Reg. No.										

INTERNATIONAL CENTRE FOR APPLIED SCIENCES

(Manipal University)

III SEMESTER B.S. DEGREE EXAMINATION – MAY 2016

SUBJECT: STRENGTH OF MATERIALS (CE 241)

(BRANCH : CIVIL\ MECHANICAL\ IP\ IND. BIOTECH)

21ST MAY, 2016

Time: 3 Hours **Max. Marks: 100**

- ✓ **Answer any FIVE full questions selecting at least ONE question from EACH UNIT.**
- ✓ **Assume any missing data suitably.**

UNIT - I

1A. Define:
(i) Modulus of Elasticity (ii) Modulus of Rigidity
(iii) Yield point (iv) Poissons ratio
(v) Bulk modulus

1B. A 1.5m long steel bar is having uniform diameter of 40mm for a length of 1m and in the next 0.5m its diameter gradually reduces from 40mm to 20mm as shown in the Fig Q (1b). Determine the elongation of this bar when subjected to an axial tensile load of 160 KN. Given E = 200 GPa.

(10 + 10 marks)

2A. Derive the relation between modulus of rigidity and Young's modulus of Elasticity

2B. A horizontal rigid rod is hinged at one end and subjected to a force of 200 KN at the other end is supported by 2 rods made up of steel and copper as shown in the Fig Q (2b). Find the portion of load shared by each material, the corresponding stress and change in length. Take E_s = 200 GPa , E_{cu} = 100GPa, A_{cu} = 250 mm^2 and A_s = 150 mm^2 .

(8 + 12 marks)

UNIT - II

3A. Derive the relationship between rate of loading, shear force and bending moment.

3B. What is pure bending? Explain with example.

3C. A stepped compound bar shown in the Fig Q (3c) is fixed at two ends rigidly. The bar is free from stresses when its temperature is 30^0 C. When the temperature of the bar is increased to 90^0 C, determine the stresses induced in steel and copper portions. Take E_c = 100GPa, Es = 200GPa, $\alpha c = 1.8 \times 10^{-5} / {}^0C$, $\alpha_S = 1.2 \times 10^{-5} / {}^0C$.

(6 + 4 + 10 marks)

4A. Derive the relation $\frac{\sigma}{y} = \frac{E}{R}$ in simple bending theory where σ = Bending stress at y, y = Distance of the extreme fibre from the neutral axis, E = Modulus of elasticity, R= Radius of curvature.

4B. Calculate the reactions at A and C for the beam loaded as shown in Fig Q (4b). Draw the SFD and BMD giving salient values. Also locate the point of contra-flexure if any.

(6 + 14 marks)

UNIT - III

5A. Define: i) Deflection ii) Elastic curve

5B. Establish the equation for slope and deflection for a cantilever beam of length L metre carrying a udl of W KN/m throughout. Also determine maximum slope and deflection. EI is constant.

5C. The cross section of a beam is shown in the Fig Q (5c). The shear force on the section is 410 KN. Estimate the shear stresses at various points and plot the shear stress distribution diagram.

(4 + 6 + 10 marks)

6A. Explain : i) Effective length of column ii) Slenderness ratio iii) Buckling load

6B. A simply supported beam of span 10m is loaded with two concentrated load of intensity 60 KN, one each at 3m from either ends. Find the slope at the support and the deflection under any one load. Also calculate the maximum deflection. Take EI constant.

(6 + 14 marks)

UNIT - IV

7A. At a point in a strained material, the state of the stress is as shown in the Fig Q (7a). Calculate the normal and shearing stress on the plane AC. Also find the principal stresses and their planes. Determine the maximum shear stress and their planes.

7B. Determine the Euler's crushing load for a hollow cylindrical cast iron column 150mm external diameter and 20mm thick. If it is hinged at both the ends and 6m long compare this load with the crushing load as given by Rankine's formula. Use the constants: F_c = 550MPa , $\alpha = \frac{1}{1600}$ E = 80 GPa.

(12 + 8 marks)

8A. Prove that the maximum shear stress for a beam of rectangular cross-section is 1.5 times the average shear stress.

8B. A solid shaft is required to transmit 340 KN-m at 120 rpm. Find the diameter required, if the shear stress of the material should not exceed 80MPa. What percentage saving in weight would be obtained if this shaft is replaced by a hollow one of same length, material and $d_i = 0.6\ d_0$.

