PG (CBCS) ODD SEMESTER EXAMINATION, 2021
Held in July 2022

PHYSICS
1st Semester

Course No. : PHYCC - 101
(Classical Mechanics)

Full Marks : 70
Pass Marks : 28

Time : 3 hours

The figures in the margin indicate full marks for the questions

(Answer five questions, taking one question from each unit)

UNIT - I

1. a) What are constraints and their different types? Show how a set of generalized co-ordinates can be obtained from the equation of constraints.

   b) What is d'Alembert's principle of virtual work? Hence obtain Euler-Lagrangian Equation based on d'Alembert's principle. 4+10=14

2. a) What is velocity-dependent potential? Show that it exists for electromagnetic force. Obtain the corresponding expression for Lagrangian and E-L equation for electromagnetic force.

b) Two bodies are under the action of their mutual gravity in an otherwise force-free field. Derive the expression for Lagragian and show that the angular momentum is conserved. 7+7=14

UNIT - II

3. a) State Hamilton's variational principle. Use this principle to derive EL equation of motion.

b) Apply Hamilton's variational principle to derive the equation of motion for a particle which will take shortest time, while falling from a point (x_1, y_1) to (x_2, y_2) under gravity. 2+6+6=14

4. What is Legendre's Transformation? Obtain its mathematical equation. Hence use this transformation to obtain the expression for Hamiltonian from Lagrangian for a set of canonical variables. Also deduce Hamilton's canonical equation of motion. 5+5+4=14

UNIT - III

5. Deduce a procedure, so that we can obtain a Hamiltonian K which is independent of the co-ordinate Q, from the old Hamiltonian H (q, p)
What are the generating functions involved, for carrying out the above procedures? Hence obtain the relation between any two pairs of generating functions.
7+2+5=14

6. What are Poisson's brackets? Obtain the Jacobi's identiy for the Poisson's bracket. If u is a constant of motion, then show $[H, u] = \frac{\partial u}{\partial t}$
show that Poisson Bracket's are invariant under canonical transformation. 3+3+8=14

UNIT - IV

7. State and obtain Hamilton-Jacobi equation. What are principle function and characteristic function? Obtain the equation of motion for a one-dimensional oscillator using Hamilton-Jacobi formulation. 1+6+7=14

8. What are rotation and vibration? Define 'Action' and 'Angle' variables for a periodic system. Hence show $\Delta\omega = 1$ 2+8+4=14

UNIT - V

9. What are Euler Angles? Show that the matrices corresponding to the rotation of a rigid body by three Euler Angles are non-commutative. Obtain the expression for a rotated vector for finite rotation of a rigid body. 3+5+6=14

10. Derive the Lagrangian and then the corresponding E-L equation for an one dimensional chain of n-small oscillators.
What are normal co-ordinates? Derive the frequencies for free vibration for above cases. 5+2+7=14