17311

11718

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) Define radius of gyration, polar moment of inertia.

b) Write mathematical expression of M.I. of quarter circle about centroidal XX and YY-axes.

c) Define rigid body, plastic body.

d) State Hook's law. Name the elastic constant which is related with Hook's law.

e) Define effective length of column, slenderness ratio.

f) Euler's formula is not applicable for the short column. Justify the statement.

g) Define resilience and state its unit.

h) State relation between stress produced by suddenly applied load and gradually applied load.

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

a) State four assumptions made in theory of pure bending.

b) A circular beam section 200 mm in diameter subjected to shear force of 100kN. Calculate maximum shear stress developed in section. Draw shear stress distribution across beam cross section.

c) A column, fixed at one end and free at other has length of 2.0m. Calculate effective length of the column.

Marks

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

a) A T-section has flange 60 mm × 20 mm and web 15 mm × 60 mm with overall depth of 80 mm. Calculate minimum radius of gyration.

b) Right angle triangle ABC has the base BC = 75mm, vertical side AB = 90 mm such that m<B = 90°. Calculate M.I. of triangle ABC centroidal axes XX. Also calculate M.I. about base AC and axis passing through Apex 'A'.

c) i) An equilateral triangle has base of 120 mm. Calculate its M.I. about centroidal horizontal axis. Also calculate radius of gyration about the same axis.

ii) Draw stress-strain curve for HYSD bar and show the 0.2% proof stress on the curve.

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

a) A bar ABC is axially loaded as shown in fig. No.1. If the maximum stress induced in bar is 100 MPa, calculate the value of 'P'. Also calculate net deformation of bar. Take E = 102 GPa for both parts.

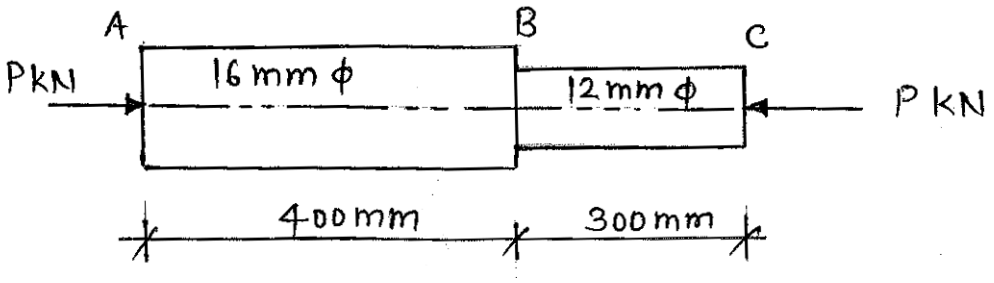

Fig No. 1

b) R.C.C. column 450 mm × 300 mm is reinforced with 6 bars of 16 mm diameter bars. Calculate stresses induced in steel and concrete. Column is subjected to an axial load of 900 kN. Take modular ratio $\frac{E_s}{E_c} = 18$.

c) A cubical element is subjected to tensile force of 300 kN along three mutually perpendicular directions. Determine volumetric strain and change in volume of cube. Take E = 2×10^5 N/mm^2 and $\mu = 0.28$ side of cube = 25mm.

Marks

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

a) A metal bar 20 mm wide, 15 mm thick and 2.8m long, is subjected to an axial pull of 36 kN. Calculate changes in length, width and thickness. Also calculate change in volume of rod. Take $E = 1.80 \times 10^5$ N/mm^2 and $\mu = 0.32$.

b) A steel rod 12m long is at temperature of 20°C. Find the free expansion of rod when temperature is raised to 70°C. If 40% of free expansion is permitted. Calculate the temperature stress produced. Take $\alpha = 12 \times 10^{-6}/^\circ C$ and E = 200 GPa.

c) A beam is supported and loaded as shown in fig. No. 2. Draw shear force and bending moment diagrams . Determine position of point of contraflexure from left hand support.

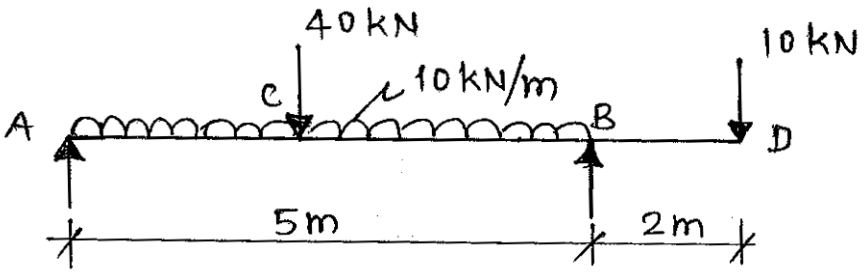

Fig No. 2

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

a) Draw SFD and BMD for a beam loaded and supported as shown in fig. No.3.

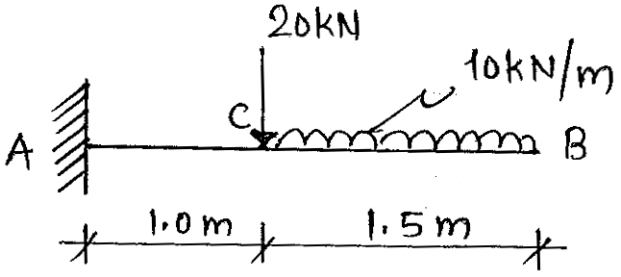

Fig No. 3

b) i) State relation between bending moment, shear force and rate of loading.

ii) A cantilever beam AB of span 3m is fixed at 'A'. It carries point loads 10 kN and 5 kN at 1.5 m and 3 m from fixed support. Draw S.F. and B.M. diagrams.

Marks

c) A timber beam 200 mm wide and 300 mm deep is simply supported over a span of 3m. It carries an UDL of 12 kN/m over entire span and a central point load of 10kN. Determine maximum bending stress induced in section and draw bending stress distribution diagram.

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

a) A beam of rectangular cross section 200 mm × 300 mm. It is subjected to shear force of 48 kN. Calculate shear stress at top layer and at distance of 50 mm, 100 mm and 150 mm from top layer. Draw shear stress distribution.

b) A hollow circular section of 250 mm external diameter and 25 mm thickness is 3.8 m long and used as column. One end of column is fixed and other end is hinged. Calculate the safe load the column can carry. Use Euler's formula.

Take E = 200 GPa factor of safety = 2.5.

c) A bar 24 mm diameter and 1.6 m long hangs vertically and it has a rigid collar attached at the lower end. When a load W is applied gradually to the rod the extension observed to be 4.6 mm ? Calculate the value of instantaneous stress developed in the rod if the same load falls freely on the collar through a height of 250 mm.

Take $E = 2 \times 10^5$ N/mm^2. Also calculate instantaneous elongation.