17304

15162

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)**

a) Define elasticity and plasticity. **2**

b) Define principal planes and principal stresses. **2**

c) Find polar moment of inertia of a circle of 50 mm diameter. **2**

d) State the expression for power transmitted by a shaft giving meaning of each term used. **2**

e) Draw a neat sketch to show core of a rectangular section. **2**

f) State Hooke's law. **2**

g) Write the equation of circumferential stress in thin cylinder and explain each term. **2**

h) State the condition for no tension at the base of a column. **2**

B) Attempt **any two** of the following. **(8)**

a) A mild steel flat 150 mm wide by 20 mm thick, 6 m long, carries an axial pull of 300 kN. If the modulus of elasticity of steel is 200 kN/mm^2 and Poisson's ratio = 0.25. Calculate the change in length, width, thickness and volume of the flat. **4**

b) A cantilever beam 2.5 meter long carries a udl of 15 kN/m over a length of 2 m from the free end. Draw shear force and bending moment diagram for the beam. **4**

c) A simply supported beam of 5 m span, carries a udl of 3 kN/m over the entire span. If the bending stress is not to exceed 165 N/mm^2, find the value of section modulus for the beam and diameter when beam is circular. **4**

Marks

2. Attempt **any four** of the following. **(16)**

a) i) Draw the sketch of stepped section showing axial load and state expression for change in length of it. **2**

ii) State the effective length for both ends hinged column and for one end fixed and other end free column. **2**

b) A steel rod 4 m long and 30 mm diameter is used as a column with one end fixed and other hinged. Determine the crippling load by Euler's formula. $E = 2\times10^5$ MPa. **4**

c) A rod 300 mm long and 20 mm in dimeter is heated through 100°C and at the same time pulled by a force P. If the total extension is 0.4 mm, what is the magnitude of P ? $E = 2\times10^5$ N/mm^2 and $\alpha = 12\times10^{-6}$/°C. **4**

d) A brass rod of 250 mm length and 20 mm diameter is fixed inside a steel tube of 40 mm external diameter and 20 mm internal diameter and of same length. The composite bar is subjected to an axial pull of 140 kN. Find the stress in each metal. Take $E_{steel} = 200$ GPa and $E_{brass} = 110$ GPa. **4**

e) The principle stresses at a point in the section of a member are 100 N/mm^2 and 50 N/mm^2 both tensile. Find the normal and tangential stresses across a plane passing through that point inclined at 60° to the plane have 100 N/mm^2 stress. **4**

f) Find hoop stress and longitudinal stress induced in a cylindrical boiler 1.6 m internal diameter subjected to an internal pressure of 2.5 MPa. Thickness of wall is 30 mm. **4**

3. Attempt **any four** of the following. **(16)**

a) A cantilever beam of span 'L' is subjected to UDL of W/unit length over entire span. Draw S.F. and B.M. diagrams. **4**

b) A cantilever beam is loaded as shown in Fig. No. 01. Draw SFD and BMD . **4**

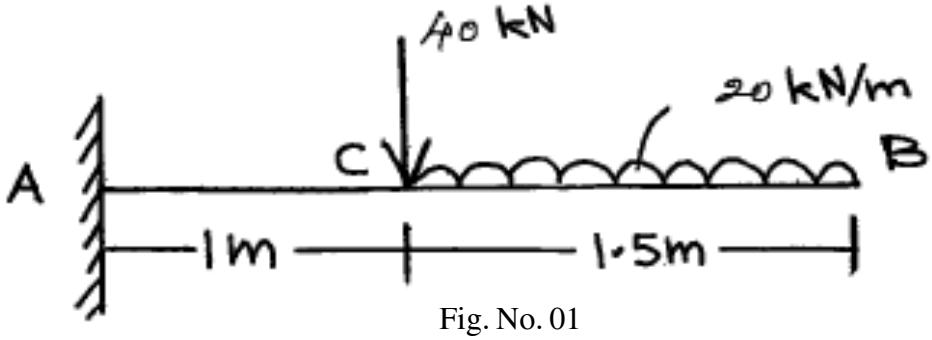

Fig. No. 01

c) Draw S.F. and B.M. diagrams for the simply supported beam shown in Fig. No. 02. **4**

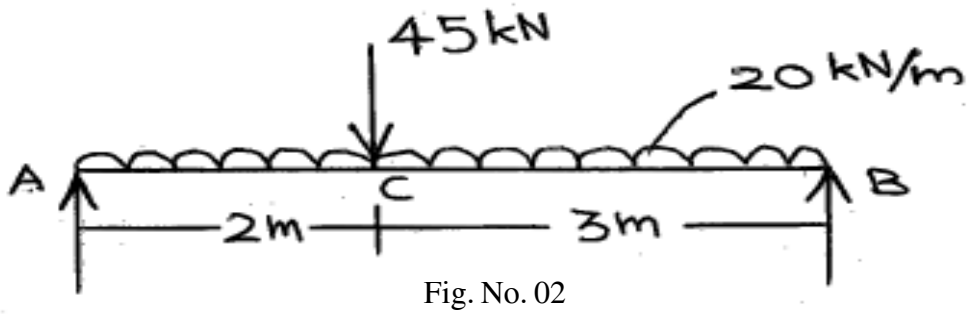

Fig. No. 02

Marks

d) A simply supported beam of span 8 m carries a udl of 12kN/m over 4 m length from L.H.S. and a point load of 80 kN at 2 m from the right support. Draw S.F.and B.M. diagram. **4**

e) A beam ABC, 6 m long is supported at A and B, 4 m apart, BC = 2 m. The beam carries a u.d.l. of 20 kN/m over the entire length alongwith a downward point load of 10 kN at point C. Plot SFD and BMD for the beam and locate the point of contraflexure. **4**

f) Calculate the M.I. of triangle having base 150 mm and height 200 mm about its base and centroidal axis parallel to base. **4**

