KAMARAJ COLLEGE (Autonomous)

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(Affiliated to Manonmaniam Sundaranar University, Tirunelveli)

(4 Pages) **Reg. No:……**

Question Code: 26E01203 **Course Code: 24UMPH31**

UG Degree - End Semester Examinations, April 2026

Third Semester

B.Sc., PHYSICS

Mechanics

(For those who joined in July 2024 onwards)

Time : 3Hours **Maximum : 75 Marks**

PART – A (10 × 1 = 10 Marks)

Answer ALL Questions

Choose the correct answer :

CO:1 K:1 1. Which of the following statements about friction is true?

(a) Friction can be reduced to zero

(b) Frictional force can accelerate a body

(c) Frictional force is proportional to the area of contact between the two surfaces

(d) Kinetic friction is always greater than rolling friction

CO:1 K:1 2. The period of a satellite in a circular orbit near a planet is independent of

(a) The mass of the planet (b) The radius of the planet

(c) The mass of the satellite (d) All of these

CO:2 K:4 3. The kinetic energy of a body becomes four times its initial value. The new linear momentum will be

(a) Same as the initial value (b) Twice of the initial value

(c) Four times of the initial value (d) Eight times of the initial value

CO:2 K:3 4. The centre of mass of a body

(a) Lies always outside the body (b) May lie within, outside or on the surface of body

(c) Lies always inside the body (d) Lies always on the surface of the body

CO:3 5. The moment of inertia of a body depends upon:

K:2

(a) The linear velocity of the body
(b) The angular velocity of the body
(c) The distribution of mass in the body
(d) Angular acceleration of the body

CO:3 6. The rotational kinetic energy and translation kinetic energy of a rolling body are same, the body is:

K:5

(a) Disc
(b) Sphere
(c) Cylinder
(d) Ring

CO:4 7. Work is always done on a body when:

K:5

(a) A force acts on it
(b) It moves through a certain distance
(c) It experiences an increase in energy through a mechanical influence
(d) None of the above

CO:4 8. If a force F is applied on a body and it moves with a velocity v, the power will be:

K:4

(a) F v
(b) F/v
(c) F/v^2
(d) $F v^2$

CO:5 9. A rigid body moving freely in space has degrees of freedom

K:2

(a) 3
(b) 4
(c) 6
(d) 9

CO:5 10. If a generalized coordinate has the dimensions of velocity, generalized velocity has the dimensions of

K:2

(a) Displacement
(b) Velocity
(c) Acceleration
(d) Force

PART – B (5 X 5 = 25 Marks)

Answer ALL Questions choosing either (a) or (b).
Answer should not exceed 250 words.

CO:1 11. (a) State and explain Newton's laws of equations of motion.

K:2

(OR)

(b) Define escape velocity. Derive an expression for it.

CO:2 12. (a) What is centre of mass? Show that in absence of external forces, the velocity of centre of mass remains constant.

K:3

(OR)

(b) Obtain an expression for the torque due to internal forces.

CO:3 K:4 13. (a) Deduce the conservation theorem of energy using Newton's laws of motion.

(OR)

(b) State and prove work-energy theorem.

CO:4 K:4 14. (a) Distinguish between the translational and rotational motion of a rigid body.

(OR)

(b) Calculate the total kinetic energy of a circular disc rolling down in an inclined plane.

CO:5 K:4 15. (a) What are constraints? Classify the constraints with some examples.

(OR)

(b) State and prove D'Alembert's principle.

PART – C (5 X 8 = 40 Marks)

Answer ALL Questions choosing either (a) or (b).

Answer should not exceed 500 words.

CO:1 K:4 16. (a) Derive an expression for the motion of a particle in a uniform gravitational field.

(OR)

(b) State and explain Newton's universal law of gravitation. Define Gravitational potential. Give an expression for it.

CO:2 K:6 17. (a) Using Newton's laws of motion, deduce the conservation theorems of linear momentum and angular momentum.

(OR)

(b) Find an expression for the velocity of a particle moving away with velocity v_1 and mass m_1 after an elastic collision with mass m_2 and at rest. Discuss the various cases.

CO:3 K:3 18. (a) What are conservative forces? Show that for a conservative force curl F = 0. Further show that in a conservative force field, the sum of kinetic and potential energies of a particle remains constant.

(OR)

(b) Define potential energy. State and explain the conservation law of energy in gravitational field.

CO:4 K:3 19. (a) State and prove the theorem of perpendicular axis in moment of inertia.

(OR)

(b) Derive an expression for the kinetic energy of a rigid body rotating about a fixed axis. Give examples.

CO:5 K:5 20. (a) Derive Lagrange's equation of motion from D'Alembert's principle.

(OR)

(b) Obtain the equation of motion of a simple pendulum by using Lagrangian method and hence deduce the formula for its time period for small amplitude oscillations.