

**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI  
(END SEMESTER EXAMINATION)**

**CLASS: I MSc / MSc  
BRANCH: PHYSICS**

**SEMESTER : VII / I  
SESSION : MO/2025**

**SUBJECT: PH403 CLASSICAL MECHANICS**

**TIME: 3 Hours**

**FULL MARKS: 50**

**INSTRUCTIONS:**

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
  2. Attempt all questions.
  3. The missing data, if any, may be assumed suitably.
  4. Before attempting the question paper, be sure that you have got the correct question paper.
  5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.
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		CO	BL
Q.1(a)	Define generalized coordinates, action, action principle and the Lagrange equation of motion?	[5] 1	2
Q.1(b)	Obtain the Lagrangian, Hamiltonian, and the equation(s) of motion for a mass M suspended from ceiling using a spring of spring constant k.	[5] 1	3
Q.2(a)	Write down Hamilton's equations (no derivation necessary). Obtain the Hamilton's equations for a two-dimensional harmonic oscillator.	[5] 2	3
Q.2(b)	Write down the generalized potential and the Hamiltonian for a charged particle in an electromagnetic field (no derivation necessary) and discuss its implications.	[5] 2	2
Q.3(a)	Prove that for any three functions F, G, and K of $q_k$ and $p_k$ , Jacobi's identity: $[F, [G, K]] + [G, [K, F]] + [K, [F, G]] = 0$ holds.	[5] 3	3
Q.3(b)	State and prove Jacobi-Poisson theorem.	[5] 3	3
Q.4(a)	Derive an expression for the rotational kinetic energy of a rigid body.	[5] 4	3
Q.4(b)	Obtain Euler's equations of motion for a rigid body using Newtonian method.	[5] 4	3
Q.5(a)	What is mechanical equilibrium? Discuss stable, unstable and neutral equilibrium.	[5] 5	1,2
Q.5(b)	Deduce the kinetic energy, potential energy and normal frequencies for small oscillations in a system of two coupled pendulums.	[5] 5	3

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