CBCS SCHEME

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17AE34

Third Semester B.E. Degree Examination, Jan./Feb.2021
Mechanics of Materials

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Derive equilibrium equations for a 3D stress system. **(12 Marks)**

b. A 1.2 m long thin cylindrical pressure vessel of 500 mm inner diameter and 14 mm wall thickness undergoes a volume change of 5×10^4 mm^3, when it is subjected to an internal pressure P. Taking E = 210 GPa and $\frac{1}{m} = 0.3$; determine (i) Internal pressure (ii) hoop stress. **(08 Marks)**

OR

2 a. With a neat sketch explain all the salient points of a stress-strain diagram for mild steel. **(08 Marks)**

b. Discuss material selection for structural performance. **(12 Marks)**

Module-2

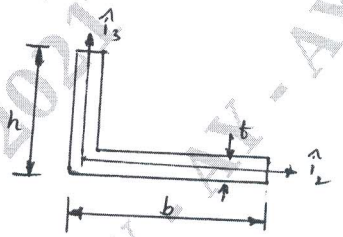
3 a. List the Euler-Bernoulli assumptions and explain its implications. **(10 Marks)**

b. A Cantilever has a length of 3 m. Its cross section is of T-section with flange 100 mm × 20 mm and web 200mm × 12mm, the flange is in tension, what is the intensity of udl that can be applied. If the maximum tensile stress is limited to 30 N/mm^2. Also compute the maximum compressive stress and show bending stress distribution. **(10 Marks)**

OR

4 a. What is three dimensional beam theory? Give its kinematic description. **(10 Marks)**

b. Find the principle centroidal bending stiffness of the beam shown in Fig. Q4 (b). The axial stiffness of section is S = Et(bth) **(10 Marks)**



h = 0.1m
b = 0.25m
t = 2.3m.

Fig. Q4 (b)

Module-3

5 a. A solid circular shaft has to transmit a power of 1000 kW at 120 rpm. Find the diameter of the shaft if the shear stress of the material must not exceed 80 N/mm^2. The maximum torque 1.25 times of its mean. What percentage of saving in material would be obtained. If the shaft is replaced by the hallow shaft is replaced by the hallow shaft having internal diameter of 0.6 times its external diameter, the length, material and the maximum shear stress being same. **(10 Marks)**

b. Discuss the application of Von mises criterion and Tresca's criterion for a propeller shaft under torsion and bending. **(10 Marks)**

OR

6 a. Explain the concept of stress flows in thin walled beams. **(10 Marks)**
b. Derive equation for shear flow distribution in open section beams subjected to shear. **(10 Marks)**

Module-4

7 a. Define principle of virtual work for a particle obtain the equilibrium of a particle. **(10 Marks)**
b. Define complementary virtual work and explain how it differs from principle of virtual work. **(05 Marks)**
c. Briefly explain the steps in unit load method to determine the deflections at specific points of a structure. **(05 Marks)**

OR

8 a. Define : (i) Castiglione's theorem (ii) Clapeyron's theorem (iii) Maxwell's theorem **(06 Marks)**
b. Two bars are subjected to equal gradually, applied tensile loads. One is of diameter 'D' throughout and the other which has the same length, is turned down to diameter D/3 over the middle third of its length, and the remainder having diameter D. Compare
(i) The strain energies of the two bars assuming that they are of the same material.
(ii) The amount of energy which the two bars can absorb in simple tension without exceeding a given stress within the limits of proportionality.
(iii) The amount of energy per unit volume if the maximum stress is to be the same for both cases.
(iv) The strain energies of the two bars assuming that they are of the different materials and $\frac{E_1}{E_2} = \frac{3}{4}$ **(14 Marks)**

Module-5

9 a. Determine the diameter 'd' of a circular shaft subjected to a bonding moment M and a torque T according to the (i) Maximum normal stress theory (ii) Maximum strain theory (iii) Maximum shear stress theory (iv) Maximum distortion energy theory. **(14 Marks)**
b. A rigid bar ABCD is hinged at A and supported by 2 identical wires as shown in Fig. Q9 (b) find the tensile forces T_1 and T_2 induced in the wire due to vertical load. Also find the stress in wires if the cross section area is 5 mm^2. **(06 Marks)**

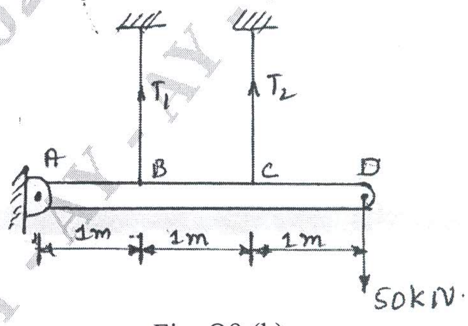


Fig. Q9 (b)

OR

10 a. Explain Kirchhoff plate theory with its assumptions and displacement field. **(10 Marks)**
b. Deduce the principle of minimum total potential energy for Kirchhoff plates. **(10 Marks)**

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