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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belgaum)

Third Semester, B.E. – Automobile Engineering

Semester End Examination; Dec. - 2014

Mechanics of Materials

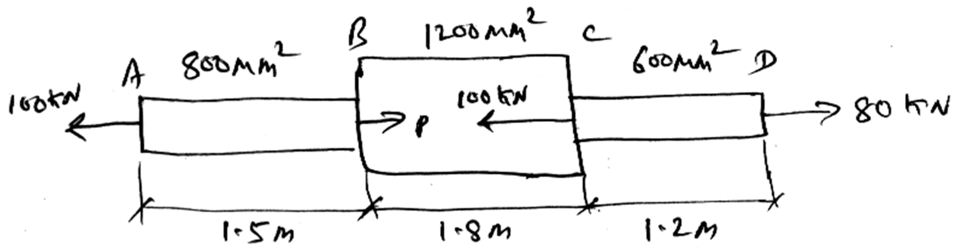
Time: 3 hrs *Max. Marks: 100*

Note *:i) Answer **FIVE** full questions, selecting **ONE** full question from each Unit.*
ii) Assume suitably missing data if any.

Unit - I

1 a. Draw stress – strain diagram for a mild steel specimen and explain briefly the salient points. 8

b. A member ABCD is subjected to a force as shown in Fig. (i). Evaluate the stresses induced on the various elements and the net changes in the length of the member. Take E = 210 GPa. 12



fig(1)

2 a. A tapering rod has diameter ‘d_1’ at one end and it tapers uniformly to a diameter ‘d_2’ at the other end in a length ‘l’. If modulus of elasticity of the material is ‘E’. Find the charge in length when subjected to an axial force ‘P’. 8

b. A bar of 20 mm diameter is subjected to a pull of 40 kN. The measured extension on gauge length of 200 mm is 0.13 mm and the change in diameter is 0.004 mm. Calculate the three modules. 12

Unit - II

3 a. What are thermal stresses? 5

b. An RCC column is 300 mm x 300 mm in section, the column is provided with 4 bars of 20 mm diameter. The column carries a load of 160 kN. Find the stresses in concrete and steel rods. Also determine the change in length of the column if the original length of the column is 3 ms. Take E_S = 210 GPa, E_C = 14 GPa. 15

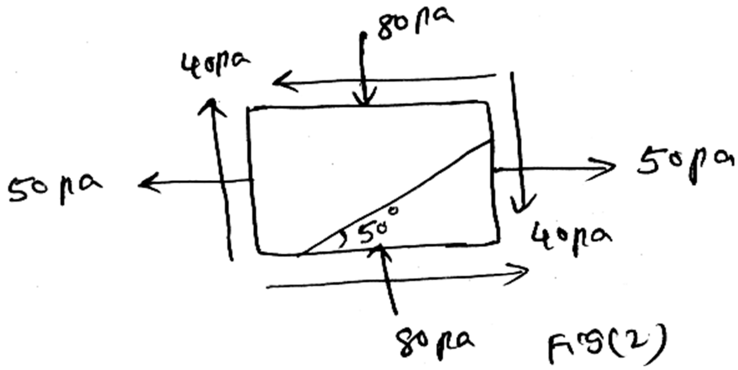
4 a. Derive an expression for normal and tangential stresses developed on an inclined plane in a member subjected to 2 dimensional stress systems. Also find the plane on which the maximum normal stress occurs. 10

b. The state of stress at a point in a material under plane stress is as shown in Fig. (2). Determine;

(i) Principal planes and stresses on them

(ii) Maximum shear stress and its plane

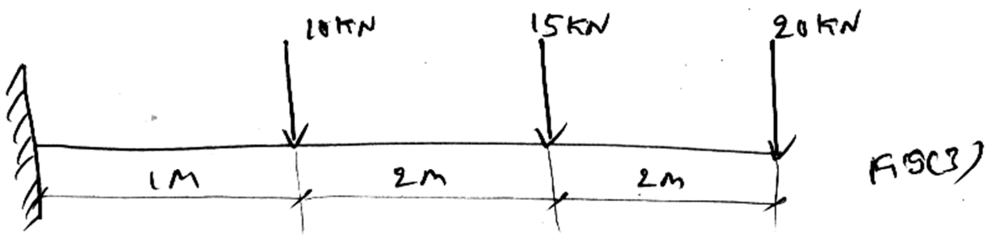
(iii) Resultant stress on an inclined plane inclined at 50º to the horizontal as shown in Fig. (2). 10



