Exam.Code:0472
Sub. Code: 3703

2012
M.Sc. (Physics)
First Semester
PHY-8012: Classical Mechanics

Time allowed: 3 Hours Max. Marks: 80

***NOTE**: Attempt five questions in all, including Question No. 9 (Unit-V) which is compulsory and selecting one question each from Unit I - IV.*

x-x-x

Unit-I

1.(a). Define D'Alemberts principle. Hence obtain the Lagrange's equation of motion using D'Alembert's principle for holonomic system.

(b) Prove that if transformation equations are not explicit function of time then the kinetic energy is homogeneous quadratic function of generalized velocities. (10,6)

2.(a) What are velocity dependent forces? Taking the example of electromagnetic forces, show how the lagrangian and equation of motion get modified in the presence of such forces.

(b) Prove that if function $f(y, y', x)$ does not depend on x explicitly, then

$$f - y' \frac{\partial f}{\partial y'} = constant.$$ (10,6)

Unit -II

3.(a) What are Euler angles? Represent a general rotation matrix as a product of three simple rotation matrices in terms of Euler angles.

(b) What are orthogonal transformations ? For infinitesimal rotations the transformation matrix is written as $A=1+\varepsilon$. Show that orthogonality of A implies that ε is antisymmetric. (10,6)

4.(a) Describe in detail the motion of heavy symmetrical top in a uniform gravitational field with one point fixed.

(b) What is coriolis effect? Deduce the expression for deviation of a falling body from the vertical . (10,6)

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Unit III

5.(a) What are cyclic co-ordinates? Show that if a given co-ordinate is cyclic in lagrangian ,it will also be cyclic in Hamiltonian?

(b) Find the frequency and normal coordinates of vibration of a linear triatomic molecule considering small displacement from the mean position. (4,12)

6.(a) What do you mean by stable and unstable equilibrium? Explain with examples.

(b) State and prove principle of least action. What is the Jacobi's form of principle of least action ?

(c) What is the difference between Δ-variation and δ-variation? (4,8,4)

Unit IV

7. (a) A canonical transformation relates the old co-ordinates (q,p) to the new ones(Q,P) by the relation $Q=q^2$, $P=2q$. Find the generating function for the transformation.

(b) Prove that Poisson bracket of two constants of motion is itself a constant of motion even the constraints depend on time explicitly.

(c) Discuss the difference between Hamilton priciple function (S) and Hamilton characteristic Function (W). (6,6,4)

8.(a) Find the value of Poisson Bracket$[|r|, |p|]$.

(b) Discuss the harmonic oscillator problem in two sets of canonical coordinate system. (4,12)

Unit V

9.(a) No cyclones are set up at equator. Why? (3)

(b) Discuss with example different types of constraint of motion. (3)

(c) What is the significance of energy function 'h'. (3)

(d) Define configuration space and phase space. (3)

(e) Show that symplectic condition $MJ\tilde{M} = J$ also holds good for ICT. (4)

x-x-x