(10 + 10 marks)

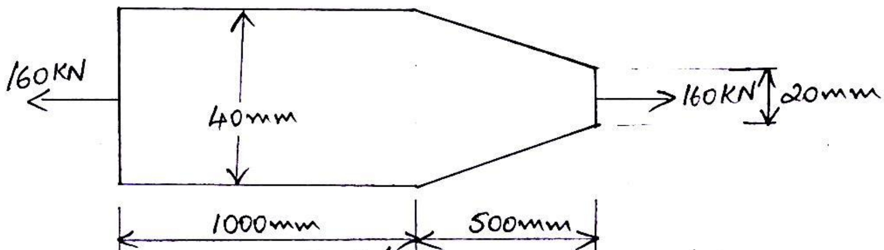

Fig Q (1b)

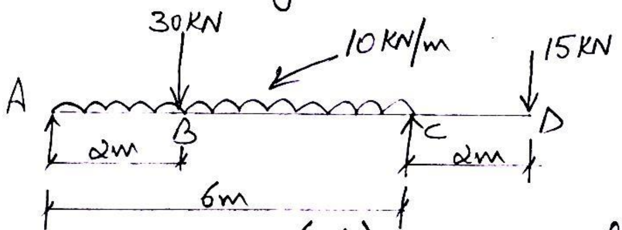

Fig Q (4b)

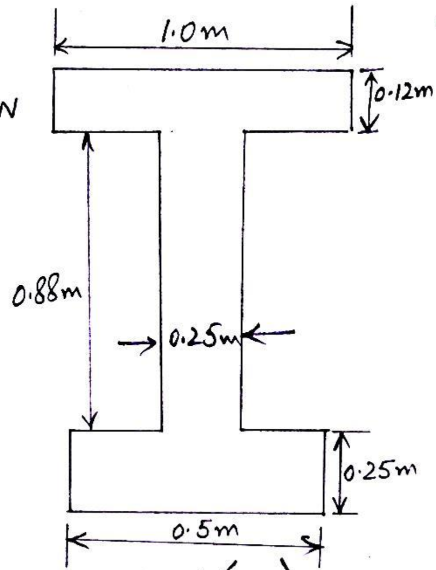

Fig. Q (5C)

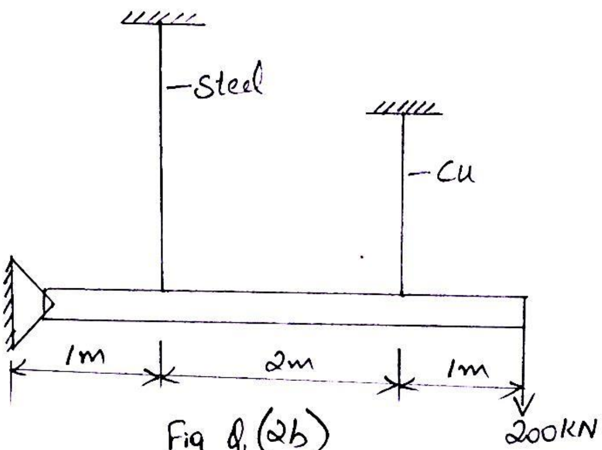

Fig Q (2b)

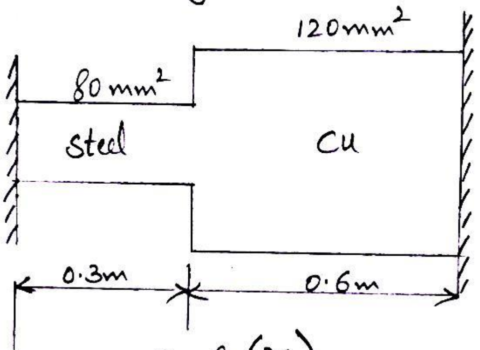

Fig. Q (3C)

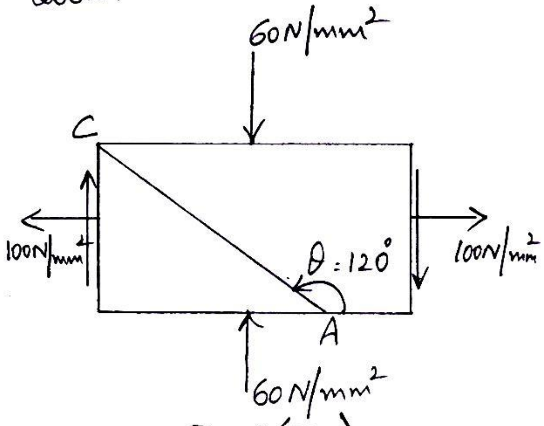

Fig. Q (7a)