19002637

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Reg. No.....

Name.....

M.Sc. DEGREE (C.S.S.) EXAMINATION, OCTOBER 2019

First Semester

Faculty of Science

Branch II—Physics (A)—Pure Physics

PH 1C 02—CLASSICAL MECHANICS

Time : Three Hours | Maximum Weight : 30

Part A

Answer any **six** *questions.*
Each question carries 1 *weight.*

1. What are cyclic co-ordinates ? How are they related to conservation laws ?
2. Give the physical significance of the principle of least action.
3. State and explain Hamilton's principle.
4. Distinguish between different types of equilibria. Give examples.
5. What are action-angle variables ?
6. What is the effect of coriolis force on a missile sent in the Northern Hemisphere ?
7. Show that for a particle executing harmonic motion the trajectory in phase space is an ellipse, when steady. What is the effect of damping ?
8. What do you mean by Lyapunov exponent ? How is it related to Chaos ?
9. Define Hamilton's principal function.
10. Show that fractals have fractional value of dimension.

$(6 \times 1 = 6)$

Part B

Answer any **four** *questions.*
Each question carries 2 *weight.*

11. Explain how action angle variables can be used to find frequencies of periodic motion.
12. Prove that kinetic energy and angular momentum are constants of motion for a rigid body rotating torque free.
13. Prove that $\frac{d}{dt}[\alpha, \beta] = \left[\frac{\partial \alpha}{\partial t}, \beta\right] + \left[\alpha, \frac{\partial \beta}{\partial t}\right]$ where $[\alpha, \beta]$ is the Poisson Bracket.

Turn over

14. Show that the transformation $P = \frac{1}{2}(p^2 + q^2)$, $Q = \tan^{-1}\frac{q}{p}$ is Canonical.

15. A μ meson with lifetime 2×10^{-8} sec. enters the Earth's atmosphere with a speed 0.8 C. Find how long the meson would be able to travel taking into account time dilation.

16. Obtain the transformation matrix for second rotation thro' Euler angle.

(4 × 2 = 8)

Part C

Answer **all** *questions.*
Each question carries 4 *weight.*

17. (a) Obtain Lagrange's equation from Hamilton's principle. Give examples of generalized co-ordinates.

Or

(b) Solve Kepler problem using Hamilton Jacobi equation.

18. (a) Discuss the general theory of small oscillations and deduce eigenvalue equation.

Or

(b) Discuss Harmonic oscillator problem as an example of canonical transformation. Give examples of canonically conjugate variables.

19. (a) Discuss the central force problem and give the classification of different orbits.

Or

(b) Obtain the Euler equations of motion. Derive the period of precession of Earth.

20. (a) Explain principle of equivalence and of general covariance. Discuss how a point mass moves in a gravitational field.

Or

(b) Differentiate between linear and non-linear systems. Explain the period doubling route to chaos with a suitable example.

(4 × 4 = 16)