MANGALORE INSTITUTE OF TECHNOLOGY & ENGINEERING
(A Unit of Rajalaxmi Education Trust®, Mangalore)
Autonomous Institute affiliated to VTU, Belagavi, Approved by AICTE, New Delhi
Accredited by NAAC with A+ Grade & ISO 9001:2015 Certified Institution

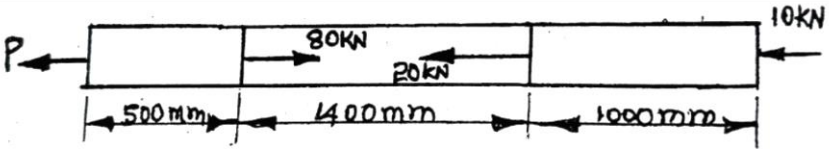
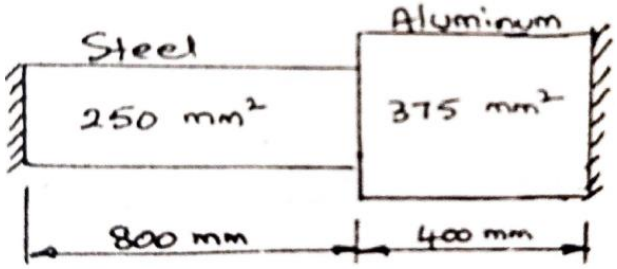
# Model Question Paper

## Third Semester BE Degree Examination

## Strength of Materials

**Time: 3 Hours** **Max. Marks: 100**

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

| | | Module -1 | M | L | C |
|---|---|---|---|---|---|
| Q1 | a. | State Hooke's law. Give the stepwise mathematical formulation of expression for the extension of uniformly tapering circular bar subjected to axial load. | 10 | L2 | CO1 |
| | b. | A brass bar having uniform cross sectional area of 300 $mm^2$ is subjected to a load as shown in fig. Q1(c). Find the total elongation of the bar and the magnitude of load P, if Young's Modulus is 84 GPa.   Fig. Q1(c) | 10 | L3 | CO2 |
| | | **OR** | | | |
| Q2 | a. | Give the stepwise mathematical formulation of relationship between E and G. | 10 | L2 | CO1 |
| | b. | A composite bar consisting of steel and aluminium components shown in the fig. Q2(b) is held firmly between two grips at the ends at a temperature of $60^0$C. Find the stresses in the two rods, when temperature falls to $20^0$C, if (i) the ends do not yield and (ii) the ends yield by 0.25 mm. Take $E_s$ = 2 X $10^5$ N/$mm^2$, $\alpha_s$ = 1.17 X $10^{-5}$ /$^0$C, Ea = 0.7 X $10^5$ N/$mm^2$ and $\alpha_a$ = 2.34 X $10^{-5}$ /$^0$C.   Fig. Q2(b) | 10 | L3 | CO2 |
| | | **Module- 2** | | | |
| Q3 | a. | Derive an expression for normal stress, shear stress and resultant stress on an oblique plane inclined at an angle of θ with the vertical axis in a biaxial stress system subjected to $\sigma_x$, $\sigma_y$, and $\tau_{xy}$. Also find angle of obliquity φ. | 08 | L3 | CO2 |
| | b. | The state of stress in a two dimensionally stressed body is as shown in the fig. Q3(b). Determine the principal planes, principal stresses, maximum shear stress and their planes. | 12 | L3 | CO2 |

