Class Test-II (Engineering Physics - IAS-201) B.Tech. 2nd Semester (2024-25) IET Lucknow

[Time: 1.00 hour Maximum Marks: 20 Note: Attempt all questions. Each question carries equal marks]

Q1. Derive an expression for Compton shift ($\nabla\lambda$) in terms of scattering angle (θ) in Compton scattering experiment.

Q2. What do you mean by acceptance angle and acceptance cone of optical fiber ? Derive the expression for it.

Q3. Explain the formation of spectra with a grating. Monochromatic light of wavelength 6.56×10^{-7}m falls normally on a diffraction grating 2cm wide. The first order spectrum is produced at an angle of $18^{o}15'$ from the normal. Calculate the total number of lines on the grating.

Q4. Give an account of the experimental results, which distinguish the superconducting state from the normal state of a metal.

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[Time: 1.00 hour Maximum Marks: 20 Note: Attempt all questions. Each question carries equal marks]

Q1. Define what do you mean by Spectral Energy density in Black Body hollow cavity. Discuss variation of Spectral Energy Density (Black body spectrum) with wavelength through graphs for three different temperature. Describe the connection of above with Wien's Displacement Law and Stefan's Law.

Q2. Write down Maxwell equations of Electromagnetic waves. Explain physical significance of each equation.

Q3. (a) Explain why two coherent sources are required for sustained interference of light?

(b) A thin film of refractive index μ is illuminated by white light at an angle of incidence i. In reflected light two consecutive bright fringes of wavelengths λ_1 and λ_2 are found overlapping. Obtain an expression for thickness of the film.

Q4 Write in brief about the optical properties of nanoparticles. Critical temperature of superconductor when no magnetic field is applied is Tc. Find the temperature at which the critical field becomes half of its value at 0K.

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Subject Code: IAS201 Roll No.:

B.TECH.
SEMESTER EXAM.
ENGINEERING PHYSICS

[Max. Marks: 70]

[TIME: 3 hrs.]

Note: *Attempt All Questions. All Questions carry equal marks.*

		Marks
Q1.	Answer ALL parts.	
(a)	Write down the time independent Schrodinger wave equation. Using the equation, derive an expression for the energy Eigen-value and energy Eigen-function (normalized wave function) of a particle in a one-dimensional box.	7
	OR	
	What is Compton effect? Find out the expression for Compton shift in the wavelength of the scattered X- ray beam in a Compton scattering experiment.	
(b)	(i) Find out the phase velocity of a relativistic particle moving with constant velocity with speed v. Show that the group velocity for the wave packet associated with the relativistic particle is same as the velocity of the particle.	7
	(ii) If the de-Broglie wavelength of an electron is 6000 A^0, calculate its kinetic energy (rest mass of Electron=9.1×10^{-31} kg, Planck's constant=6.63×10^{-34} joule-sec).	
Q2.	Answer ALL parts.	
(a)	Explain the concept of displacement current and show how it led to the modification of Ampere's law.	7
(b)	Derive the electromagnetic wave equations in free space and show its transverse nature.	7
	OR	
	Derive the electromagnetic wave equations in conducting medium and explain skin depth.	
Q3.	Answer ALL parts.	
(a)	Show that the interference patterns of reflected and transmitted monochromatic light in thin film of uniform thickness are complementary.	7
	OR	
	(i) Prove that in reflected monochromatic light diameters of the bright Newton's rings are proportional to the square root of the odd natural numbers.	
	(ii) Two plane glass surfaces in contact along one edge are separated at the opposite edge by a thin wire enclosing a thin air film. If 20 interference fringes are observed between these edges in sodium light (λ=5893Å) at normal incidence, what is the diameter of the wire?	

(b) (i) Derive an expression for the intensity in Fraunhofer diffraction at a double slit. 7
(ii) What particular spectra in a plane transmission grating would be absent if width of the transparencies and opacities of the grating are equal?

OR

(i) Show that the dispersive power of grating can be expressed as $\frac{1}{\sqrt{[(a+b)/n]^2 - \lambda^2}}$ where all the terms have their usual meaning.
(ii) A parallel beam of monochromatic light is allowed to be incident normally on a plane grating having 1250 lines per cm and a second order spectral line is observed to be deviated through 30^0. Calculate the wavelength of the spectral line.

Q4. Answer **ALL** parts.
(a) (i) What do you mean by acceptance angle of optical fiber? Explain the propagation mechanism in Optical fiber. 7
(ii) If the fractional difference between the core and cladding refractive indices of the optical fiber is 0.014 and numerical aperture NA is 0.235, calculate the refractive indices of core and cladding materials.
(b) (i) What do you mean by stimulated emission of radiation in a laser? Explain the basic component of a laser system. 7
(ii) What are Einstein's coefficients? Establish relation between them.

