Student Exam No._____

# GANPAT UNIVERSITY

B. Tech. Semester 3rd Mechatronics 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 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. (05)

2 (A) Draw shape of shear distribution diagram for beams having following cross sections under a shear force 'S' (06)
(a) Rectangular and circular shape (b) I-shape (c) channel 'C' shape (d) channel 'U' shape (e) H shape (f) Hollow rectangular shape (g) plus (+) shape (h) Hollow circular shape (i) T shape (j) Inverted Tee (⊥)shape.

(B) The principal stresses at a point in a strained material are 40 MPa both are unlike stress. Find analytically and graphically the normal, tangential and resultant stresses on a plane inclined at 45° with principal planes. (06)

OR

2 (A) Derive graphically expressions for finding out normal tangential and resultant stresses on an oblique plane in a rectangular element subjected to direct unlike stresses in two mutually perpendicular directions. (06)

(B) A simply supported beam is 'T' shape of flange is 150 mm wide & 10 mm thick and web is 200 mm long and 20 mm thick. Overall depth of T-section is 210 mm. Beam AB is simply supported with a point load of 60 KN at 2 m from left end A. Also carries U.D.L. of 20 KN/m on 4 m length from B end. Total span AB is 8 m. Find Location where maximum average vertical shear stress exists and Magnitude of maximum average vertical shear stress (06)

3 (A) What do you understand by neutral layer and neutral axis? (02)

(B) Define section modulus and its importance in bending? (03)

3 (C) A simply supported beam of span 'L' m carries a Uniformly distributed load of 25 KN/m over its entire span and a point load 50 KN at the centre of beam. If the beam material can bear 100 N/mm$^2$ tensile stress and 160 N/mm$^2$ compressive stress, find out maximum permissible span length. The cross section of beam is I-section. Thickness of flange and web are 20 mm. Top flange width is 200 mm. Bottom flange width is 100 mm. Overall depth is 340 mm. (0

OR

3 (A) Derive an expression for bending stress at a layer in a beam. (04)

(B) A wooden beam of width 175 mm and depth 400 mm is strengthened by steel plates having thickness 10 mm and height 300 mm as shown in figure no 1. If the beam is used as cantilever and the allowable stress is steel is 120 N/mm$^2$, calculate moment of resistance of section. The ratio of modules of elasticity of steel to wood is 10. (08)

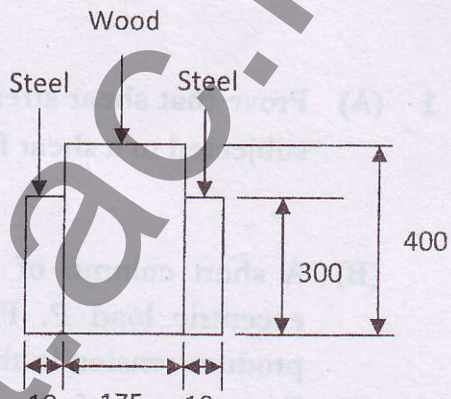


Figure No : 1

## Section - II

4 (A) Write the assumptions made in the derivation of shear stress produced in a circular shaft subjected to torsion. Also prove that the torque transmitted by a solid circular shaft is $=\prod/16 \times F_s \times d^3$. (04)

(B) A solid shaft 150 mm diameter is used to transmit torque.Find the maximum torque transmits by the shaft if the maximum shear stress induced to the shaft is 45 N/mm$^2$ (04)

(C) A solid shaft 80 mm in diameter transmit 80 KW at 180 rev/min.Calculate the maximum shear stress induced and the angle of twist in degrees for a length of 8 metres. Consider G= 80 GPA. (04)

OR

4 (A) A beam of length 8 m is simply supported at its end .It carries a uniformly distributed load of 40 kn/m up to 4m of length and it starts at 1 m from left end of the beam. Determine the deflection of the beam at its mid point and also the position of maximum deflection. Take E = 2 X 10$^5$ N/mm$^2$ and I = 4.3 X 10$^6$ mm$^4$. (04)

(B) An overhanging beam ABC ,in which BC(3 m) is the hanging portion and AB(6m) is the beam.A 10 KN load is applied at the end point of the overhanging portion.Find the slopes over each point and deflection at the end point. (04)

4 (C) A horizontal beam AB is simply supported at A and B,6m apart.The beam is subjected to clockwise couple at 300KNm at a distance of 4 m from the left end.Calculate deflection at the point where couple is acting and the maximum deflection.Take E =2 x $10^5$ N/$mm^2$ and I=2 X $10^8$ $mm^4$. (04)

5 (A) A cylindrical pipe of diameter 1.5 m and thickness 1.5 cm is subjected to an external fluid pressure of 1.2 N/$mm^2$ .Determine i)Longitudinal stress developed in the pipe and the circumferential stress developed in the pipe (04)

(B) A thin cylinder of internal diameter 1.25mm contains a fluid at an internal pressure of 2 N/$mm^2$.Determine the maximum thickness of the cylinder if , (i)Longitudinal Stress is not to exceed 30N/$mm^2$ (ii)The circumferential stress is not to exceed 45 N/$mm^2$. (04)

(C) A cylinder of thickness 1.5 cm has to withstand maximum internal pressure of 1.5 N/$mm^2$.If the ultimate tensile stress in the material of the cylinder is 300N/$mm^2$, factor of safety 3.0 and joint efficiency 80%.Determine the diameter of the cylinder. (03)

OR

5 (A) What is strength of rivet? Explain pitch length, guage length and edge length with proper diagrams and also write the formula for strength of rivet in bearing tearing and shearing. (04)

(B) A 6 mm thick angle section is jointed to a 10mm thick gusset plate. The angle is supporting a load of 55 KN. Find out the number of 16 mm diameter power driven rivets. (04)

(C) Calculate the value of a rivet in lap joint used to connect two plates 12mm thick in power driven and hand driven rivets. Use Unwin formula. (03)

6 (A) A hollow mild steel tube 10 m long, 8 cm internal diameter and 5mm thick is used as a strut with both ends hinged. Find the crippling load and Safe load. Take factor of Safety = 3.0 and E = 2 x $10^5$ N/$mm^2$. (04)

(B) A hollow cylindrical cast iron column is 3.5 m long with both ends fixed. Determine minimum diameter of column, if it has to carry a safe load of 250 KN with a factor of safety of 5. Take the internal diameter as 0.7 times the external diameter. (04)

(C) What is 'equivalent length of column'? Give the ratio of equivalent length and actual length of columns with various end conditions. (04)

THE END