17311

21314

3 Hours/100 Marks

Seat No. | | | | | | | |

Instructions : (1) ***All*** *questions are* ***compulsory****.*

(2) *Answer* ***each*** *next main question on a* ***new*** *page.*

(3) *Illustrate your answers with neat sketches* ***wherever*** *necessary.*

(4) *Figures to the* ***right*** *indicate* ***full*** *marks.*

(5) ***Assume*** *suitable data, if* ***necessary****.*

(6) ***Use*** *of Non-programmable Electronic Pocket Calculator is* ***permissible****.*

(7) *Mobile Phone, Pager and any other Electronic Communication devices are* ***not permissible*** *in Examination Hall.*

MARKS

1. A) Solve **any six** of the following : **12**

a) State parallel axis theorem of moment of inertia.

b) Calculate MI of a square of side 100 mm about its diagonal.

c) State Hooke's law.

d) State the meaning of elastic limit.

e) Define slenderness ratio.

f) Write Euler's formula with the meaning of the terms involved.

g) Define proof resilience and modulus of resilience.

h) A bar elongates by 0.6 mm due to load of 60 kN applied gradually. Calculate the strain energy stored in Joules.

B) Solve **any two** of the following : **8**

a) State the meaning of moment of resistance. State the factors on which it depends. How does it differ from bending moment ?

b) A beam 120 mm wide and 200 mm deep is subjected to a shear force of 48 kN at a particular section. Calculate maximum shear stress and sketch shear stress distribution diagram across the section.

c) Define effective length for a long column. With the help of neat sketches show effective lengths for different end conditions for long columns.

MARKS

2. Solve **any two** of the following : **16**

 a) A triangle ABC has base BC = 75 mm and vertical side AB = 90 mm such that $m\angle B = 90^\circ$. Calculate MI of triangle about the sides AB and BC.

 b) A tee section has a flange 60mm × 10mm and web 10mm × 70mm. Calculate MI about xx, yy and polar M.I.

 c) i) State perpendicular axis theorem. Using it determine polar MI of hollow circular section of diameters 100 mm and 80 mm.

 ii) A hole of diameter 10 mm is to be punched through a plate of 8 mm thickness. If the permissible shear stress in material of the plate is 80 MPa calculate the force required to punch a hole.

3. Solve **any two** of the following : **16**

 a) A bar ABCD of varying cross section is subjected to an axial pull of 75 kN. Part AB is 300 mm long, hollow circular with external diameter 30 mm and internal diameter 26 mm. Part BC is square in section of side 15 mm and is 150 mm long. Part CD is 200 mm long and solid circular in section of diameter 20 mm. Determine deformation of each part and the net deformation. Take E_{AB} = 200 GPa, E_{BC} = 100 GPa and E_{CD} = 75 GPa.

 b) A steel tube, 25 mm external diameter, has a metal thickness of 3 mm. It firmly encloses a brass rod of 16 mm diameter. Calculate the safe load carried by the composite member if stress in steel is 140 MPa. Also calculate the deformation of 1 m length of each metal, load shared by each metal. Take E_s = 200 GPa and E_b = 100 GPa.

 c) Write the relation between modulus of elasticity (E), modulus of rigidity (G) and Poisson's ratio (μ). Also state the relation between E, bulk modulus (K) and μ. Using these two relations obtain the relation between E, G and K.

4. Solve **any two** of the following : **16**

 a) A bar 25 mm wide and 5 mm thick is 1.2 m long. It is subjected to an axial pull of 30 kN. Calculate the changes in (i) length, (ii) width, (iii) thickness and (iv) volume of the bar. Take E = 190 GPa and $\mu = 0.24$.

 b) A steel bar 30 mm in diameter and 1 m long is heated through 50°C with its ends clamped before heating. Calculate the magnitude and nature of stress developed in the bar if the clamps (i) do not yield and (ii) yield by 0.12 mm. Take E = 200 GPa and $\alpha = 11.5\times10^{-6}$/c°.