4. Attempt **any four** of the following. **(16)**

a) Find M.I. about X-X axis of T section having flange 150 mm × 50 mm and web150 mm ×50 mm, overall depth 200 mm. **4**

b) State with neat sketches perpendicular axis theorem and parallel axis theorem. **4**

c) A symmetical I-section of overall depth of 300 mm, has its flanges 150 mm × 10 mm and web 10 mm thick. Find the M.I. about its centroidal axis perpendicular to the flanges. **4**

d) A hollow circular section with 210 mm external diameter and 110 mm internal diameter. Calculate the moment of inertia of the section about any of its tangents. Also find polar moment of inertia. **4**

e) State any four assumptions of theory of simple bending. **4**

f) A rectangular beam 100 mm wide is subjected to a maximum shear force of 50 kN. The maximum shear stress induced is 4 N/mm^2. Find the depth of the beam. **4**

5. Attempt **any four** of the following. **(16)**

a) A circular beam of 120 mm diameter is simply supported over a span of 10 m and carries a udl of 1200 N/m. Find the maximum bending stress produced and also draw the bending stress variation diagram. **4**

b) A short column 210 mm × 210 mm is subjected to an eccentric load of 105 kN at an eccentricity of 65 mm in the plane bisecting the two opposite faces. Find the maximum and minimum intensities of stress at the base section. **4**

c) Calculate the limit of eccentricity for a circular section having diameter 60 mm. **4**

d) A C.I. hollow circular stanchion has external diameter of 250 mm and internal diameter of 200 mm. It is subjected to a vertical load of 20 kN at a distance of 400 mm from the vertical axis of the stanchion. Calculate the maximum and minimum stresses at the base of stanchion. **4**

e) A M.S.link as shown in Fig No.03 transmits a pull of 90 kN. Find the dimensions 'b' and 't' if b = 3t. Assume the permissible tensile stress as 65 MPa. **4**

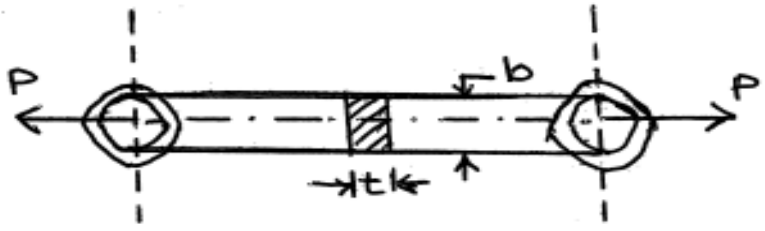

Fig. No. 03

Marks

f) A 30 mm diameter rod is bent up to form an offset link as shown in Fig. No.04. If permissible tensile stress is 80 MPa, determine the maximum value of P. **4**

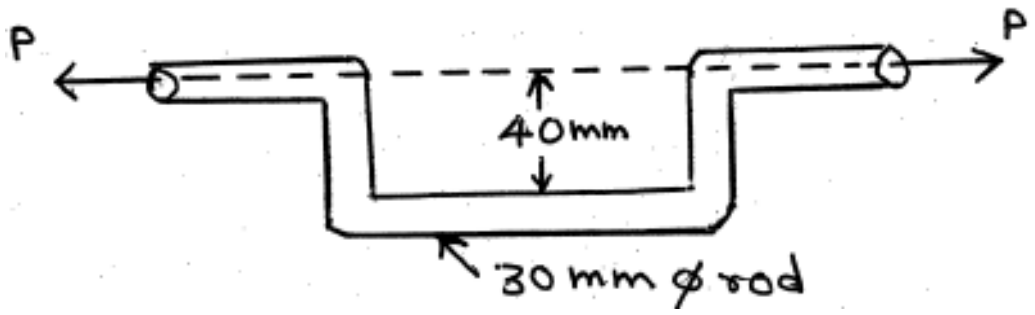

Fig. No. 04

6. Attempt **any four** of the following. **(16)**

a) State four assumptions in theory of pure torsion. **4**

b) A 200 mm diameter shaft is subjected to a twisting moment. If the angle of twist is to be restricted to 2° in a length of 8 m, find the maximum twisting moment that can be applied. Consider C = 0.8×10^5 MPa. **4**

c) A shaft of hollow circular cross-section has outer diameter 120 mm, inner 90 mm. It is subjected to a torsional moment of 20 kN/m. For this shaft compute shear stress at the outer surface. **4**

d) A solid circular shaft is replaced by a hollow circular shaft of the same material to transmit the same power. If the inside diameter of the hallow is $\frac{2}{3}$ of outside diameter, find the saving in material, if any, by this replacement. **4**

e) To transmit the same torque, a solid circular shaft 80 mm in diameter is to be replaced by a hollow circular shaft having external diameter 1.5 times the internal diameter. The material for solid and hollow shaft is the same. Determine the diameters of the hollow shaft. **4**

f) i) Draw a shear stress distribution diagram for a hollow rectangular section giving location and value of mass shear stress. **2**

ii) Define torque and state its S.I. units. **2**