Reg. No ..... Name ..... **18P118**

**M.Sc DEGREE END SEMESTER EXAMINATION - NOVEMBER 2018**

**SEMESTER 1 : PHYSICS**

COURSE : **16P1PHYT02 : CLASSICAL MECHANICS**

***(For Regular - 2018 Admission & Supplementary - 2016 / 2017 Admissions)***

Time : Three Hours Max. Marks: 75

## Section A
**Answer all the following (1 mark each)**

1. The Lagrangian for a non -conservative system is
   (a) $T - q(\phi + v.A)$ (b) $T + q(\phi - v.A)$ (c) $T - q(\phi - v.A)$ (d) $T + \dot{q}(\phi + v.A)$
2. Which of the following equation does not represent Hamilton's principle for a conservative system
   (a) $\delta \int pdq = 0$ (b) $\delta \int Tdt = 0$ (c) $\delta H > 0$ (d) $\delta S = 0$
3. Choose the correct statement
   (a) The generating function $F = \sum_j q_j P_j$ cannot generate the identity transformation
   (b) The generating function $F = \sum_j q_j P_j$ generates the identity transformation
   (c) The generating function $F = -\sum_j q_j P_j$ generates the identity transformation
   (d) The generating function $F = \sum_j q_j P_j$ generates the identity transformation $q_j = -Q_j$ and $P_j = -p_j$.
4. Which among the following are the first integrals in central force problem?
   (a) acceleration (b) angular momentum (c) force (d) total energy
5. Einstien's field equation can be obtained as an approximation of Newton's law is
   (a) True always (b) False always (c) True in strong fields (d) True in weak fields

**(1 x 5 = 5)**

## Section B
**Answer any 7 (2 marks each)**

6. Differentiate between conservative and dissipative systems.
7. Explain the physical significance of dissipation function.
8. Explain the physical significance of Euler-Lagrange's equations.
9. For small displacements, the condition for stable equilibrium is that the potential energy is minimum at the equilibrium configuration. Substantiate.
10. How action-angle variables can be used to obtain the frequency of periodic motion?

11. Explain an orthogonal transformation.
12. Show that the Coriolis force owes its existence to the motion of a particle with respect to a rotating frame of reference.
13. Show that infinitesimal rotations commute.
14. Explain graphically the period doubling bifurcation in logistic map.
15. What is "butterfly effect" in chaos?

**(2 x 7 = 14)**

## Section C
## Answer any 4 (5 marks each)

16. Setup Hamilton's equations of motion for a projectile in space. Neglect the effects of earth's rotation.
17. Show that the transformations $q = \sqrt{2P}\sin Q$ and $p = \sqrt{2P}\cos Q$ is canonical. Obtain the generator of the transformation.
18. Show that the function $S = \int L dt$, satisfies the Hamilton-Jacobi equation.
19. Discuss virial theorem.
20. Using suitable figures, explain the three cases of nutation.
21. Derive Einstein's field equation.

**(5 x 4 = 20)**

## Section D
## Answer any 3 (12 marks each)

22.1. Discuss with theory
(a) Homogeneity of space and conservation of linear momentum
(b) Isotropy of space and conservation of angular momentum
(c) Homogentity of time and conservation of Hamiltonian.

**OR**

2. Deduce Hamilton's principle from D'Alembert's principle. Derive Lagrange's equation from it.

23.1. Disscuss the use of action and angle variables in the solution of problems in periodic motions.

**OR**

2. What are Euler angles? Derive an expression for the complete transformation matrix in terms of Euler angles.

24.1. Explain the rate of change of a vector and derive an expression for the Coriolis force.

**OR**

2. Discuss the phase plane analysis of a dynamical system. Discuss the phase curves of a simple Harmonic oscillator and draw its phase portrait.

**(12 x 3 = 36)**