Unit - III

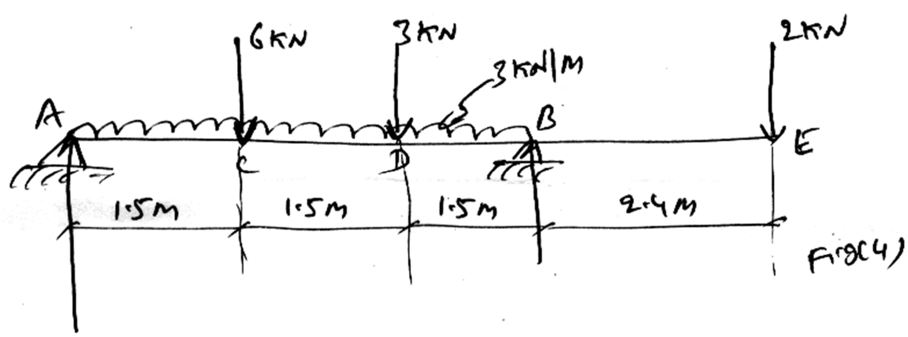
5 a. What is a beam? Explain briefly the different types of beams. 5

b. Draw SFD and BMD for a cantilever beam subjected to point loads as shown in Fig. (3). 15



6 a. Explain the relationship between shear force and bending moment and loading intensity. 5

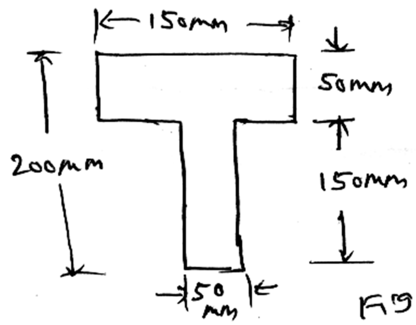
b. Draw SFD and BMD for the loaded beam as shown in Fig. (4). Mark the salient values on the fig. 15



Unit - IV

7 a. What are the assumptions made in theory of pure bending? 4

b. Two wooden planks 50 mm x 150 mm each are connected together to form a cross section of a beam as shown in Fig. (5). If a bending moment of 3400 Nm is applied about the horizontal neutral axis, find the stresses at the extreme fibers of the cross section. Also calculate the total tensile force on the cross section. 16



Fig(5)

8.a. Determine the differential equation for deflection $M = EI\frac{d^2y}{dx^2}$ 8

b. A beam of uniform section is 10 m long and is simply supported at the ends. It carries concentrated loads of 100 kN and 60 kN at distances of 2 m and 5 m respectively from the left end. Calculate the deflection under each load. Find also the maximum deflection Take $I = 18 \times 10^4\ mm^4$ and $E = 200\ kN/mm^2$. 12

Unit - V

9 a. A thin cylindrical shell 1m in dia and 3m long has a metal thickness of 10 mm. It is subjected to an internal fluid pressure of 3MPa. Determine the change in length, diameter and volume. Also find the maximum shearing stress in the shell. Assume Poisson's ratio 0.3 and E = 210 GPa. 10

b. A thick cylindrical pipe of outside dia 300 mm and thickness of metal 60 mm is subjected to an internal fluid pressure of 40 MPa. Determine the maximum and minimum intensifies of hoop stress and radial stresses induced in the pipe section. Plot the hoop and radial stresses induced. 10

10 a. A hollow circular shaft transmits a power of 300 kW at 100 rpm. If the shear stress in limited to 70 MPa and the external dia is twice the internal diameter. Calculate the external and internal dia of the shaft. Take maximum torque as 1.5 times the average torque. 10

b. Find the Euler's crippling load for a hollow cylindrical steel column 40 mm external dia and 4 mm thick. The length of the column is 2.5 m and is hinged at both the ends. Also compute the Rankine's Crippling load using constant 335 MPa, $\alpha = \frac{1}{7500}$, E = 205 GPa. 10

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