SUNDARBAN MAHAVIDYALAYA

Intermediate Examination: 2020

Sub: PHSA

PAPER: Third Paper

Full Mark:50. **Time: 2 hrs**

Answer **Question No. 1** and any **four questions** from the rest.

1. Answer **any** five:. 2x5=10

a) Show that electrostatic field is conservative.
b) Define susceptibility and dielectric constant how are they related?
c) State Poynting theorem in connection with electromagnetic theory.
d) A series RC circuit is excited by a source of constant voltage switches on at time t = 0. what is the maximum growth rate of charge on the capacitor?
e) Convert decimal number 123.25 into its equivalent binary.
f) What is Brewster's angle?
g) What is the reverse saturation current of a P-N junction diode? what is its order for Ge and Si diode?
h) What is meant by transistor current gain for PNP and NPN transistor.
i) Define longitudinal and transverse spherical aberration with a diagram.
j) Explain Rayleigh criterion of resolution.

2.

a) A metal sphere of radius 'a' is surrounded out to a radius 'b' by a linear dielectric material of permitivity€. Determine the capacitance of the sphere. 4
b) what is electrical image. state its usefulness in solving electrostatic problems. 2
c) Prove, by the method of boundary condition, that the field inside a spherical cavity in an isotropic dielectric is given by $E_i = E + p/3\varepsilon_0$ where different symbol have their usual meaning. 4

3.

a) State kirchhoff's law for distribution of current in a network of conductors. Show that the first law is consistent with the principle of conservation of charge and second law is consistent with the conservation of energy. 1+2+2
b) Starting from the expression for magnetic vector potential $\mathbf{A} = \mu_0/4\pi \oint dl/r$, Obtain the expression for magnetic induction **B.** Also show that $\nabla \cdot \mathbf{B} = 0$ 3+2

4.

a) Explain What do you mean by free current and bound current in connection with magnetization of matter? 3
b) Show that in homogeneous magnetisation **M** gives rise to a volume current density $\mathbf{J} = \nabla \times \mathbf{M}$ within the matter. Symbol have their usual meaning. 4
c) The magnetic field in some region has the form **B**=kxî where k is a constant. Find the force on a square loop of side 'a' lying in y-z plane and centre at origin. Given that the loop carries a steady current I in anticlockwise direction as you look down the x axis. 3

5.

a) In a double slit interference arrangement 'd' represent the slit separation and 'D' the distance between source and the screen. If one of the slit is covered by a thin transparent sheet of thickness t and refractive index μ, Obtain an expression for the shift of the Central Fringe. 3
b) What do you mean by interference produced due to division of wavefront and due to division of amplitude? Give examples. 2
c)
d) If a liquid of refractive index μ is introduced between the lens and the glass plate how will the ready of the dark rings change? 2
e) In the Newton's rings arrangement if the incident light consists of two wavelengths 5890Å and 5896Å, calculate the distance (from the point of contact) at which the ring will disappear. The radius of curvature(R) of the convex surface of the lens being 300 cm. 3

6.

a) What is quartz crystal? Indicate, How it can be used to obtain a polarised light . 2

b) Explain the origin of optical activity. 2

c) A left circularly polarized light is passed through a half wave plate. what will be the state of polarization of the emergent light? Explain. 3

d) A plane polarised light of wavelength 600 nm changes to a circularly polarized light on passing through a quartz crystal cut parallel to optic axis. Calculate the minimum thickness to produce such effect. Given($n_o - n_e) = 0.005$. 3

7.

a) Explain avalanche and Zener breakdown mechanism. What is the maximum permissible current through a 5.6 volt, 400mW Zener diode? 2+2

b) Can you measure the potential barrier across a p-n junction diode with a voltmeter connected across the junction? Explain. 2

c) Convert($E3B)_{16}$ to its octal equivalent. 2

d) Design a to input XOR gate using NOR gates exclusively. 2