



(Compulsory Question)

1. (a) Define degrees of freedom. 2
- (b) What are the advantages of using generalized coordinates ? 2
- (c) Define the following : 2
- (i) Vibration
- (ii) Oscillation.
- (d) What is the difference between Damped and Undamped oscillations ? 2
- (e) What is a frame of reference ? 2
- (f) Write down the postulates of special theory of relativity. 2
- (g) What do you mean by relativistic momentum ? 2
- (h) What do you mean by four vector ? 2

Unit I

2. (a) Explain generalized velocity and generalized acceleration. 10
- (b) What are constraints ? Explain various types of constraints with example. 6

3. (a) State Hamilton's principle and obtain Lagrange's equation of motion for a conservation system from the Hamilton's principle. 12
- (b) Two masses 10 g and 6 g are tied together by means of a light inextensible cord and the cord passes round a light frictionless pulleys such that two masses hang on the two sides of the pulley. If released from rest, what is the acceleration of the two masses ? 4

Unit II

4. (a) What do you mean by compound pendulum ? Derive an expression for the time period. 12
- (b) A spiral spring having mass 2.5 kg and stiffness constant of 81 N/m vibrates periodically. Calculate the periodic time of the spring. 4

5. (a) Derive an expression for total energy of a mechanical oscillator. 8
- (b) What is damping ? Derive the differential equation of a damped S.H.O. 8

Unit III

6. (a) Define Galilean transformations. Show that length and acceleration are Galilean invariant whereas velocity is not Galilean invariant. 12
- (b) Find the length of a metre stick moving at a speed of $0.6c$, where c is speed of light. 4
7. Discuss the Michelson-Morley experiment. What conclusions can be drawn from it regarding the existence of ether ? 16

Unit IV

8. (a) Derive the formula for relativistic variation of mass with velocity. 12

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- (b) Find the velocity of the particle whose mass becomes equal to three times its rest mass. 4

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9. (a) Obtain relativistic formula for the addition of velocities and prove that a particle cannot travel with a velocity more than the velocity of light. 8
- (b) What do you mean by relativistic Doppler's effect ? Derive an expression for transverse Doppler's effect. 8

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