Reg. No. | | | | | | | | | | | | |

Question Paper Code : 60852

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2016.

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 bulk modulus.

2. Specify the significance of Mohr's circle.

3. What is meant by point of contra flexure?

4. Write the bending equation.

5. What is meant by torsional rigidity?

6. Define spring constant.

7. List out the limitations of McCauley's method.

8. State Maxwell's reciprocal theorem.

9. Show the possible ways of failure of thin cylinder.

10. Sketch the radial pressure and hoop stress distribution across the section of a thick cylinder subjected to internal pressure

PART B — (5 × 16 = 80 marks)

11. (a) A steel rod of 12 mm in diameter passes centrally through a copper tube of internal diameter 36 mm and external diameter 48 mm and of 2.5 m length. The tube is closed at each end by 24 mm thick steel plates which are secured by nuts. The nuts are tightened until the copper tube is reduced in length by 0.50 mm. The whole assembly is then raised temperature by 60°C. Calculate the stresses in copper and steel before and after the rise of temperature, assuming the thickness of the plates remains unchanged. Take $E_s = 210$ GN/m^2, $E_c = 105$ GN/m^2, $\alpha_s = 1.2 \times 10^{-5}$ per °C and $\alpha_c = 1.75 \times 10^{-5}$ per °C. (16)

Or

(b) Two mutually perpendicular planes of an element of material are subjected to direct stresses of 10.5 MN/m^2 (tensile) and 3.5 MN/m^2 (comp.) and shear stress of 7 MN/m^2. Find the magnitude and direction of principal stress. Also find magnitude of normal and shear stresses on a plane on which the shear stress is maximum. (16)

12. (a) A horizontal beam AB 8 m long is supported at A and C 6 m from A. The beam supports a U.D.L. of 1.5 kN/m over its entire length and also concentrated loads of 3 kN and 1.5 kN at D and B respectively, D being 2 m from A. Draw the S.F. and B.M diagrams for the beam. Where does the maximum B.M. occur and what is its value? (16)

Or

(b) Two wooden planks 150 mm × 50 mm each are connected to form a T- section of a beam. If a moment of 3.4 kNm is applied around the horizontal neutral axis, inducing tension below the neutral axis, find the stresses at the extreme fibers of the cross-section. Also calculate the total tensile force on the cross-section. (16)

13. (a) A solid shaft of mild steel 200 mm in diameter is to be replaced by hollow shaft of alloy steel for which the allowable shear stress is 22 percent greater. If the power to be transmitted is to be increased by 20 percent and the speed of rotation increased by 6 percent, determine the maximum internal diameter of the hollow shaft. The external diameter of the hollow shaft is to be 200 mm. (16)

Or

(b) For a close-coiled helical spring subjected to an axial load of 300 N having 12 coils of wire diameter of 16 mm, and made with coil diameter of 250 mm. Find the axial deflection, strain energy stored, maximum torsional shear stress in the wire and maximum shear stress using Wahl's correction factor. C = 80 GN/m^2.

14. (a) A simply supported beam 5m long carries concentrated loads of 90 kN and 60 kN at two points 1m and 1.5m from the two ends respectively. Calculate deflection and slope under the two loads. Also find maximum slope and deflection by moment area method. $EI = 1.2 \times 10^4 kNm^2$. (16)

Or

(b) A beam ABC is simply supported at ends A and C over a span of 10 m. It is made up of two portions AB at 8m and BC at 2m. The moments of inertia of AB and BC are 4I and I respectively. The beam carries point load of 15 kN at B. Determine the slope at end A, deflection at the mid span and maximum deflection by Conjugate beam method. $I = 8 \times 10^{-5} m^4$ and E = 200 × 10^6 kN/m^2. (16)

15. (a) A boiler shell is to be made of 15 mm thick plate having tensile stress of 120 MN/m^2. If the longitudinal and circumferential efficiencies are 70% and 30% respectively, determine the maximum permissible diameter of the shell for an internal pressure of 2 MN/m^2 and permissible intensity of internal pressure when the shell diameter is 1.5 m. (16)

Or

(b) A steel cylinder is 1m inside diameter and is to be designed for an internal pressure of 8 MN/m^2. Calculate thickness if maximum shearing stress is not to exceed 35 MN/m^2. Also calculate increase in volume due to working pressure, if cylinder is 6 m long with closed ends. E = 200 GN/m^2 and Poisson ratio = 1/3. Neglect any constraint due to ends. (16)