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Total Number of Pages : 2

AR-19

M.Sc

M.Sc 1<sup>ST</sup> SEMESTER REGULAR EXAMINATIONS, NOV/DEC 2019-20

PHPC102-CLASSICAL MECHANICS

Time: 3 Hours

Max Marks: 80

The figures in the right hand margin indicate marks.

**SECTION – A**

- Q.1 Answer any four of the following [4×4=16]
- a Explain orthogonal transformations. 4
  - b Show that the kinetic energy of a rigid body is  $\frac{1}{2}\vec{L}\cdot\vec{\omega}$ , where  $\vec{L}$  is the angular momentum and  $\vec{\omega}$  is the angular velocity of the rigid body. 4
  - c Show that the shortest curve joining two points is a straight line. 4
  - d Prove that for a conservative system, the Hamiltonian function  $H$  represents the total energy of the system. 4
  - e Show that the transformation  $P = \frac{1}{2}(p^2 + q^2)$  and  $Q = \tan^{-1}\left(\frac{q}{p}\right)$  is canonical. 4
  - f What is Poisson bracket? State its properties. 2+2

OR

2. Answer all questions from the following. [2×8=16]
- a What do you understand by inertia tensor? 2
  - b What is the effect of coriolis force on a particle thrown horizontally at earth's north pole? 2
  - c State Hamilton's principle. 2
  - d Explain the principle of least action. 2
  - e State Poisson's theorem. 2
  - f Define Lagrange bracket. 2
  - g What is meant by integral invariance of Poincare? 2
  - h State Liouville's theorem. 2

**SECTION-B**

3. Answer all Questions. [16×4=64]
- a What are Euler angles? Find out the complete transformation matrix in terms of Euler angles, if a three dimensional coordinate system is transformed to another having same origin. 2+14

OR

- b Derive Euler's equations of motion of a rotating rigid body. Then, discuss about the torque free motion of the rigid body. 8+8

4.

- a What is meant by calculus of variations? Using the calculus of variations, derive Euler- Lagrange equation. 2+14

OR

- b What is Legendre transformation? Derive Hamilton's equations of motion. 6+10



- 5.
- a What are canonical transformations? Find out the generating function of canonical transformations and write the four forms of generating function. 6+8+2
- OR
- b Explain the harmonic oscillator problem as an example of Hamilton – Jacobi method. 16
- 6.
- a Explain normal coordinates and normal modes of small oscillations. 16
- OR
- b Describe the theory of coupled system of two oscillators and find out the normal mode frequencies. 16