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752102

Mar. 2022

M.Sc. (Physics) - I SEMESTER

Classical Mechanics (MPH-102)

Time : 90 Minutes] [Max. Marks : 25

Instructions :

1. *It is compulsory to answer all the questions (1 mark each) of Part-A in short.*
2. *Answer any three questions from Part-B in detail.*
3. *Different sub-parts of a question are to be attempted adjacent to each other.*

PART-A

1. (a) Define constraints on a dynamical system. (1)

(b) State Hamilton's Principle. (1)

(c) Define Kepler's 2nd law of motion. (1)

(d) What is length contraction? (1)

(e) The dimension of action will be analogous to ..... ? (1)

(f) At what speed, the mass density of an object will increase by 25% of its rest mass. (1)

(g) Define Virial theorem. (1)

(h) State Liouville's theorem. (1)

(i) What are Holonomic constraints? (1)

(j) How many number of non-zero frequency normal modes exists for a system of 12 degree of freedom? (1)

PART-B

2. Derive an expression for the Lagrangian equation of motion for Atwood machine. (5)

3. (a) Show that the transformation equation

$$P = 2(1 + q^{1/2} \cos p)\, q^{1/2} \sin p$$

and $Q = \log (1 + q^{1/2} \cos p)$

is canonical. (2)

(b) Generating function of this transformation is $F_3 = -(e^Q - 1)^2 \tan P$. (3)

4. Prove that $[J_x, p_x] = 0$ and $[J_y, J_z] = J_x$. (5)

5. Apply the Hamilton-Jacobi method to determine the motion of a body falling vertically in a uniform gravitational field. (5)

6. (a) Derive mass-energy equivalence relation. (2)

(b) A clock keeps correct time. With what speed should it be moved relative to an observer so that it may seem to lose 2 minutes in 24 hours. (3)