ABV-Indian Institute of Information Technology & Management-Gwalior

Major Examination DEC 28, 2024

IMT & IMG - Ist Semester Engineering Physics

Time Duration: Three hours **Maximum Marks**: 50

Note: - Attempt All. Non-Programmable scientific calculator is allowed.

Q. 1. Answer in True/False to *Any 7* of the following and justify your answer. **14**

a) The intensity of blackbody radiation increases with the temperature according to the Stefan-Boltzmann law.

b) The uncertainty in energy and time is related by $\Delta E.\Delta t \geq h/2$.

c) The time-independent Schrödinger equation is used for systems where the Hamiltonian is not time-dependent.

d) The wave function in Schrödinger's equation provides the exact trajectory of a particle.

e) The wavelength of a particle is larger when its momentum is higher.

f) Optical fibers can only carry light in the visible spectrum.

g) Gauss's law of magnetism states that magnetic monopoles exist.

h) The curl of an irrotational field is always zero.

i) The gradient of a vector field measures the rotation of the field around a point.

Q.2. Why does carbon can form so many different compounds? Discuss the different forms of carbon, especially the 0D, 1D, 2D and 3D? **06**

Q.3.

A. Explain the condition for Lasing action using suitable diagram, also explain the reason why in two level system the lasing action is not possible. **03**

B. Find the ratio of the population of the higher energy state to the lower energy state when optical pumping is used at 25°C and photons of wavelength 5000×10^{-8} m are emitted. **03**

Or

How bonding affects the properties of material? Using Bond Energy (E) vs Bond length (r) curve, explain any two properties of the material. **03**

Q.4.

A. Explain how classical mechanics fails to explain the Blackbody Radiation and how this can be explained with the new branch of physics called Quantum mechanics. **03**

B. Calculate the spectral radiance B (λ, T) of a blackbody at 3000 K at a wavelength of $\lambda = 1 \times 10^{-5}$ m and Boltzmann constant = 1.38×10^{-23} J/K, **03**

Or

Explain how the Davisson and Germer experiment verified the De-Broglie hypothesis experimentally. **03**

Q.5.

A. Write the differential and integral forms of the Maxwell equations. Do write about their importance. **03**

B. If the electric field $E=x^2\,i + y^2\,j + z^2\,k$. Find divergence and Curl for E. What is the charge density at point (101) in space? **03**

Or

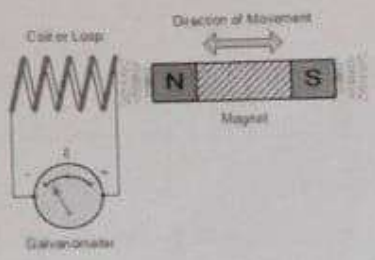

Fig. A

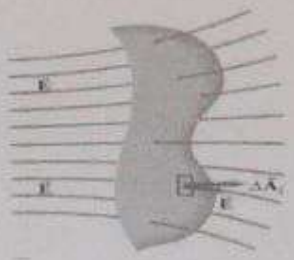

Fig. B

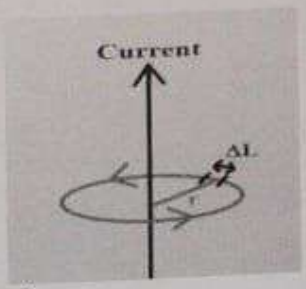

Fig. C

A. Identify the Fig A, Fig B and Fig C, which laws are associated with the corresponding figures, Explain. **03**

B. Given the electric field $E=2xy\,i + 3yz\,j + 4zx\,k$, Find divergence and curl of the Electric field. Calculate the charge density at unit distance from origin in all directions. **03**

Q.6. Using suitable diagram explain the different types of optical fibers and their applications? Write brief note on the following terms: **06**

a) Modes | b) Dispersion | c) Bending and splice loss

Q.7.

A. For a simple cubic crystal, the interplanar spacing d for the plane with Miller indices (1, 1, 1) is 0.2 nm Find Lattice Constant. Calculate the angle between this plane and the (1, 0, 0) plane. **03**

B. An electron has an uncertainty in position $\Delta x = 0.2$ nm. Estimate the uncertainty in its velocity, given the mass of the electron is $m = 9.11\times10^{-31}$ kg. **03**

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