ARYA COLLEGE OF ENGINEERING
GUESS PAPER
**(II B. Tech. III Semester 2025-
2026)**

3ME3-04-ENGINEERING MECHANICS

Unit 1:

Short Answers: (2 Marks Each)

Q. 1 State the parallelogram law of forces

Q.2 State the Lami's theorem.

Q.3 State the principle of virtual work

Q.4 Explain the condition of equilibrium.

Q.5 What are the various characteristics of a force?

Q.6 State the Varignon's principle of moments.

Q.7 State the principle of transmissibility of forces.

Q.8 What is a free body diagram (FBD)? Why is it important?

Q.9 Differentiate between method of joints and method of sections.

Q.10 What is meant by a determinate truss?
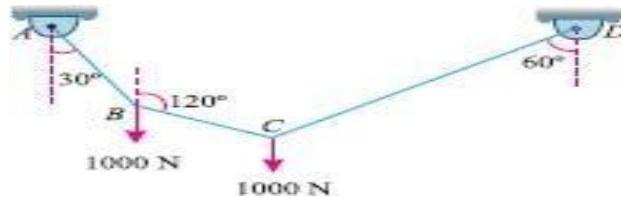
Descriptive Answers: (5 to 20 Marks)

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Q. 1 State and prove Lami's theorem.

Q. 2 State and prove parallelogram law of forces

Q. 3 A string ABCD, attached to fixed points A and D has two equal weights of 1000 N attached to it at B and C. The weights rest with the portions AB and CD inclined at angles as shown in Fig.
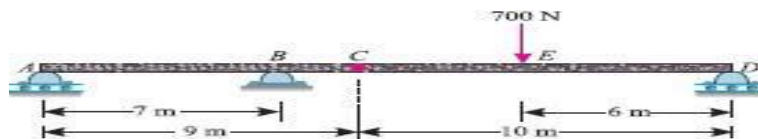

Q. 4 The following forces act at a point :
(i) 20 N inclined at 30° towards North of East,
(ii) 25 N towards North,
(iii) 30 N towards North West, and
(iv) 35 N inclined at 40° towards South of West.
Find the magnitude and direction of the resultant force.

Q. 5 Find the magnitude of the two forces, such that if they act at right angles, their resultant is √10 N. But if they Act at 60°, their resultant is √13 N.

Q.6 Two beams AC and CD of length 9 m and 10 m respectively are hinged at C.

These are supported on rollers at the left and right ends (A and D). A hinged support is provided at B, 7m from A as shown in Fig.

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Q.7 Define a truss and State the basic assumptions of truss analysis.

Q.8 Discuss the determinacy and stability of trusses with examples.

Unit 2:

Short Answers: **(2 Marks Each)**

Q. 1 State the law of Machine..

Q. 2 In a certain weight lifting machine, a weight of 1 kN is lifted by an effort of 25 N. While the weight moves up by 100 mm, the point of application of effort moves by 8m. Find mechanical advantage, velocity ratio and efficiency of the machine.

Q. 3 Define the term centre of gravity.

Q. 4 Define mechanical advantage of a machine.

Q. 5 What do you understand by the term 'Reversibility' of a machine?

Q. 6 State the theorem of perpendicular axis applied to moment of inertia.

Q.7 Explain reversibility of machines.

Q.8 What is radius of gyration? State parallel axis theorem.

Q.9 Define Mechanical Advantage, Velocity Ratio, and Efficiency.

Q.10 What is an ideal machine?

Descriptive Answers: (5 to 20 Marks)

Q. 1 Describe the working of a Weston's differential pulley block

Q. 2 State and prove the theorem of perpendicular axis applied to moment of inertia.

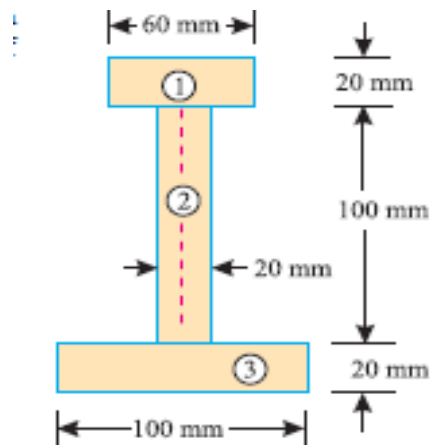Q.3 What is pulley? State the working of first system, second system, and third system of pulleys.

Q. 4 What do you understand by the term 'Reversibility' of a machine? Explain the difference between a reversible machine and a self-locking machine.

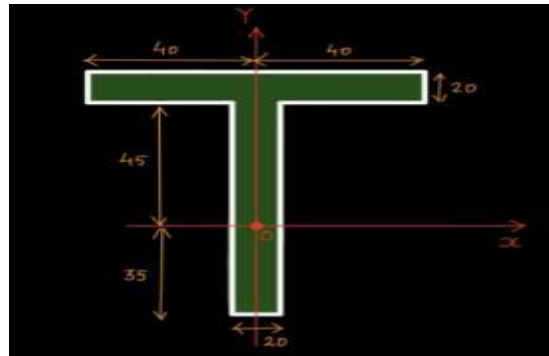Q. 5 What is law of a machine? Derive an equation for the same.

Q. 6 An I-section is made up of three rectangles as shown in Fig. Find the moment of inertia of the section about the horizontal axis passing through the centre of gravity of the section.

