18002139

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Reg. No.....

Name.....

M.Sc. DEGREE (C.S.S.) EXAMINATION, DECEMBER 2018

First Semester

Faculty of Science

Branch II : Physics–(A)–Pure Physics

PH 1C 02—CLASSICAL MECHANICS

(2012 Admission onwards)

Time : Three Hours Maximum Weight : 30

Part A

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

1. State and explain Hamilton's principle.
2. What are normal co-ordinates and normal modes ?
3. What are the conditions for transformations to be canonical ?
4. Show that Poisson bracket of two arbitrary functions is invariant under canonical transformations.
5. What are action and angle variables ?
6. What are the first integrals of motion under a central force ?
7. Write a note on Euler angles.
8. What is coriolis effect ? Explain its effect due to earth's rotation.
9. Show that Hamilton-Jacobi equation is the short wavelength limit of Schrodinger equation.
10. State and explain Virial theorem.

(6 × 1 = 6)

Part B

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

11. Use Lagrange's equation to find the equation of motion of a compound pendulum which oscillates in a vertical plane about a fixed horizontal axis. Also find the period of oscillation of compound pendulum.
12. A charged particle is moving under the influence of point nucleus. Find the orbit of the particle and the periodic time in the case of elliptical orbit.

Turn over

13. Show that the transformation $= \frac{1}{2}\left(p^2 + q^2\right), Q = \tan^{-1}\left(\frac{q}{p}\right)$ is canonical.

14. Three equal mass points are located at $\left(0, \frac{a}{\sqrt{2}}, \frac{a}{\sqrt{2}}\right), \left(0, \frac{a}{\sqrt{2}}, -\frac{a}{\sqrt{2}}\right)$ and $(a, 0, 0)$. Find the principal moments of inertia about the origin and a set of principal axes.

15. The length of a rocket ship is 100 m on the ground. When it is in flight, its length observed on the ground is 99 m. Calculate its speed.

16. Calculate the fractal dimensions of cantor set and Sierpinski gasket.

(4 × 2 = 8)

Part C

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

17. (a) From Hamilton's principle, obtain Lagrange's equation.

Or

(b) Obtain Hamilton's equation for motion of a body in a central force field and show that angular momentum is conserved for a body moving in a central force field.

18. (a) Establish the Lagrangian and deduce the Lagrange's equation of motion for small oscillations of a system in the neighbourhood of stable equilibrium.

Or

(b) Deduce the condition for canonical transformation. Discuss harmonic oscillator problem as an example of canonical transformation and obtain its solution.

19. (a) Discuss Kepler problem as an example of Hamilton-Jacobi technique.

Or

(b) Obtain Euler's equation of motion for a symmetric top.

20. (a) Discuss the central force problem and obtain the equivalent one dimensional problem.

Or

(b) Illustrate the essential features of chaos using logistic map.

(4 × 4 = 16)