Seat No: _____ Enrollment No: _____

PARUL UNIVERSITY

FACULTY OF ENGINEERING & TECHNOLOGY

B.Tech. Summer 2022 - 23 Examination

Semester: 4 **Date: 27/03/2023**
Subject Code: 203109257 **Time: 02:00 pm to 04:30 pm**
Subject Name: Strength of Materials **Total Marks: 60**

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

Q.1 **Objective Type Questions** - (Fill in the blanks, one word answer, MCQ-not more than Five in case of MCQ) (All are compulsory) (Each of one mark) **(15)**

1. At the point maximum deflection, the slope is _____ for a simply supported beam.
2. _____ is the ratio of lateral strain to longitudinal strain for a given material when the material is stressed within the elastic limit.
3. _____ is the property by virtue of which the materials return back to their original position after removal of external force.
4. Section modulus is the ratio of ____ of a section about the neutral axis to the distance of the outermost layer from the neutral axis.
5. The maximum stress induced in a body due to suddenly applied load is _____ the stress induced when the same load is applied gradually.
6. State the flexural/bending equation.
7. Stress is a tensor quantity. True/False
8. State the units of twist.
9. Write the location of the maximum bending moment for a cantilever subjected to vertical point load at the free-end.
10. Name the plane with no shear stress acting on it.
11. When a body is subjected to a direct tensile stress (σ) in one plane, then the tangential stress on an oblique section of the body inclined at an angle (θ) to normal of the section is equal to
    a. p sin 2θ
    b. p cos 2θ
    c. $\frac{p}{2}$ sin 2θ
    d. $\frac{p}{2}$ cos 2θ
12. Polar moment of inertia of a solid circular shaft of diameter D is
    a. $\pi D^3/32$
    b. $\pi D^4/32$
    c. $\pi D^3/64$
    d. $\pi D^4/64$
13. The bending moment on a section is maximum where shearing force is
    a. maximum
    b. minimum
    c. changing sign
    d. zero
14. The flexural rigidity for the deflection of the beam is expressed as
    a. I/E
    b. E/I
    c. 1/EI
    d. EI
    where E=modulus of elasticity, I=moment of inertia
15. The expression $EI\frac{d^2y}{dx^2}$ at a section of a member represents
    a. bending moment
    b. shearing force
    c. rate of loading
    d. slope

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

A) Explain the Theory of simple bending and list down the assumptions for it.

B) Derive the equation for shear stress produced in a circular shaft subjected to torsion. Also, determine the maximum torque transmitted by the shaft if maximum shear stress induced in the shaft is 45N/mm^2. Consider a solid shaft of 150mm diameter.

C) Name the different methods for determining slope and deflection at a section in a loaded beam. Also, for a 6m long simply supported beam subjected to point load of 50kN at its centre, determine the i. deflection at the centre, ii. Slope at the supports. The moment of inertia of the beam cross-section is 78 x 10^6 mm^4 and the Young's modulus for the beam material is 2.1 x 10^5 N/mm^2.

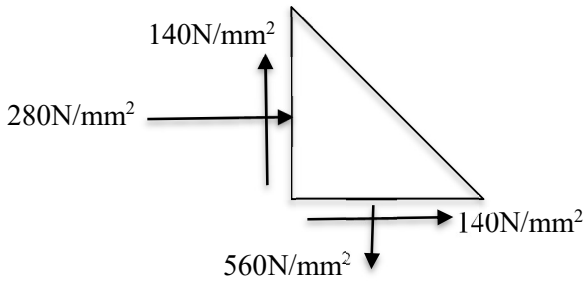
D) What do you understand by the term "Theories of failure"? Name the theories of failure and explain any one in detail.

Q.3 A) A simply supported beam carrying uniformly distributed load of 40kN/m runs over the whole span. The section of the beam is rectangular having a depth of 500mm. Determine the length of beam if the maximum stress in the beam material is 120N/mm^2 and moment of inertia of the section is 7 x 10^8 mm^4. **(07)**

B) Considering a point in a strained material, a plane is subjected to normal and shear stresses of 560N/mm^2 and 140N/mm^2 respectively. While another plane is subjected to 280N/mm^2 of normal stress and 140N/mm^2 of shear stress as shown in the figure. Determine the following: **(08)**

i. principal stresses and location of the planes on which they act,

ii. maximum shear stress and the plane on which it acts.



OR

B) A wooden beam of rectangular cross-section supports a uniformly distributed load of 20kN over a span of 3.6m when the beam is simply supported. If the depth of the section is to be twice the breadth, and the stress is not to exceed 7N/mm^2, then find the dimensions of the cross-section. Also, what would be dimensions of the cross-section, if it carries a concentrated load of 20kN placed at the centre with same ratio of breadth to depth? **(08)**

Q.4 A) A beam with an isosceles triangle cross-section is subjected to a shear force of 30kN at a section with 150mm as the base width and 450mm height. Calculate i. horizontal shear stress at the neutral axis, ii. The distance from the top of the beam where shear stress is maximum, iii. Value of maximum shear stress. **(07)**

OR

A) A bolt is subjected to an axial pull of 12kN together with a transverse shear force of 6kN. The elastic limit of the material is 300N/mm^2. Determine the bolt's diameter using the following theories: **(07)**

i. maximum principal stress theory

ii. maximum shear stress theory

iii. maximum strain energy theory

Assume the factor of safety as 3, Poisson's ratio as 0.3.

B) Define the following terms: strain energy, resilience, proof of resilience, modulus of resilience. Derive the expression for strain energy stored in the body when the load is applied gradually. **(08)**