Registration No.: | | | | | | | | | | |

Total Number of Pages: 03 **B.Tech/IDD**
23ES1004

1st Semester Regular/Back Examination: 2025-26
SUBJECT: Engineering Mechanics
BRANCH(S): AE, AERO, AG, AIML, AUTO, BIOTECH, CHEM, CIVIL, CSE, CSEAI, CSEAIML, CSEDS, CSEIOT, CSIT, CST, CST, ECE, EEE, EEVDT, ELECTRICAL, ELECTRICAL & C.E, ELECTRONICS & C.E, ETC, IT, MECH, METTA, MINERAL, MINING, MME
Time: 3 Hours
Max Marks: 100
Q.Code: U638
Answer Q1 (Part-I) which is compulsory, any eight from Part-II, and any two from Part-III.
The figures in the right hand margin indicate marks.

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Part-I

Q1 **Answer the following questions:** **(2 x 10)**

a) Differentiate between moment and couple.
b) What is the difference between static and kinetic friction?
c) Find the resultant of two forces equal to 50 N and 30 N acting at an angle of 60°.
d) State the Varignon's principle of moments.
e) Find the moment of inertia of a rectangular section 30 mm wide and 40 mm deep about X-X axis and Y-Y axis.
f) How will you distinguish between static friction and dynamic friction?
g) What is zero-force member in a truss? Give one example.
h) A force of 50 N acts at an angle of 60° to the direction of virtual displacement of 0.2 m. Find the virtual work done.
i) A bullet is fired with a velocity of 100 m/s at an angle of 45° with the horizontal. How high the bullet will rise?
j) A body of mass 10 kg is moving with a velocity of 15 m/s. Find its kinetic energy and momentum.

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) Find the angle between two equal forces P, when their resultant is equal to (i) P and (ii) P/2.
b) A body is in equilibrium under the action of three concurrent forces of 100 N, 150 N, and 200 N. The angle between the first two forces is 60°. Find the angles between the remaining forces.
c) A ball overtakes another ball of twice its own mass and moving with $1/7^{th}$ of its own velocity. If coefficient of restitution between the two balls is 0.75, show that the first ball will come to rest after impact.
d) A bar AB supported at both ends of length 4 m is subjected to a point force of 10 kN at a distance of 1.5 m from A. Using principle of virtual work, determine the reactions at the two supports.

e) A projectile is fired from the ground with a velocity of 40 m/s at an angle of 30° with the horizontal. Find: (a) Maximum Height, (b) Time of flight, (c) Maximum Range

f) A roller of radius 300 mm and weight 2000 N is to be pulled over the curb of height (h) of 150 mm by horizontal pull force (P), applied at the end of the string, wound around the circumference of the roller as shown in Fig. 1. Find the magnitude of the pull force (P) required to start the roller over the curb.

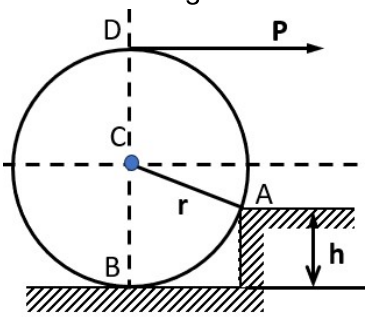

Fig. 1

g) For the frame shown in Fig. 2, find the relation between force P and Q to keep the frame in the equilibrium. The length of each member is "a".

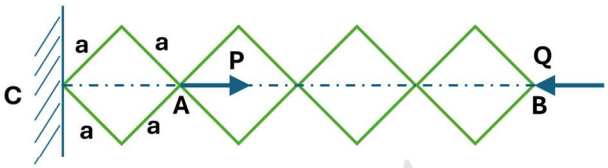

Fig. 2

h) Find the moment of inertia of a triangular lamina of base *'b'* and height *'h'* about its centroid axis.

i) A uniform lamina shown in Fig. 3 consists of a rectangle, a circle and a triangle. Determine the centroid of the lamina. All dimensions are in mm.

