Roll No. .... Total Pages : 5

013404

August/September 2022
B.Tech. (ME) IV SEMESTER
STRENGTH OF MATERIALS-II (PCC-ME-404-21)

Time : 3 Hours] [Max. Marks : 75

Instructions :

1. *It is compulsory to answer all the questions (1.5 marks each) of Part-A in short.*
2. *Answer any four questions from Part-B in detail.*
3. *Different sub-parts of a question are to be attempted adjacent to each other.*

PART-A

1. (a) What is tensor? (1.5)

(b) Discuss briefly generalized Hooke's law. (1.5)

(c) State maximum principle strain theory for failure. (1.5)

(d) The maximum shear stress and the distortional energy density theories are suitable for .... materials, while the former is more........... than the latter. (1.5)

(e) Define Proof Resilience and proof stress. (1.5)

(f) Enlist the several types of loading. (1.5)

(g) Define slenderness ratio. (1.5)

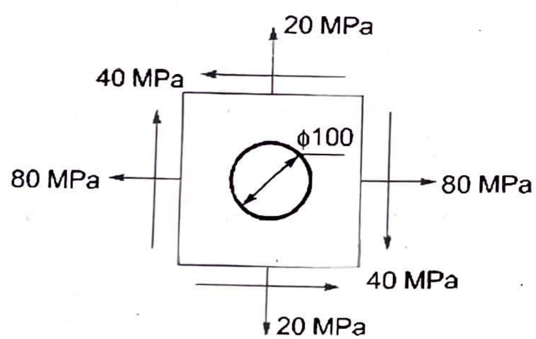
(h) What is equivalent length of a column? Write the expression of equivalent length in fixed-free end conditions column. (1.5)

(i) Enlist the types of Curved Bars on the Basis of Initial Curvature. (1.5)

(j) For thin rotating rings of mean radius R, the tensile hoop stress set up is given by.................. (1.5)

PART-B

2. (a) A circle of 100 mm diameter on a steel plate which is loaded as shown in figure. As a result the circle is deformed into an ellipse. Determine the lengths of major and minor axes in mm. E = 200 GPA, $\mu = 0.25$. (10)

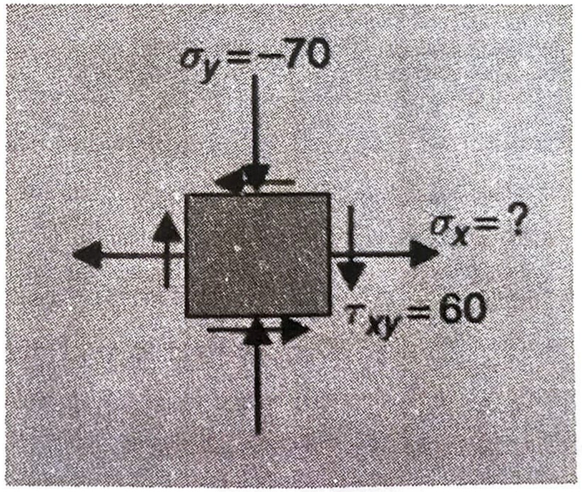


(b) A material is subjected to the following stress state. What are the principal stresses in the material?

$$\sigma = \begin{pmatrix} 100 & 20 & 0 \\ 20 & 0 & 20 \\ 0 & 20 & 100 \end{pmatrix} \text{MPa}$$ (5)

3. (a) A cast pipe made of an aluminum alloy with the outer diameter D = 90 mm, and the inner diameter d = 50 mm is submitted to static torsion by an applied torque moment M_t = 15 kNm. Consider the maximum principal stress failure theory to determine the factor of safety, supposing that the values of ultimate strengths in tension and compression are S_{ut} = 290 MPa and S_{uc} = –330 MPa, respectively. (5)

(b) In a tensile test on a metal specimen having a cross-section of 20 mm × 10 mm failure occurred at a load of 70 kN. A thin plate made from the same material is subjected to loads such that at a certain point in the plate the stresses are σ_y = –70 N/mm², τ_{xy} = 60 N/mm². Determine from the von Mises and Tresca criterions the maximum allowable tensile stress, σ_x, that can be applied at the same point. (10)



4. (a) An axial pull of 20 kN is suddenly applied on a steel rod 2.5 m long and 1000 mm^2 in cross-section. Calculate the strain energy, which can be absorbed in the rod. Take E = 200 GPa. (5)

(b) Determine the following when a prismatic bar AB of length L and solid circular cross-section of diameter 'd' is loaded by a uniformly varying torque 't' have an intensity of 't' Nm/m at the fixed end. Find

(i) Maximum torsional shear stress.

(ii) Angle of twist at free end.

(iii) Angle of twist at a cross-section located at a distance L/2 from the free end.

(iv) Strain energy of the shaft. (10)

5 (a) Compare the ratio of the strength of a solid steel column to that of a hollow of the same cross-sectional area. The internal diameter of the hollow column is 3/4 of the external diameter. Both the columns have the same length and are pinned at both ends. (5)

(b) What are the assumptions and limitations of Euler's Column Theory? Discuss how to find out crippling load by Rankine's Formula in long as well as short columns. (10)

6. (a) A beam of circular section of diameter 20 mm has its center line curved to a radius of 50 mm. Find the intensity of maximum stresses in the beam, when subjected to a moment of 5 kN-mm. (5)

(b) Develop the expressions for stresses in circular rings subjected to tension or compression. (10)

7. (a) The cross-section of a turbine rotor disc is designed for uniform strength under rotational conditions. The disc is keyed to a 60 mm diameter shaft at which point its thickness is a maximum. It then tapers to a minimum thickness of 10 mm at the outer radius of 250 mm where the blades are attached. If the design stress of the shaft is 250 MN/m^2 at the design speed of 12000 rev/min, what is the required maximum thickness? For steel p = 7470 kg/m^3. (5)

(b) Derive the expressions for hoop and radial stresses in rotating thick cylinders. (10)
