STELLA MARIS COLLEGE (AUTONOMOUS) CHENNAI – 600 086
(For candidates admitted from the academic year 2023 – 2024)

M.Sc. DEGREE EXAMINATION, APRIL 2024
BRANCH III PHYSICS
SECOND SEMESTER

COURSE : MAJOR CORE
PAPER : CLASSICAL MECHANICS
SUBJECT CODE: 23PH /PC/CM24
TIME : 3 HOURS MAX. MARKS: 100

Q. No.	SECTION-A (10x3 marks = 30 marks)	CO	KL
1.	What is generalized coordinates? Write transformation equations.	CO1	K1
2.	Brief the independent coordinates of a rigid body.	CO1	K1
3.	How does Hamiltonian differ from Lagrangian?	CO1	K1
4.	What is the essence of Hamilton-Jacobi method?	CO1	K1
5.	State conservation theorem for generalized momentum and angular momentum.	CO2	K2
6.	Write the Hamilton's canonical equations of motion.	CO2	K2
7.	What is Legendre's transformation?	CO2	K2
8.	Point out lemmas about the nature of the eigen values.	CO2	K2
9.	Obtain Euler's equation for the motion of a rigid body with one point fixed.	CO3	K3
10.	Write a short note on the mechanics of small oscillations?	CO3	K3
Q. No.	**SECTION-B (8 x 5 marks = 40 marks)**	**CO**	**KL**
	PART A **Answer any TWO questions (2 x 5 = 10 marks)**		
11.	Find the horizontal component of the Coriolis force acting on a body of mass 1.5 kg, moving northward with a horizontal velocity of 100 m/s at 30° N latitude on earth.	CO3	K3
12.	Show that the transformation, $Q = (2q)^{1/2} e^{\alpha} \cos p$; $P = (2q)^{1/2} e^{-\alpha} \sin p$ is canonical.	CO3	K3
13.	Find the principal axes and their associated moments of inertia for a cube of mass 'M' and sides 'a'	CO3	K3
	PART B **Answer any SIX questions (6 x 5 marks = 30 marks)**	**CO**	**KL**
14.	A particle is moving (consider radial motion only) in a central field of force. (i) What is the effective potential in which the radial motion occurs? (ii) Calculate the angular frequency for circular orbit, if the central potential is ½ (kr^2).	CO4	K4
15.	If 'T' be the kinetic energy, '**G**' be the external torque about the instantaneous axis of rotation and '**ω**' the angular velocity, then prove that the rate of change of kinetic energy is equal to **G**. **ω.**	CO4	K4
16.	Using variational principle, deduce Hamitonian equations of motion.	CO4	K4

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17.	Show that the Poisson bracket of two constants of motion is itself a constant of motion using Jacobi's identity.	CO4	K4
18.	Derive the Lagrange's equations of motion for small oscillations.	CO4	K4
19.	Based on the concept of D'Alembert's principle, Obtain Lagrange's equation of motion of second kind.	CO4	K4
20.	Use Jacobi's form of principle of least action to obtain the equation of orbit for the Kepler's problem.	CO4	K4
21.	Calculate the normal frequencies of a linear triatomic molecule	CO4	K4
Q. No.	**SECTION C** **Answer any TWO questions (2 x 15 marks = 30 marks)**	**CO**	**KL**
22.	A uniform disc of radius 'a' and mass 'm' rotates about a fixed axis. A massless rope is fixed to a point on the outside circumference and leads to massless spring which is in turn fastened to a fixed point. At a radius 'a/2' another cord is fastened to a spring which connects to a mass 'm'. Set up the Lagrange's equation of the disc and the mass.	CO5	K5
23.	Discuss and analytically solve the equations of motion for a symmetric free top.	CO5	K5
24.	Solve harmonic oscillator problem by the method of Hamilton-Jacobi method.	CO5	K5
25.	Show that triple pendulum is a degenerate system.	CO5	K5

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