# Code : 021306

## B.Tech 3rd Semester Examination, 2016

## Strength of Material

*me : 3 hours* *Full Marks : 70*

***structions :***

*(i) There are Nine Questions in this Paper.*

*(ii) Attempt Five questions in all.*

*(iii) **Question No. 1 is Compulsory.***

*(iv) The marks are indicated in the right hand margin.*

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Choose the correct answer of the following (any seven): 2×7=14

(a) A localised compressive stress at the area of contract between two members is known as:

(i) Shear

(ii) Crushing

(iii) Bending

(iv) Tensile

(b) In case of a circular section the section modulus i given as:

(i) $\pi d^2/16$

(ii) $\pi d^3/16$

(iii) $\pi d^3/32$

(iv) $\pi d^4/64$

(c) For no tension in the section, the eccentricity must not exceed:

(i) $k^2/d$

(ii) $2k^2/d$

(iii) $4k^2/d$

(iv) $k/\sqrt{d}$

(d) The slope and deflection at the section in a loaded beam can be found out by which of the following methods?

(i) Double integration method

(ii) Moment area method

(iii) Macaulay's method

(iv) Any of the above

(e) A cantilever of length 1 is carrying a uniformly distributed load of *w* per unit run over the whole span. The deflection at the free end is given as:

(i) $W1^3/4EI$

(ii) $W1^2/4EI$

(iii) $W1^4/8EI$

(iv) $W1^4/16EI$

(f) A beam of length 4 m, fixed at both ends carries a point load 120 kN at the centre. If EI for the beam is 20000 $kNm^2$, deflection at the centre of the beam is:

(i) 1 mm

(ii) 2 mm

(iii) 5 mm

(iv) 10 mm

(g) Pressure vessels are made of:

(i) Non-ferrous materials

(ii) Sheet steel

(iii) Cast iron

(iv) Any of the above

(h) In thick cylinders the variation in the radial as well as circumferential stress across the thickness is obtained with the help of:

(i) Clapeyron's Theorem

(ii) Castigliano Theorem

(iii) Lame's Theorem

(iv) None of the above

(i) The strength of a hollow shaft for the same length, material and weight is _____ a solid shaft:

(i) Less than

(ii) More than

(iii) Equal than

(iv)None of the above



(j) In case of a solid shaft strain energy in torsion, per unit volume is equal to:

(i) $\tau^2 / 2C$

(ii) $\tau^2 / 4C$

(iii) $\tau^2 / 6C$

(iv) $\tau^2 / 8C$

2. (a) A rod of length "1" tapers uniformly from diameter $d_1$ to a diameter $d_2$. Its wider end is fixed and lower end is subjected to an axial tensile load P. Calculate the elongation in case of above taper rod. 7

(b) A bar of steel is 60 mm* 60 mm in section and 180 mm long. It is subjected to a tensile load of 300 kN along the longitudinal axis and tensile loads of 750 kN and 600 kN on the lateral faces. Find the change in the dimensions of the bar and change in the volume. Take E=200 GN/m$^2$ and 1/m=0.3. 7

3. Draw the Mohr's stress circle for the direct stresses of 65 MN/m$^2$ (tensile) and 35 MN/m$^2$ (compressive) and estimate the magnitude and direction of the resultant stresses on the planes making angles of 20° and 65° with the plane of the first principal stress. Find also the normal and tangential stresses on these planes. 14

4. (a) What is shaft Couplings ? 4

(b) A solid steel shaft is subjected to a torque of 45 kNm. If the angle of twist is 0.5° per metre length of the shaft and the shear stress is not allowed to exceed 90 MN/m². find:

(i) Suitable diameter for the shaft, (ii) Final maximum shear stress and angle of twist and (iii) Maximum shear strain in the shaft, assume C=80 GN/m². 10

5. A simple beam with an overhang is supported at points A and B (Figure 1). A uniform load of intensity q=200 lb/ft acts throughout the length of the beam and a concentrated load P=14 k at a point 9 ft. from the left-hand support. The span length is 24 ft. and the length of the overhang is 6 ft. Calculate the shear force V and bending moment M at cross section D located 15 ft. from the left-hand support. 14

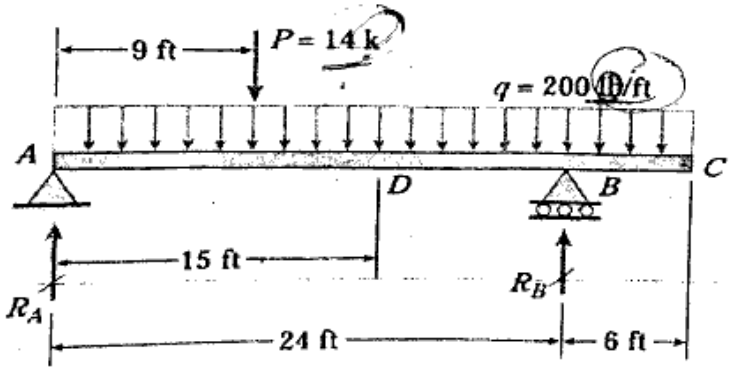


Figure (i) Beam



6. (a) Assuming suitable example discuss "Moment area method" to find the defection of beam. Why Moment area method is more useful as compared to double integration method. 6

(b) A cantilever of length I carrying uniformly distributed load *w* per unit run for a distance 'a' from the fixed end. Calculate deflection at the end of uniformly distributed load and at the end of cantilever. 8

7. (a) Define (i) Hoops stresses (ii) Longitudinal stresses and (iii) Maximum shear stress induced in context to thin shells. 6

(b) A built up cylindrical shell of 300 mm diameter, 3 m long and 6 mm thick is subjected to an internal pressure of 2 MN/m². Calculate the change in length, diameter and volume of the cylinder under that pressure if the efficiencies of the longitudinal and circumferential joints are 80% and 50% respectively. Take E=200 GN/m² and m=3.5. 8

8. (a) Calculate circumferential and radial stress in a thick cylinder assuming internal pressure =$P_i$ and outer surface of cylinder is exposed to atmospheric conditions. 8

(b) A thick cylinder of 150 mm outside radius and 100 mm inside radius is subjected to an external pressure of 30 MN/m² and the internal pressure of 60 MN/m². Calculate the maximum shear stress in the material of the cylinder at the inner radius. 6

9. (a) Consider a solid circular shaft of length l and radius R, subjected to a torque T producing a twist $\theta$ in the length of the shaft. Calculate strain energy in torsion. 6

(b) A 1 m long beam rectangular in section 30 mm wide and 40 mm deep is supported on rigid supports at its ends. If it is struck at the centre by a 12 kg mass falling through a height of 60 mm find: (i) The instantaneous stress developed and (ii) The instantaneous strain energy stored in the beam. Take E=200 GN/m². 8

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