CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐   18AE/AS33

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.   Define Hooke's law. Draw and explain the stress-strain curves for ductile and brittle materials.   **(10 Marks)**

     b.   Derive the equilibrium equations for a 3-D stress system.   **(10 Marks)**

OR

2   a.   A steel bar ABCD 4m long is subjected to forces as shown in Fig.Q.2(a). Find the elongation of the bar. Take E for the steel as 200GPa.   **(10 Marks)**
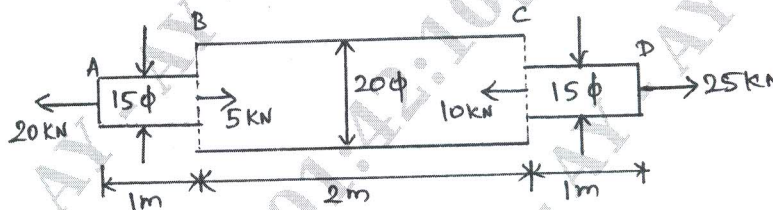

Fig.Q.2(a)

     b.   A plane element in a body is subjected to a tensile stress of 100MPa accompanied by a shear stress of 25MPa. Find:
       i)   The normal and shear stress on a plane inclined at an angle of 20° with the tensile stress and
       ii)   The maximum shear stress on the plane.   **(06 Marks)**

     c.   Write the expression for temperature stress and explain each term.   **(04 Marks)**

Module-2

3   a.   Derive the relationship between shear force and bending moment.   **(04 Marks)**

     b.   A beam of 8M span simply supported at its end carries loads of 2kN and 5kN at a distance of 3m and 6m respectively from right support. In addition, the beam carries a UDL of 4kN/m for its entire length. Draw the SF and BM diagram.   **(12 Marks)**

     c.   What are the different types of beams?   **(04 Marks)**

OR

4 a. Derive the Euler-Bernoulli beam theory equations. **(10 Marks)**
   b. A cast iron bracket of I-shape with unequal flanges as shown in Fig.Q.4(b). If the section is subjected to a shear force of 1kN. Draw the shear stress distribution over the depth of the section. **(10 Marks)**
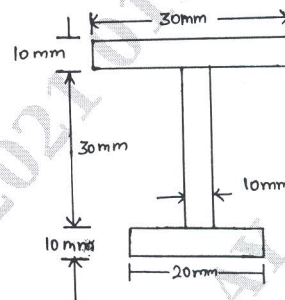

Fig.Q.4(b)

Module-3

5 a. Write the relation between slope, deflection and radius of curvature. **(08 Marks)**
   b. A steel cantilever 6m long carries two point loads, 15kN at the free end and 25kN at a distance of 2.5m from the free end. Find:
      i)   Slope at the free end
      ii) Deflection at the free end. Take $I = 1.3 \times 10^8 mm^4$ and $E = 2 \times 10^5 N/mm^2$ by using Double Integration method and Maculay's method. **(12 Marks)**

OR

6 a. A hollow shaft is to transmit 300kW at 80rpm. If the shear stress is not to exceed $50MN/m^2$ and diameter ration is 3/7. Find the external and internal diameter if the twist is $1.2°$ and length is 2m. Assuming maximum torque is 20% greater than mean. Take $C = 80GN/m^2$. **(12 Marks)**
   b. What are the assumptions made in theory of pure torsion? **(04 Marks)**
   c. Define torsional rigidity and write the equation for power transmitted by the shaft. **(04 Marks)**

Module-4

7 a. Explain the principle of virtual work for a particle and write the statements. **(10 Marks)**
   b. Define principles of virtual work for a rigid body and state the difference between principles of virtual work and principle of complementary virtual work. **(10 Marks)**

OR

8 a. State and explain Castigliano's I and II theorem. **(10 Marks)**
   b. State and derive Maxwell's reciprocal theorem. **(10 Marks)**

Module-5

9 a. Define Fracture. Explain Type-I, II and III of fractures. **(10 Marks)**
   b. Define creep. Explain all the three stages of creep. **(10 Marks)**

OR

10 a. Draw S-N diagram and explain in detail. **(10 Marks)**
   b. Write a short note on endurance limit. **(05 Marks)**
   c. Define fatigue and explain the types of fatigue loading. **(05 Marks)**

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