Student Exam No._____

GANPAT UNIVERSITY

B. Tech. Semester 3rd Mechanical Engineering, Regular Examination November – December: 2013

STRENGTH OF MATERIAL

Time: 3 Hours

Total Marks: 70

Instruction:
1. Answer to the two sections must be written in separate answer books.
2. Assume suitable data if required.
3. Figures to the right indicate full marks

Section - I

1 (A) Prove that shear stress distribution in a rectangular section of a beam which is subjected to a shear force F is given by $\tau = \frac{F}{2I}\left(\frac{d^2}{4} - y^2\right)$ (06)

(B) A cast iron water pipe, 400 mm inside diameter and 450 mm outside diameter, is subjected at two points 8 m apart. Find maximum stress in the metal, when the pipe is running full of water. The density of metal is 7gm/cm^3 and that of water is 10 kN/m^3. (05)

2 (A) Derive classic flexural formula based on theory of pure bending. (06)

(B) Three beams have the same length, the same allowable stress and same bending moment. The cross section of beam are a square, a rectangle with depth twice the width and a circle. Find the retentions of weight of the circular and rectangular beams with respect to the square beam. (06)

OR

2 (A) A circular beam is cantilever supported at the end and carries a point load at the free end. Prove that the ratio of span to diameter $= \frac{\text{Maximum Bending Stress}}{6 \times \text{Maximum Shear Stress}}$ (06)

(B) An inverted T-beam is simply supported having a point load of 100 KN at midspan. Flange & Web thicknesses are 100 mm. Flange and Web are 500 mm and 300 mm long respectively. Overall depth of T-section is 400 mm. Draw shear stress distribution diagram across the section at point of maximum shear force, including values at all important points. (06)

3 (A) Explain clearly, the graphical method of finding out stresses in a rectangular element subjected to normal stresses σ_1 and σ_2 and shear stress (s). Using the same method, find out principal planes and principal stresses. (08)

(B) A short column of external diameter D and internal diameter d carries an eccentric load P. Find the maximum eccentricity of the load that cannot produce tension in the cross section. (04)

OR

3 (A) A rectangular block subjected to a direct tensile stress of 800 N/mm^2 along with shear stress. Determine the shear stress if major principal stress not to exceed 1200 N/mm^2 (tensile). Also find the minor principal stress. Check the answer by Mohr's circle method. (06)

(B) A Short hollow pier of 1.2 m square section outer side and 1.0 m square section inside is subjected to a direct load of 120 kN along its outer edge point. Determine the final stresses at the base of the pier. Draw neat sketch of stress distribution diagram. (06)

Section - II

4 (A) A solid shaft is required to transmit 80 KW power at 100 rpm Find the suitable diameter of the shaft if the maximum torque transmitted in each revolution exceed the mean by 15%.Take allowable shear stress as 60 N/mm^2 for the material of the shaft. (04)

4 (B) A solid shaft of 60 mm diameter is transmitting 80 KW power at 300r.p.m.Calculate the maximum shear stress induced in the shaft and the angle of twist in degrees for a length of 8 m. Take N =6 X 10^4 N/mm^2 (04)

4 (C) A solid shaft is subjected to a torque of 14000 N-m. Find the necessary diameter of the shaft if the allowable shear stress in 80 N/mm^2 and the allowable twist is 1^0 for every 10 diameters length of the shaft. Take N=0.6 X 10^5.Find the suitable diameters. (04)

OR

4 (A) A cylinder of internal diameter 0.60 m contains air at a pressure of 6N/mm^2.If the maximum permissible stress induced in the material is 70 N/mm^2, find the thickness of the cylinder. (04)

(B) A cylindrical pipe of diameter 2.5m and thickness 1.5 m and is subjected to an internal fluid pressure of 2.2 N/mm^2.Determine the longitudinal stress developed in the pipe & Circumferential stress developed in the pipe. (04)

(C) Derive the relation between slope, deflection and radius of curvature. (04)

5 (A) A double riveted double cover butt joint is plates 14 mm thick is made with 20 mm rivets at 60 mm pitch. Calculate the pull per pitch length at which the joint will fail and also its efficiency. Take stress as 460,730,340 N/mm^2 for tearing, bearing and shearing respectively. (04)

(B) What is lap joint and butt joint explain in detail? Draw the diagrams for (i) Single and double riveted lap joint (ii) Single and double cover double riveted butt joint. (04)

(C) A double riveted double cover butt joint in plates 14 mm thick is made with 20 mm diameter rivets, at 80mm pitch. If the σ_t for the plates is 420MPa and ζ_s and σ_b for rivets are 300 and 620 MPa respectively. Calculate the pull per pitch length at which the joint will fail and its efficiency. (03)

OR

5 (A) Derive the equation for the crippling load for the column when both ends of the column are hinged with proper diagrams and notations. (04)

(B) A beam 4m long simply supported at its end is carrying a point load of 60 kn at its centre. The moment of inertia of the beam is 78 X 10^6 mm^4.If E for the material of the beam = 3.1 X 10^5 N/ mm^4.Calculate the deflection at the centre of the beam and slope at the supports. (04)

(C) A beam of length 8m is simply supported at its end and carries two point loads of 48 KN and 40 KN at a distance of 2m and 3m respectively from the left support. Find the deflection under each load, maximum deflection and the point at which maximum deflection occurs take E =2.5X 10^5 N/mm^2 and I = 45 X 10^6 mm^4. (03)

6 (A) A mild steel tube 25 mm internal diameter, 32 mm external diameter, length 3 meters is used as a strut one end fixed and the other ends hinged. Calculate the euler's collapse load using E = 2 X 10^5 Also find the euler's collapse load by other three cases. (04)

(B) Compare the crippling load of a solid circular section of 350 mm diameter with a hollow circular section of the same area and 30 mm thickness. The other conditions are the same for both columns. (04)

(C) A rectangular column section of size B x D is hinged at both the ends. Determine the limiting length of the column so that the critical stress is 6 N/mm^2. Take E=18000N/mm^2 (04)

END OF PAPER