U.S.N | | | | | | | | | |

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

*(An Autonomous Institution affiliated to VTU, Belgaum)*

## Third Semester, B.E. - Automobile and Engineering
## Semester End Examination, Dec - 2015
## Mechanics of Materials

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

***Note**: Answer **FIVE** full questions selecting **ONE** full question from each **unit**.*

### UNIT - I

1 a. Draw the stress-strain diagram for mild steel. Show the salient points on the diagram. 6

b. Write a note on : (i) Factor of safety and ii) Hooke's law. 4

c. A specimen of steel 25 mm diameter with a gauge length of 200 mm is tested to destruction. It has an extension of 0.16 mm under a load of 80 kN and the load at elastic limit is 160 kN. The maximum load is 180 kN.
The total extension at fracture is 56 mm and diameter at neck is 18 mm. Find 10
i) The stress at elastic limit ii) Young's modulus iii) Percentage elongation
iv) Percentage reduction in area v) Ultimate tensile stress

2 a. A steel bar of variable section is subjected to forces as shown in Fig. Q2(a). Taking; E = 205 kN/mm$^2$ determine the total elongation of the bar. 10

b. A bar of 20 mm diameter is tested in tension. It is observed that when a load of 37.7 kN is applied, the extension measured over a gauge length of 200 mm is 0.12 mm and contraction in diameter is 0.0036 mm. Find Poisson's ratio and elastic constants E, G and K. 10

### UNIT - II

3 a. A compound bar consists of a circular rod of steel of diameter 20 mm rigidly fitted into a copper tube of internal diameter 20 mm and thickness 5mm. if the bar is subjected to a load of 100 kN. Find the stresses developed in the two materials. Take; $E_S = 2x10^5$ N/mm$^2$ and $E_C = 1.2x10^5$ N/mm$^2$. 10

b. The composite bar shown in Fig. Q3(b) is 0.2 mm short of distance between the rigid supports at room temperature. What is the maximum temperature rise which will not produce stresses in the bar? Find stresses induced when temperature rise is 40ºC. Given 10
$\alpha_S = 12x10^{-6}$ /ºC, $\alpha_c = 17.5x10^{-6}$/ºC, $E_S = 2x10^5$ N/mm$^2$, $E_C = 1.2x10^5$ N/mm$^2$, $A_S : A_C = 4:3$.

4 a. Show that the sum of the normal stresses on any two planes at right angles in a general two dimensional stresses system is constant. 8

b. A point in a strained material, the stress on two planes at right angles to each other are 80 N/mm$^2$ (Tensile) and 40 N/mm$^2$(tensile). Each of the above stresses is accompanied by a shear stress of 60 N/mm$^2$. Determine; 12

Contd….2

i) Normal stress, shear stress and resultant stress on an oblique plane inclined at an angle of 45º to the axis of minor tensile stress. Also find major principal stress, minor principal stress and their location, maximum shear stress and its location.

5 a. What are the different types of beams? What are the different types of loads acting on a beam? Explain with sketches. 10

b. Draw the shear force and bending moment diagram for the cantilever beam shown in Fig. Q5(b). 10

6. a. Explain the following terms : 10

i) Sagging bending moment ii) Hogging bending moment iii) Point of contraflexure

b. A simply supported beam of 6 m long is subjected to loads 2 kN, 5 kN and 4 kN at distances 1.5 m, 3 m and 4.5 m from the left support. Draw the SFD and BMD. 10

**UNIT - IV**

7 a. Prove that in case of a rectangular section of a beam, the maximum shear stress is 1.5 times average shear stress. 8

b. A cantilever of square section 200 mm x 200 mm, 2 m long, just fails in flexural when a load of 12 kN is placed at its free end. A beam of the same material and having a rectangular cross section 150 mm wide and 300 mm deep is simply supported over a span of 3 m. calculate the minimum central concentrated load required to break the beam. 12

8 a. A cantilever beam 2m long is carrying a load of 20 kN at its free end and 30 kN at a distance of 1 m from the free end. Find the slope and deflection at the free end. Take; $I = 15 \times 10^7$ mm$^4$, $E = 2 \times 10^5$ N/mm$^2$. 8

b. Show that for a simply supported beam of length '*l*' carrying a concentrated load W at its mid span, the maximum deflection is $\frac{Wl^3}{48EI}$; Use Macaulay's method. 12

**UNIT - V**

9 a. A thin cylinder shell, 2 m long has 20 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; $E = 2 \times 10^5$ N/mm$^2$ and $\mu = 0.30$. 10

b. A pipe of 400 mm internal diameter and 100 mm thickness contains a fluid at a pressure 80 N/mm$^2$. Find the maximum and minimum hoop stresses across the section. Also sketch the radial and hoop stress distribution across the section. 10

10 a. Determine the diameter of solid shaft which will transmit 440 kW at 280 rpm. The angle of twist must not exceed one degree per metre length and the maximum torsional shear stress is to be a limited to 40 N/mm$^2$. Assume G = 84 kN/mm$^2$. 10

Contd….3

b. A 1.5 m long column has a 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 the safe load using;

(i) Rankine's formula taking yield stress 560 N/mm$^2$ and $\alpha = 1/1600$;

ii) Euler's formula, taking E = 1.2x10$^5$ N/mm$^2$. 10

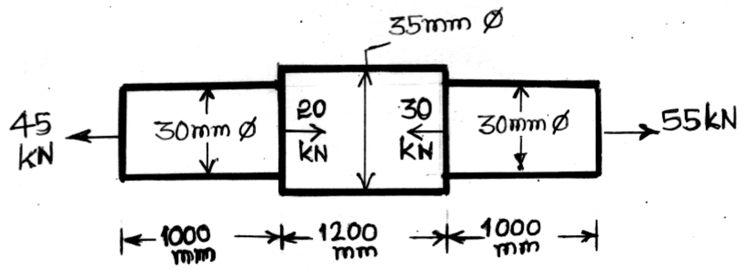


Fig. 2(a)

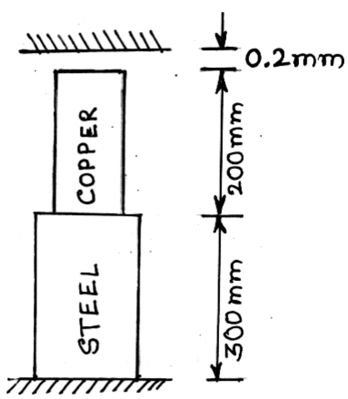


Fig. 3(b)

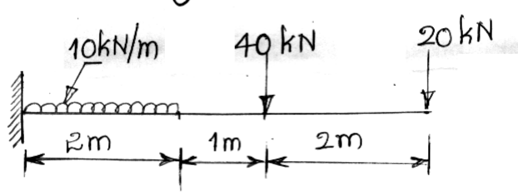


Fig. 5(b)

* * * *