LOYOLA COLLEGE (AUTONOMOUS) CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION – **MATHEMATICS**

FOURTH SEMESTER – **NOVEMBER 2024**

PMT4MC03 – CLASSICAL MECHANICS

Date: 16-11-2024 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)	State principle of virtual work.	
b)	Define rigid body.	
c)	When a coordinate is said to be cyclic?	
d)	Define Poisson Bracket.	
e)	What are the two types of periodic function in a dynamical system?	
	SECTION A – K2 (CO1)	
	Answer ALL the questions	**(5 x 1 = 5)**
2	**MCQ**	
a)	The work of the external force fields on a particle is (i) $W=\int F.dr$ (ii) $W=\int F\times dr$ (iii) $W=F\times dr$ (iv) $W=F.dr$	
b)	In Eulerian angles, the angle φ is called (i) precession angle (ii) nutation angle (iii) body angle (iv) space angle	
c)	If the system is conservative and the coordinate transformation is independent of time then the Hamiltonian equals _____ of the system. (i) potential energy (ii) kinetic energy (iii) total energy (iv) Lagrangian	
d)	The transformed equation for ICT in terms of Poisson bracket is (i) $\delta u=\varepsilon[u,G]$ (ii) $\delta u=0$ (iii) $\delta u=constant$ (iv) $\delta u=[u,G]$	
e)	The Hamilton - Jacobi equation is formulated in which the motion of a particle can be represented as a (i) wave (ii) straight line (iii) oscillation (iv) rotation	
	SECTION B – K3 (CO2)	
	Answer any THREE of the following	**(3 x 10 = 30)**
3	State D'Alembert's principle and hence deduce Hamilton's principle from it.	

4	Derive an expression for the angular momentum of a rigid body.

5	State and prove the conservation theorem for linear momentum.
6	Show that Poisson bracket is invariant under canonical transformation.
7	Determine the action-angle variable for simple harmonic oscillator.
	SECTION C – K4 (CO3)
	Answer any TWO of the following **(2 x 12.5 = 25)**
8	Derive the equation of motion for a simple pendulum and motion of a particle in cartesian coordinates.
9	Determine the moments and product of inertia of a uniform rectangular parallelopiped with respect to its edges of length a, b, c.
10	State Hamilton's principle and hence develop Hamilton's canonical equations from it.
11	Defend Liouville's theorem with a suitable proof.
	SECTION D – K5 (CO4)
	Answer any ONE of the following **(1 x 15 = 15)**
12	Defend the principle of least action with an appropriate proof.
13	State and prove Euler's theorem for a rigid body.
	SECTION E – K6 (CO5)
	Answer any ONE of the following **(1 x 20 = 20)**
14	(a) Derive the Lagrange's equation of motion for a holonomic system and hence deduce it for the conservative system. (15 marks) (b) Explain Legendre transformation briefly. (5 marks)
15	(a) Determine the solution for simple harmonic oscillator problem by Hamilton Jacobi method. (10 marks) (b) Analyze the Angular momentum - Poisson bracket relation with a suitable proof. (10 marks)

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