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B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2017
Fourth Semester
Mechanical Engineering
ME 2254 – STRENGTH OF MATERIALS
(Common to Automobile Engineering/Production Engineering)
(Regulations 2008)
(Also Common to PTME 2254 – Strength of Materials for B.E. (Part-Time)
Fourth Semester – Mechanical Engineering – Regulations 2009)

Time : Three Hours | Maximum : 100 Marks

Answer ALL questions.

PART – A **(10×2=20 Marks)**

1. Calculate the elongation of mild steel rod 25 mm in diameter and 2 m long when subjected to an pull of 80 kN. E for steel is 200 kN/mm^2.
2. What do you mean by Proof Resilience ?
3. What are the types of beam and draw a neat sketch for each type ?
4. Define shear flow.
5. A closely coiled helical spring is to carry a load of 500 N. Its mean coil diameter is to be 10 times that of the wire diameter. Calculate these diameters if the maximum shear stress in the material of the spring is to be 80 MN/m^2.
6. Write down the torsion equation.
7. Write down the relationship between slope, deflection and radius of curvature.
8. Define slenderness ratio of a column.
9. 'A cylindrical pipe of diameter 1.5 m and thickness 1.5 cm is subjected to an internal fluid pressure of 1.2 N/mm^2. Determine the longitudinal stress developed in the pipe.
10. How will you find major principal stress and minor principal stress ? Also mention how to locate the direction of principal planes.

PART – B (5×16=80 Marks)

11. a) A steel rod 18 mm in diameter passes centrally through a steel tube 30 mm in external diameter and 2.5 mm thickness. The tube is 0.75 m long and is closed by rigid washers of negligible thickness which are fasted by nuts threaded on the rod. The nuts are tightened until the compressive load on the tube is 20 kN. Calculate the stresses in the tube and rod.

(OR)

b) A bar of variable cross-section is 550 mm long and is subjected to an axial pull of 30000 N. The bar has a diameter of 30 mm over a length of 200 mm, 20 mm over a another length of 200 mm and 10 mm over the remaining length of 150 mm. If E for the bar material is 100 kN/m^2, determine : (i) elongation of the bar, (ii) maximum stress set up in the bar and (iii) minimum stress set in the bar.

12. a) An overhanging beam ABC is simply supported at A and B over a span of 6 m and BC overhangs by 3 m. If the supported span AB carries central concentrated load of kN and overhanging span BC carries 2 kN/m completely draw S.F. and B.M. diagrams indicating salient points.

(OR)

b) An I section girder 12 cm deep has the following cross-sectional dimensions : Top flange 6 cm wide by 1 cm thick, bottom flange 12 cm wide by 1 cm thick, web 1 cm thick. The girder is 5 m long simply supported over a span of 3m, overhanging both supports by the same amount and it carries a concentrated load 2 kN each end. Find the maximum stress in the material due to bending.

13. a) 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 to be allowed to exceed 90 MN/m^2 find : (i) Suitable diameter for the shaft; (ii) Final maximum shear stress and angle of twist. Take modulus of rigidity as 80 GN/m^2.

(OR)

b) A closely coiled helical spring is made out of 10 mm diameter steel rod. The coil consists of 10 complete turns with a mean diameter of 120 mm. The spring carries an axial pull of 200 N. Find the maximum shear stress induced in the section of the rod. If modulus of rigidity is 80 GN/m^2, find the deflection in the spring, the stiffness and strain energy stored in the spring.

14. a) A beam of uniform section, 10 metres long, is simply supported at the ends. It carries point loads of 100 kN and 60 kN at distances of 2 m and 5 m respectively from the left end. Calculate : (i) the deflection under each load ; (ii) the maximum deflection.

(OR)

b) Find the Euler crushing load for a hollow cylindrical cast iron column, 15 cm external diameter and 2 cm thick, if it is 6m long and hinged at both ends, E = 80 GN/m^2. Compare this load with the crushing load given by Rankine's formula, using σ_c = 567 MN/m^2 and α = 1/1600. For what length of strut of this cross-section does the Euler formula cease to apply ?

15. a) A rectangular block material is subjected to a tensile stress of 100 MN/m^2 on one plane and a tensile stress of 50 MN/m^2 on a plane at right angles, together with the shear stresses of 60 MN/m^2 on the same planes. Find : (i) The magnitude of the principal stresses (ii) The directions of the principal planes, (iii) The magnitude of the greatest shear stress.

(OR)

b) The gauge pressure in a boiler of 1.5 m diameter and 12.5 mm thickness is 2 MN/m^2; find the longitudinal and circumferential stresses in the boiler plate and circumferential, longitudinal and volumetric strains. Take E = 200 GN/m^2 and Poisson's ratio = 0.25.
