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# MANIPAL UNIVERSITY

## THIRD SEMESTER B.S. (ENGG.) DEGREE EXAMINATION – DECEMBER 2015

### SUBJECT: STRENGTH OF MATERIALS (CE 241)
### (BRANCH: MECHANICAL/IP/ CIVIL/BIOM./INDUSTRIAL BIOTECH./CHEMICAL)

Monday, December 14, 2015

Time: 10:00-13:00 Hrs. Max. Marks: 100

- **Answer any FIVE full questions, selecting at least ONE question from each UNIT.**
- **Assuming any data required suitably and indicates.**

## UNIT – I

1A. Derive an expression for the total extension of the tapered bar of rectangular cross section and uniform thickness, when subjected to an axial tensile load.

1B. The composite bar shown in FIG.Q.NO.1B. is subjected to a tensile force of 30kN. The extension observed is 0.372mm. Find the Young's Modulus of Brass, if Young's Modulus of Steel is $2\times10^5$ N/mm$^2$.

(10+10 = 20 marks)

2A. The bar ABCD is very rigid. It has pin-jointed support at A and is supported by a steel wire BE and copper wire CF as shown in FIG.Q.NO.2A. Find the stresses produced in steel and copper wires when a load of 12 kN acts at free end. Find also the deflection of free end. Take $A_S$= 400mm$^2$, $A_C$= 600mm$^2$, $E_s=2\times10^5$ N/mm$^2$, $E_C=1.2\times10^5$ N/mm$^2$.

2B. A brass rod 20mm diameter enclosed in a steel tube of 25mm internal diameter and 10mm thick. The bar and the tube are initially 2m long and rigidly fastened at both the ends. The temperature is raised from 20°C to 80°C. Find the stresses in both the materials. If the composite bar is then subjected to an axial pull of 50kN, find the total stress. $E_s$=200GPa, $E_b$=80GPa, $\alpha_s=12\times10^{-6}$/°C, $\alpha_b=19\times10^{-6}$/°C.

(10+10 = 20 marks)

## UNIT – II

3A. Draw SFD and BMD for a single overhanging beam subjected to loading as shown in FIG.Q.NO.3A. Mark absolute maximum bending moment on BMD and locate point of contra-flexure.

3B. Define shear force and bending moment. Derive the relationship between load, shear force and bending moment.

(10+10 = 20 marks)

4A. Determine the values of deflections at points C, D and E in the beam as shown in FIG.Q.NO.4A. Take $E=2\times10^5$ MPa, $I= 60\times10^8$ mm$^4$.

4B. Draw the shear stress variation diagram for a square section placed with one of its diagonals horizontal. Show that the maximum shear stress is equal to $\frac{9}{8}$ times the average shear stress.

(10+10 = 20 marks)

## UNIT – III

5A. A cast iron beam has a section as shown in FIG.Q.NO.5A. When subjected to bending moment the tensile stress at the bottom fibre is 25 N/mm$^2$. Find the value of bending moment and the stress at top fibre.

5B. The cross-section of a beam is an I-section of overall depth 240mm, width of flanges 160mm, thickness of both flanges and web 20mm. If it carries a shear force of 70kN, draw the shear stress distribution diagram. Also find the percentage of shear carried by the web alone.

(10+10 = 20 marks)

6A. Derive the torsion formula $T/J=\tau/R=G\theta/L$.

6B. A hollow marine propeller shaft turning at 110 rpm is required to propel a vessel at 12m/s for the expenditure of 6220kW, the efficiency of the propeller being 68%. The diameter ratio of the shaft is to be (2/3) and the direct stress due to thrust is not to exceed 8MPa. Calculate the shaft diameters and the maximum shearing stress due to torque.

(10+10 = 20 marks)

## UNIT – IV

7A. A hollow C.I column whose outside diameter is 200mm has a thickness of 20mm. It is 4.5m long and is fixed at both ends. Calculate the safe load by Rankine's formula using a factor of safety of 4. Take $\sigma_c=550$MN/m$^2$, $a=1/1600$.

7B. Determine the ratio of the buckling strengths of two columns of circular cross-section one hollow and other solid when both are made of the same material, have the same length, cross sectional area and end conditions. The internal diameter of the hollow column is half of its external diameter.

(10+10 = 20 marks)

8A. With assumptions in deflection derive the equation $M=EI\,(d^2y/dx^2)$.

