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

(An Autonomous Institution affiliated to VTU, Belgaum)

Third Semester, B.E. - Mechanical 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 suitable missing data if any.

Unit - I

1. a. With stress-strain curve differentiate between nominal stress and true stress. 6

   b. What is factor of safety? State four reasons to consider factor of safety. 6

   c. A hollow steel tube is to be used to carry an axial compressive load of 140 kN. The yield stress for steel is 250 N/mm^2. A factor of safety of 1.75 is to be used in the design. Determine the thickness of the tube if the external diameter is 101.6 mm. 8

2. In a tensile test on a specimen of mild steel 20 mm diameter, the following readings were recorded using extensometer of 200 mm gauge length.

Load (kN)	0	10	20	30	40	50	60
Extension (no. of Divisions)	0	32	64	95	127	160	190

Find the value of young's modulus, if one division of extensometer is equal to 0.001 mm.

All along the length of the specimen markings were made at an interval of 100 mm. The test was carried upto fracture and the following were noted. Load at breaking point = 93 kN Distance between two adjoining markings including neck portion after fracture = 122 mm. Diameter at neck = 14.7 mm. 20

Find nominal stress and true stress at breaking point. Find also percentage, elongation and percentage reduction in area.

Unit - II

3 a. Three pillars, two of aluminium and one of steel support a rigid plat-form of 200 kN as shown in Fig. Q 3(a) If area of each aluminium pillar is 1000 mm^2 and that of steel pillar is 800 mm^2, find the stresses developed in each pillar;

Take $E_a = 1x10^5$ N/mm^2 and $E_S = 2x10^5$ N/mm^2 What additional load P can it take if working stresses are 65 N/mm^2 in aluminium and 150 N/mm^2 in steel. 12

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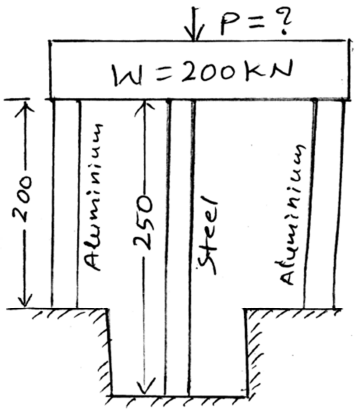

Fig. Q 3(a)

b. A steel rail is 12.6 m long and is laid at a temperature of 24ºC.The maximum temperature expected is 44ºC. Estimate the minimum gap between two rails to be left so that temperature stresses do not develop. Also calculate the thermal stresses developed in the rails if no expansion joint is provided. 8

4. The stress on two perpendicular planes through a point in a body are 30 MPa and 15 MPa both tensile along with shear stress of 25 MPa. Find analytically and graphically
(i) The magnitude and direction of principal stresses (ii) The planes of maximum shear stress
(iii) The normal and shear stresses on the planes of maximum shearing stress. 20

Unit-III

5. A girder 6 m long rests on two supports with equal overhangs on either side and carries a uniformly distributed load of 30 kN per metre run over the entire length. Calculate the overhangs if the maximum bending moment, positive or negative is to be as small as possible. Draw SF and BM diagram for the double overhang beam. 20

6. Draw the SF and BM diagrams for the beam shown in Fig. Q (6) and mark the salient points. Find the point of contra flexure and maximum bending moment. 20

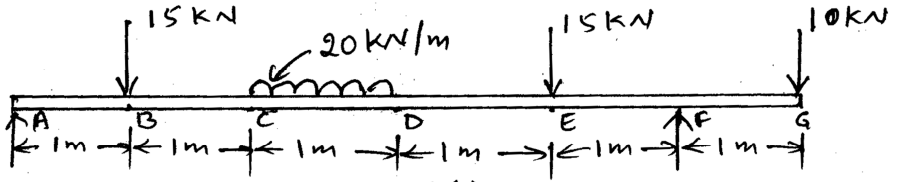

Fig. Q(6)

Unit - IV

7 a. Obtain the relationship between moment and radius of curvature in a beam. 6

b. Determine the cross-section of a rectangular beam of uniform strength for a simply supported beam of 6m span subjected to a central concentrated load of 20 kN.
(i) by keeping depth of 300 mm throughout
(ii) by keeping width of 200 mm throughout 14

8. A simply supported beam of span L is subjected to equal load $\frac{W}{2}$ at each of $\frac{1}{3}$rd span points. Find the expressions for deflection under the load and at mid span using Macaulay's method. 20

Unit - V

9 a. Obtain expressions for changes in diameter, length and volume of thin cylinder. 6

b. Write the assumptions in the theory of pure torsion. 5

c. A 2 m long pin ended column of square cross-section is to be made of wood. Assuming E = 12 GPa and allowable stress being limited to 12 MPa. Determine the size of the column to support 95 kN of load safely. 9

10 a. A thin cylindrical shell, 2 m long has 200 mm diameter and thickness of metal 10 mm. It is filled completely with a fluid at atmospheric pressure. If an additional 25000 mm^3 fluid is pumped in, find the pressure developed and hoop stress developed. Find also the changes in diameter and length. Take E = $2x10^5$ N/mm^2 and $\mu = 0.3$ 10

b. Calculate the maximum intensity of shear stress induced and the angle of twist produced in degrees in solid shaft of 100 mm diameter, 10 m long, transmitting 112.5 kW at 150 rpm. Take; G=82 kN/mm^2 5

c. Obtain an expression for crippling load for a column both ends fixed. 5

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