17304

21718

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) **Attempt any SIX of the following:** **12**

(i) Define ductility and state names of two ductile metals.

(ii) Define principal plane and principal stress.

(iii) State theorem of parallel axis for moment of inertia along with a diagram.

(iv) Define axial load and eccentric load.

(v) State an expression for power transmitted by a shaft giving meaning of each term used in it.

(vi) Define Poison's ratio. Also state common value of Poison's ratio for C.I.

(vii) Define hoop stress and longitudinal stress.

Marks

(viii) In relation with eccentric load, draw stress distribution diagram for –

1) direct stress > bending stress and

2) direct stress = bending stress

b) **Attempt any <u>TWO</u> of the following:** **8**

(i) Calculate minimum diameter of steel wire to lift a load of 8.2 kN, if the permissible stress in wire is 120 MPa.

(ii) A cantilever beam, fixed at 'A' has span of 1.5 m. Beam is loaded with uniformly distributed load of 4 kN/m over entire span and downward point load of 2 kN at free end 'B'. Draw shear force and bending moment diagrams for the beam.

(iii) A simply supported beam of span 5m is subjected to downward point load of 20 kN at 2m from left end. Cross section of beam is 200 mm wide and 300 mm deep. Calculate maximum bending stress developed in beam material. Also draw bending stress distribution across the section of beam.

2. Attempt any <u>FOUR</u> of the following: **16**

a) (i) Define composite section and modular ratio.

(ii) State equivalent length for column which is fixed at one end and hinged at other.

b) A column fixed at one end and free at other has effective length of 6 m. Calculate its actual length.

c) A steel rod 12 mm dia. and 2.2 m in length is at 40°C. Find expansion of rod if the temperature is raised to 110°C. If this expansion is fully prevented, find the magnitude and nature of the stress induced in the rod.

Take $E = 2.1 \times 10^5$ N/mm^2 and $\alpha = 12 \times 10^{-6}$/°C.

Marks

d) A metal rod of 20 mm diameter and 1.8 m long when subjected to an axial tensile force of 58 kN showed an elongation of 2.2 mm and reduction in diameter was 0.006 mm. Calculate Poisson's ratio and modulus of Elasticity.

e) At a point, the normal stress 'σ' is associated with a shearing stress 'q'. If the principal stresses at the point are 80 MPa (tensile) and 30 MPa (compressive), determine values of 'σ' and 'q'.

f) A cylindrical shell is 4 m long with internal diameter 900 mm and thickness 10 mm. If the tensile stress in the material is not to exceed 54 MPa, determine the maximum fluid pressure which can be allowed in shell.

3. Attempt any FOUR of the following: **16**

a) A simply supported beam of span 'L' is subjected to downward point load of 'w' at a distance 'a' from left support and 'b' from right support. Draw S.F. and B.M. diagrams. Take a > b.

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

c) A cantilever AD, 1.5 m long, carries point loads of 500 N, 700 N and 900 N at 0.5 m, 1.0 m and 1.5 m from fixed end A respectively. Draw S.F. and B.M. diagrams for cantilever. Neglect self weight of the beam.

Marks

d) Figure No. 1 shows a shear force diagram for a simply supported beam ABCD of span 5m. Draw loading diagram and locate the position from support 'A' where bending moment will be maximum. (There is no couple acting on the beam.)

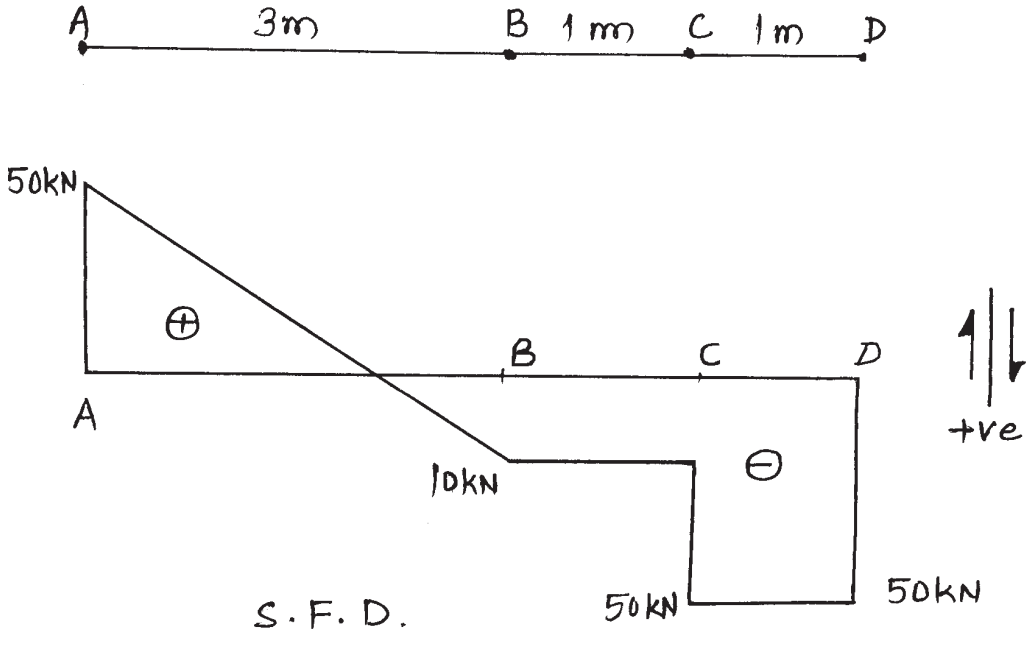


Fig. No. 1

e) A simply supported beam ABC is supported at 'A' and 'B' 5 m apart with an overhang BC 1.5 m long, carries uniformly distributed load of 10 kN/m over AB and downward point load of 20 kN at 'C'. Draw S.F. and B.M. diagrams. State the value of maximum positive B.M. calculations for point of contraflexure not expected.

