

**LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034****M.Sc. DEGREE EXAMINATION – PHYSICS****FIRST SEMESTER – APRIL 2023****PPH1MC01 – CLASSICAL MECHANICS**

Date: 29-04-2023

Dept. No. 

Max. : 100 Marks

Time: 09:00 AM - 12:00 NOON

**SECTION A****Answer ALL the questions**

<b>1</b>	<b>Answer the following</b>	<b>(5 x 1 = 5)</b>	
a)	When a horse pulls a cart, which is the force that helps the horse to move forward?	K1	CO1
b)	Define configuration space.	K1	CO1
c)	What are generalised co-ordinates?	K1	CO1
d)	Write down Hamilton- Jacobi equation.	K1	CO1
e)	If a lighter object and a heavier object have the same kinetic energy, which one will have the greater momentum?	K1	CO1
<b>2</b>	<b>Answer the following</b>	<b>(5 x 1 = 5)</b>	
a)	Check whether the force $\mathbf{F} = x^2 yz \mathbf{i} - xyz^2 \mathbf{k}$ is conservative or non-conservative.	K2	CO1
b)	What is Inertia tensor?	K2	CO1
c)	Show that the work done by force of constraint in a rigid body is zero.	K2	CO1
d)	With examples, classify constraints.	K2	CO1
e)	State the conservation theorem for angular momentum for a system of N-particles.	K2	CO1

**SECTION B**

	<b>Answer any THREE of the following in 500 words</b>	<b>(3 x 10 = 30)</b>	
3	State D'Alembert's principle. What is its importance?	K3	CO3
4	Explain the terms :Normal frequencies, Normal modes of vibrations and Normal co - ordinates of a coupled system.	K3	CO3
5	Prove that $[F+K, G] = [F, G] + [K, G]$ .	K3	CO3
6	The moment of inertia is the rotational analogue of mass of a body, Explain.	K3	CO3
7	Using Hamilton's canonical equations, derive the equation of motion of a particle moving in a force field in which the potential is given by $V = -k/r$ , where $k$ is positive.	K3	CO3

**SECTION C**

	<b>Answer any TWO of the following in 500 words</b>	<b>(2 x 12.5 = 25)</b>	
8	The Lagrangian of a system in terms of generalised co-ordinates $x$ and $y$ is given by $L = \dot{x}\dot{y} - xy$ . Find Lagrangian equations of motion.	K4	CO3
9	Discuss the problem of scattering of a charged particle by a coulomb field and obtain Rutherford formula for scattering cross section.	K4	CO3
10	Describe any two applications of Legendre transformation in mechanics.	K4	CO3
11	Discuss in detail the vibrations of a linear triatomic molecule.	K4	CO3

**SECTION D****Answer any ONE of the following in 1000 words****(1 x 15 = 15)**

12	Show that the K.E. of a rotating rigid body in a co-ordinate system of principal axes is given by $T = 1/2 (I_1\omega_1^2 + I_2\omega_2^2 + I_3\omega_3^2)$	K5	CO4
13	When is Hamilton -Jacobi theory useful? Discuss the harmonic oscillator problem using Hamilton-Jacobi method.	K5	CO4

**SECTION E****Answer any ONE of the following in 1000 words****(1×20=20)**

14	What is Hamilton's principle? Derive Lagrange's equation from Hamilton's principle for a conservative system. Derive equation of motion for a particle moving under a central force.	K6	CO5
15	Consider the case of two coupled pendulums. Determine a. T and V matrices. b. The normal frequencies. c. The normal co-ordinates. d. The equation of motion. e. The eigen-vectors. f. The general solution.	K6	CO5

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