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B.Tech. (ME) IV SEMESTER

Advanced Strength of Materials (PCC-ME-208)

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.*
4. *Assume suitable data if any missing.*

PART–A

1. (a) Differentiate between Zero, first and second order tensors. (1.5)

(b) Which theories of failure give most conservative design? (1.5)

(c) What is the importance of Hook's Law? (1.5)

(d) What are the utility of Maxwell theorem? (1.5)

(e) List the assumptions made to drive the expression for rotational stresses in rims and discs. (1.5)

(f) What is the difference between straight beam, beam with small initial curvature and beam with large curvature? (1.5)

(g) Why trapezoidal section is preferred for crane hook design? (1.5)

(h) Compare theories of failures graphical various. (1.5)

(i) Differentiate sudden, gradual and Impact loading. (1.5)

(j) Draw the graph for circumferential and radial stresses of a hollow cylinder. (1.5)

PART–B

2. A bolt is required to resist an axial tension of 25 kN and a transverse shear of 20 kN. Find the size of the bolt by

(i) The maximum principal stress theory.

(ii) The maximum shear stress theory.

(iii) The maximum distortion energy theory.

The elastic limit of the material is 300 N/mm^2. Poisson's ratio = 0.3 and factor of safety = 3.0. (15)

3. (a) Drive an Expression for Castigliano's theorm. (5)

(b) A bar 3 m long and 5cm diameter hangs vertically and has a collar securely attached to the lower end. Find the maximum stress inducted when,

(i) A weight of 2.5 kN falls from 12 cm on the collar.

(ii) A weight of 25 kN falls 1 cm on the collar

Take E = 2X 10^5 N/mm^2. (10)

4. What is meant by a disc of uniform strength? Prove that the thickness of such a disc at any radius r is given by

$$t = t_o \exp\left[\frac{-\rho w^2 r^2}{2\sigma}\right]$$

Where t_0 is the thickness at $r = 0$, σ is the stress due to rotation at w radian/second. (15)

5. The horizontal cross-section of a crane hook is a trapezium with parallel sides 24 mm wide at the inside and 12 mm wide at the outside and the parallel sides are 30 mm apart. The hook carries a load of 6 kN, the line of load being at a horizontal distance of 300 mm from the inside edge of the horizontal cross-section through the center of curvature and the center of curvature being 36 mm from the same edge. Make calculation to determine the:

(i) location of neutral axis

(ii) maximum and minimum stresses induced in the hook. Show the variation of these stresses in the horizontal section. (15)

6. In a triaxial stress system, the six components of the stress at a point are given below:

$\sigma_x = 6$ MN/m^2 $\tau_{xy} = \tau_{yx} = 1$ MN/m^2

$\sigma_y = 5$ MN/m^2 $\tau_{yz} = \tau_{zy} = 3$ MN/m^2

$\sigma_z = 4$ MN/m^2 $\tau_{zx} = \tau_{xz} = 2$ MN/m^2

Find the magnitude of three principal stresses. (15)

7. What is stress tensor? Drive an expression of small strain tensor and compatibility. (15)
