LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION – **PHYSICS**

FIRST SEMESTER – **NOVEMBER 2023**

PPH1MC01 – CLASSICAL MECHANICS

Date: 31-10-2023 Dept. No. Max. : 100 Marks
Time: 01:00 PM - 04:00 PM

	SECTION A – K1 (CO1)
	Answer ALL the questions (5 x 1 = 5)
1.	**Answer the following.**
a)	Find the nature of force, conservative (or) non conservative given by $\mathbf{F}=x^2yz\mathbf{i}-xyz^2\mathbf{k}$.
b)	In Rutherford's experiment 10^5 α particles are scattered at an angle of 2^O. Calculate the number of α particles scattered at an angle of 20^O.
c)	Define "Phase space".
d)	Apply variational principle to find the equation of motion for 1D Harmonic oscillator.
e)	Write down the condition for canonical transformation to be exact differential.
	SECTION A – K2 (CO1)
	Answer ALL the questions (5 x 1 = 5)
2.	**Answer the following.**
a)	Briefly discuss whether the constraint is holonomic (or) non holonomic. a. A particle moving on an ellipsoid under the influence of gravity. b. A pendulum with variable length
b)	What are the body and space coordinates in relation to the motion of a rigid body.?
c)	Prove that $\sum_{k=1}^{n}[p_k,q_i][p_k,p_j]+\sum_{k=1}^{n}[q_k,q_i][q_k,p_j]=0$
d)	A coin left free to fall on the ground from a moving train with constant velocity. Explain the path as seen by an observer on the ground and on the train.
e)	When is the Hamilton -Jacobi theory more useful ?
	SECTION B – K3 (CO2)
	Answer any THREE of the following in 300 words (3 x 10 = 30)
3.	Find the Lagrange's equation of motion for an electrical circuit comprising an inductance L and capacitance C. The capacitor is charged to q coulomb and current flowing in the circuit is I ampere.
4.	Show that in absence of the external torque the total angular momentum of a system of particles is conserved.
5.	Describe the Hamiltonian and Hamilton's equations for an ideal spring-mass arrangement
6.	Given I_1,I_2,I_3 be the principal moments of Inertia .Prove that $I_1\leq I_2+I_3$; $I_2\leq I_3+I_1$; $I_3\leq I_1+I_2$'under what conditions do they (or)all of the equality signs hold?
7.	List the Characteristics of motion under a central force**.**
	SECTION C – K4 (CO3)
	Answer any TWO of the following in 500 words (2 x 12.5 = 25)
8.	Calculate the inertia tensor for the system of four point masses 1, 2, 4 and 5 gms located at the points (1 0 0) (1 1 0)(1 2 1) and (2 1 -1) c.m.
9.	If a rigid body is rotating about an axis through origin, deduce the relations connecting the components of total angular momentum with the components of the angular velocity

10.	Given [Φ,ψ] as the poisson bracket ,prove that $\partial/\partial t\,[\Phi,\psi]=[\partial\Phi/\partial t,\psi]+[\Phi,\partial\psi/\partial t]$.
11.	State and prove Jacobi's identity for the dynamical variables X,Y and Z.
	SECTION D – K5 (CO4)
	Answer any ONE of the following in 750 words **(1 x 15 = 15)**
12.	Obtain Euler's equations of motion for a rotating rigid body.
13.	Using Possion brackets relation, prove that $[J_x, J_y]=J_z$.
	SECTION E – K6 (CO5)
	Answer any ONE of the following in 1000 words **(1 x 20 = 20)**
14.	Discuss the problem of scattering of charged particles by a coulomb field and obtain Rutherford's formula for the differential cross section
15.	Establish the Lagrangian and deduce the Lagrange's equation of motion and derive secular equation for small oscillations of the system in the neighborhood of stable equilibrium.
