19P106 (Pages: 2) Name: …….…….

Reg. No…….……...

FIRST SEMESTER M.Sc. DEGREE EXAMINATION, NOVEMBER 2019

(CUCSS PG)

CC19P PHY1 C01 – CLASSICAL MECHANICS

(Physics)

(2019 Admission Regular)

Time: Three Hours Maximum: 30 Weightage

Section A

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

1. Show that rotational invariance leads to conservation of angular momentum.
2. State the principle of least action. How does the principle of least action lead to Fermat's principle in geometrical optics?
3. Explain how action-angle variables can be used to obtain the frequencies of a periodic motion.
4. Obtain a generating function which generates exchange transformation.
5. An infinitesimal rotation can be represented by a vector along the instantaneous axis of rotation. Substantiate.
6. What is Coriolis force? What are the effects of Coriolis force due to Earth's rotation?
7. Show that the phase trajectory for a linear harmonic oscillator is an ellipse.
8. What is logistic map? Express it mathematically.

(8 x 1 = 8 Weightage)

Section B

Answer any ***two*** questions, each question carries 5 weightage.

9. Set up the differential equation of the orbit for planetary motion. Derive Kepler's laws from the differential equation.
10. Explain canonical transformations. Show that Poisson Brackets are invariant under canonical transformation.
11. Derive Euler's equation of motion for rigid bodies. Explain the force free motion of a symmetric top.
12. Discuss the longitudinal vibrations of a linear triatomic molecule.

(2 x 5 = 10 Weightage)

Section C

Answer any ***four*** questions. Each question carries 3 weightage.

13. A particle moving in a central force field located at r = 0 describes a spiral $r = e^{-\theta}$. Prove that the magnitude of force is inversely proportional to r^3
14. Plot the equivalent one dimensional potential for an attractive inverse square law of force. How does the value of eccentricity and energy determine the shape of the orbit in a central force problem? Explain the various possibilities of the trajectory.
15. Obtain the equation of motion of two masses connected by an inextensible string passing over a small smooth pulley.
16. Prove that the transformation defined by the equations Q = 1/p and $P = qp^2$ is canonical. Also obtain the generating function.
17. Apply the Hamiton-Jacobi method to study the motion of a freely falling body.
18. A system of two harmonic oscillators having spring constant k is coupled by a light spring of spring constant k. If the mass connected to each of the harmonic oscillators is m, show that the system has the normal frequencies $\sqrt{\frac{k}{m}}$ and $\sqrt{\frac{3k}{m}}$
19. Calculate the inertia tensor for the system of four point masses 1g, 2g, 3g and 4g located at the points (1, 0, 0), (1, 1, 0), (1, 1, 1) and (1, 1, -1) cm.

(4 x 3 = 12 Weightage)

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