OR

Discuss the construction and working of helium-neon laser with suitable diagram. Explain why optical pumping is not suitable for gas lasers.

Q5. Answer **ALL** parts.
(a) (i) What are superconductors? Explain how Meissner effect proves the superconductor to be a perfect diamagnetic material. 7
(ii) Calculate the critical current which can flow through a long thin superconducting wire of aluminium of diameter 10^{-3} m. The critical field for aluminium is 7.9×10^3 A/m.
(b) (i) Explain in brief the basic concept of Quantum Confinement effect in Quantum dots, Quantum wire and Quantum well and also discuss the special properties of nanomaterials. 7
(ii) Explain Type I and Type II superconductors with the help of magnetization curve.

OR

Discuss the top-down approach (CVD) and bottom-up approach (Sol-Gel) of fabrication of nano-materials with its advantages and disadvantages.

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Subject Code: BAS-101

B.Tech.

(SEM I) ODD SEMESTER EXAMINATION 2022-23

ENGINEERING PHYSICS

[TIME: 3 hrs.] **[Max. Marks: 70]**

Note: ***Attempt All Questions. All Question carry equal marks.***

		Marks
Q1.	Answer **ALL** parts.	
(a)	What is Planck's quantum hypothesis of radiation?	3.5
(b)	What is Compton wavelength? Explain why Compton shift is not observed for visible light?	3.5
(c)	Derive the de-Broglie wavelength of a particle as function of temperature.	3.5
	OR	
	Describe Davission –Germer experiment to prove that electron possess wave nature	
(d)	Deduce a relation between phase velocity and group velocity. What happens if the phase velocity is independent of frequency?	3.5
	OR	
	Find an expression for the energy state of a particle in one-dimensional box.	
Q2.	Answer **ALL** parts.	
(a)	Explain the concept of displacement current. How it make Ampere's law to valid for non-steady state?	7
(b)	(i) What is Poynting vector? Write down Poynting theorem and explain its physical significance.	7
	(ii) A mercury lamp is radiating light of power 10 watts. Calculate electric and magnetic field strength at a distance 5 meter from the lamp.	
	OR	
	(i) Write down Maxwell's equations in conducting medium and using these equations derive wave equations.	
	(ii) What do you understand by Skin depth? Calculate the skin depth for a frequency of 10^{20} Hz for silver. If $\mu_0 = 4\pi \times 10^{-7} Weber/A-m$, $\sigma = 3 \times 10^7 S/m$	
Q3.	Answer **ALL** parts.	
(a)	(i) Explain the phenomenon of interference in thin films due to reflected light.	7
	(ii) A square piece of cellophane film with index of reference 1.5 has a wedge shaped section so that its thickness at two opposite sides are t_1 and t_2. If the number of fringes appearing with wavelength 6000A° is 10, calculate the difference $(t_1 - t_2)$.	
(b)	(i) Explain briefly the diffraction pattern observed in single slit.	7
	(ii) A diffraction grating used at normal incidence gives a green line (5400 A°) in a certain order n superimposed on the violet line (4050 A°) of the next higher order. If the angle of diffraction is 30°. Calculate the value of n. Also, find how many lines per cm are there in the grating.	
	OR	

(i) What is meant by resolving power of an optical instrument? Derive an expression for the resolving power of plain transmission grating.

(ii) A light of wavelength of 5000A° falls on a grating normally. Two adjacent principal maxima occur at sin θ=0.2 and sin θ=0.3 respectively. Calculate the grating element. If the width of the grating surface is 2.5 cm. Calculate the resolving power in the second order.

Q4. Answer **ALL** parts.

(a) (i) Explain the light propagation mechanism of an optical fiber. 7

(ii) An optical signal has lost 75% of its power after traversing 500 meter of fiber. What is the loss in dB/km of this fiber?

(b) (i) Explain spontaneous and stimulated emission of radiation. 7

(ii) Derive the relation between Einstein's coefficients.

OR

(i) Explain the principle of laser action. Why two level laser system is not possible?

(ii) Calculate the population ratio of two states (N_2/N_1) in He-Ne laser that produces light of wavelength 6000A°at 300K. Boltzman constant $k=8.6\times10^{-5}$ eV/K, $h=6.62\times10^{-34}$ j-s.

Q5. Answer **ALL** parts.

(a) (i) What are superconductors? Describe the effect of magnetic field on superconductors. 7

(ii) A lead wire has critical magnetic field of 5.5×10^4 A/m at 0K. The critical temperature is 6.2 K. At what temperature would the critical field drop to 3.5×10^4 A/m?

(b) What are nanomaterials? Explain its various properties. Also give the concept of quantum dots and quantum wire. 7

OR

How the nanomaterials are fabricated? Explain CVD approach. Also, give some applications of nanomaterials.