CBCS SCHEME

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15AE34

Third Semester B.E. Degree Examination, Feb./Mar. 2022
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 the equilibrium equations in polar co-ordinates for a two-dimensional state of stress. **(10 Marks)**

b. Displacement field at the point on a body is given as follows :

$u = [y^2i + 3yzj + (4 + 6x^2)k]*10^{-2}$

Determine strain components at (1, 0, 2) and express them in matrix form. **(06 Marks)**

OR

2 a. Write a note on constitutive law for isotropic materials. **(04 Marks)**

b. Draw a stress-strain diagram for mild steel and mention the salient points. **(04 Marks)**

c. A cylinder shell is 3m long and is having 1m internal diameter, 15mm thickness. Calculate maximum intensity of shear stress induced and also change in dimension of the shell, if it is subjected to an internal fluid pressure of 1.5 N/mm^2. Take E = 200 GPa, Poisson's ratio is 0.3. **(08 Marks)**

Module-2

3 a. List out the Euler-Bernoulli assumption and its implications. **(06 Marks)**

b. A cantilever beam of square section 200mm × 200mm, 2 m long just fails in bending when a load of 20 kN is placed at its free end. A beam of same material having a rectangular cross-section 150mm × 300mm simply supported over a span of 3m is to be used under a uniform distributed load 'W' N/m. What can be the maximum value of 'W'? **(10 Marks)**

OR

4 a. What are the governing equations for a three-dimensional beam? Explain. **(08 Marks)**

b. What are the equilibrium equations for the "Beam subjected to transverse load"? **(08 Marks)**

Module-3

5 a. A solid shaft rotating at 500 rpm transmits 30 kW. Maximum torque is 20% more than Mean torque. Allowable shear stress 65 MPa and modulus of rigidity 81 GPa, angle of twist in the shaft should not exceed 1° in 1 meter length. Determine suitable diameter. **(10 Marks)**

b. Discuss the application of Von-Mises Criterion and Tresca's criterion for a propeller shaft under torsion and thrust. **(06 Marks)**

OR

6 a. Calculate the position of the shear centre of the thin walled channel section shown in Fig.Q6(a). The thickness 't' of the walls is constant.

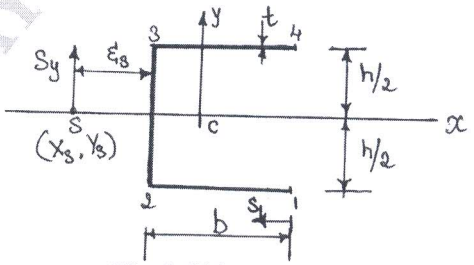

Fig.Q6(a) **(08 Marks)**

b. Determine the shear distribution in the walls of the thin walled section beam as shown in Fig.Q6(b). The wall thickness 't' is constant throughout.

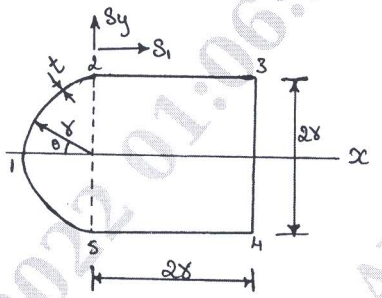

Fig.Q6(b) **(08 Marks)**

Module-4

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

b. What are the difference between principle of virtual work and principle of complementary virtual work? **(08 Marks)**

OR

8 a. Determine the strain energy of the prismatic beam AB for a loading as shown in Fig.Q8(a). Take E = 200 GPa.

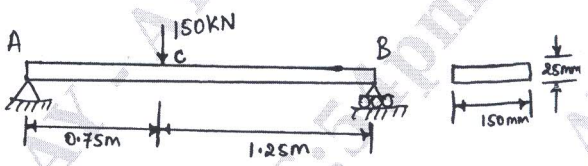

Fig.Q8(a) **(10 Marks)**

b. Explain Maxwell's theorem in detail. **(06 Marks)**

Module-5

9 a. Explain Tresca's and Von-Mises criterion. **(08 Marks)**

b. A steel tube of 25mm external diameter and 18mm internal diameter enclose a copper rod of 15mm diameter. The ends are rigidly fastened to each other. Calculate the stress in the rod and the tube when the temperature is raised from 15°C to 200°C. Take $\alpha_{st} = 11\times10^{-6}/°C$, $\alpha_{cu} = 18\times10^{-6}/°C$, $E_{st} = 200$ GPa, $E_{cu} = 100$ GPa. **(08 Marks)**

OR

10 Explain Kirchoff plate theory and derive the following , with assumptions :

a. Total displacement field

b. Strain field **(16 Marks)**

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