CBCS SCHEME

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BAE304

# Third Semester B.E./B.Tech. Degree Supplementary Examination, June/July 2024

## Mechanics of Materials

Time: 3 hrs. Max. Marks: 100

*Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.*
*2. M : Marks , L: Bloom's level , C: Course outcomes.*

| | | Module – 1 | M | L | C |
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| Q.1 | a. | Define the following :<br>i) Plane stress ii) Plane strain iii) Young's modulus<br>iv) Elasticity v) Plasticity. | 10 | L1 | CO1 |
| | b. | Derive the equilibrium equations for a three dimensional stress system. | 10 | L3 | CO1 |
| | | **OR** | | | |
| Q.2 | a. | Explain volumetric strain and obtain the expression for volumetric strain due to three mutually perpendicular stress applied in a 3D rectangular block. | 10 | L2 | CO2 |
| | b. | At a certain print in a strained material, has tensile stress of 500 MPa and compressive stress at 350 MPa acting on two mutually perpendicular planes and equal shear stress of 100MPa on its plane. Determine the principal stresses, position of principal plane and maximum principal stress. | 10 | L4 | CO4 |
| | | **Module – 2** | | | |
| Q.3 | a. | List out the different types of beams and explain the different types of loads acting on the beams. | 5 | L2 | CO1 |
| | b. | Show that the rate of change of bending moment is equal to the shear force. | 5 | L2 | CO2 |
| | c. | A simply supported beam AB of 10 meters long has supports at its ends A and B. It carries a point load of 5kN at 3 meters from A and a point load of 5 kN at 7 meters from A and a uniformly distributed load of 1 kN per meter between the point loads. Construct the shear force and bending moment diagrams for the beam. | 10 | L4 | CO2 |
| | | **OR** | | | |
| Q.4 | a. | Show that $\frac{M}{I}=\frac{\sigma_b}{y}=\frac{E}{R}$ with used notations. | 10 | L2 | CO2 |
| | b. | An I section beam 350mm × 200mm has a web thickness of 10 mm and a flange thickness of 20 mm. It carries a shear ring force of 100 kN at a section. Construct the shear stress distribution diagram across the section. | 10 | L4 | CO2 |
| | | **Module – 3** | | | |
| Q.5 | a. | Derive the deflection equation $EI\frac{d^2y}{dx^2}=M$. | 10 | L3 | CO2 |

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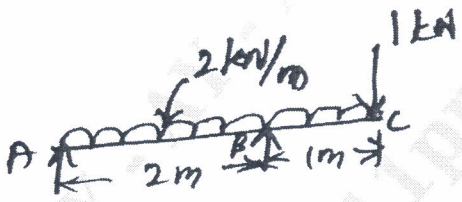
| | b. | Using double integration method, evaluate the slope and deflection for a cantilever beam subjected to uniformly distributed load throughout its entire span. | 10 | L4 | CO2 |
| | | **OR** | | | |
| Q.6 | a. | Determine the diameter of a solid shaft which will transmit 440 kW at 280 rpm. The angle of twist should not exceed one degree per meter length and the maximum torsional shear stress is to be limited to 40 N/mm$^2$. Assume G = 84 kN/mm$^2$. | 10 | L3 | CO2 |
| | b. | Derive an expression for crippling load in a column when both of its ends are hinged. | 10 | L3 | CO2 |
| | | **Module – 4** | | | |
| Q.7 | a. | Explain principles of virtual work for a rigid body and state the differences between principle of virtual work and principles of complementary virtual work. | 10 | L2 | CO2 |
| | b. | An overhanging beam ABC is loaded with material 2 kN/m, if it has span of 3 m as shown in Fig Q7(b). Find the reactions at A and B by applying principle of virtual work.<br>  <br><br>Fig Q7(b) | 10 | L3 | CO2 |
| | | **OR** | | | |
| Q.8 | a. | Define the following :<br>i) Strain energy ii) Proof Resilience iii) Castiglione's second theorem<br>iv) Maxwell's reciprocal theorem v) Saint – Venant's principle. | 10 | L2 | CO2 |
| | b. | Show that the strain energy stored in a body when a load is gradually applied on it is equal to $\frac{\sigma^2}{2E} \times V$ with usual notations. | 10 | L2 | CO3 |
| | | **Module – 5** | | | |
| Q.9 | a. | Explain the three types of fracture with a neat sketch. | 10 | L2 | CO3 |
| | b. | Explain the three stages of creep with a neat sketch. | 10 | L2 | CO3 |
| | | **OR** | | | |
| Q.10 | a. | What is fatigue? Classify fatigue loadings with examples. | 10 | L3 | CO3 |
| | b. | Explain S-N curve with a neat sketch. | 10 | L3 | CO3 |

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