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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

May 2023 Semester End Main Examinations

Programme: B.E. **Semester: III**
Branch: Mechanical Engineering **Duration: 3 hrs.**
Course Code: 22ME3PCSOM / 19ME3DCSOM / 15ME3DCSOM **Max Marks: 100**
Course: Strength of Materials **Date: 19.05.2023**

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may suitably be assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

UNIT - I

1 a) List and define the elastic constants of an engineering material and write down the relevant expressions and units. **08**

b) A round compound rod is made of uniform rod of diameter 30 mm attached with a 200 mm long tapering rod with big end diameter 30 mm & small end diameter 20 mm as shown in fig 1b. The compound rod is subjected to an axial tensile force of 40 KN. Determine the length L_1 of the uniform rod if the total deformation is limited to 0.2 mm. Take E=200 Gpa. **06**

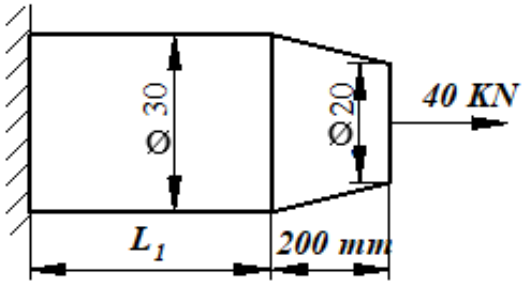

fig 1b

c) A 70 mm long block has cross section of 50mm x 10 mm. The block is subjected to forces 60 KN (tensile) on 50mm x 10mm face and 110 KN (compressive) on the 70mm x 10mm face. Determine the force to be applied on 70 mm x 50 mm face such that there is no change in volume of the block. Take E=200 GPa & Poisson's ratio as 0.3. **06**

OR

2 a) A compound bar consists of a solid copper rod enclosed in an aluminum tube of equal length arranged coaxially and fixed by rigid plates on either ends. The cross-sectional areas of the copper rod & aluminum tube are 1000 mm^2 and 1600 mm^2 respectively. Taking the allowable stress in Aluminum as 72 MPa, determine the maximum axial load that can be applied on the compound bar. E_{Al}=70 Gpa, E_{Cu}=140 Gpa. **06**

b) What are principal stresses? Write down the expressions for the magnitude and directions of principal stresses in a general biaxial stress system with shear. **04**

c) A point in a machine member is subjected to stresses as shown in fig. 2c Pot Mohr circle and determine: **10**

(i) Normal & shear stress on a plane inclined at 60^0.
(ii) Magnitude of principal stresses.
(iii) Magnitude of max shear stresses.

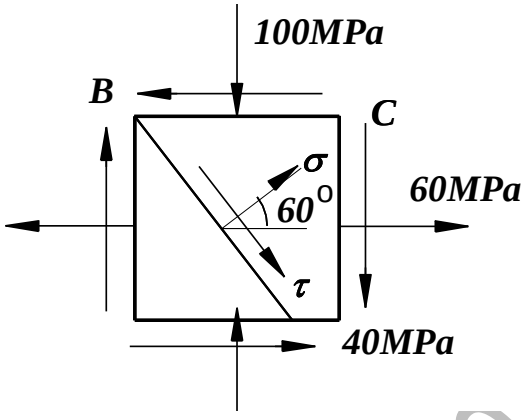

fig. 2c

UNIT - II

3 a) Derive the relationship between load intensity, shear force & bending moment at any point in a beam subjected to distributed load. **06**

b) The shear force diagram for a beam, simply supported at its ends is shown in fig 3b. Determine the reactions and draw shear force and bending moment diagrams. Also find the maximum bending moment and its location. **14**

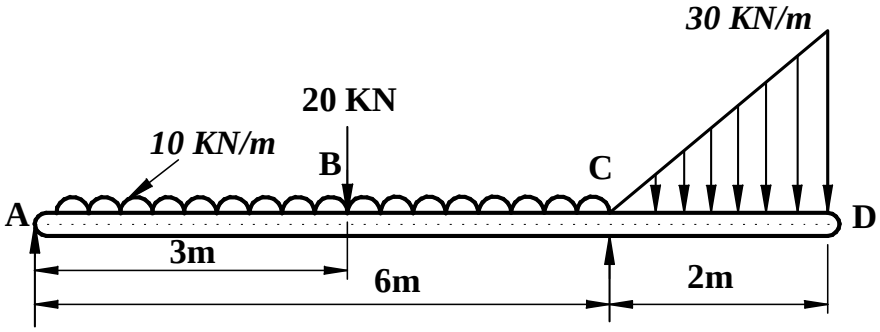

fig 3b

UNIT - III

4 a) List the assumptions made in deriving the bending equation. With usual notations and a neat sketch, derive the Euler-Bernoulli bending equation. **10**

b) A beam with symmetric I section of flange width 180 mm and total depth of 310 mm and flange & web thickness 15 mm is subjected to a shear force of 60 KN. Determine & sketch the shear stress distribution along the depth of the section. **10**

OR

5 a) Define the terms (i) Elastic curve (ii) Slope (iii) Deflection (iv) Curvature as applied to determinate beams. **04**

b) For the beam shown in fig 5b, determine the location & value of maximum deflection taking flexural rigidity EI=11x10^4 KN-m^2. **16**

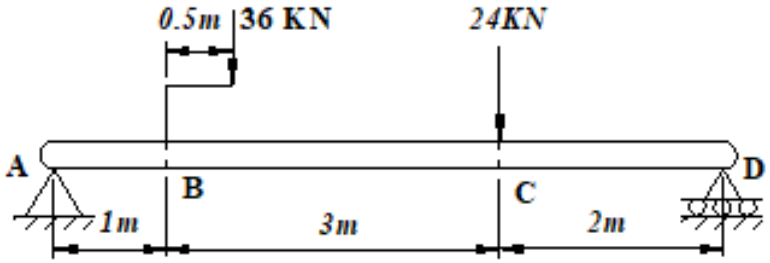

fig 5b

UNIT - IV

6 a) Prove that, for the same mass, material & length, a hollow shaft of diameter ratio k, ($k=d_i/d_0$) is stronger & stiffer than a solid shaft of diameter d. **12**

b) A solid shaft rotating at 500 rpm transmits 30 KW. Max torque is 20% more than the mean torque. Material of the shaft has an allowable shear stress 65 Mpa and modulus of rigidity 81 GPa. Angle of twist in the shaft should not exceed 1^0 per meter length of shaft. Determine the safe diameter of shaft. **08**

UNIT - V

7 a) A thick cylindrical vessel of 500 mm inner diameter is subjected to an internal pressure of 9 MPa. Taking allowable stress for the material of the cylinder as 40 MPa, determine; **10**

(i) Wall thickness of the cylinder (ii) Circumferential stress at the outer radius and (iii) % error involved if thickness is calculated based on thin vessel theory.

b) A column with a circular section of 20 mm diameter is hinged at its both ends. The column with two different lengths is tested under buckling load resulting in the following values; **10**

Length L in mm	Bucking load (KN)
300	60
400	47

Determine the Rankine's constant & crushing (yield) stress for the material of the column.

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