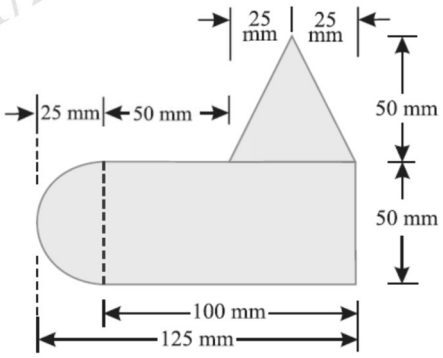

Fig. 3

j) Find the moment of inertia about the centroidal X-X and Y-Y axes of the angle section shown in Fig. 4.

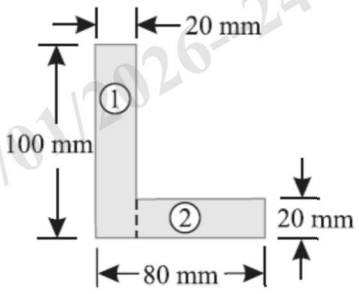

Fig. 4

k) A car of mass 1000 kg is moving at 15 m/s. The brakes apply a constant force of 3000 N. Find the stopping distance.

l) Two bodies of masses 5 kg and 3 kg move along a straight line with velocities 10 m/s and 4 m/s respectively in the same direction. Find their common velocity after collision if they stick together.

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Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 A block of mass 20 kg slides down a rough inclined plane inclined at 30° to the horizontal from a height of 5 m. The coefficient of friction between the block and the plane is 0.25. Using the work–energy principle, determine the velocity of the block at the bottom of the plane. **(16)**

Q4 A ladder 5 m long rests on a horizontal ground and leans against a smooth vertical wall at an angle of 65° with the horizontal. The weight of the ladder is 800 N and acts at its center of gravity. The ladder is at the point of sliding, when a man weighing 650 N stands on a bar of the ladder 1.5 m from the bottom of the ladder. Calculate the coefficient of friction between the ladder and the floor. **(16)**

Q5 Determine the nature and magnitude of the forces in the members BC, GC, and GF of the truss shown in Fig. 5. **(16)**

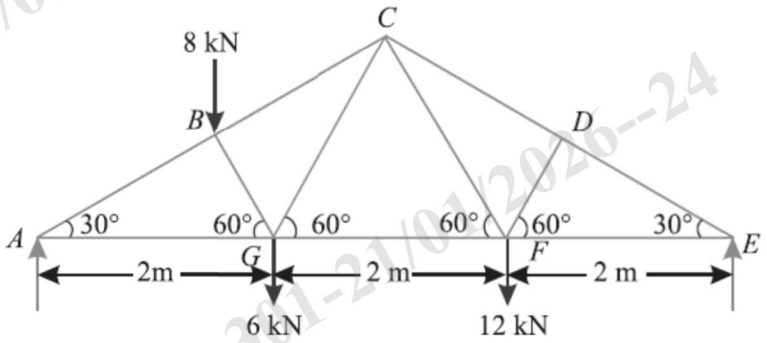

Fig. 5

Q6 A man weighing 712 N stands in a boat so that he is 4.5 m from a pier on the shore (Fig. 6). He walks 2.4 m in the boat towards the pier and then stops. How far from the pier will he be at the end of this time? The boat weighs 890 N, and there is assumed to be no friction between it and the water. **(16)**

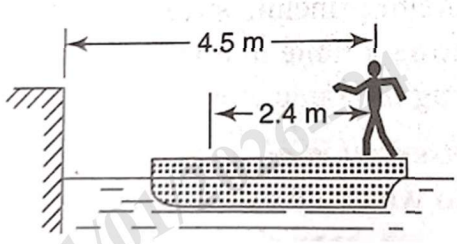

Fig. 6

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