Printed Page:-05 Subject Code:- BME0301

Roll. No:

NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

B.Tech

SEM: III - THEORY EXAMINATION (2024 - 2025)

Subject: Engineering Mechanics & Strength of Material

Time: 3 Hours Max. Marks: 100

General Instructions:

IMP: *Verify that you have received the question paper with the correct course, code, branch etc.*

1. This Question paper comprises of three Sections -A, B, & C. It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.

2. Maximum marks for each question are indicated on right -hand side of each question.

3. Illustrate your answers with neat sketches wherever necessary.

4. Assume suitable data if necessary.

5. Preferably, write the answers in sequential order.

6. No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.

SECTION-A 20

1. Attempt all parts:-

1-a. Effect of a force on a body depends upon [CO1, K1] 1

(a) magnitude

(b) direction

(c) position or line of action

(d) all of the above

1-b. The ratio of limiting friction and normal reaction is known as. [CO1, K1] 1

(a) Coefficient of friction

(b) Angle of friction

(c) Angle of repose

(d) Sliding friction

1-c. The MOI of a circle with diameter d about its centroidal axis is ….. [CO2, K1] 1

(a) $\Pi d^2/32$

(b) $\Pi d^2/64$

(c) $\Pi d^4/32$

(d) $\Pi d^4/64$

1-d. Which of the following is not a basic type of strain?[CO2,K1] 1

(a) Compressive strain.

(b) Shear strain

(c) Area strain

(d) Volume strain

1-e. Section modulus is given as. [CO3, K1] 1

(a) Z = I/ Ymax

(b) Z = I/ Ymin

(c) Z = IYmax

(d) Z = Ymax/I

1-f. The value of maximum bending moment in case of cantilever beam loaded with one point load w at the free end. [CO3, K1] 1

(a) WL

(b) $WL^2/2$

(c) WL/4

(d) $WL^2/8$

1-g. A solid circular shaft transmits 75 kW power at 200 rpm. Calculate the shaft diameter, if the twist in the shaft is not to exceed 1^o in 2 m length and the shear strength is limited to50MN/m2. Take G= 100 GN/m2. [CO4,K2] 1

(a) 80.4 mm

(b) 106.73 mm

(c) 106.73 cm

(d) 80.4 cm

1-h. Torsion equation is. [CO4,K1] 1

(a) $T/J = \tau/R = G\Theta/L$

(b) $T/J = R/\tau = G\Theta/L$

(c) $J/T = \tau/R = G\Theta/L$

(d) $T/J = \tau/R = GL/\Theta$

1-i. Which theory is used to determine stress in thin pressure vessels?[CO5, K1] 1

(a) Hooke's Law

(b) Poisson's Ratio

(c) Lame's Theory

(d) Thin Shell Theory

1-j. What is the primary failure mode considered in thin pressure vessel theory?[CO5, K1] 1

(a) Tensile failure

(b) Shear failure

(c) Buckling failure

(d) Yielding failure

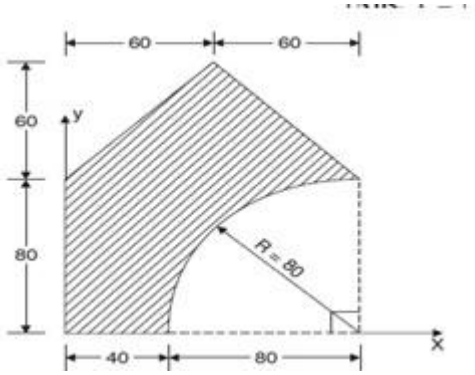
2. Attempt all parts:-

2.b.	Write down the equilibrium conditions for coplanar concurrent and non concurrent force systems. [CO1,K2]	2
2.a.	Define-hoop stress & longitudinal stress. [CO5,K2]	2
2.c.	Define radius of gyration. [CO2,K3]	2
2.d.	Define section modulus.[CO3,K2]	2
2.e.	Write down the assumptions made during derivation of torsion equation.[CO4,K2]	2

SECTION-B 30

3. Answer any five of the following:-

3-a.	State and Prove Varignon's theorem. [CO1,K3]	6
3-b.	A ladder of length 6m weighing 300N is placed against a vertical wall at 60^0 with the horizontal. the coefficient of friction between the wall and the ladder is 0.25 and that between ladder and floor is 0.30. A man of weight 750N stands at a distance 4m from the bottom of the ladder. find minimum horizontal force applied at the bottom of ladder to prevent slipping. [CO1, K3]	6
3-c.	Compute the first moment of area of the channel section shown in Fig. [CO2,K3]	6

