

## Assignment 02

(Substitute of Mid Term Exam)

Trimester: Summer 2024

Course code: PHY 2105

Course Title: Physics

Full Marks: 10

- 1 a. Briefly discuss the applications of damped harmonic motion (DHM) that you observe in your real life. 1
- b. Why does the amplitude of the damped harmonic motion (DHM) decrease with time? Briefly Explain. 1
- 2 a. For a damped oscillator  $m = 200 \text{ g}$ ,  $k = 90 \text{ N/m}$  and  $b = 68 \text{ g/s}$ . 2
  - (i) How long does it take for the amplitude of the damped oscillations to drop to one fifth of its initial value?
  - (ii) The maximum displacement of undamped oscillator is  $35 \text{ cm}$ . If the damping is stopped after  $Z$  cycles, what is the damping energy? Here  $Z$  is the last digit of your student ID. If the last digit of your ID is 0 then use  $Z = 5$ .
- b. Calculate the value of  $L$  that is required to construct a critically damped RLC circuit with  $R = 50 \Omega$ ,  $C = 0.2 \mu\text{F}$ . Construct the equation of charge if the initial charge in the capacitor is  $Q_0 = 5 \text{ C}$  and  $L = 0.3 \text{ mH}$ ,  $R = 50 \Omega$ ,  $C = 0.2 \mu\text{F}$ . 2
- c. A mass spring system in DHM with  $m = 500 \text{ g}$ ,  $b = 80 \text{ g/s}$ . 2
  - (i) What must be the spring constant of the spring for the system to be oscillatory?
  - (ii) If the time period of the undamped oscillator is  $2 \text{ s}$  and the initial amplitude of the oscillator is  $2 \text{ m}$ , what will be the displacement at  $t = M \text{ sec}$ ? Here  $M$  is the last digit of your Student ID. If the last digit of your ID is 0 then use  $M = 7$ .
- 3 A mass spring system is undergoing DHM with mass  $m$  and the equation of displacement 2
$$y = 5e^{-2t}\cos 2t$$
Show that damping energy decreases faster compared to the amplitude using the damping constant. [ Use equations to justify your answer].