CBCS SCHEME

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15AE34

Third Semester B.E. Degree Examination, Dec.2019/Jan.2020
Mechanics of Materials

Time: 3 hrs. Max. Marks: 80

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Define state of stress at a point. **(03 Marks)**

b. Displacement field at a point on a body is given as follows :
$u = (x^2yz + z^2)$; $v = (xy^2z + y^2)$ $w = (xyz^2 + x^2)$. Determine strain components at (2, 1, 2) and express them in matrix form. **(05 Marks)**

c. Derive equilibrium equation for 3D state of stress in rectangular coordinate system. **(08 Marks)**

OR

2 a. An element is subjected to stresses as shown in Fig.Q2(a). Determine
i) Normal stress and shear stress on a plane whose normal makes an angle 20^0 with horizontal axis.
ii) Principal stress and orientations of principal planes.
iii) Maximum and minimum shear stresses and their orientations. **(10 Marks)**

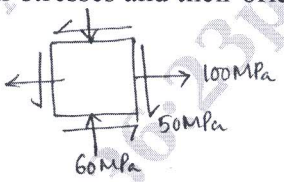

Fig.Q2(a)

b. Draw stress – strain curve for ductile material and mention salient points. **(06 Marks)**

Module-2

3 a. State and prove the implications of Euler Bernoulli beam theory. **(08 Marks)**

b. A beam having T section with its flanges of (180mm × 10mm) and web of (220mm × 10mm) is subjected to sagging bending moment 15kNm. Determine the maximum tensile stress and maximum compressive stress and their locations in the sections. Draw a sketch showing bending stress distribution. **(08 Marks)**

OR

4 a. Formulate the sectional constitutive laws of three dimensional Euler Bernoulli beam theory. **(08 Marks)**

b. Derive the governing differential equations for a three dimensional beam. **(08 Marks)**

Module-3

5 a. A hollow shaft with inner diameter to outer diameter ratio of 0.8 is to transmit a torque of 2500Nm. Taking the allowable shear stress for the shaft material as 45MPa and the limiting angle of twist is 2 meters length of shaft as 1.5^0. Determine the inner and outer diameters of the shaft. Take G = 81 GPa. **(10 Marks)**

b. Discuss the application of the Von – Mises criterion for a propeller shaft subjected to Bending Moment and torque. **(06 Marks)**

OR

6 a. What is wrapping of thin – walled beam under torsion? Give kinematic description. **(08 Marks)**

b. Explain the following terms with respect to the basic equations for thin walled beam.
   i) The thin wall Assumptions ii) Stress flow
   iii) Stress resultants iv) Shear flow. **(08 Marks)**

Module-4

7 a. Explain the principle of virtual work for a particle and write the statements. **(08 Marks)**

b. Define principle of virtual work for a rigid body and state the difference between principle of virtual work and principle of complementary virtual work. **(08 Marks)**

OR

8 a. State and explain Castigliano's I and II theorem. Determine the deflection at the free end of a cantilever beam subjected to point load P at its free end using Castigliano's theorem. **(10 Marks)**

b. What is conservative forces? Derive the expression for work done by conservative forces along any path joining two points. **(06 Marks)**

Module-5

9 a. Explain Tresca's criterion in detail for uniaxial state of stress, plane state of stress and pure shear. **(10 Marks)**

b. Explain the Analysis of a Rigid bar with root torsional spring (considering the system is perfect). **(06 Marks)**

OR

10 Explain Kirchoff plate theory and derive the following with assumptions.
   a. Total displacement field and strain field.
   b. Equilibrium equations. **(16 Marks)**

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