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NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA**(An Autonomous Institute Affiliated to AKTU, Lucknow)****B.Tech****SEM: II - THEORY EXAMINATION (2024 - 2025)****Subject: Engineering Physics****Time: 3 Hours****Max. Marks: 100****General Instructions:****IMP:** Verify that you have received the question paper with the correct course, code, branch etc.**1.** This Question paper comprises of **three Sections -A, B, & C**. It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.**2.** Maximum marks for each question are indicated on right -hand side of each question.**3.** Illustrate your answers with neat sketches wherever necessary.**4.** Assume suitable data if necessary.**5.** Preferably, write the answers in sequential order.**6.** No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.**SECTION-A**

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1. Attempt all parts:-

- 1-a. The rest mass of photon of energy E is: (CO1, K1) 1
- (a) zero
 - (b) Ec^2
 - (c) E/c^2
 - (d) None of above
- 1-b. Special theory of relativity deals with the events in the frames of reference which move with constant _____. (CO1, K1) 1
- (a) Mass
 - (b) Velocity
 - (c) Acceleration
 - (d) Momentum
- 1-c. Wave function Ψ gives the idea for (CO2, K1) 1
- (a) Energy of particle
 - (b) Probability of finding particle
 - (c) Momentum of particle
 - (d) None of these
- 1-d. deBroglie wavelength associated with lighter particle is (CO2, K1) 1
- (a) lesser than heavier particle wavelength
 - (b) equal to the heavier particle wavelength

- (c) None of these
- (d) greater than heavier particle wavelength
- 1-e. Which of the following is the correct expression for the ratio of the intensity of principal maxima to the intensity of secondary maxima? (CO3, K1) 1
- (a) $1 + (N^2 - 1) \sin^2 \beta$
- (b) $1 / 1 + (N^2 - 1) \sin^2 \beta$
- (c) $(N^2 - 1) \sin^2 \beta$
- (d) $1 / (N^2 - 1) \sin^2 \beta$
- 1-f. By observing the diffraction pattern, the two images are said to be just resolved when _____. (CO3, K1) 1
- (a) The central maxima of one image coincide with central maxima of the other
- (b) The central maxima of one do not coincide with central maxima of the other
- (c) The central maxima of one image coincides with the first minimum of the other
- (d) The central maxima of one image do not coincide with the first minimum of other
- 1-g. In Electromagnetic waves the path difference electric field vector and magnetic field vector is (CO4, K1) 1
- (a) zero
- (b) $\pi/2$
- (c) π
- (d) $\pi/3$
- 1-h. Which of the following is the expression for Lorentz force? (CO4, K1) 1
- (a) qE
- (b) $q(v \times B)$
- (c) $ma + qE$
- (d) $qE + q(v \times B)$
- 1-i. When the air in a capacitor is replaced by a medium of dielectric constant K, the capacity (CO5, K1) 1
- (a) Decreases K times
- (b) Increases K times
- (c) The K^2 times
- (d) Remains constant
- 1-j. The Loss factor of a dielectric depends upon (CO5, K1) 1
- (a) Its Conductivity
- (b) Real part of dielectric constant
- (c) The thickness of dielectric
- (d) The initial polarization of dielectric

2. Attempt all parts:-

- 2.a. Why is $E = m_0 c^2$ called the rest mass energy of an object? What is the significance 2

- of mass energy relation? (CO1, K2)
- 2.b. Define group velocity and phase velocity. (CO2, K2) 2
- 2.c. Two independent sources could not produce interference, why? (CO3, K2) 2
- 2.d. What are the units, dimension and physical significance of Poynting vector. (CO4, K2) 2
- 2.e. Write down the relation between electric field E , the displacement vector D and Polarization P in a dielectric material. (CO5, K2) 2

SECTION-B

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3. Answer any five of the following:-

- 3-a. A particle of rest mass m_0 moves with speed $c/\sqrt{2}$. Calculate its mass and momentum. (CO1, K3) 6
- 3-b. Calculate the percentage contraction of a rod moving with a velocity of $0.8c$ in a direction inclined at 60° to its own length. (CO1, K3) 6
- 3-c. Calculate the velocity and kinetic energy of a neutron having deBroglie wavelength 1\AA . (CO2, K3) 6
- 3-d. Find the probabilities of finding a particle trapped in a box of length L in the region from $0.45L$ to $0.55L$ for the ground and first excited state. (CO2, K3) 6
- 3.e. A grating has 15 cm of the surface ruled with 6000 lines per cm. What is the resolving power of grating in the first order? (CO3, K3) 6
- 3.f. What will be the peak values of the electric and magnetic fields at the Earth's upper atmosphere layer if it receives 1420 Watt/m^2 of energy from the sun? (CO4, K3) 6
- 3.g. Determine the ionic polarizability of silicon if it has 4.42×10^{28} atoms/ m^3 and a dielectric constant of 12. (CO5, K3) 6

SECTION-C

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4. Answer any one of the following:-

- 4-a. State Einstein's postulates of special theory of relativity. Derive the Lorentz transformation equations. (CO1, K3) 10
- 4-b. Deduce Einstein's mass – energy relation $E = mc^2$ and discuss it. Give some evidence showing its validity. (CO1, K3) 10

5. Answer any one of the following:-

- 5-a. What do you mean by the term wave packet and matter wave? Give the statement of Heisenberg uncertainty principle. Discuss one application of this principle. (CO2, K3) 10
- 5-b. Distinguish between phase velocity and group velocity. Prove that wave group associated with moving particle travels with same velocity as that of particle? (CO2, K3) 10

6. Answer any one of the following:-

- 6-a. What are Newton rings? Find the expression for diameter of dark and bright fringes in Newton's ring arrangement. (CO3, K3) 10

- 6-b. What do you understand by missing order spectrum? Show that only first order is possible if the width of grating element is less than twice of wavelength of light. (CO3, K3) 10
7. Answer any one of the following:-
- 7-a. What do you understand by displacement current? Explain in detail. Also, write and discuss the work energy theorem for the flow of energy in an electromagnetic wave. (CO4, K3) 10
- 7-b. Write and derive the expression for electromagnetic wave equation in free space. Using the expression, find the velocity of electromagnetic wave. (CO4, K3) 10
8. Answer any one of the following:-
- 8-a. What do you mean by internal field? Derive an expression for internal field in liquids and solids. (CO5, K3) 10
- 8-b. Explain ferroelectricity and piezoelectricity along with examples. Write the characteristics and applications (CO5, K3) 10

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