f) A circular disc has diameter of 80 mm. Calculate moment of inertia about its any one tangent.

4. Attempt any FOUR of the following: **16**

a) An angle section 120 mm × 100 mm × 20 mm is placed such as its longer leg is vertical. Calculate M.I. about centroidal horizontal axis. Only [i.e. I_{xx} only]

b) Define polar moment of inertia. Also state perpendicular axis theorem of M.I.

c) An equilateral triangle has base of 100 mm. Using parallel axis theorem, calculate its M.I. about base.

Marks

d) A T-section has flange 120 mm × 20 mm and web 15 mm × 120 mm, overall depth 140 mm. Calcualte M.I. about its vertical centroidal yy-axis. [i.e. I_{yy} only]

e) State four assumptions made in theory of simple bending.

f) Draw shear stress distribution diagram for circular beam section. State the formula to calculate average shear stress for circular section having diameter '*d*'.

5. Attempt any <u>FOUR</u> of the following: **16**

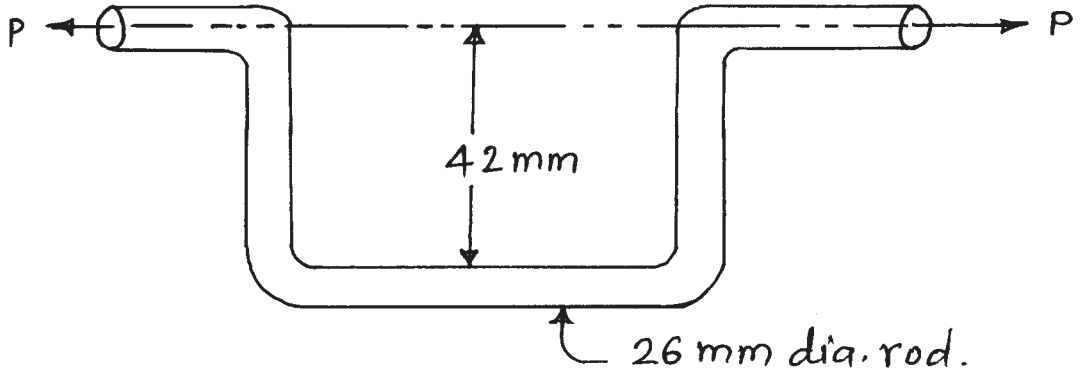
a) With reference to theory of simple bending, explain neutral axis and moment of resistance.

b) Calculate diameter of core of section for circular column section having diameter of 240 mm. Using basic principles draw neat sketch for the same with dimensions. [Do not use direct formula]

c) A rectangular column 450 mm wide and 300 mm thick carries a load of 420 kN at an eccentricity of 110 mm in the plane bisecting the thickness. Calculate maximum and minimum stress intensities at the base along with their nature.

d) A hollow circular column having external and internal diameters 280 mm and 240 mm respectively is subjected to an eccentric vertical load of 110 kN at an eccentricity of 100 mm. Calculate maximum and minimum intensities of stress across the section.

e) A 26 mm diameter rod is bentup to form as offset link as shown Figure No. 2. If permissible tensile stress is 90 N/mm^2, calculate maximum value of 'P'.



<u>Fig. No. 2</u>

P.T.O.

Marks

f) Calculate maximum eccentricity for a hollow circular section having external diameter and internal diameter equal to 250 mm and 120 mm respectively, so that stress distribution is of same nature.

6. Attempt any FOUR of the following: **16**

a) State torsional equation with meaning of each term.

b) A shaft required to transmit 25 kW power at 180 r.p.m. The maximum torque may exceed the mean torque by 30%. If shear stress is not to exceed 60 N/mm^2, determine the minimum diameter of the shaft.

c) A solid circular shaft of 30 mm diameter is subjected to torque of 0.28 kN.m, causing angle of twist of 3.50° in a length of 2m. Calculate modulus of rigidity for the material of shaft.

d) Compare the torsional strengths of two shafts A and B, made up of same material having equal weight and length. Shaft A is solid and B is hollow circular with D = 1.6 d.

e) A hollow shaft, having external diameter 1.5 times the internal diameter, is to transmit 150 kW at 200 r.p.m. If allowable angle of twist is 2° in a length of 3m. Calculate diameters of the shaft. Take $T_{max} = 1.2\ T_{mean}$. G = 80 GPa.

f) (i) Draw bending stress distribution for rectangular beam section which is used for cantilever beam, subjected to downward load.

(ii) Define torque and state its S.I. unit.
