(7 pages) **Reg. No. :** ....

Code No. : 9074 **Sub. Code : PPHM 11**

M.Sc. (CBCS) DEGREE EXAMINATION, NOVEMBER 2017.

First Semester

Physics

CLASSICAL MECHANICS

(For those who joined in July 2017 onwards)

Time : Three hours Maximum : 75 marks

PART A — ($10 \times 1 = 10$ marks)

Answer ALL questions.

Choose the correct answer :

1. For a conservative system, generalized force has the dimension of

(a) force (b) energy

(c) torque (d) pressure

2. A particle of mass 'm' has momentum p, its kinetic energy will be

(a) mp (b) p^2/m

(c) $p^2/2m$ (d) p^2m

3. The trajectory of a projectile in a

(a) straight line (b) circle

(c) parabola (d) ellipse

4. The differential equation of the orbit of the particle in

(a) $M\ddot{r} - Mr\dot{\theta}^2 = -kr\cos\theta$

(b) $y = mx + c$

(c) $y = a\cos wt$

(d) $M\ddot{r} - Mr\dot{\theta}^2 = 0$

5. The rank of moment of inertia tensor is

(a) three (b) four

(c) one (d) two

6. Constraint in a rigid body is

(a) holonomic (b) non holonomic

(c) scleronomic (d) rheonomic

7. The action and angle variables have the dimensions of angle and

(a) force

(b) energy

(c) angular momentum

(d) mass

8. For one dimensional harmonic oscillator, the representative point in two dimensional phase space traces

(a) an ellipse (b) parabola

(c) hyperpola (d) straight line

9. The normal frequencies of double pendulum system is

(a) $w^2 = \frac{g}{l}\left(2 \pm \sqrt{2}\right)$

(b) $w^2 = \frac{l}{g}\left(2 + \sqrt{2}\right)$

(c) $\frac{1}{2\pi}\sqrt{\frac{l}{g}}$

(d) none

10. An example of unstable equilibrium is

(a) pendulum at rest

(b) a rod standing on its one end

(c) book placed flat on a table

(d) a suspension galvanometer at its zero position

PART B — (5 × 5 = 25 marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 250 words.

11. (a) Prove the laws of conservation of linear momentum and angular momentum for a system of interacting particles.

Or

(b) State and explain the principle of virtual work.

12. (a) Show that the number of particles scattered in the elementary solid angle is inversely proportional to the fourth power of the sine of deflecting half-angle.

Or

(b) Obtain the equations of motion and first integrals for central force problem.

13. (a) Explain how the independent coordinates of a rigid body can be choosen.

Or

(b) Show that the kinetic energy of a rigid body can be expressed as $T = \frac{1}{2} L\bar{W}$.

14. (a) For what values of m and n do the transformation equations

$Q = q^m \cos np$

$P = q^m \sin np$

Present a canonical transformation.

Or

(b) Discuss the harmonic oscillator problem as on example of Hamilton Jacobi method.

15. (a) Obtain the normal frequencies and normal modes of a double pendulum.

Or

(b) Discuss the properties of T, V and W.

PART C — (5 × 8 = 40 marks)

Answer ALL questions, choosing either (a) or (b).

Each answer should not exceed 600 words.

16. (a) Explain Hamilton's principle. Derive Lagrangian equation from it.

Or

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

17. (a) Use Hamilton's equations to find the differential equation for planetary motion and prove that it areal velocity in constant. Assume force $f(r) = -k / r^2$.

Or

(b) Discuss scattering in a central force field. Obtain Rutherford scattering cross-section for the scattering of α-particles by an atomic molecules.

18. (a) Define Euler's angles and derive the Euler's equation of motion in terms of Euler's angle.

Or

(b) Discuss the following

(i) Coriolis effect

(ii) Inertia tensor and principle moments of inertia.

19. (a) Discuss the harmonic oscillator problem using Hamilton Jacobi method.

Or

(b) Obtain Hamilton's equation from variational principle.

20. (a) Discuss the free vibrations of a linear triatomic molecules and get the eigen vectors general solutions.

Or

(b) Discuss and derive the eigen value equation and the principle of transformation for small oscillations.