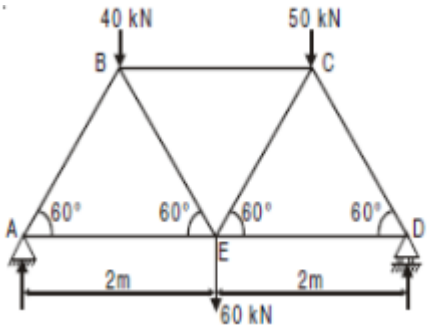


3-d.	Derive the mass moment of inertia of solid sphere. [CO2,K3]	6
3.g.	A square beam 20mm×20mm in section and 2m long is supported at the ends. The beam fails when a point load of 400N is applied at the centre of the beam. What uniformly distributed load per metre length will break a cantilever of the same material 40mm wide 60mm deep and 3m long. [CO3,K3]	6
3.e.	A steel bar of rectangular cross section 30 x 50 mm pinned at each end is 2 m long. Determine the buckling load when it is subjected to axial compression and also calculate axial:stress using Euler's expression. Determine the minimum length for which Euler's equation may be valid. Take proportionality limit as 250 MPa and E = 200 GPa . [CO4,K3]	6
3.f.	A cylindrical shell 3m long which is closed at the ends has an internal diameter of 1.5m and a wall thickness of 20mm. Calculate the circumferential and longitudinal stresses induced and also change in the dimensions of the steel. If it is subjected to an internal pressure of 1.5 N/mm2 Take E=2×105N/mm2 and poisons ratio=0.3. [CO5, K3]	6

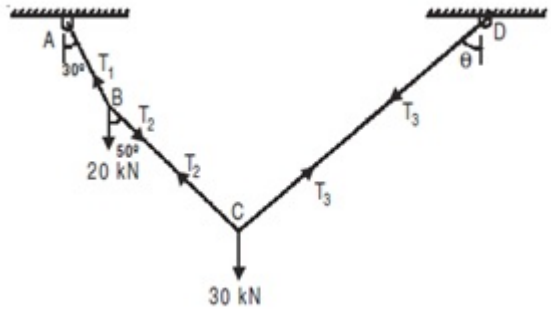
SECTION-C 50

4. Answer any one of the following:-

4-a. Analyze the truss and find the forces in all the members of the trusses shown in Fig. below Indicate the nature of forces using the convention tension as +ve and compression as –ve. [CO1,K4] 10

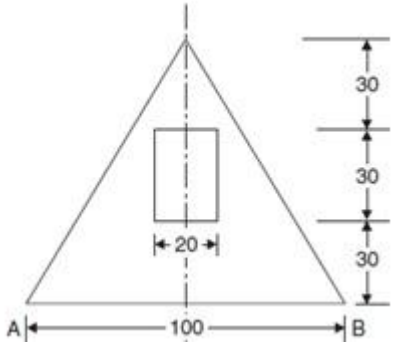


4-b. A wire rope is fixed at two points A and D as shown in Figure. Two weights 20 kN and 30 kN are attached to it at B and C, respectively. The weights rest with portions AB and BC inclined at angles 30° and 50° respectively, to the vertical as shown in figure. Find the tension in the wire in segments AB, BC and CD and also the inclination of the segments CD to vertical.[CO1,K4] 10



5. Answer any <u>one</u> of the following:-

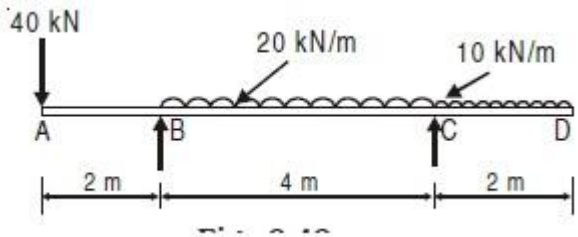
5-a. Locate the centroid of the plane area shown in Fig.and calculate the MOI about centroidal axis. [CO2,K4] 10



5-b. At a point in a strained material, the principle stresses are 100N/mm^2 tensile and 40 N/mm^2 compressive. Determine the resultant stress in magnitude and direction on a plane inclined at 60^0 to the axis of the major principle stress. What is the maximum intensity of shear stress in material at the point.[CO2,K3] 10

6. Answer any <u>one</u> of the following:-

6-a. Draw the shear force and bending moment diagram of the following:-[**CO3, K3]** 10



6-b.	A water main 500mm internal diameter and 25 mm thickness runs full and is freely supported for 20 m. span length. determine maximum bending stress induced in the pipe metal if weight of water and that of pipe is taken into consideration. Take specific weight of steel and water as 75KN/m^3 and 10 kN/m^3 respectively. [CO3, k4]	10

7. Answer any <u>one</u> of the following:-

7-a.	Derive the torsion equation of the circular shaft. Also write down the assumption made in torsion. [CO4, K3]	10
7-b.	Derive the crippling load by Eulers's formula for a column being both end hinged.[CO4, K3]	10

8. Answer any <u>one</u> of the following:-

8-a.	Derive the expression for max shear stress in a tin cylindrical shell subjected to internal pressure.[CO5, K3]	10
8-b.	A cylindrical thin drum 80cm in diameter and 3m long has a shell thickness of 1cm. If the drum is subjected to an internal pressure of 2.5 N/mm2, determine, (i) change in diameter. (ii) change in length and (iii) change in volume Take, E=2×105N/mm2 and poisons ratio=0.25.[CO5, K3]	10