Seat No: _____   Enrollment No: _____

PARUL UNIVERSITY
FACULTY OF ENGINEERING & TECHNOLOGY
B.Tech. Summer 2022-2023 Examination

Semester: 4th   Date: 27/03/2023
Subject Code: 203109267   Time: 2hr: 30min
Subject Name: Strength of Materials   Total Marks: 60

Instructions:
1. All questions are compulsory; Figures to the right hand side indicate full marks.
2. Make suitable assumptions wherever necessary.
3. Start new question on new page.

Q.1   Objective Type Questions (All are compulsory) (Each of one mark)   (15)

1. In the below **Figure 01,** what are the end conditions of column?
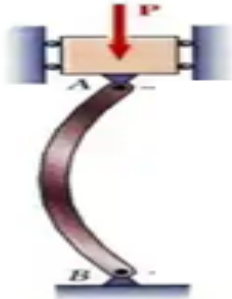
   (a) Both ends hinged
   (b) Both ends free
   (c) Both ends fixed
   (d) One end fixed , other end hinged

   Figure 01

2. Out of below statement which is the correct one?
   (a) Hooke's law holds good up to limit of proportionality.
   (b) Energy absorbed up to the elastic limit is called Modulus of Toughness.
   (c) Energy absorbed up to maximum tensile stress is called strain energy.
   (d) Yield point is the point where specimen elongates in proportion to load applied.

3. Hollow circular Shaft subjected to torsion will have _____ shear stress at the outer surface.
   (a) zero (b) Maximum (c) average (d) none of above.

4. Mathematically, Strain energy = _____ (within the elastic limit).
   (a) Power (b) Work done (c) Young's Modulus (d) all of above.

5. Young`s Modulus is the ratio of
   (a) volumetric stress and volumetric strain
   (b) Longitudinal stress and longitudinal strain
   (c) Shear Stress to Shear Strain
   (d) Longitudinal stress and lateral strain

6. Out of below, which stress distribution is straight line?
    I. Bending stress of beam
    II. Torsional shear stress of shaft
   III. Transverse shear stress of beam

   (a) I only (b) II only (c) I and II (d) I ,II and III

7. For a certain strained body, Mohr Circle radius represents 50 MPa. What is the value of maximum shear stress ? (in MPa)

8. On Principal plane _____ stress is not existed.

9. In a **Figure 02** below, an element subjected to tension $\sigma 1$= 300 Mpa(Tensile) and $\sigma 2$=300Mpa (Compressive) .Maximum shear Stress is _____Mpa.

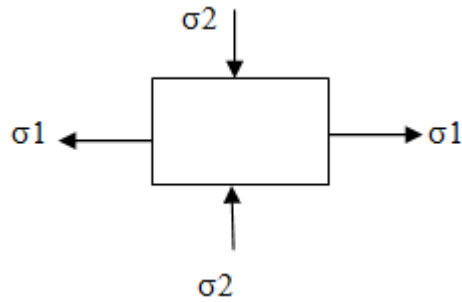**Figure 02**

10. In a **Figure 03** below, a body subjected to shear stress τ=45 MPa.The major, minor principal stress and maximum shear stress possess the same value as 45 MPa. Is this True or false?

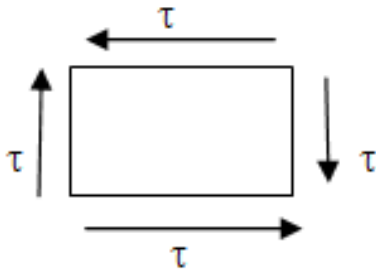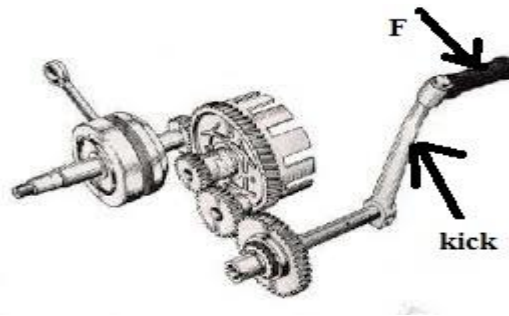**Figure 03**   **Figure 04**

11. In an motorcycle kick **Figure 04**, force of F=400 N is applied , length of kick is 400 mm , find out the torque(in Nm) produced in the shaft attached to kick.

12. Write any two methods to find out deflection of the beam.

13. In a solid shaft subjected to torsion is required to run at 500 r.p.m and producing 60000 N mm Torque. Find out the Power transmitted by a shaft in kW only.

14. For a given certain fixed value of Torque T, shaft diameter d and Shear Modulus G, the angle of Twist θ =0.5°for 1 meter length shaft. What is the angle of Twist θ for 4 meter length shaft (keeping the T,d and G constant) ?

