# DEPARTMENT OF CIVIL ENGINEERING
# SCHEME OF COURSE WORK

**Course Details:**

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| Course Title | **STRENGTH OF MATERIALS** |
| Course Code | **20CE1107** |
| L T P C | **3 0 0 3** |
| Program | **B.Tech.** |
| Specialization | **CIVIL ENGINEERING** |
| Semester | **III** |
| Prerequisites | **Strength of Materials, Building Materials and Concrete Technology, Structural Analysis.** |
| Courses to which it is a prerequisite | **Advanced Reinforced Concrete Structures** |

**COURSE OUTCOMES (COs):**

After completion of this course the student would be able to

| CO | Course Outcomes | Learning Outcomes |
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| 1 | Draw Shear force and bending moment diagrams for statistically determinate beams and calculate stress distribution. | 1. analyse the determinate beams for shear force and bending moment diagrams for cantilevers, simply supported beams and Overhanging beams with different loads (L4)<br>2. explain the relationship between shear force and bending moments (L2)<br>3. derive bending and shear stress equation (L3)<br>4. calculate the flexural and shear stresses for different cross sections (L3) |
| 2 | Apply Energy theorem, Double integration and Macaulay's methods for Simple Beams and Simple Portal Frames and calculate the deflections | 1. compute slopes and deflections of beams with different boundary conditions (L3)<br>2. discuss effect of different loads on propped cantilever beams (L2)<br>3. determine the slopes & deflection using Castigliano's theorem (L3) |
| 3 | Analyze principal stresses and strains using theories of failure | 1. identify critical planes in two dimensional stress systems (L3)<br>2. estimate principal stresses (L3)<br>3. assess safety of structural elements using different theories of failure (L3) |
| 4 | Estimate pure torsion and power transmitted by shaft under different loading conditions and calculate crushing load of various columns with different end conditions. | 1. analyze members subjected to torsion, combined torsion and bending moment (L3)<br>2. calculate power transmission through shafts (L3) 3. compute load carrying capacity using different formulae (L3) |
| 5 | Estimate Stresses and strains developed in thin and thick cylinders. . | 1. differentiate between thin and thick cylinders (L2)<br>2. calculate stresses and strains for thin and thick cylinders (L3)<br>3. design of thick cylinders (L3) |

**PROGRAMME OUTCOMES**

1. Graduates will be able to apply the knowledge of mathematics, science, engineering fundamentals to solve complex civil engineering problems.
2. Graduates will attain the capability to identify, formulate and analyse problems related to civil engineering and substantiate the conclusions
3. Graduates will be in a position to design solutions for civil engineering problems and design system components and processes that meet the specified needs with appropriate consideration to public health and safety.
4. Graduates will be able to perform analysis and interpretation of data by using research methods such as design of experiments to synthesize the information and to provide valid conclusions.
5. Graduates will be able to select and apply appropriate techniques from the available resources and modern civil engineering and software tools, and will be able to predict and model complex engineering activities with an understanding of the practical limitations.
6. Graduates will be able to carry out their professional practice in civil engineering by appropriately considering and weighing the issues related to society and culture and the consequent responsibilities.
7. Graduates will be able to understand the impact of the professional engineering solutions on environmental safety and legal issues.
8. Graduates will transform into responsible citizens by resorting to professional ethics and norms of the engineering practice.
9. Graduates will be able to function effectively in individual capacity as well as a member in diverse teams and in multidisciplinary streams.
10. Graduates will be able to communicate fluently on complex engineering activities with the engineering community and society, and will be able to prepare reports and make presentations effectively.
11. Graduates will be able to demonstrate knowledge and understanding of the engineering and management principles and apply the same while managing projects in multidisciplinary environments.
12. Graduates will engage themselves in independent and life-long learning in the broadest context of technological change while continuing professional practice in their specialized areas of civil engineering.

**PROGRAMME SPECIFIC OUTCOMES(PSOs):**

1. Collect, process and analyse the data from topographic surveys, remote sensing,

hydrogeological investigations, geotechnical explorations, and integrate the data for planning of civil engineering infrastructure.