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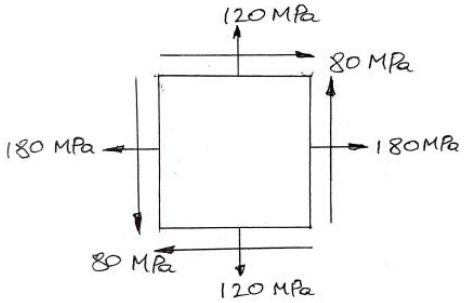
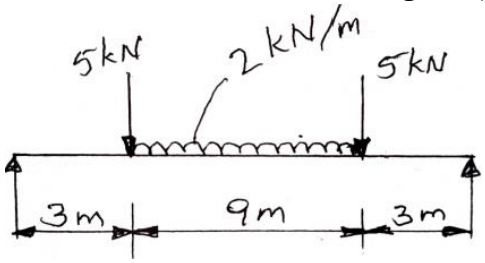
|---|---|---|---|---|---|
| | |  <br>Fig. Q3(b) | | | |
| **OR** | | | | | |
| Q4 | a. | Derive an expression for volumetric strain in thin cylinder with usual notations. | 08 | L3 | CO2 |
| | b. | A thick cylinder is 250 mm in internal diameter and 50 mm wall thickness is subjected to an internal pressure of 10 MPa due to the movement of the fluid. Find the maximum Hoop stress developed in the cylinder. Also calculate the radial and hoop stresses at a point 20 mm from the inner surface. Sketch the stresses. | 12 | L3 | CO2 |
| **Module - 3** | | | | | |
| Q5 | a. | Give the stepwise mathematical formulation of relationship between load, shear force and bending moment | 06 | L2 | CO1 |
| | b. | Draw the SFD and BMD for the beam shown in the fig. Q5(b).<br>  <br>Fig. Q5(b) | 14 | L3 | CO3 |
| **OR** | | | | | |
| Q6 | a. | Give the stepwise mathematical formulation of section modulus for rectangular cross section | 06 | L2 | CO1 |
| | b. | A beam of an I-section consists of 180 mm X 15 mm flanges and a web of 280mm X 15mm thickness. It is subjected to a shear force of 60 kN. Sketch the shear stress distribution along the depth of the section. | 14 | L3 | CO3 |
| **Module - 4** | | | | | |
| Q7 | a. | Give the stepwise mathematical formulation of expression for strain energy, when a member is subjected to impact load. | 06 | L2 | CO1 |
| | b. | A hollow circular shaft of 2 m length has an external diameter of 100 mm and a thickness of 10 mm. If it is subjected to a torque of 10 kN-m, determine the strain energy stored in the shaft. Take E = 80 GPa. | 14 | L3 | CO4 |
| **OR** | | | | | |
| Q8 | a. | Give the stepwise mathematical formulation of torsion equation with usual notations. State the assumptions made in theory of pure torsion. | 08 | L2 | CO1 |
| | b. | Determine the diameter of the shaft to transmit 440 kW at 280 rpm, if maximum torsional shear stress is to be limited to 40 N/mm2. Assume G = 84 kN/mm2. | 12 | L3 | CO4 |
| **Module - 5** | | | | | |
| Q9 | a. | Explain (i) Maximum principal stress theory (ii) Maximum shear stress theory | 08 | L2 | CO1 |
| | b. | A bolt is subjected to an axial pull of 12 kN together with a transverse shear of 6 kN. Determine the diameter of the bolt by using:<br>(i) Maximum principal stress theory (ii) Maximum shear stress theory | 12 | L3 | CO5 |

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| | | Take Elastic limit in tension = 300 N/mm2, Factor of safety = 3, Poisson's ratio = 0.3. | | | |
| **OR** | | | | | |
| Q10 | a. | Give the stepwise mathematical formulation of an expression for Euler's buckling load for a long column having one end fixed and other end hinged. | 08 | L2 | CO1 |
| | b. | A 1.5 m long column has circular cross section of 50 mm diameter. One end of the column is fixed in direction and position and the other end is free. Taking the factor of safety as 3, calculate:<br>(i) Safe load according to Rankine's formula taking $\sigma c$ = 560 MPa and $\alpha$ = 1/1600<br>(ii) Safe load according to Euler's formula taking E = 120 GPa. | 12 | L3 | CO5 |

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