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

(An Autonomous Institution affiliated to VTU, Belgaum)

Third Semester, B.E. - Civil Engineering

Semester End Examination; Dec. - 2014

Strength 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. State and explain any three types of strains. 6

   b. How do you explain i) ultimate stress ii) working stress iii) factor of safety. 6

   c. Derive an expression for the volumetric strain of a cylindrical rod of diameter 'd' and length '*l*' . 8

2 a. Derive an expression for the elongation of a tapering rod of diameter d_1 at one end to a diameter d_2 at the other end. 10

   b. A straight bar of steel rectangular in section is 3 m long and is of uniform thickness 15 mm. The width of the rod varies uniformly from 100 mm at one end to 40 mm at the other. If the rod is subjected to an axial tensile load of 30 kN, find the extension of rod. Take $E_S = 2x10^5$ N/mm^2. 10

UNIT - II

3 a. What are principal stresses and planes? 4

   b. What is Mohr's circle of stresses? 4

   c. The principal tensile stresses at a point across two perpendicular planes are 80 N/mm^2 and 40 N/mm^2. Find the normal tangential stress and the resultant stress and its obliquity on a plane at 20^o with the major principal plane. Find also the intensity of stress which acting alone can produce the same maximum span. Take Poisson's ratio = ¼. 12

4. a. Differentiate between thick and thin cylinders. 4

   b. A shell 3.25 m long, 1 m in diameter is subjected to an internal pressure of 1 N/mm^2. If the thickness of the shell is 10 mm, find the circumferential and longitudinal stresses. Find the circumferential and longitudinal stresses. Find also the maximum shear stress and the change in the dimensions of the shell. Take E = $2x10^5$ N/mm^2 and $1/m = 0.3$ 16

UNIT - III

5 a. Derive the relationship between loading, shear force and bending moment. 6

   b. A simply supported beam of span 9 m carriers a uniformly distributed load of 18 kN/m for a distance of 4 m from the left support A. Draw SFD and BMD. Also calculate the values of maximum BM and SF. 14

6 a. How do you distinguish between sagging and hogging bending moments? 4

   b. Show that the shape of BM of a simply supported beam carrying udl throughout the span is parabolic and maximum BM is $\frac{wl^2}{8}$ 6

Contd…2

c. Sketch the SFD and BMD for the beam shown in Fig. Q 6(c). Also locate the position of contra flexure, if any. 10

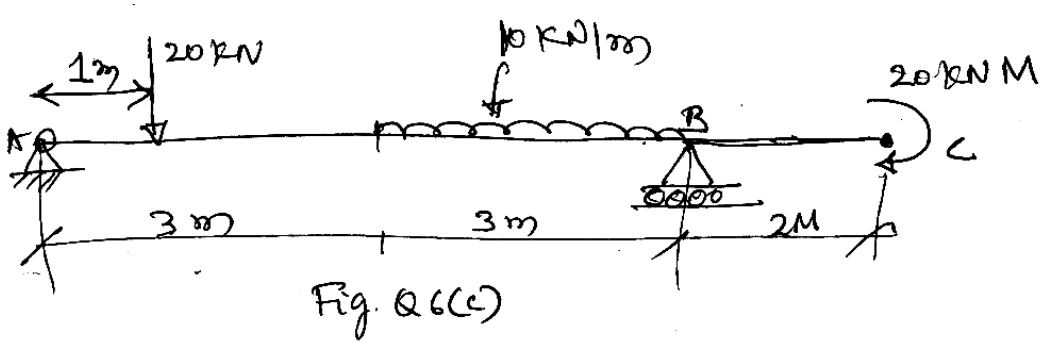

Fig. Q 6(c)

UNIT - IV

7 a. State the assumptions in the bending theory. 5

b. With usual notations derive the expression 5

$$\frac{M}{I} = \frac{E}{R} = \frac{f}{y}$$

c. A rolled steel Joist of I section has the following dimensions: 10

flange: 250mm wide and 24mm thick , Web: 12 mm thick, Overall depth: 60 mm

If this beam carries a uniformly distributed load of 50 kN/m runs on a span of 8 m. Calculate the maximum stress produced due to bending.

8 a. Derive the differential equation for slope and deflection. 6

b. A Beam of uniform section is 10m long and is simply supported at ends. It carries concentrated loads of 100 kN and 60 kN at distance of 2m and 5m respectively from the left end. Calculate the deflection under each load. Find also the maximum deflection. Take I = 18×10^8 mm^4 and E = 2×10^5 N/mm^2. 14

UNIT - V

9 a. Derive the torsion equation $\frac{f}{R} = \frac{q}{r} = \frac{C\theta}{l}$. 8

b. A Solid circular shaft transmits 100 BHP at 200 rpm. Calculate the shaft diameter if the twist in the shaft is not to exceed 1º in 2 m length of shaft and the shearing stress is limited to 50 N/mm^2. Take $F_C = 1 \times 10^5$N/mm^2. 12

10a. Derive the Euler's buckling load for a one end fixed and other end hinged column. 6

b. How do you distinguish between short and long column. 4

c. An ISMB 250 RSJ is to be used as a column 4 m with one end fixed and the other end hinged. Find the safe axial load on the column allowing a factor of safety of 3. 10

Take; F_C = 320 N/mm^2 and $\alpha = 1/7500$.

Properties of column sections are;

Area = 4755mm^2, $I_{xx} = 5131.6 \times 10^4$ mm^4, $I_{yy} = 334.5 \times 10^4$ mm^4

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