



# LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

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

**FIRST SEMESTER – NOVEMBER 2022**

**PPH1MC01 – CLASSICAL MECHANICS**

Date: 23-11-2022

Dept. No.

Max. : 100 Marks

Time: 01:00 PM - 04:00 PM

## SECTION - A

**Answer ALL the Questions**

<b>1 Answer the following</b>		<b>(5 x 1 = 5)</b>	
a)	A body is kept moving with uniform speed on a circle of radius $r$ by a centripetal force $F$ acting on it. How much work is done in one rotation?	K1	CO1
b)	Define phase space.	K1	CO1
c)	What are generalised co-ordinates?	K1	CO1
d)	Write down Hamilton's characteristic function.	K1	CO1
e)	A uniform string having a mass is suspended from ceiling with a load at the lower end. Will the tension in the string be uniform? Where will the tension be maximum?	K1	CO1
<b>2 Answer the following</b>		<b>(5 x 1 = 5)</b>	
a)	Is the force $\mathbf{F} = (2xy + yz^2)\mathbf{i} + (x^2 + xz^2)\mathbf{j} + 2xyz\mathbf{k}$ conservative (or) non conservative.	K2	CO1
b)	Give an example of cyclic co-ordinate.	K2	CO1
c)	What is the dimension of the product of generalised co-ordinate and its conjugate momentum?	K2	CO1
d)	Determine the number of degrees of freedom of a particle moving on a space curve.	K2	CO1
e)	State conservation theorem for linear momentum for an N-particles system.	K2	CO1

## SECTION - B

<b>Answer any THREE of the following in 500 words</b>		<b>(3 x 10 = 30)</b>	
3	Write the Hamiltonian of a simple pendulum and obtain its equation of motion.	K3	CO2
4	Derive Lagrange's equation from Hamilton's principle.	K3	CO2
5	Calculate the inertia tensor for a system of four point masses 1 g, 2 g, 4 g and 5 g located at the points (1 0 0), (1 1 0), (1 2 1), (2 1 -1) cm.	K3	CO2
6	Show that in the absence of the external torque the total angular momentum of a system of particles is conserved.	K3	CO2
7	Prove that $[J_x, J_y] = J_z$ .	K3	CO2

**SECTION - C****Answer any TWO of the following in 500 words****(2 x 12.5 = 25)**

8	Deduce the Lagrange's equation of motion for an L-C circuit comprising of an inductance L and capacitance C; consider that the capacitor is charged to q coulomb and current flowing in the circuit is I ampere.	K4	CO3
9	A particle describes a conic $r=p/(1+e \cos \theta)$ where p and e are constants. Show that the force under which the particle is moving in a central force. Deduce the force law.	K4	CO3
10	Deduce the eigen-value equation for coupled oscillators. How will you obtain the eigen-values ( $\omega^2$ ) and eigen-vectors from this equation?	K4	CO3
11	Classify the various types of constraints with examples.	K4	CO3

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

12	Obtain the Lagrangian, Hamiltonian and equation of motion for a projectile near the surface of the earth.	K5	CO4
13	Discuss in detail the torque free motion of a rigid body .	K5	CO4

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

14	Briefly discuss the motion for a particle under inverse square law of force and obtain the condition for a closed orbit.	K6	CO5
15	What are action angle variables? How do you determine the frequency of a harmonic oscillator.	K6	CO5

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