LOYOLA COLLEGE (AUTONOMOUS) CHENNAI – 600 034

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

FIRST SEMESTER – **NOVEMBER 2024**

PPH1MC01 – CLASSICAL MECHANICS

Date: 08-11-2024 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)	Write the Hamiltonian of a simple pendulum.	
b)	Show that the curl of a conservative force is zero.	
c)	Give an example for central force.	
d)	If the torque acting on a system of particles is zero, what is conserved?	
e)	What is the relation between Lagrange and Poison brackets?	
	SECTION A – K2 (CO1)	
	Answer ALL the questions	**(5 x 1 = 5)**
2	**Answer the following**	
a)	Find whether the constraint is holonomic (or) non-holonomic and give a reason, for a bead moving on a circular wire.	
b)	What is the physical significance of the Hamiltonian function?	
c)	Give a reason why Canonical transformations are considered to be useful.	
d)	Calculate the reduced mass of the HCl molecule.	
e)	A light body and a heavy body have the same kinetic energy; which one will have the greater momentum?	
	SECTION B – K3 (CO2)	
	Answer any THREE of the following	**(3 x 10 = 30)**
3	A point mass moves in a vertical plane along a given path in a gravitational field. The equation of motion in parametric form is x = x (s), z = z (s). Write down the Lagrange‘s equations.	
4	Obtain the Hamiltonian and equation of motion for a projectile near Earth's surface.	
5	Prove Jacobi’s Identity: for any three functions F, G, and K of p_k and q_k, the following relation holds true: [F, [G, K]] + [G, [K, F]] + [K, [F, G]] = 0.	
6	Neatly draw and explain Euler’s angle and transformation matrix.	
7	Calculate the inertia tensor for the system of four point masses (1 gm, 2 gm, 3 gm, and 4 gm) located at the points (1 0 0), (1 1 0), (1 0 1), and (2 0 -1) cm.	

	SECTION C – K4 (CO3)
	Answer any TWO of the following **(2 x 12.5 = 25)**
8	Use Lagrange‘s equations to find the equation of a compound pendulum in a vertical lane about a fixed horizontal axis. Hence, determine the period of small amplitude oscillations of the compound pendulum.
9	What are constraints? Classify the constraints with a few examples.
10	Describe the Hamiltonian and Hamilton’s equations for an ideal spring mass arrangement.
11	Use Hamilton’s equation to find the differential equation for planetary motion and prove that the areal velocity is constant.
	SECTION D – K5 (CO4)
	Answer any ONE of the following **(1 x 15 = 15)**
12	Derive Lagrange‘s equations of motion for conservative systems. How will the result be modified for the non-conservative system?
13	Find the relation between the angular momentum vector, the inertia tensor, and the angular velocity vector.
	SECTION E – K6 (CO5)
	Answer any ONE of the following **(1 x 20 = 20)**
14	Discuss the vibrations of a linear triatomic molecule.
15	Discuss the problem of scattering of charged particles by a Coulomb field and obtain Rutherford’s formula for the differential cross section.

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