Physics Division

Military Institute of Science & Technology

B. Sc. in Industrial & Production Engineering (IPE)

Mid Term Exam, L-1, T-I (Spring Semester-2023)

Course Code: PHY-101, Course Title: Waves and Oscillations, Modern Physics and Optics

Full Marks: 30, Time : 45 minutes

Answer all the questions

Section A

Question -1

a. Obtain an expression for the resultant displacement of a particle which is being simultaneously acted upon by two simple harmonic vibrations of same frequency but different phase and amplitude. Derive also the equation of the resultant amplitude and phase. 9

b. What does it happen for the resultant displacement of the question 1(a), if the two vibrations are (i) in the same phase, (ii) in the same phase with equal amplitude, (iii) in the opposite phase and (iv) in the opposite phase with equal amplitude. 6

Section B

Question -2

a. Define the following terms : (i) cutoff frequency, (ii) kinetic energy, (iii) stopping potential and (iv) Compton effect. 4

b. What is photoelectric effect? Discuss Einstein's explanation for the Photoelectric effect. 7

c. X-ray of wavelength 10 pm are scattered from a target. (i) Find the wavelength of the X-rays scattered through 45° and (ii) find the maximum wavelength present in the scattered X-rays. 4

Physics Division

Military Institute of Science & Technology

B. Sc. in IPE, L-1, T-I (Spring Semester-2023)

Class Test-01, Course Code: PHY-101, Course Title: Modern Physics

Full Marks: 20, Time: 30 minutes

Answer all the Questions

1. Define inertial frame of reference. Why Lorentz transformation is used instead of Galilean transformation in special theory of relativity? 5

2. What do you mean by time dilation? Derive an expression for the time dilation and length contraction by using Lorentz transformation. 9

3. A particle of rest mass 1.4 kg moves with a speed of 0.8c relative to an inertial system. Calculate (i) the rest mass energy, (ii) relativistic kinetic energy, and (iii) relativistic total energy for the particle. 3

4. Calculate the kinetic energy of an electron with a velocity of 0.98c times the velocity of light in the laboratory system. 3

Physics Division
Military Institute of Science & Technology
B. Sc. in Biomedical Engineering (BME); L-I, T-I, Class Test-1 (Spring, 2023)
Course Code: PHY 101, Course Title: Waves and Oscillations
Full Marks: 20; Time: 30 minutes
Answer all the questions

1. Describe the term oscillatory motion and torsional pendulum with diagram. **(3)**
2. Consider a simple pendulum system. **(3+5+2+1)**
   (a) Derive its differential equation.
   (b) Find a general solution of the system.
   (c) Show the graphical representation of velocity and acceleration.
   (d) Find the time period formula for simple pendulum.
3. If frequency is not constant for some oscillation, does the oscillation be simple harmonic motion. **(2)**
4. A particle performs SHM is given by the equation $y = 20\ sin\ (\omega t + \delta)$, if the time period is 30 *seconds* and the particle has a displacement of $10cm$ at $t = 0$, Find (i) epoch, (ii) the phase at $t = 5$ *seconds* and (iii) the phase difference between two positions of the particle 15 *seconds* apart. **(4)**

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CamSc

Physics Division
Military Institute of Science & Technology
B. Sc. in Biomedical Engineering (BME)
Make up exam , L-1, T-I, (Spring Semester-2023)
Course Code: PHY-101, Course Title: Waves and Oscillation, Modern
Full Marks: 30, Time: 40 minutes
Answer all the Questions

1. Differentiate between simple harmonic oscillation and damped oscillation.
2. Define progressive wave. Show that for a progressive wave:

   $\frac{d^2y}{dt^2} = v^2 \frac{d^2y}{dx^2}$.

3. Deduce the equation of resultant vibration of a particle influenced b perpendicular simple harmonic vibrations having same time period. I graphs when the phase difference is (i) 0°, (ii) $\frac{\pi}{2}$ *and* (iii) π.
4. A simple harmonic motion is represented by, $y = 10\sin(10t - \pi/4)$.

   Calculate (i) time period, (ii) frequency and (iii) maximum velocity.

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Physics Division
Military Institute of Science and Technology
B.Sc. in BME, L-1, T-I (Spring Semester-2023)
Mid-Term Test, Course Code: PHY-101
Course Title: Waves and Oscillations, Optics and Modern Physics
Full Marks: 30, Time: 45 minutes
Answer all the questions
Section –A

Question 1

a. Define interference. What are the conditions of interference of light? (2)

b. Show that, in Young's double slit experiment, the width of the fringe is directly proportional to the wavelength of the light. (10)

c. In a Young's double slit experiment, the separation between the sources is 0.41 mm. The fringes are observed on a screen 80 cm away. If with certain monochromatic source of light, the fourth bright fringe is situated at a distance of 8.5 mm from the central bright fringe, find the wavelength of light. (3)

(c) Show the graphical representation of velocity and acceleration.
(d) Find the time period formula for simple pendulum.

3. If frequency is not constant for some oscillation, does the oscillation be simple harmonic motion. (2)

4. A particle performs SHM is given by the equation $y = 20\ sin\ (\omega t + \delta)$, if the time period is 30 *seconds* and the particle has a displacement of $10cm$ at $t = 0$, Find (i) epoch, (ii) the phase at $t = 5$ *seconds* and (iii) the phase difference between two positions of the particle 15 *seconds* apart. (4)

CamSca

Physics Division
Military Institute of Science & Technology
B. Sc. in Biomedical Engineering (BME)
Make up exam , L-1, T-I, (Spring Semester-2023)
Course Code: PHY-101, Course Title: Waves and Oscillation, Modern
Full Marks: 30, Time: 40 minutes
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Physics Division
Military Institute of Science and Technology
B.Sc. in BME, L-1, T-I (Spring Semester-2023)
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Section –B

Question 2

a. Write down the postulates of special theory of relativity. (2)

b. What do you understand by length contraction and time dilation? Derive the equation of length contraction and time dilation using Lorentz transformation. (10)

c. The rest length of a rod is 6 m. What would be its length for an observer if it be moving relative to him in a direction parallel to its own length, (i) with velocity 0.5 c, (ii) moving with velocity c, and (iii) what would be its length for an observer who himself is moving along with it with the same velocity. (3)

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