D 13157   (Pages : 2)   Name...

                                          Reg. No.....................................

FIRST SEMESTER M.Sc. DEGREE (REGULAR/SUPPLEMENTARY) EXAMINATION, NOVEMBER 2021

(CBCSS)

Physics

PHYIC01—CLASSICAL MECHANICS

(2019 Admission onwards)

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. *The instruction if any, to attend a minimum number of questions from each sub section / sub part / sub division may be ignored.*

4. *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 7.5 minutes)

Answer **all** *questions.*
Each carries weightage 1.

1. State d' Alembert's principle.

2. Define Poisson bracket of two variables and discuss its important properties.

3. Distinguish between Centrifugal and Coriolis forces

4. Define normal frequency and discuss its significance.

5. What are limit cycles ? Distinguish between stable limit cycle and semistable limit cycle.

6. What is chaos ? How does it arise ?

7. Explain different types of constraints.

8. What are canonical transformations ? What is the use of using canonical transformation?

(8 × 1 = 8 weightage)

Turn over

Section B

(4 essay questions answerable within 30 minutes)

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

9. Explain bow action angle variables can be used to find frequencies of periodic motion in Kepler problem.

10. Discuss the precisional motion-with and without rotation of a spinning top under gravity.

11. Find the frequencies of free vibrations of a linear triatomic symmetric molecule.

12. Discuss Pitch Forck bifurcation, period of doubling and fixed points with respect to logistic Map.

$(2 \times 5 = 10$ weightage$)$

Section C

(7 problems answerable within 15 minutes)

Answer any **four** *questions.*
Each carry Weightage 3.

13. In the absence of external torque on a body, prove that : (i) The kinetic energy is constant ; and (ii) The magnitude of the square of the angular momentum (L 2) is constant.

14. A bead of mass m slides freely on a frictionless circular wire of radius a that rotates in a horizontal plane about a point on the circular wire with a constant angular velocity ω. Find the equation of motion of the bead by Lagrange's method. Also show that the bead oscillates as a pendulum of

    length $= \dfrac{g}{\omega^2}$.

15. Using Lagrange's method of undetermined multiplier, find the equation of motion and force of constraint in the case of a simple pendulum.

16. Using the Poisson bracket, show that the transformation $q = \sqrt{2P} \sin Q$, $p = \sqrt{2P} \cos Q$ is canonical.

17. Find Lagrange's equation of motion of the bob of a simple pendulum.

18. Obtain the Hamiltonian of a charged particle in an electromagnetic field.

19. Show that the transformation $p = m\omega q \cot Q$ and $P = \dfrac{m\omega q^2}{2 \sin^2 Q}$ is canonical. Also obtain the generating function for the transformation.

$(4 \times 3 = 12$ weightage$)$