MAHATMA GANDHI UNIVERSITY

PG-CSS MODEL QUESTION PAPER 2012

SEMESTER I

PAPER: PH1RC2 CLASSICAL MECHANICS AND RELATIVITY

Time : 3 hrs Total Weight:30

Part A (Short answer questions)

(Answer any six questions. Each question carries weight one.)

1. What are the generalised coordinates? What are the advantages of using them?
2. What are Poisson Brackets?
3. What are action and angle variables?
4. What is the importance of Perturbation theory in classical mechanics
5. Distinguish between Time-independent and Time-dependent perturbations
6. Show that rigid body has six degrees of freedom
7. Explain coriolis force
8. What are Euler angle.
9. Write notes on relativistic Doppler effect.
10. Briefly explain the principle of covariance.

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Part B (Problems)

(Answer any four questions. Each question carries weight two.)

11. Show that the transformation of $Q = \log\left(\frac{\sin p}{q}\right)$ and P= q cot p is canonical and find the generating function
12. Using Lagrange's equation derive an expression for the period of oscillation of a linear harmonic oscillator.
13. Apply time dependent perturbation theory to the case of a simple pendulum with finite amplitude
14. Show that the moment of inertia is a symmetric second rank tensor.
15. Show that the angular acceleration is the same in fixed and rotating frames of reference.
16. How fast and in what direction must galaxy A be moving if an absorption line found at wavelength 550nm (green) for a stationary galaxy is shifted to 450 nm (blue) (a "blue-shift") for galaxy A?

4x2= 8 weight

Part C (Essay)

(Answer all questions. Each question carries weight four.)

17. Using the Hamilton's principle of least action derive the Lagrange's equations for system of particles

OR

Obtain Lagrange's equations for a simple pendulum

18. (i)Derive the equation of motion for all angles for a heavy symmetrical top with one point fixed. Discuss the precession and nutation qualitatively

OR

(ii) What are normal vibrations and normal co-ordinates? Discuss the small oscillations of the CO_2 molecule and obtain the frequencies of their modes.

19. (i) Obtain Hamiltonian formulation for continuous systems

OR

(ii) Outline Lagrangian formulation of a continuous system and discuss sound vibrations in a gas

20. (i) Deduce Lagrangian and Hamilltonian of a relativistic particle,

OR

(ii) Obtain Schwarzchild's exterior solution for the gravitational field of a single mass at rest and explain on the basis of this solution the advance of the perihelion of the planet Mercury.

4x4= 16 weight