MARKS

c) Draw SF and BM diagrams for the beam loaded as shown in Figure No. 1. Also locate the position and determine the maximum B.M.

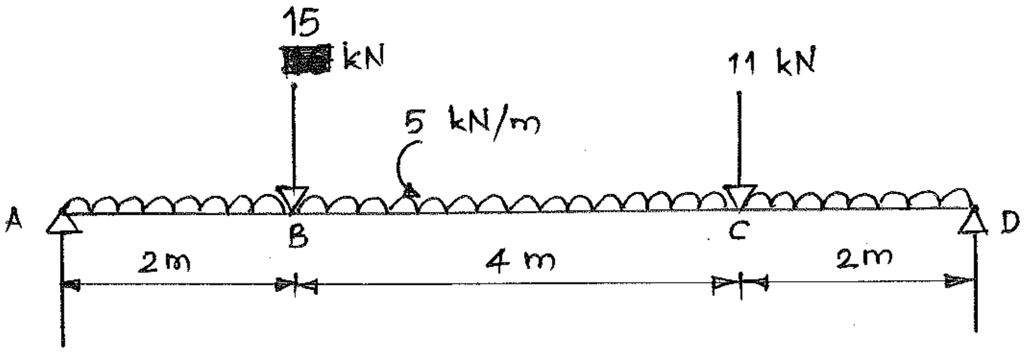

Figure No. 1

5. Solve **any two** of the following : **16**

a) Draw SF and BM diagrams for the beam shown in figure No. 2. Also locate the point of contraflexure.

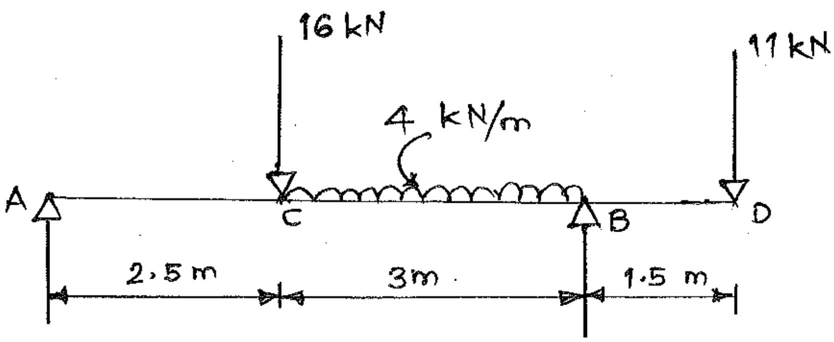

Figure No. 2

b) i) State the relation between shear force and bending moment. How it is used to locate the position of maximum B.M ?

ii) A cantilever, fixed at left end, is 2m long and weighs 500 N/m. Point loads of 800 N and 600 N act at 1 m and 2 m from fixed end respectively. Draw SF and BM diagrams.

c) A rectangular beam 120 mm wide and 200 mm deep is simply supported over a span of 4 m. If the bending stress in the material of the beam is not to exceed 80 MPa calculate the maximum udl (including self weight) the beam can carry.

MARKS

6. Solve **any two** of the following : **16**

a) A tee section having flange 200 mm wide and 40 mm thick and web 40 mm wide and 200 mm deep is used as a beam. It is subjected to a shear force of 75 kN at a particular section. Calculate the shear stresses at (i) bottom of flange, (ii) junction of flange and web and (iii) neutral axis.

b) A hollow steel tube of external diameter 100 mm and internal diameter 80 mm is used as a column 4 m long with one end fixed and other hinged. Calculate the crippling load using Rankine's formula if a = 1/7500 and σc = 320 MPa. Also calculate the safe load with a factor of safety of 2.5.

c) An unknown weight 'p' kN falls through 10 mm on a collar attached to the lower end of a vertical bar 2.5 m long and 600 mm^2 in section. If the maximum elongation of the bar is 2.5 mm evaluate p and calculate the corresponding maximum stress. Take E = 200 GPa.