2. Analyse and design of substructures and superstructure for buildings, bridges, irrigation structures and pavements.

3. Estimate, cost evaluation, execution and management of civil engineering projects.

**Course Outcome Vs Program Outcomes:**

| CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | 1 | 1 | | 1 | | | | | | | |
| CO2 | 1 | 2 | | | | | | | | | | |
| CO3 | 1 | 1 | 2 | 2 | | | 1 | | | 1 | | 1 |
| CO4 | 1 | 2 | | 1 | 1 | 1 | | 1 | | 1 | 1 | |
| CO5 | 1 | 1 | | | | | | | | | | |

**Course Outcome Vs Programme Specific Outcomes:**

| CO | PSO1 | PSO2 | PSO3 |
|---|---|---|---|
| CO1 | 1 | 2 | 3 |
| CO2 | | 2 | 2 |
| CO3 | 1 | 3 | 2 |
| CO4 | 1 | 2 | 2 |
| CO5 | 1 | 2 | 2 |

Mapping Levels:
1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), put -: No Correlation

| **Assessment Methods:** | Assignment / Quiz / Seminar / Case Study / Mid-Test / End Exam |
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**Teaching-Learning and Evaluation:**

| Week | TOPIC / CONTENTS | CO | Sample questions | Teaching - learning strategy | Assessment Method & Schedule |
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| 1 | **INTRODUCTION:** Definition of beam- Types of beams based on support conditions , concept of shear force and bending moment - S.F and B.M diagrams for cantilever | 1 | Explain the concept of shear force and bending moment | Lecture Problem solving | Assignment/ Quiz |
| 2 | simply supported and overhanging beams subjected to point loads, UDL, UVL point of contra flexure - Relation between SF, B.M and rate of loading on a beam | 1 | Problems on udl,uvl and sf,bm and rate of loading relations | Lecture Problem solving | |
| 3 | Derivation of formula – Shear stress distribution across various beam sections like rectangular, circular, | 1 | Problems on shear stresses | Lecture Problem solving | |

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| | triangular, I, T angle sections | | | | |
| 4 | Theory of simple bending – Assumptions – Derivation of bending equations, Determination of bending stresses for various beam sections | 2 | Problems on bending stresses.section. | Lecture Problem solving | |
| 5 | Conjugate beam method , Double integration and Macaulay's methods for determination of slope and deflection for cantilever and simply supported beams subjected to point loads | 2 | principles of different deflection methods | Lecture Problem solving | |
| 6 | UDL, UVL - Moment area method – application to simple cases. | 2 | Problems on moment areas | Lecture Problem solving | |
| 7 | Introduction – Strain energy in linear elastic system, expression of Strain Energy due to axial load, BM and SF., determination of deflections of simple beams using Castigliano's theorem | 2 | Explain about strain energy theory. | Lecture Problem solving Drawing | |
| 8 | Introduction – Stresses on an inclined section of a bar under axial loading – compound stresses – Normal and tangential stresses on an inclined plane for biaxial stresses – Two perpendicular normal stresses accompanied by a state of simple shear | 3 | Explain principal stresses | Lecture Problem solving Drawing | |
| 9 | **MID TEST – I** | | | | |
| 10 | Mohr's circle of stresses– Principal stresses – Analytical and graphical solutions.. | 3 | Explain about mohr circle. | Lecture Problem solving | |
| 11 | Introduction –Various Theories of failures like Maximum Principal Stress theory – Maximum Principal Strain theory – Maximum shear stress theory – Maximum strain energy theory – Maximum shear strain energy theory, Vonmises theory including yield criteria | 3 | Explain the torsion in shafts. | Lecture Problem solving | Assignment/ Quiz |

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| 12 | Theory of pure torsion – Derivation of Torsional Rigidity equation – Assumptions made in the theory of pure torsion – Torsional moment of resistance – Polar section modulus – Power transmitted by shafts – Combined bending and torsion and end thrust | 4 | Explain about power transmission in shafts | Lecture Problem solving Drawing | |
| 13 | Theory of pure torsion – Derivation of Torsional Rigidity equation – Assumptions made in the theory of pure torsion – Torsional moment of resistance – Polar section modulus – Power transmitted by shafts | 4 | What is theory of pure torsion | Lecture Problem solving | |
| 14 | Limitations of Euler's theory – Rankine – Gordon formula – Secant formula Stresses under the combined action of direct loading and B.M, core of a column section | 4 | What is the core of a section | Lecture Problem solving | |
| 15 | Thin seamless cylindrical shells – derivation of longitudinal and hoop stresses | 5 | Derive the longitudinal stresses | Lecture Problem solving Drawing | |
| 16 | – volumetric strains and circumferential strain. | 5 | Explain volumetric strain | Lecture/ Discussion/ Problem solving | |
| 17 | Introduction to thick cylinders - derivation of Lame's formulae design of thick cylinders – compound cylinders | 5 | . Derive Lame equation for thick cylinder./Lecture/ | Lecture / Discussion Problem solving | |
| | **MID TEST - II** | | | | |
| | **END EXAM** | | | | |