable to Sustainable development, urban problems related to energy, Water conservation, rain water harvesting, watershed management, Resettlement and rehabilitation of people; its problems and concerns. Case Studies, Environmental ethics: Issues and possible solutions, Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies.                                                                                   |                                                                    |                |            |
| <b>Exemplars / Practical Applications and usage:</b><br>Recycle and reuse of waste water                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                    |                |            |
| <b>Assignments:</b><br>1. Write a short note on Water conservation<br>2. What is mean by global warming<br>3. Explain ozone layer depletion                                                                                                                                                                                                                                                                                                                                                   |                                                                    |                |            |
| <b>Course Projects:</b><br>-                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                    |                |            |
| <b>Textbooks:</b><br><ul style="list-style-type: none"> <li>Water Supply Engineering, S. K. Garg, Khanna Publishers, New Delhi.</li> <li>Text book for Environmental studies by UGC</li> <li>Text book for Environmental studies by S Chand</li> </ul>                                                                                                                                                                                                                                        |                                                                    |                |            |
| <b>Reference Books:</b><br><ul style="list-style-type: none"> <li>Environmental Engineering, Peavy and Rowe, McGraw Hill Publications.</li> <li>Fundamentals of Ecology by Eugene P. Odum</li> <li>Environmental Studies by M.P Punia Khanna publications</li> </ul>                                                                                                                                                                                                                          |                                                                    |                |            |

  
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**MOOCs Links and additional reading material:**

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**Strength of CO-PO-PSO Mapping**

| CO   | PO1  | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PSO1 | PSO2 | PSO3 |
|------|------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|------|------|------|
| CO1  | 3    | 1   | -   | -   | -   | 3   | 3   | -   | -   | 3    | -    | 2    | 2    | 2    |
| CO2  | 3    | 2   | -   | -   | 2   | -   | 3   | -   | -   | -    | -    | 2    | 2    | 2    |
| CO3  | 2    | 3   | 3   | -   | 3   | 3   | 3   | 2   | 2   | -    | -    | 2    | 2    | 2    |
| CO4  | 1    | -   | 3   | 3   | -   | 3   | 3   | 3   | -   | 2    | 2    | 2    | 2    | 2    |
| Avg. | 2.25 | 2   | 3   | -   | 2.5 | 3   | 3   | 2.5 | 2   | 2.5  | 2    | 2    | 2    | 2    |

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

**Assessment Pattern**

| BT Level | CCE |     |             |                |                             |                          | ESE |
|----------|-----|-----|-------------|----------------|-----------------------------|--------------------------|-----|
|          | CT1 | CT2 | Assignments | Course Project | Field Activity / Case Study | Quiz / presentation etc. |     |
| K1       | ✓   | -   | ✓           | -              | -                           | ✓                        | -   |
| K2       | ✓   | -   | ✓           | -              | -                           | ✓                        | -   |
| K3       | -   | -   | -           | -              | -                           | -                        | -   |
| K4       | -   | -   | -           | -              | -                           | -                        | -   |
| K5       | -   | -   | -           | -              | -                           | -                        | -   |
| K6       | -   | -   | -           | -              | -                           | -                        | -   |

This course serves as a prerequisite for / maps with the following future courses:

1. Water Supply and Wastewater Engineering
2. Air pollution and control
3. Solid Waste Management

**Job Mapping:**

Job opportunities that one can get after learning this course:

An Environmental Studies course maps to roles like **Environmental Consultant**, **EIA Analyst**, and **Sustainability Coordinator**. It qualifies professionals to assess ecological impacts, ensure regulatory compliance for construction projects, manage waste/water treatment systems, and design sustainable corporate strategies across both public and private sectors.

  
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