D 51474 (Pages : 3) Name.....

Reg. No.....

THIRD SEMESTER B.Sc. DEGREE EXAMINATION, NOVEMBER 2013

(UG–CCSS)

Core Course—Physics/Applied Physics

PH 3B 05/AP 3B 05—MECHANICS

(Common for Physics and Applied Physics)

Time : Three Hours Maximum : 30 Weightage

I. Objective Type Questions. Answer *all* twelve questions :

1 For two inertial frames connected by Galilean transformations, which among the following physical quantity is observed to be the same ?

(a) Co-ordinate. (b) Velocity.

(c) Momentum. (d) Acceleration.

2 The only fictitious force acting on a particle at rest in a rotating frame is :

(a) Centrifugal force. (b) Coriolis force.

(c) Gravitational force. (d) Electromagnetic force.

3 For a conservative system, which among the following quantity is conserved ?

(a) Kinetic energy.

(b) Potential energy.

(c) Sum of kinetic and potential energy.

(d) Difference of kinetic and Potential energy.

4 Identify the non-conservative force :

(a) Elastic force. (b) Frictional force.

(c) Gravitational force. (d) Electrostatic force.

5 The moment of linear momentum is :

(a) Force. (b) Torque.

(c) Angular momentum. (d) Energy.

6 The planar motion in planetary system is a result of the law of conservation of :

(a) Linear momentum. (b) Kinetic energy.

(c) Potential energy. (d) Angular momentum.

7 When two masses move apart, the gravitational potential energy :

(a) Decreases. (b) Increases.

(c) May increase or decrease. (d) Will not change.

8 The period of a satellite in a circular orbit of radius R is T. The period of another satellite in a circular orbit of radius 4R is :

(a) 4T. (b) 8T.

(c) 16T. (d) 32T.

9 According to the principle of virtual work, the work done by the applied forces ——— for a system in equilibrium.

(a) Remains constant. (b) Is infinity.

(c) Vanishes. (d) Is high.

10 The momentum conjugate to a cyclic co-ordinate is :

(a) Zero. (b) Infinity.

(c) Conserved. (d) None of these.

11 Michelson-Morley experiment confirmed that :

(a) There is an absolute frame. (b) There is no absolute frame.

(c) Velocity of light is relative. (d) Velocity of light is zero.

12 What is the speed of a particle of zero rest mass ?

(a) Zero. (b) Infinity.

(c) c. (d) None of these.

(12 × ¼ = 3 weightage)

II. Short Answer Type Questions. Answer *all* nine questions. Each question carries a weight of 1 :

13 Define Newton's second law. Show that when there is no applied force on a body, its velocity is conserved.

14 Discuss the effects of Coriolis force as a result of earth's motion.

15 What is the relation between Force and Potential energy for a conservative system ?

16 Write down an expression for the position vector of the center of mass of a system of two particles m_1 and m_2 having position vectors r_1 and r_2.

17 What do you mean by an inverse square law force ? Give example.

18 What is D'Alembert's principle ?

19 What are the postulates of the special theory of relativity ?

20 What do you mean by space time ?

21 Write down the relation between Lagrangian and Hamiltonian.

(9 × 1 = 9 weightage)

III. Short Essay Type Questions. Answer any *five* questions. Each question carries a weight of 2 :

22 Determine the time in which the plane of oscillation of a Foucault's pendulum makes a complete revolution if the pendulum is located at the equator.

23 Show that the force given by $F = \left(2xy + z^2\right)\hat{i} + x^2\hat{j} + 2xz\hat{k}$ is conservative.

24 Three particles of masses 100, 200 and 400 grams have a velocity of 20 m/s magnitude along positive X, Y, Z axis having unit vectors $\hat{i}$, $\hat{j}$, $\hat{k}$ respectively. Estimate the velocity of the first particle, if due to the force of attraction, the third particle stops and the velocity of the second particle becomes $\left(10\hat{j} + 5\hat{k}\right)$.

25 Estimate the potential energy of a mass of 1 kg. on the surface of earth assuming that the potential energy is zero at infinity. Given, the radius of earth = 6.4×10^6 m., mass of earth = 6×10^{24} kg.

26 Estimate the number of degrees of freedom of a system of three particles connected in the form of a triangle in a three dimensional space.

27 Obtain the Lagrange's equation for a one-dimensional harmonic oscillator.

28 An electron and a positron practically at rest come together and annihilates. Estimate the energy releases.

(5 × 2 = 10 weightage)

IV. Essay Questions. Answer any *two* questions. Each question carries a weight of 4 :

29 Discuss (a) work-energy theorem and energy function ; (b) stable and unstable equilibria using potential energy curve ; and (c) energy conservation in non-conservative systems.

30 What do you mean by a central force ? Give examples. Show that the angular momentum about the origin is conserved when a particle moves in a central force. Obtain an expression for the escape velocity of a body from the surface of earth.

31 Write down the Lorentz transformation equations for co-ordinates and time for two inertial frames. Discuss length contraction, time dilation and relativity of simultaneity based on the Lorentz transformations.

(2 × 4 = 8 weightage)