USN | | | | | | | | | | |

06ME34

# Third Semester B.E. Degree Examination, Dec.2013/Jan.2014
## Mechanics of Materials

Time: 3 hrs. Max. Marks:100

**Note:** ***Answer FIVE full questions, selecting at least TWO questions from each part.***



### PART – A

1 a. Explain clearly, i) Proportional limit ii) Elastic limit iii) Ultimate stress **(03 Marks)**

b. A rod of radius $r_1$ at one end tapers uniformly to a radius of $r_2$ at the other end over a length L. It is subjected to an axial force P. Derive an expression for its change in length. **(07 Marks)**

c. A stepped bar is subjected to external loading as shown in Fig. Q1 (c). Calculate change in length of the bar. E = 200 GPa for steel, E = 100 GPa for copper and E = 70 GPa for aluminium. **(10 Marks)**

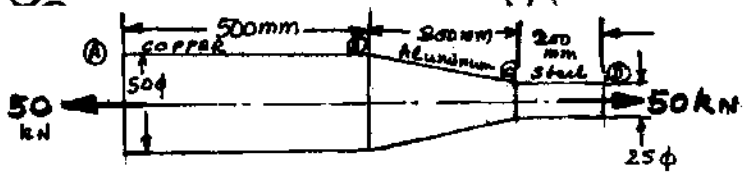


Fig. Q1 (c)

2 a. Define bulk modus. Derive an expression for Young's modulus in terms of bulk modulus and Poisson's ratio. **(12 Marks)**

b. A M.S. bar 20 mm dia and 300 mm long is encased in a brass tube whose external diameter is 30 mm and interval dia is 25 mm. The composite bar is heated through 60°C. Calculate stresses in each metal.

$\alpha_{steel} = 0.0000112/^\circ C$ and $\alpha_{brass} = 0.0000165/^\circ C$

$E_{steel} = 2\times10^5$ N/mm$^2$, $E_{brass} = 1\times10^5$ N/mm$^2$ **(08 Marks)**

3 a. Define principal stress and principal strain. **(02 Marks)**

b. Prove that sum of normal stresses in any two mutually perpendicular direction is a constant. **(08 Marks)**

c. At a certain point in a strained material the stress condition is obtained is as shown in Fig. Q3 (c).

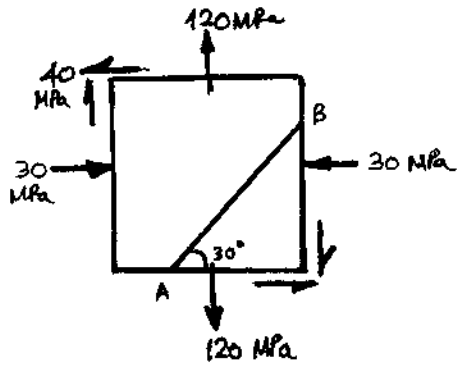


Fig. Q3 (c)

Find i) Normal and shear stresses on the inclined plane, AB
ii) Major and Minor principal stresses. **(10 Marks)**

4 a. Derive an expression for the circumferential and longitudinal stress of a thin cylinder subjected to an internal pressure. **(10 Marks)**

b. Find the thickness of metal necessary for a thick cylinder of internal dia 150 mm to withstand an interval fluid pressure of 10 N/mm$^2$. The maximum hoop stress in the section is not to exceed 25 N/mm$^2$. **(10 Marks)**

## PART – B

5 Draw the bending moment and shear force diagrams for the beam shown in Fig. Q5 below: **(20 Marks)**

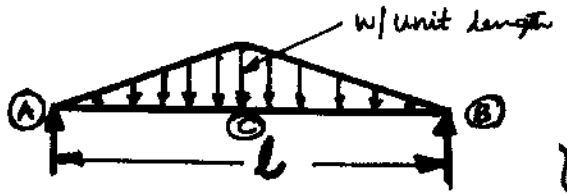


Fig. Q5

6 a. Prove the relation $\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$ with usual notations. **(10 Marks)**

b. Determine the maximum allowable span of length L for a simple beam as shown in Fig. Q6 (b). The rectangular beam of cross section 125 × 250 mm is subjected to a udl of 8 kN/m. Allowable bending stress = 6 MPa. **(10 Marks)**

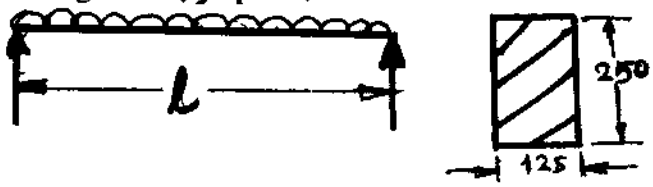


Fig Q6 (b)

7 a. Derive an expression $M = EI\frac{d^2y}{dx^2}$ with usual notations. **(05 Marks)**

b. A simply supported beam of 6 meters is subjected to a concentrated load of 18 kN at 4 meters from left hand support as shown in Fig. Q7 (b). Calculate position and magnitude of maximum deflection if E = 200 GPa and I = 30 × 10$^6$ mm$^4$. **(15 Marks)**

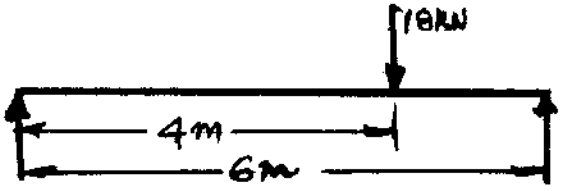


Fig. Q7 (b)

8 a. A solid round bar has 60 mm dia and length 2.5 meters. Find the safe compressive load for the column if i) both ends are hinged ii) if both ends are fixed. E = 2 × 10$^5$ N/mm$^2$ and factor of safety = 3. **(10 Marks)**

b. A hollow shaft of 250 mm outer diameter has the same area as that of a solid shaft of 150 mm diameters. Compare i) Power transmitted by the above shafts for the same speed. ii) compare angle of twists of them for the same length and same material. **(10 Marks)**

* * * * *