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Q. 7 Find the centroid of the T-section shown in the figure below. All dimensions are given in the figure.
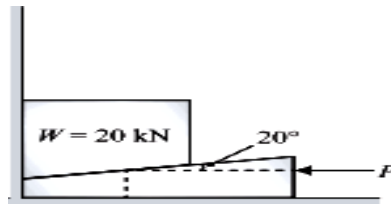

Unit 3:

Short Answers: (2 Marks Each)

Q. 1 What do you understand by the term friction ?

Q. 2 Define angle of repose.

Q. 3 How will you distinguish between static friction and dynamic friction ?

Q. 4 State the laws of friction.

Q. 5 What do you mean by the term angle of friction. .

Q. 6 Discuss briefly the various types of belts used for the transmission of power.

Q.7 Write the expression for ratio of belt tensions in a flat belt drive.

Q.8 What is meant by slip in belt drive?

Q.9 Give two advantages of V-belt over flat belt.

Q.10 State the laws of dry friction.

Descriptive Answers: (5 to 20 Marks)

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Q. 1 Derive an expression for the length of the open belt derive.

Q. 2 Define angle of repose. Show that the angle of friction is equal to angle of repose.

Q. 3 Two pulleys, one 450 mm diameter and the other 200 mm diameter are on parallel shafts 1·95 m apart and are connected by a crossed belt. Find the length of the belt required and the angle of contact between the belt and each pulley. What power can be transmitted by the belt, when the larger pulley rotates at 200 rev/min, if the maximum permissible tension in the belt is 1 kN, and the coefficient of friction between the belt and pulley is 0·25 ?

Q. 4 A ladder 5 meters long rests on a horizontal ground and leans against a smooth vertical wall at an angle 70° with the horizontal. The weight of the ladder is 900 N and acts at its middle. The ladder is at the point of sliding, when a man weighing 750N stands on a rung 1.5
Meter from the bottom of the ladder. Calculate the coefficient of friction between the ladder and the floor.

Q. 5 A block weighing 1500 N, overlying a 10° wedge on a horizontal floor and leaning against a vertical wall, is to be raised by applying a horizontal force to the wedge. Assuming the coefficient of friction between all the surface in contact to be 0.3, determine the minimum horizontal force required to raise the block.

Q. 6 Derive an expression for the tension ratio for the flat belt.

Q.7 Derive the formula for ratio of belt tensions ($T_1/T_2 = e^{\mu\theta}$).

Q.8   Determine the minimum force required to move the wedge shown in Fig. (a). The angle of friction for all contact surfaces is 15°.

Unit 4:

Short Answers: (2 Marks Each)

Q. 1 Distinguish clearly between speed and velocity

Q. 2 A train travelling at 27 kmph is accelerated at the rate of 0.5 m/s2. What is the distance travelled by the train in 12 seconds?

Q. 3 State D'Alembert principle.

Q. 4 What is a projectile?

Q. 5 What is the difference between uniform acceleration and variable acceleration?

Q. 6 What do you understand by the term 'acceleration? Define positive acceleration and negative acceleration..

Descriptive Answers: (5 to 20 Marks)

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Q. 1 A motor car takes 10 seconds to cover 30 meters and12 seconds to cover 42 meters. Find the uniform acceleration of the car and its velocity at the end of 15 seconds.

Q. 2 A body was thrown vertically downwards from the top of a tower and traverses a distance of 40 meters during its 4th second of its fall. Find the initial velocity of the body.

Q. 3 Derive a relation for the distance travelled by a body in the nth second.

Q. 4 Two guns are pointed at each other, one upward at an angle of 30°, and the other at the same angle of depression the muzzles being 30 m apart. If the guns are shot with velocities of 350 m/s upwards and 300 m/s downwards respectively, find when and where they will meet?

Q. 5 How would you find out (a) time of flight (b) range of a projectile, when projected upwards on an inclined

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plane?

Q. 6 A particle is thrown with a velocity of 5 m/s at an elevation of 60° to the horizontal. Find the velocity of another particle thrown at an elevation of 45° which will have (a) equal horizontal range, (b) equal maximum height, and (c) equal time of flight.

Unit 5:

Short Answers: **(2 Marks Each)**

Q. 1 What do you understand by the term 'energy'?

Q. 2 Define the coefficient of restitution.

Q. 3 Explain the term 'work'.

Q. 4 State the law of conservation of momentum.

Q. 5 Explain the term collision.

Q. 6 Explain the Newton second law of motion.

Descriptive Answers: (5 to 20 Marks)

Q. 1 Three perfectly elastic balls A, B and C of masses 2 kg, 4 kg and 8 kg move in the same direction with velocities of 4 m/s, 1m/s and 0.75 m/s respectively. If the ball A impinges with the ball B, which in turn, impinges with the ball C, prove that the balls A and B will be brought to rest by the impacts.

Q. 2 State the impulse –Momentum relation.

Q. 3 State and prove the law of conservation of energy.

Q. 4 A ball of mass 1 kg moving with a velocity of 2 m/s impinges directly on a ball of mass 2 kg at rest. The first ball, after impinging, comes to rest. Find the velocity of the second ball after the impact and the coefficient of restitution.

Q. **5** What do you understand by the term 'energy'? Explain the various forms of mechanical energies.

Q.6 Explain the work energy relation.

Q.7 Derive the equations of motion in radial and transverse components.

Q.8 State and explain the work-energy principle for a particle and rigid body with example.