CBCS SCHEME

USN | | | | | | | | | | |

15AE34

Third Semester B.E. Degree Examination, Jan./Feb. 2023
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. Derive equilibrium equation for 3D state of stress in rectangular coordinate system. **(10 Marks)**

b. With a neat sketch, explain the stress strain curve for mild steel. **(06 Marks)**

OR

2 a. Briefly explain:
i) Stress ii) Strain iii) Hooke's law iv) Elasticity v) Toughness. **(10 Marks)**

b. Displacement field at a point on a body is given as follows :
$u = (x^2y^2 + z^2)$; $v = (xy^2z + y^2)$; $w = (xyz^2 + x^2)$. Determine strain components at (2, 1, 2) and express them in matrix form. **(06 Marks)**

Module-2

3 a. Formulate the relationship between intensity of load, shear force and bending moment. **(06 Marks)**

b. State and prove implications of enter Bernoulli beam theory **(10 Marks)**

OR

4 Formulate the sectional constitutive laws of three dimensional Euler Bernoulli beam theory. **(16 Marks)**

Module-3

5 a. Derive Torsion equation $\frac{T}{J} = \frac{\tau}{R} = \frac{G\theta}{\ell}$ with usual notations. **(08 Marks)**

b. A solid shaft is to transmit 192kW at 450rpm. Taking the allowable shear stress for the shaft material as 70MPa. Determine the diameter of the solid shaft. What percentage of saving in weight would be obtained if this shaft were to be replaced by a hollow shaft whose internal diameter is 0.8 times external diameter? The length, material, powers to be transmitted and speed are equal to both cases. Torsinal strength of both solid and hollow shaft should be equal. **(08 Marks)**

OR

6 Briefly explain :
a) Shearing of thin walled beams
b) Structural Idealization
c) Shear center
d) Torsion of closed section beams **(16 Marks)**

Module-4

7 a. Define principle of virtual work for a particle and obtain the equilibrium of a particle. **(08 Marks)**

b. State and explain Castiglione's I and II theorem. Also find the deflection at free end of the cantilever shown in Fig Q7(b)

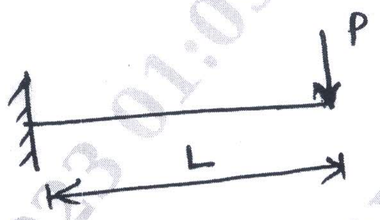

Fig Q7(b) **(08 Marks)**

OR

8 a. Define a conservative force and obtain the work done by a conservative force along any path joining two points. **(08 Marks)**

b. State and prove Maxwell's reciprocal theorem. **(08 Marks)**

Module-5

9 State and explain the assumptions in Kirchhoff's plate theory and obtain the expressions for total displacement field and strain field. **(16 Marks)**

OR

10 a. Explain Tresca's & Von Mises yielding criteria. **(08 Marks)**

b. Discuss the applications of Von Mises and Tresca's criterion for a propeller shaft subjected to

i) Axial thrust and Torque

ii) Bending moment and torque. **(08 Marks)**

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