15. Write down flexure and torsion equation with standard notations.

Q.2 Answer the following questions. (Attempt any three).   **(15)**

A) Draw Stress Strain diagram of a ductile material and show critical points on that.
B) What is concept behind theories of failures ? Enlist any 3 theories of failures and Compare their region of safety through graphical representation.
C) Design the diameter of a solid Circular shaft used to transmit 75 kW at 200 r.p.m. The Yield Stress in Shear is 280 Mpa , Factor of Safety is 4. Take maximum Torque transmitted at each revolution 30% higher than mean torque.
D) Cantilever beam of 1 m length is subjected to point load 1200N at free end. Find out the deflection at free end. Take the Value of flexural rigidity EI = 20×10^{10} N-mm^2.

Q.3 A) At a certain point in a strained material, the stresses on two planes at right angles to each other   **(07)** are 20 Mpa and 10 Mpa respectively. They are accompanied by a shear stress of 10 Mpa. Find principal stress and max shear stress analytically.

B) A tensile load of 60 kN is applied to a circular bar of 4 cm diameter and 5m long . If the value of **(08)** $E= 2.0 \times 10^5$ N/mm^2 .Find out the Strain energy absorbed when (i) 60 kN applied gradually (ii) 60 kN applied suddenly.

OR

B) **Figure 05** shows a loaded beam and section. Find out Shear stresses at (1) upper fiber (2) lower **(08)** fiber (3)Neutral axis and   (4) Junction of Web and flange. Draw its distribution diagram. XX shows the position of C.G and neutral axis.
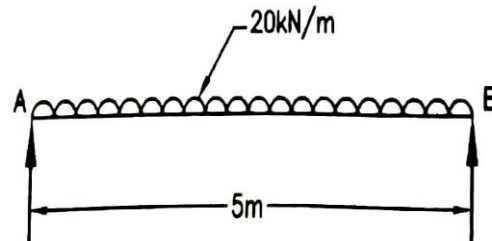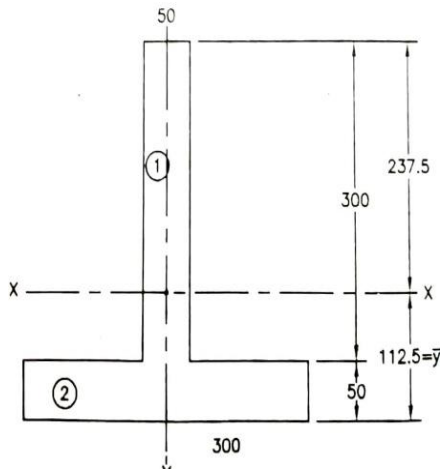

Figure 05

Q.4 A) Draw the shear stress distribution diagram for the following shapes. **(07)**
(i)Regular I section (ii) T- Section (iii) Circular (iv) rectangle (v) Hollow circular (vi) L section (vii) inverted T section.

OR

A) Determine Euler`s crippling load for a T section 400 x 200 x10 mm and 8 m long used as a **(07)** column with both ends fixed . Take E= 2.1 x10^5 MPa. Syc (Yield strength in compression) = 330 MPa. Ixx= 19786 x 10^4 mm^4 , Iyy= 1336.5 x 10^4 mm^4 **See Figure 06**.
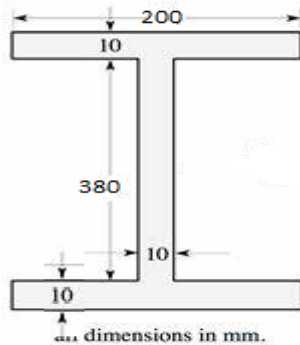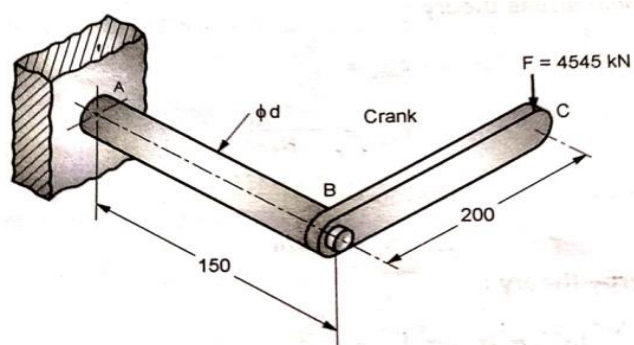

Figure 06

Figure 07

B) A wall bracket of Mild steel whose yield strength in tensile Syt is 324 N/mm2 .It is subjected to **(08)** a static load of 4545N as shown in **Figure 07**. If the diameter d of the rod is 37.5 mm , determine the factor of safety based on maxium shear stress theory.Take Ssy= 0.5 Syt.

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