GURU NANAK INSTITUTE OF TECHNOLOGY
An Autonomous Institute under MAKAUT
2022
PHYSICS-I
PH201

TIME ALLOTTED: 3 Hrs **FULL MARKS: 70**

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable

GROUP – A
(Multiple Choice Type Questions)

Answer any ***ten*** from the following, choosing the correct alternative of each question: **10×1=10**

		Marks	Co No.
1. (i)	Missing order in the interference maxima in Fraunhofer double slit diffraction occurs if a) slit width is increased b) slit width is constant but the separation between the slits is increased c) distance between the slit is decreased d) none of the above	1	CO3
(ii)	Ratio of Einstein's A and B coefficients are proportional to a) ν b) $1/\nu$ c) ν^3 d) ν^5	1	CO2
(iii)	Two light waves interfere constructively at a point if their path difference is a) odd multiple of $\lambda/2$ b) even multiple of $\lambda/2$ c) odd multiple of π d) even multiple of π	1	CO2
(iv)	Angle between plane of polarization and plane of vibration is a) 0° b) 45° c) 30° d) 90°	1	CO4
(v)	The carrier waves responsible for signal transmission in optical fiber is a) radio waves b) microwaves c) light waves d) sound waves	1	CO3
(vi)	The activator atom in Ruby laser is a) oxygen b) aluminium oxide c) chromium d) iron	1	CO1

(vii) Two S.H.M.s of the same amplitude, period and phase act right angles to each other. The resultant vibration will be — 1 — CO3
a) Circular
b) Elliptical
c) Straight line
d) None of these

(viii) For critical damping, the motion is — 1 — CO2
a) Oscillatory
b) Non-oscillatory
c) Harmonic
d) none of these

(ix) Which of the following is not a characteristics of "Well behaved" wave function — 1 — CO4
a) Single valued
b) Infinite in space
c) Vanishes at boundary
d) Continuous 1st order derivative

(x) The momentum of a moving photon is — 1 — CO1
a) $p = \frac{hc}{\lambda}$
b) $p = \frac{h}{\lambda}$
c) $p = \frac{h}{c\lambda}$
d) $p = h\lambda$

(xi) What is the effect of intensity on the stopping potential? — 1 — CO1
a) As intensity increases, stopping potential increases linearly
b) As intensity increases, stopping potential decreases linearly
c) As intensity decreases, stopping potential increases exponentially
d) No effect

(xii) For an object other than a black body, it's emissivity, ε is given by — 1 — CO1
a) 1
b) $0 < \varepsilon < 1$
c) $\varepsilon > 1$
d) $\varepsilon = 0$

GROUP – B
(Short Answer Type Questions)
(Answer any **three** of the following) $3 \times 5 = 15$

		Marks	CO No
2.a)	Write down the basic differences between Fresnel & Fraunhofer class of diffraction.	2	CO3
b)	In Young's experiment, the width of the fringe obtained with light of wavelength 6000 A° is 2 mm. What will be the fringe width if the entire apparatus is immersed in a liquid of refractive index 1.5?	3	CO2
3.a)	Distinguish between step index and graded index optical fiber.	3	CO3
b)	An optical fiber is made of glass core of refractive index $\mu_1 = 1.45$ and the cladding of refractive index $\mu_2 = 1.40$ with a core diameter of 30 μm. Calculate the critical angle of the fiber.	2	CO3
4.	Describe how polarized light can be obtained with the help of Nicol Prism.	5	CO4
5.a)	What is the physical significance of Wave function?	2	CO2
b)	Normalize the following wave function $\Psi = A \sin\frac{\pi x}{L}$, for $0 < x < L$	3	CO3
6.a)	What do you mean by Miller Indices?	2	CO1
b)	Calculate the packing factor for bcc structure	3	CO3

GROUP – C
(Long Answer Type Questions)
(Answer any **three** of the following) **$3 \times 15 = 45$**

		Marks	Co No
7.a)	Derive the intensity expression due to single-slit diffraction phenomenon. Hence plot intensity distribution curve for single slit.	7	CO3
b)	A parallel beam of light is incident normally on a plane grating having 4250 lines/cm and the second order spectrum is formed at an angle 30^0. Calculate the wavelength of the monochromatic light.	3	CO3
c)	Calculate the limit of resolution of a microscope from the following data : N.A. = 0.12, λ = 6 x 10-7 m.	2	CO3
d)	What changes are expected in diameter of the Newton's rings if air film is replaced by liquid film ?	3	CO3
8.a)	Distinguish between positive and negative crystal.	3	CO2
b)	Explain the working principle of He-Ne laser with energy level diagram.	5	CO4
c)	Two polarizers are kept parallel so that the intensity of the transmitted light is maximum. Through what angle must either be rotated so that intensity becomes half of the initial value?	2	CO3
d)	What is the physical significance of numerical aperture in relation to optical fiber communication.	2	CO3
e)	Calculate the probability of stimulated emission if the probability of spontaneous emission is 0.07 in a laser action which radiates 6328 A° wavelength	3	CO4
9.a)	Derive Bragg's law related to Crystal diffraction	5	CO3
b)	Monochromatic X-rays of wavelength $1.2A^0$ are incident on a crystal plane. Find different orders of Bragg's diffraction if the crystal spacing is $1.4A^0$.	4	CO3
c)	Name an experiment that proves the existence of matter wave. Explain how the experiment verifies the existence of matter waves.	6	CO4

10.	a)	Write down the equation of damped vibration. Under what condition the motion becomes oscillatory? Derive the equation for oscillatory motion.	5	CO4
	b)	A mass of 0.01 kg is acted upon by a restoring force of 0.01 N/m and a resisting force of $2 \times 10^{-3}\, N.s.m^{-1}$. Find out whether the motion is oscillatory or non-oscillatory.	3	CO3
	c)	Starting from the steady state solution of a forced oscillator, find the resonance frequency for the amplitude resonance and also find the maximum amplitude at resonance frequency.	7	CO4
11.	a)	Draw the (experimentally found) blackbody spectrum. What is ultraviolet catastrophe?	4	CO4
	b)	What is the source of unmodified line in Compton effect? What is Compton shift? In an experiment related to Compton Effect, if the incoming photon energy is made doubled keeping the photon scattering angle fixed, then what will be the changes in Compton shift.	5	CO4
	c)	Derive a relation between phase velocity and group velocity and mention how it gets modified for a non dispersive medium.	5	CO3
	d)	State Heisenberg's Uncertainty Principle.	1	CO1