

Ajay Kumar Garg Engineering College, Ghaziabad
Department of Applied Sciences & Humanities
Pre-University Test

Course: B.Tech
 Session: 2024-25
 Subject: Engineering Physics
 Max Marks: 70

Semester: II
 Section: S11-S20
 Sub. Code: BAS201
 Time: 3Hrs.

OBE Remarks:

Q.No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
CO No.	1	1	2	2	3	4	5	1	1	2	2	3	4	4	5	5	3
Bloom's Level	L2	L1	L2	L2	L3	L2	L2	L4	L5	L4	L4	L5	L4	L5	L5	L3	L4
Weightage CO4: 16 Weightage CO5: 16																	

Note : Answer all the sections.

Section-A

A. Attempt all the parts.

(7x2 =14)

1. Explain the terms group velocity and phase velocity in the context of wave packets?
2. What are the necessary conditions for a wave function to be physically acceptable?
3. What is displacement current, and how is it different from conduction current?
4. Write integral and differential form of Maxwell equations.
5. Why the center of Newton's rings is dark in reflected light?
6. What is population inversion state and how it is achieved in a laser system?
7. Explain the term critical temperature and critical current in the context of superconductivity.

Section-B

B. Attempt any three.

(3x7 = 21)

8. Solving Schrodinger's equation find energy eigen values and eigen functions for a particle enclosed in an infinite potential well of width a . Calculate the energy difference between ground state and first excited state for an electron in one dimensional rigid box of width 1.2\AA .
9. What is Compton's effect? Derive an expression for Compton's shift. An X-ray photon with a wavelength of 0.1 nm is scattered at an angle of 90° . Calculate the change in wavelength.
10. Derive plane electromagnetic wave equations in free space and prove that velocity of electromagnetic wave in free space is equal to velocity of light. In a capacitor with vacuum between the plates, the electric field is increasing at a rate of $2.5 \times 10^{12} \text{ V/ms}$. Calculate the displacement current density.
11. How can Newton's rings be used to measure the wavelength of monochromatic light? Also describe how the refractive index of unknown liquid can be measured? The diameter of the 5th dark ring in air is 2.5 mm . When a liquid is introduced, the same ring's diameter becomes 2.0 mm . Calculate the refractive index of the liquid.
12. What is Poynting vector? Derive an expression for Poynting theorem and explain physical significance of each term. If earth receives $1398\text{ Joule}/(\text{sec m}^2)$ of solar energy. Find the value of electric field and magnetic field of radiation.

Section-C

(5x7 = 35)

C. Attempt all the parts.

13. Attempt any one.

- a) Explain construction, energy level diagram and working of helium-neon laser? How it is superior to Ruby laser? The Ruby laser has two states at 27°C . If it emits light of wavelength 7000 \AA , then calculate population ratio (N_2/N_1).
- b) Explain with suitable diagram that how light is guided in multimode step index, monomode step index and multimode graded index optical fibers. Also discuss different types of losses in optical fibers.

14. Attempt any one.

- a) Explain acceptance angle, acceptance cone and numerical aperture in optical fibers also derive an expression for them. Calculate the critical angle, acceptance angle and numerical aperture for an optical fiber if refractive index of core is 1.50 and cladding 1.48.
- b) Define stimulated absorption, spontaneous emission and stimulated emission of radiation with suitable diagram. What are Einstein's coefficients A and B? Derive Einstein's relation between Einstein's coefficients.

15. Attempt any one.

- a) Explain perfect diamagnetic behavior of superconductors on the basis of Meissner's effect. Differentiate between Type-1 and Type-2 superconductors in detail.
- b) What is the difference between top down and bottom up methods for synthesis of nanoparticles? Describe the basic principle and main steps of chemical vapor deposition and sol-gel methods.

16. Attempt any one.

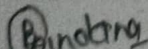
- a) What is the meaning of term quantum confinement? On the basis of this describe quantum well, quantum wire and quantum dots.
- b) Define critical magnetic field in superconductors? Explain its variation with temperature with suitable diagram. The transition temperature for Pb is 7.2K . Obtain the value of critical field at 0K if at 5K it possesses critical field $3.3 \times 10^4 \text{ A/m}$.

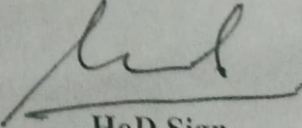
17. Attempt any one.

- a) What is a Rayleigh criterion of resolution? Define resolving power of a grating and derive an expression for it. A diffraction grating is just able to resolve two lines of wavelengths 5150.35 \AA and 5150.85 \AA in the first order. Will it resolve the lines 8037.30 \AA and 8037.60 \AA in the second order?
- b) Explain the phenomena of Fraunhofer diffraction due to single slit and prove that ratio of intensities of maximas are nearly $1: 4/9\pi^2: 4/25\pi^2: 4/49\pi^2$.

Physical constants:

Planck's constant, $h = 6.625 \times 10^{-34} \text{ Js}$, Speed of light, $c = 3 \times 10^8 \text{ m/s}$,
 Rest mass of electron $= 9.1 \times 10^{-31} \text{ kg}$, Boltzmann's constant $= 1.38 \times 10^{-23} \text{ J/K}$,
 Absolute permittivity $\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$


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 HoD Sign