CBCS SCHEME

USN | | | | | | | | | |

18AE/AS33

Third Semester B.E. Degree Examination, Aug./Sept.2020
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. Analyze the stress at a point in 3D Elastic body and derive 3D stress equilibrium equations at that point. Deduce the equations to plane stress conditions. **(10 Marks)**

b. Draw the stress-strain curves for the below mentioned materials mentioning/illustrating salient features of stress-strain curves:
(i) Mild steel (ii) Aluminium (iii) High carbon steel
(iv) Cast iron (v) Glass **(05 Marks)**

c. Define the following with example:
(i) Normal stress (ii) Shear stress (iii) Bending stress
(iv) Torsional stress (v) Bearing stress **(05 Marks)**

OR

2 a. Show that total Elongation in an uniformly tapering circular section bar is $\delta_\ell = \frac{4PL}{\pi E d_1 d_2}$. **(06 Marks)**

b. Determine the stresses in various segments of the circular bar shown in Fig.Q2(b). Compute the total Elongation taking Young's modulus to be 195 GPa.

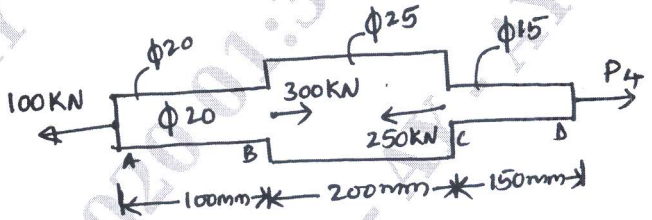

Fig.Q2(b) **(08 Marks)**

c. A point in a strained material is subjected to a tensile stress 500 N/mm^2 and 300 N/mm^2 in two mutual perpendicular planes. Calculate: (i) Normal stress (ii) Tangential stress (iii) Resultant stress, on plane making 30° to lateral axis. **(06 Marks)**

Module-2

3 a. Explain types of beams, loads and supports with neat illustrations. **(06 Marks)**

b. Find the reactions at the fixed end and draw SFD and BMD for the Cantilever beam shown in Fig.Q3(b).

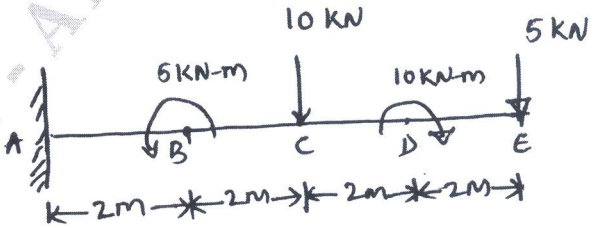

Fig.Q3(b) **(07 Marks)**

c. Draw the SFD and BMD of the simply supported beam loaded as shown in Fig.Q3(c) and locate maximum bending moment.

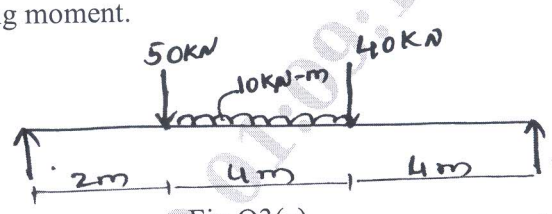

Fig.Q3(c) **(07 Marks)**

OR

4 a. Mention the assumptions of Euler-Bernoulli's beam theory and derive the bending stress equation. **(10 Marks)**

b. The cross section of a beam is shown in Fig.Q4(b). If permissible stress is 150 N/mm^2, find its moment of resistance. Compare it with equivalent section of the same area of square section.

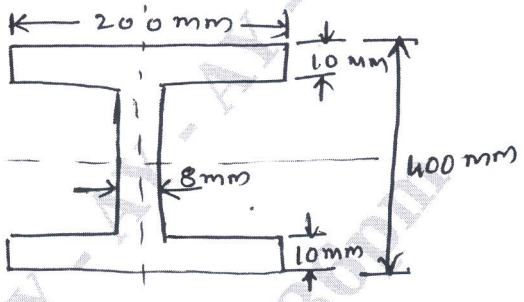

Fig.Q4(b) **(10 Marks)**

Module-3

5 a. Derive the deflection of cantilever beam with a point load at the free end. **(10 Marks)**

b. A simply supported beam is loaded as shown in Fig.Q5(b). Determine the deflection at points B, C and D. Take E = 200 GPa and I = 10^9 mm^4.

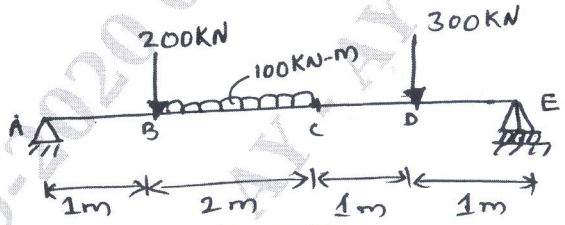

Fig.Q5(b) **(10 Marks)**

OR

6 a. List the assumption of pure torsion and derive torsion equation. **(10 Marks)**

b. 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 hollow one whose internal diameter is 0.6 times its external diameter, the length, material and maximum shear stress being same. **(10 Marks)**

Module-4

7 a. Show that the total work done by the forces is zero for a small arbitrary displacement of the particle. **(10 Marks)**

b. Calculate the support reactions in simply supported beam shown in Fig.Q7(b) using virtual work method.

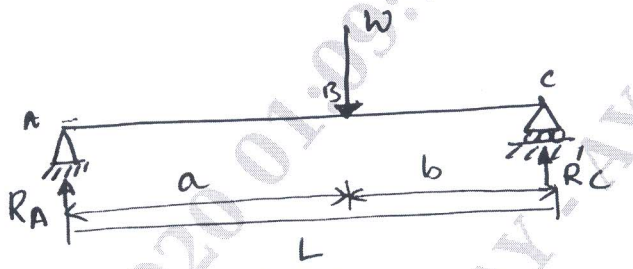

Fig.Q7(b) **(10 Marks)**

OR

8 a. Determine the strain energy stored within an elastic bar subjected to an axial tensile force of 'P' and length 'L'. **(06 Marks)**

b. Show that the strain energy within beam subjected to a pure bending moment M is $U = \int_0^{\ell} \frac{M^2 dx}{2EI}$. **(08 Marks)**

c. A simply supported beam of span 'ℓ' carries a point load 'P' at mid-span. Determine the strain energy stored by the beam. Also find the deflection at mid-span. [Refer Fig.Q8(c)]

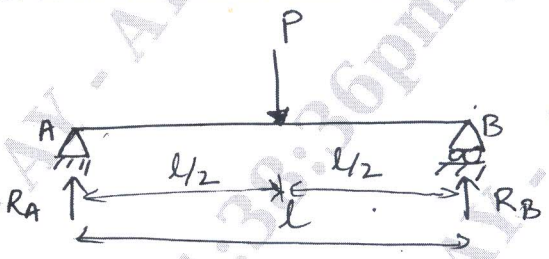

Fig.Q8(c) **(06 Marks)**

Module-5

9 a. Define fracture. Explain types of fracture in materials. **(10 Marks)**

b. What is creep? Explain the stages of creep deformation. **(10 Marks)**

OR

10 a. Define fatigue. Explain the stages of fatigue failure. **(10 Marks)**

b. Write a note on the following:

(i) S-N diagram

(ii) Factors affecting fatigue **(10 Marks)**

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