Graphic Era
HILL UNIVERSITY
Established by an Act of the State Legislature of Uttarakhand (Adhiniyam Sankhya 12 of 2011)
University under section 2(f) of UGC Act, 1956

End Term (Even) Semester Examination May-June 2025

Roll no.....

Name of the Program and semester: **B.Tech IV SEM**
Name of the Course: **Mechanics of Materials**
Course Code: **TME 406**
Time: 3 hour
Maximum Marks: 100

Note:
(i) All the questions are compulsory.
(ii) Answer any two sub questions from a, b and c in each main question.
(iii) Total marks for each question is 20 (twenty).
(iv) Each sub-question carries 10 marks.

Q1. (2X10=20 Marks)

a. Explain the following terms: CO2
(i) Moment of Inertia
(ii) Section Modulus
(iii) Ultimate Strength
(iv) Young's Modulus
(v) Bulk modulus

b. A circular bar tapers uniformly from 40 mm to 20 mm diameter over a length of 1 m. Determine elongation due to axial load of 50 kN. Take E = 200 GPa. CO1

c. The stresses on two perpendicular planes through a point in a body are 30 MPa and 15 MPa both tensile along with a shear stress of 25 MPa. CO6
Find:
(i) The magnitude and direction of principal stresses
(ii) The planes of maximum shear stress

Q2. (2X10=20 Marks)

a. Derive the general relationship between load, shear force and bending moment in a beam. CO5

b. Draw the SFD and BMD for a simply supported beam subjected to uniformly distributed load. CO5

c. A cantilever beam of 10m span carries loads of 4 kN and 6 kN at 2m and 6m respectively from the fixed end along with another load of 6 kN at free end. Draw the shear force and bending moment diagram. CO5

Q3. (2X10=20 Marks)

a. Deduce the torsion equation stating the assumptions made. CO4

b. A hollow steel shaft transmits 200 kW of power at 150 rpm. The total angle of twist in a length of 5 m of the shaft is 3°. Find the inner and outer diameters of the shaft if the permissible shear stress is 60 MPa. G = 80 GPa. CO4

c. A 120 mm wide and 10 mm thick steel plate is bent into a circular arc of 8 m radius. Determine the maximum value of stress produced. Also find the bending moment which will produce the maximum stress? E = 200 GPa. CO4

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Q4. (2X10=20 Marks)

a. Derive the expression for maximum deflection of cantilever beam subjected to point load at free end. CO4

b. What assumptions are taken in the analysis of thin cylinders? Deduce the expression for circumferential and longitudinal stresses developed in them. CO3

c. A simply supported beam of 8 m span carries central point load of 50 kN. Determine maximum slope and deflection. E = 200 GPa, I = 200 x 10^6 mm4. CO4

Q5. (2X10=20 Marks)

a. What is meant by crippling or buckling load? Derive the formula for Euler's crippling load for a column subjected to both ends hinged, end conditions. CO3

b. A thin cylindrical shell 1.2 m long, 500 mm in diameter and 6 mm thick is subjected to an internal pressure of 2 MPa. CO3

Calculate:

(i) Hoop stress
(ii) Longitudinal stress
(iii) Change in diameter and length

Take E = 200 GPa and Poisson's ratio = 0.3

c. A 3.2 m long fixed-end hollow cast-iron column has its internal and external diameters as 60 mm and 80 respectively. Determine Rankine's crippling load using the value of crushing stress to be 500 MPa and the value of the Rankine's constant 1/1600. CO3