

May 2023

B.Tech (ME/ME(HINDI)) 4th Sem., May 2023

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.
 4. Assume suitable value for any missing data.

PART -A

- Q1 (a) Which theories of failure give most conservative design? (1.5)
- (b) What is the importance of factors of safety? (1.5)
- (c) Why trapezoidal section is preferred for crane hook design? (1.5)
- (d) Why Euler's buckling load formula is applicable for long column only? (1.5)
- (e) A thin solid disc of diameter 40 cm is rotating at N r.p.m. If the maximum radial stress developed is 200 N/mm², then what will be the maximum hoop stress developed in it? (1.5)
- (f) Differentiate hinged, Rolled and Fixed support. (1.5)
- (g) What are the utility of Castigliano's first theorem? (1.5)
- (h) Define Engineering strain tensor. (1.5)
- (i) What do you mean by curved beam? (1.5)
- (j) Differentiate between Zero, first and second order tensors. (1.5)

PART -B

Q2	A cast iron column of hollow circular section, external diameter 25 cm and thickness of metal 3.5 cm has to transmit an axial compressive load P . The column is 7 m long with both the ends hinged. Take factor of safety as 8. Determine the value of P . Rankine's constants for $\sigma_c=5.6 \text{ Kg/cm}^2$ is $a=1/1600$.	(15)
Q3	An unknown weight falls through a height of 10 mm on a collar rigidly attached to the lower end of vertical bar 500 cm long and 600 mm ² in section. If the maximum extension of the rod is to be 2mm, what is the corresponding stress and magnitude of the unknown weight? Take $E=2.0 \times 10^5 \text{ N/mm}^2$.	(15)
Q4 (a)	Write a note on significance of theories of failure.	(5)
(b)	A bending moment of 4 kN is found to cause elastic failure of a solid circular shaft. An exactly similar shaft is now subjected to a torque T . Determine the value of T which causes failure of the shaft according to the following theories: (i) Maximum principal stress (ii) Maximum principal strain (iii) Maximum Strain Energy Theory (Poisson ratio = 0.3)	(10)

Q5	(a)	The state of stresses at a point is given by the Cartesian stresses tensor: $\sigma = \begin{bmatrix} 2 & -1 & 2 \\ -1 & 3 & -1 \\ 2 & -1 & 2 \end{bmatrix} MPa$ Find the following 1. The three stress invariants 2. Characteristic equation 3. Principal stress 4. Any one normal to the principal plane	(8)
	(b)	Derive the Cauchy's equation for components of traction along the x,y and z direction. Also derive the characteristic equation for the principle stresses and principle plane from Cauchy's equation.	(7)
Q6		A curved bar of rectangular cross section 4 cm x 6 cm is subjected to a bending moment of 2 kNm, its centre line is curved to a radius of 20 cm Determine the maximum tensile and compressive stress in beam, if the bending moment tends to increase the curvature. What is the stress at the CG of the section? Plot the stress distribution diagram to a suitable scale along any section.	(15)
Q7	(a)	A thin uniform steel disc of diameter 40 cm is rotating about its axis at 1800 r.p.m. Calculate the maximum principal stress and maximum shearing stress in the disc. Draw the circumferential and radial stress distribution along the radius of the disc. Density = 7700 kg/m ³ , Poisson's ratio=0.3	(8)
	(b)	Drive an expression for thickness at any radius for disc of Uniform strength.	(7)
