# United International University

## School of Science and Engineering

Mid Term Examination; Year 2020; Trimester: Summer
Course: PHY 105/2105; Title: Physics; Sec: A-E
Full Marks: 20; Time: 1 Hour 15 Minutes

Any examinee found adopting unfair means will be expelled from the trimester / program as per UIU disciplinary rules.

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

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| 1. | (a) The displacement of a Simple Harmonic Motion (SHM) is $x = A\omega cos(-\omega t - \delta)$. Find the velocity and draw the displacement and velocity graph in a single plot. | 2 | CO1 |
| | (b) If the two waves are not in phase, then draw the phase difference of two waves for out of phase. | 1 | CO1 |
| | (c) How can you get back from Damped Harmonic motion (DHM) to SHM? | 1 | CO1 |
| 2. | (a) In an electric shaver, the blade moves back and forth over a distance of 10 mm in SHM, with a frequency 120Hz. The mass of the suspended spring inside the machine has mass 500 gm and spring constant *K*=7 N/m. When the shaver machine exceeded the distance 2mm, the instantaneous velocity can be found as $v = \omega\sqrt{A^2 - x^2}$. Find (i) the amplitude, (ii) the maximum blade speed, (iii) the magnitude of the maximum acceleration of blade, (iv) the total energy, and (v) the kinetic energy. | 3 | CO3 |
| | (b) A 700 gm block on a spring is pulled a maximum distance of 30 cm from its equilibrium position. The subsequent oscillations are measured to have a period of 0.80 s. (i) At what position (or positions) is the speed of the block 180 cm/s? (ii) What is the maximum velocity of the block? | 2 | CO3 |
| | (c) A body oscillates with SHM according to the equation $x = 10\cos(3\pi t + \frac{\pi}{3})$. Calculate the velocity when t=3s. | 1 | CO3 |
| 3. | (a) The equation of a travelling wave is $y = 10\sin(10t - \frac{\pi}{6}x)$. Calculate (i) the amplitude of the vibrating particle, (ii) wave velocity, (ii) wave length, (iv) frequency and (v) time period. | 3 | CO3 |
| | (b) What is the Coulomb force between two 4gm pennies one meter apart if we remove all the electrons from the Sodium ($^{23}_{11}Na$) atoms? Mass and charge of electron are $9.1\times10^{-31}$ kg and $1.6\times10^{-19}$ Coulomb, respectively. | 2 | CO3 |
| | (c) A condenser of capacity 1 mF, an inductance of 0.2 mH and a resistance of 800 Ω are joined in series. If the circuit is oscillatory, then what is the resonant frequency of the circuit? | 1 | CO3 |
| 4. | (a) Draw the Lissajou's figures: $x = a\sin\left(\omega t + \frac{\pi}{4}\right)$ and $y = b\cos\left(\omega t + 5\frac{\pi}{4}\right)$. | 2 | CO2 |
| | (b) Suppose, the instantaneous displacement of a SHM is $x = a\sin(\omega t + 45)$. How can you calculate the total energy of the SHM? | 2 | CO2 |
| 5. | (a) If you have resistor, inductor and capacitor, then draw a circuit comprising all. Obtain a differential equation for that circuit. | 2 | CO2 |
| | (b) Find out the resultant amplitude and antinode positions in terms of λ of the wave equations $y_{1,2} = A\ \sin\left(\frac{1}{3}kx \pm \omega t\right)$. | 2 | 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.