B. Tech.
2nd Semester (2023AB & Back)
Spring 2024 (SAS)

MID SEMESTER EXAMINATION, SPRING 2024
Subject: PHYSICS
Code: PH10001

Full Marks: 20 **Time: 90 minutes**

Answer any FOUR QUESTIONS including question No. 1 which is compulsory.
The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable. All parts of a question should be answered at one place only.

Q.1	Answer the following Questions	Marks	CO
a)	Can two independent sources of light produce steady interference pattern? Justify your answer.	1	CO2
b)	Differentiate between interference due to division of amplitude and division of wavefront.	1	CO2
c)	Two identical damped harmonic oscillators oscillating in two separate resistive mediums have damping coefficients in ratio 2:1. Calculate the ratio of their relaxation times.	1	CO1
d)	An undamped oscillator has a time period of 1.8 seconds. It was subjected to damping of damping coefficient 0.5 second^{-1}. If the oscillator is to oscillate in the condition of amplitude resonance, what should be the angular frequency of external periodic force?	1	CO1
e)	Give two examples of coupled oscillations.	1	CO1

Q.2		Marks	CO
a)	With a neat schematic diagram, calculate the effective path difference between reflected rays to obtain a sustained interference pattern in a thin wedge-shaped film when a beam of monochromatic light is incident on it.	4	CO2
b)	The differential equation of a monochromatic progressive wave is given by: $$\frac{\partial^2\psi}{\partial t^2} = 1.296 \times 10^5 \frac{\partial^2\psi}{\partial x^2}$$ Where all quantities are in SI unit. If the wavelength of the wave is 0.1 meter, calculate the frequency of the wave.	1	CO2

Q.3		Marks	CO
a)	Establish the differential equation of motion for a damped harmonic oscillator subjected to a resistive force proportional to its velocity and obtain its general solution. Find out the expression for amplitude in case of under-damped oscillation.	4	CO1
b)	The equation of motion of an oscillator is given as: $$5\frac{d^2y}{dt^2} + 20\frac{dy}{dt} + 45x = 0$$ All units are in SI. Calculate the time period of oscillation of the oscillator.	1	CO1

Q.4		Marks	CO
a)	Derive the differential equations of motion to describe the oscillation of a system of two identical pendulums, each having a bob of mass 'm' suspended by rigid, weightless rods of length 'l' and coupled to each other by a light spring of force constant 'k'. Decouple the equations and find the expressions for normal mode frequencies.	4	CO1
b)	A plane progressive wave is represented by the equation: $y = 3.1\ Cos\ \pi(2t - 10x)$, where x and y are in meter and t is in second. Find the frequency and velocity of the wave.	1	CO2

Q.5		Marks	CO
a)	A body of mass 4 gm is oscillating in a weak resistive medium under the action of an external periodic force $10sin\pi t$ dyne. Taking the force constant (k) to be 40 dyne/cm and damping constant (b) as 0.8 gm/sec: I. Set up the differential equation of motion for the said forced harmonic oscillator. II. Estimate the value of amplitude of oscillation and phase difference between the driving force and displacement of the oscillator.	4	CO1
b)	When seen by reflected light, why an excessively thin film appears perfectly dark?	1	CO2

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