Jhargram Raj College

Internal Exam 2022
Paper: DSE 1 [Physics]
Full Marks : 10

Send the answer script before 5 p.m to *physics.jhargramrajcollege@gmail.com* with 'subject' of the Email as "Paper DSE-1" Please mention your name , Roll Number, Registration Number, Examination etc. both in answer sheet and in Email.

Answer any one of these questions.

1. (a) Explain what is meant by "virtual displacement". [2]
   (b) State the D'Alembert principle. [2]
   (c) Write down the Lagrangian of a particle moving under a central force. Find the equation of motion. Is there any cyclic co-ordinate in the system? [2+3+1]

2. Consider two blocks and three springs as shown in the figure. Assume that all the motion are horizontal. When the blocks are at rest, all the springs are unstretched.

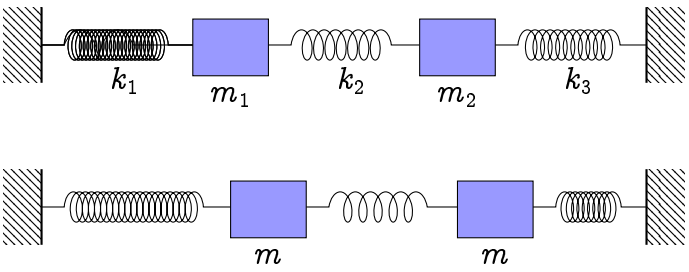

Figure 1: Horizontal motion of spring-mass system

   (a) Choose generalized coordinates as the displacement of each block from its equilibrium position, and write the Lagrangian. [2]

(b) Find the $\mathbf{T}$ and $\mathbf{V}$ matrices. [2]

(c) Suppose $m_1 = m, \quad m_2 = m, k_1 = 2k, \quad k_2 = k, \quad k_3 = 2k$. Find the frequencies of small oscillations. [2]

(d) Find the normal modes of the oscillation. [2+2]

3. (a) Write down the postulates of Special Theory of Relativity. [2]

(b) Consider the potential energy $V(x)$ of a particle as given by

$$V(x) = 3x^4 - 8x^3 - 6x^2 + 24x$$

Determine the points of stable and unstable equilibrium. [3]

(c) Two similar springs with spring constant k, hang vertically downward from a rigid support with two equal masses m attached to them as shown in the figure. Show that the normal mode frequencies for small oscillation (vertically) are given by $\omega_{\pm} = \sqrt{\frac{k}{2m}(3 \pm \sqrt{5})}$. [5]

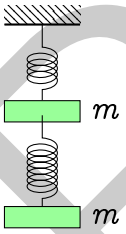

Figure 2: Vertical motion of spring-mass system