Reg No.:_____ Name:_____

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Third Semester B.Tech Degree (S,FE) Examination December 2022 (2015 scheme)

Course Code: ME201

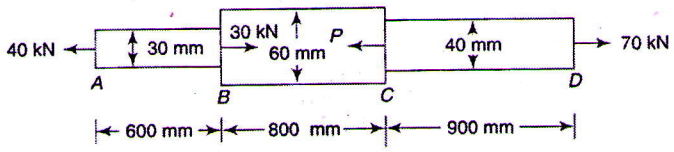
Course Name: MECHANICS OF SOLIDS (ME, MP, MA,MT,AU,PE,SF)

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any three full questions, each carries 10marks Marks

1 A circular bar made of steel has sections with diameters as shown in the figure is subjected to various forces. Determine the force 'P' required to keep the member in equilibrium. Also, find the total elongation of the bar (Assume E_{steel} = $2.02x10^5 N/mm^2$). 10



2 a) Draw the stress-strain curve of a ductile material and mark a) Yield point, b) Ultimate tensile stress 5

b) Distinguish between orthotropic and anisotropic materials. 5

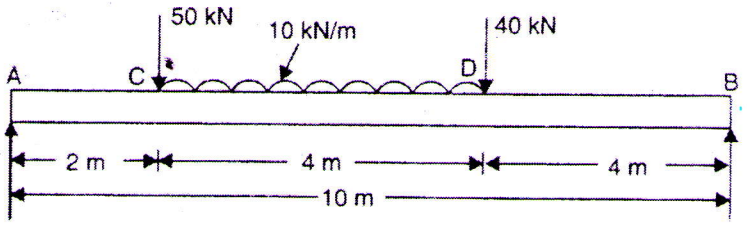
3 Write stress matrix and strain matrix for a 3D state of stress. Explain components of the stress matrix with a suitable sketch. 10

4 Two shafts of the same material and same length are subjected to the same torque. The first shaft has a solid circular section and the other has a hollow circular section having an internal diameter 2/3 rd of the external diameter. If the maximum shear stresses developed are the same, compare the weights of the shafts. 10

PART B

Answer any three full questions, each carries 10marks

5 Draw the shear force and bending moment diagrams of the simple beam as shown below 10



6 Obtain the relation between load, shear force, and bending moment. 10

7 A simply supported beam of span 3.0 m has a rectangular cross-section of 120 mm × 180 mm. If the permissible stress in the material of the beam is 10 N/mm^2, determine 10

(i) Maximum uniformly distributed load it can carry

(ii) Maximum concentrated load at a point 1 m from left support

8 Derive the expression for the shear stress distribution across the cross-section of a rectangular beam ('b' x 'd') carrying shear force 'F' and plot the distribution of stresses. 10

PART C

Answer any four full questions, each carries 10marks.

9 Explain the double integration method to find the slope and deflection of a cantilever beam carrying point load 'w' at the free end. 10

10 Obtain the slope at the support and maximum deflection for the case of a simply supported beam carrying point load 'w' at the centre using moment area method 10

11 a Write plain stress and plain strain matrices for a 2D element subjected to normal stresses and normal strains alone. 5

b For the case of 2D state of stress $\begin{pmatrix} 10 & 2 \\ 2 & 5 \end{pmatrix}$ (in kN/mm^2), find the normal and tangential stresses on a plane inclined 60° to the larger normal stress. 5

12 The maximum allowable shear stress in a hollow shaft of external diameter equal to twice the internal diameter is 80N/mm^2. Determine the diameter of the shaft if it is subjected to a twisting moment of 4 x 10^6 N-mm and a bending moment of 3 x 10^6 N-mm. 10

13 For the plane stress condition characterized by σ_{xx} =50N/mm^2 σ_{yy}= 35N/mm^2, and τ_{xy} = 40N/mm^2, determine principal stresses and maximum shear stress using the method of Mohr's circle. Also, determine the inclination of the plane on which maximum principal stress act. 10

14 A tubular column that is pinned at both the ends has outer and inner diameters of 40 and 36mm respectively and a length of 2400mm. Compare the crippling load given by Euler's and Rankine's formulae. Assume E = 204GPa, Yield strength of the material = 310GPa and $\alpha = 1/7500$. 10

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