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Question Paper Code : 21852

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2015.

Fourth Semester

Mechanical Engineering

ME 2254/ME 45/CE 1259/10122 ME 405/080120018 – STRENGTH OF MATERIALS

(Common to Production Engineering and Automobile Engineering)

(Regulations 2008/2010)

(Common to PTME 2254/10122 ME 405 – Strength of Materials for B.E. (Part-Time) Third Semester, Mechanical Engineering, Regulations 2009/2010)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define Poisson's ratio.

2. Give the relation between Young's modulus and Bulk modulus.

3. What do you mean by point of contraflexure?

4. Write down the simple bending equation .

5. Define the term torsional rigidity.

6. What is Spring? Name the two important types of spring.

7. What are the methods used to determine the slope and deflection at a section in a loaded beam?

8. Define slenderness ratio.

9. What are the stresses developed when a thin cylindrical vessel is subjected to internal fluid pressure?

10. Define principal planes and principal stress.

PART B — (5 × 16 = 80 marks)

11. (a) Two vertical rods one of steel and the other of copper are each rigidly fixed at the top and 50 cm apart. Diameters and lengths of each rod are 2 cm and 4 m respectively. A cross bar fixed to the rods at the lower ends carries a load of 5000 N such that the cross bar remains horizontal even after loading. Find the stress in each rod and the position of the load on the bar. Take E for steel $= 2 \times 10^5 N/mm^2$ and E for copper $= 1 \times 10^5 N/mm^2$.

Or

(b) Calculate the modulus of rigidity and bulk modulus of a cylindrical bar of diameter 30 mm and of length 1.5 m if the longitudinal strain in a bar during a tensile test is four times the lateral strain. Find the change in volume, when the bar is subjected to a hydrostatic pressure of $100 N/mm^2$. Take $E = 1\ X10^5 N/mm^2$.

12. (a) A cantilever 1.5 m long is loaded with a uniformly distributed load of 2 kN/m run over a length of 1.25 m from the free end. It also carries a point load of 3 kN at a distance of 0.25 m from the free end. Draw the shear force and bending moment diagrams of the cantilever.

Or

(b) A timber beam of rectangular section is to support a load of 20 kN uniformly distributed over a span of 3.6 m when beam is simply supported. If the depth of section is to be twice the breadth, and the stress in the timber is not to exceed $7 N/mm^2$, find the dimensions of the cross section. How would you modify the cross section of the beam, if it carries a concentrated load of 20 kN placed at the centre instead of 20 KN uniformly distributed load with the same ratio of breadth to depth?

13. (a) A hollow shaft is to transmit 300 kW power at 80 r.p.m. If the shear stress is not to exceed 60 N/mm^2 and the internal diameter is 0.6 of the external diameter, find the external and internal diameters assuming that the maximum torque is 1.4 times the mean.

Or

(b) A closely coiled helical spring made of 10 mm diameter steel wire has 15 coils of 100 mm mean diameter. The spring is subjected to an axial load of 100 N. Calculate: (i) the mean shear stress induced, (ii) the deflection and (iii) stiffness of the spring.

14. (a) Find an expression for the slope and deflection of a simply supported beam carrying a point load *(W)* at the centre.

Or

(b) A simply supported beam of length 4 m is subjected to a uniformly distributed load of 30 kN/m over the whole span and deflects 15 mm at the centre. Determine the crippling loads when the beam is used as a column with the following conditions:

(i) One end fixed and the other end hinged

(ii) Both the ends pin joined.

15. (a) The stresses at a point in a bar are 200 N/mm^2 (tensile) and 100 N/mm^2 (compressive). Determine the resultant stress in magnitude and direction on a plane inclined at 60° to the axis of the major stress. Also determine the maximum intensity of shear stress in the material at the point.

Or

(b) A cylindrical thin drum 80 cm diameter and 3 m long has a shell thickness of 1 cm. If the drum is subjected to an internal pressure of 2.5 N/mm^2, determine (i) change in diameter, (ii) change in length and (iii) change in volume. Take $E = 2 \times 10^5 N/mm^2$; Poisson's ratio = 0.25.
