

D 93432

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Name.....

Reg. No.....

**FIRST SEMESTER M.Sc. DEGREE (REGULAR/SUPPLEMENTARY)  
EXAMINATION, NOVEMBER 2020**

(CBCSS)

Physics

PHY IC 01—CLASSICAL MECHANICS

(2019 Admissions)

Time : Three Hours

Maximum : 30 Weightage

**General Instructions**

1. *In cases where choices are provided, students can attend **all** questions in each section.*
2. *The minimum number of questions to be attended from the Section / Part shall remain the same.*
3. *There will be an overall ceiling for each Section / Part that is equivalent to the maximum weightage of the Section / Part.*

**Section A**

8 short questions answerable within 7½ minutes.

Answer **all** questions, Each carry weightage 1.

1. State the principle of least action.
2. Explain how action angle variables can be used to obtain the frequency of periodic motion.
3. What do you mean by precession and nutation ?
4. Briefly explain stable and unstable equilibrium.
5. Explain the concept of Universality.
6. Describe the fixed point using suitable example.
7. State and explain Hamilton's principle.
8. Give the relation between Lagrangian bracket and Poisson bracket.

(8 × 1 = 8 weightage)

Turn over

## Section B

4 Short questions answerable within 30 minutes.

Answer any **two** questions, Each carry weightage 5.

9. Obtain Lagrange's equation from d'Alembert's principle. Give examples of generalized co-ordinates.
10. Discuss the general theory of small oscillations and deduce eigenvalue equation.
11. Show that Poisson brackets are invariants under canonical transformations. Also, express equation of motion in Poisson bracket form.
12. Differentiate between linear and non-linear systems. Explain the period doubling route to chaos with a suitable example

(2 × 5 = 10 weightage)

## Section C

7 problems answerable within 15 minutes.

Answer any **four** questions, each carry weightage 3.

13. Masses  $m$  and  $2m$  are connected by a light inextensible string which passes over a pulley of mass  $2m$  and radius  $\alpha$ . Write the Lagrangian and find the acceleration of the system.
14. Show that the shortest distance between two points is a straight line.
15. Obtain Hamilton's equations for a simple pendulum. Hence, obtain an expression for its period.
16. Find the Poisson bracket of  $[L_x, L_y]$ , where  $L_x$  and  $L_y$  are angular momentum components.
17. Find the moments and products of inertia of a homogeneous cube of side  $a$  for an origin at one corner, with axes directed along the edges.
18. Find the normal frequencies and normal modes for a double pendulum, each having a mass  $m$  suspended by a string of length  $l$ .
19. Show that the following transformation is canonical.  $Q = \sqrt{2qe^{-\alpha}} \cos p$ ,  $P = \sqrt{2qe^{-\alpha}} \sin p$ ,  $\alpha$  is constant.

(4 × 3 = 12 weightage)