United International University

School of Science and Engineering

Mid Term Examination; Year 2022; Trimester: Fall

Course: PHY 105/2105; Title: Physics; Sec: A-E

Full Marks: 30; Time: 1 Hour 45 Minutes

Questions no 1, 2 and 3 are mandatory to answer. Answer any one from question no 4 and 5.

1.	(a) The displacement of a Simple Harmonic Motion (SHM) is $y = A\sin(\omega t + \frac{\pi}{2})$. Graphically show that the displacement and acceleration are out of phase to each other.	2	CO1
	(b) Why do $\omega^2 > \gamma^2/4$ oscillatory? Draw displacement vs. time graphs for (i) $\omega/\gamma = 5$ and (ii) $\omega/\gamma = 0.005$.	2	CO1
	(c) Graphically show that even though the potential and kinetic energies for Simple harmonic motion (SHM) vary with time, the total energy remains constant.	2	CO1
2.	(a) A 4.0kg block extends a spring 16cm from its equilibrium position. The block is removed and a 0.5kg block is hung from the same spring. If the spring is stretched and released, what is the period of motion?	2	CO3
	(b) Suppose the block has mass $m = 2.72 \times 10^5$ kg and is designed to oscillate at frequency f=10.0 Hz and with amplitude A=20.0 cm. (i) What is the total energy E of the spring–block system? (ii) What is the KE and PE at x= 10cm (iii) At what position KE=PE?	3	CO3
	(c)An oscillating block has kinetic energy equal to potential energy of 25J (KE=PE=25J) when the block is at x =+0.50 m. (i) what is the amplitude of oscillation? (ii) What is the kinetic energy when the block is at x = 0?	3	CO3
3.	(a) For the damped oscillator of m = 250 gm, k = 85 N/m, and b =70 gm/s. If it is oscillatory find the frequency of the oscillator. If initial amplitude of the system is 10cm, find out amplitude after 10 oscillations. What is life time of oscillation	3	CO3
	(b) Draw an LRC series circuit using L= 0.4h, C = 0.0020μF components. What is the maximum resistance for which circuit will be oscillatory?	2	CO3
	(c) An oscillator consists of a block attached to a spring (k =400 N/m). At some time t, the position, velocity, and acceleration of the block are x = 0.100 m, v=-13.6 m/s, and a=-123 m/s^2. Calculate (a) the mass of the block and (b) the amplitude of the motion.	3	CO3
4.	(a) Show that for a particle executing SHM, the instantaneous velocity is $\omega\sqrt{A^2 - x^2}$ and the maximum velocity is $\sqrt{2E/m}$, where symbols have their usual meanings.	4	CO2
	(b) Show that the phase difference between acceleration and displacement of a body executing SHM is π and that of displacement and velocity is $\frac{\pi}{2}$.	4	CO2
5.	(a) Derive differential equation for Simple pendulum. Find out expression for frequency of oscillation.	4	CO2
	(c) Derive the differential equation for RLC circuit and find out the condition for its oscillatory behavior. How the oscillation of the RLC circuit becomes that of an LC circuit?	4	CO2

CO1: Define different physical quantities with examples. CO2: Derive/Show the various equations of SHM, DHM, wave motion, electric potential, etc. CO3: Evaluate different numerical problems based on the basic characteristics of SHM, DHM, electric charge, electric potential, etc.

and provide information such as their name, position, and areas of expertise. All information on researchers and their experiments should be stored in a data table. Once a researcher has logged in, they can create or edit drug development protocols, which should also be stored in a data table. Once a protocol is created, the system generates a unique identifier for the drug development project and prompts the researcher to input data. The data is stored in a separate data table and linked to the project identifier. The system should be able to display the progress of experiments, showing which experiments are ongoing and which have been completed.

The drug development process involves multiple stages and each stage may require multiple experiments. To handle this, the system prompts the researcher to enter data for each experiment in a given stage until all the required experiments have been completed. Then the system should automatically move to the next stage of the development process. Once a stage of **drug development is complete**, the researcher should be able to generate a report on the results of the experiments for that stage. The report should be stored in a data table and linked to the project identifier. The system should also be able to generate reports on the progress of drug development projects, showing which stages have been completed and what the results were. The progress reports are then presented to the project manager of the project. The project manager analyzes the reports with the stakeholders, business team and the drug safety committee of the company and then forwards the development reports to FDA for approval. If the approval is not met, then the researcher has to redesign and experiment certain stages of the experiment for the drug to work.

a) Draw the Use case diagram for the above scenario (show at least **one extend or one include** relationship in the diagram). 4

b) Write down the descriptive form of **a major use case** shown in the use case diagram for the above scenario. 4

c) Draw a DFD diagram for the approval process of FDA **after drug development process** completed. 4

[CO3]