19P106A (Pages: 2) Name: ……………………

Reg. No…………………...

FIRST SEMESTER M.Sc. DEGREE EXAMINATION, NOVEMBER 2019

(Supplementary/Improvement)

(CUCSS-PG)

CC15P PHY1 C01/CC17P PHY1 C01 – CLASSICAL MECHANICS

(Physics)

(2015 to 2018 Admissions)

Time: Three Hours Maximum: 36 Weightage

Section A

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

1. What is central force? Show that angular momentum of a particle moving in a central force field is conserved.
2. Describe the terms configuration space and phase space.
3. What are generalized co-ordinates? Give examples.
4. Briefly discuss the principle of virtual work.
5. Write down the Hamilton's equation of motion in cartesian coordinates.
6. What is meant by infinitesimal contact transformation?
7. Explain action and angle variables.
8. For small oscillations, obtain the equations $\sum_{j=1}^{n}[T_{ij}\ddot{u}_j + V_{ij}u_j] = 0$
9. Show that the kinetic energy of a rigid body can be represented as $T = \frac{1}{2}\,\omega.J$
10. What is inertia ellipsoid? Explain invariable plane.
11. Show that the phase trajectory for a linear harmonic oscillator is an ellipse.
12. What are singular points? What are the different kinds of singular points?

(12 x 1 = 12 Weightage)

Section B

Answer any ***two*** questions. Each question carries 6 weightage.

13. Obtain the general theory of small oscillations.
14. Derive Lagrangian for a charged particle moving in an electromagnetic field. Hence obtain the Hamiltonian and equation of motion for the same particle.
15. Describe Euler's angles and obtain the complete transformation matrix.

16. a) Discuss the phase trajectories of a simple pendulum. Plot the energy diagram and phase trajectories

b) Show that the period of non - linear oscillations of a simple pendulum is

$$T = T_0\left(1 + \frac{\theta_0^2}{16}\right) \quad \text{where } T_0 = 2\pi\sqrt{\frac{l}{g}} \text{ and } \theta_0 = \text{amplitude of oscillation}$$

(2 x 6 = 12 Weightage)

Section C

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

17. Deduce the fundamental Poisson Brackets. Also evaluate $[L_x, x]$ and $[L_x, p_x]$.

18. Find the Lagrangian and equation of motion for a bead slides on a wire with the shape of cycloid, described by equations $x = a(\theta - sin\theta)$ and $y = a(1 + cos\theta)$ where $0 \leq \theta \leq 2\pi$.

19. Prove that the generating function $\sum q_i p_i$ generates the identity transformation.

20. Show that the transformations $Q = \sqrt{2q}e^{t}\cos p$ and $P = \sqrt{2q}e^{-t}\sin p$ are canonical.

21. A particle of mass m moves under the action of central force whose potential is $V(r) = kmr^3$ $(k > 0)$, then for what kinetic energy and angular momentum will the orbit be a circle of radius R about the origin.

22. The Lagrangian of a problem is $L = \frac{1}{2}m(\dot{r}^2 + r^2\dot{\theta}^2) + V(r)$. Identify the cyclic co-ordinate and the corresponding conservation law for the problem.

(4 x 3 = 12 Weightage)

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