8B. A 50mm×100mm tie member of a timber truss has a glued joint as shown in FIG.Q.NO.8B. at an inclination of 40° to the longitudinal axis. If it is subjected to an axial force of 200 kN, check whether there is a risk of failure. The permissible normal and shear stress for the joint are 25 MPa and 16 MPa respectively.

(10+10 = 20 marks)

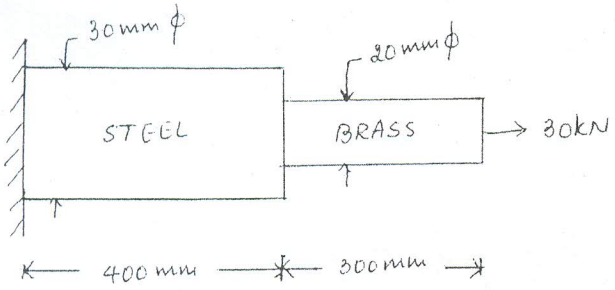


FIG.Q. NO. 1B

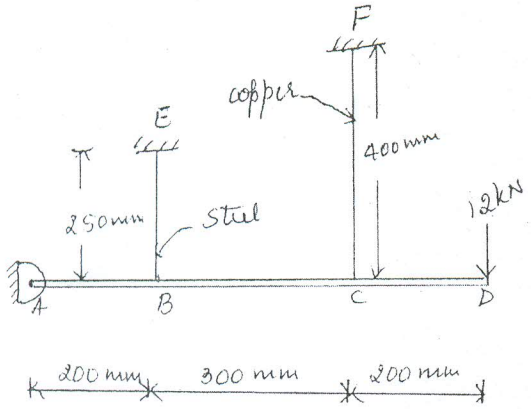


FIG.Q. NO. 2A

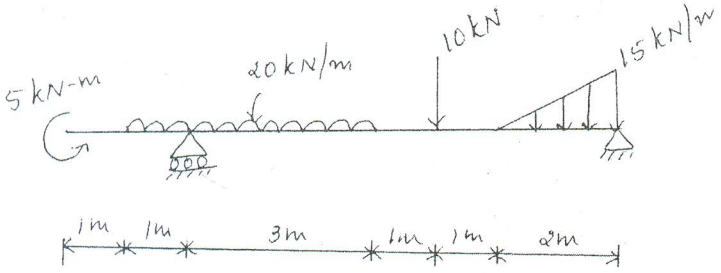


FIG.Q. NO. 3A

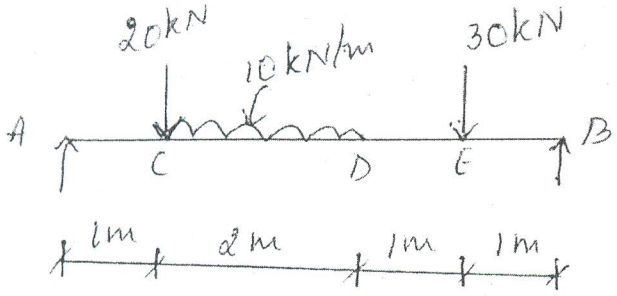


FIG.Q. NO. 4A

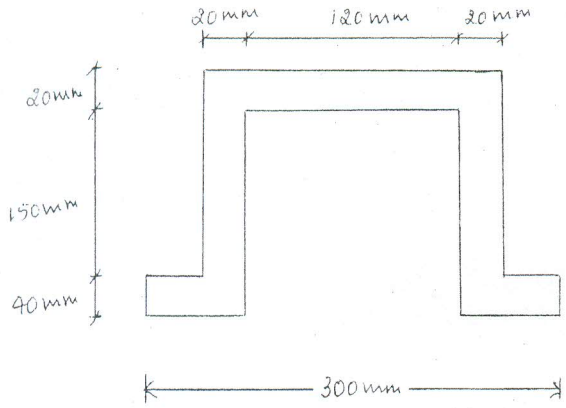


FIG.Q. NO. 5A

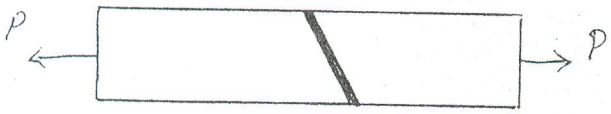


FIG.Q. NO.8B