

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.





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

 $(4 \times 2 = 8)$

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.

 $(4 \times 4 = 16)$ 