GURU NANAK INSTITUTE OF TECHNOLOGY

An Autonomous Institute under MAKAUT

2022

ELECTROMAGNETIC FIELDS

EE(PH)301

TIME ALLOTTED: 3Hours **FULL MARKS:70**

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable

GROUP – A

(Multiple Choice Type Questions)

Answer any ***ten*** from the following, choosing the correct alternative of each question: **10×1=10**

		Marks	CO No
1. i)	Electric field containing in charge free regions can be found using a) Laplace's equation b) Poisson's equation c) Coulombs law d) Helmholtz equation	1	CO2
ii)	If there is a total charge of 20 pC over a surface area of 0.1 m^2, the surface charge density will be a) $200\frac{pC}{m^2}$ b) $200\frac{C}{m^2}$ c) $100\frac{pC}{m^2}$ d) $100\frac{C}{m^2}$	1	CO3
iii)	Electronic Polarizability of a monatomic gas atom is proportional to a) R b) R^2 c) R^3 d) R^4 R is the atomic radius.	1	CO3
iv)	Magnetostatic field is a) Conservative b) Solenoidal c) Irrotational d) Both a) and c)	1	CO1
v)	The dimension of $(\mu_0 \varepsilon_0)$ is a) $L^{-2}T^{-2}$ b) $L^{-2}T^{2}$ c) LT^{-1} d) $L^{-1}T^{-1}$	1	CO3

vi) Which of the following materials exhibit Ferro-magnetic property? 1 CO4
a) Iron
b) Platinum
c) Hydrogen
d) Rochelle salt

vii) According to Faraday's law, EMF stands for 1 CO2
a) Electromagnetic field
b) Electromagnetic force
c) Electromagnetic friction
d) Electromotive force

viii) In free space, the Poisson equation becomes 1 CO3
a) Maxwell equation
b) Ampere equation
c) Laplace equation
d) Steady state equation

ix) How is the residual magnetism from a material removed? 1 CO3
a) Retentivity
b) Coercivity
c) Magneton
d) Switching off magnetic field

x) When does a paramagnetic material become diamagnetic material? 1 CO1
a) At critical temperature
b) Above critical temperature
c) Below critical temperature
d) Never

xi) If $\vec{E}$ and $\vec{B}$ are the electric and magnetic fields respectively of an e.m. wave travelling in vacuum with propagation vector $\vec{K}$, then nature of e.m. wave is represented by 1 CO1, CO4
a) $\vec{K}.\vec{E}=0$
b) $\vec{K}.\vec{B}=0$
c) both a) and b)
d) $\vec{K}\times\vec{E}=-\vec{B}$

xii) Calculate the emf when the flux is given by $3\sin t + 5\cos t$ 1 CO1
a) $3\cos t - 5\sin t$
b) $-3\cos t + 5\sin t$
c) $-3\sin t - 5\cos t$
d) $3\cos t + 5\sin t$

GROUP – B
(Short Answer Type Questions)
(Answer any *three* of the following) 3 x 5 = 15

			Marks	CO No
2.	a.	Show that $\oint \vec{B}.\vec{dS}= 0$, where $\vec{B}$ is a magnetic field. State the theorem used here.	3	CO2
	b.	What is the difference between electric potential and potential difference?	2	CO1
3.	a.	Obtain Faraday's laws of e.m. induction in differential form.	2	CO1
	b.	Express Ampere's circuital law in terms of magnetic vector potential.	3	CO1
4.	a.	What is Bohr Magneton? Give the expression and value of it.	3	CO3
	b.	Why technologically all important materials are either Ferromagnetic or Ferrimagnetic?	2	CO3
5.		What is Polarization in dielectric materials? Find out a relation between D, E and P.	5	CO1
6.		Derive the Curie-Weiss law of ferromagnetism and obtain an expression for the Curie temperature.	5	CO1

GROUP – C
(Long Answer Type Questions)
(Answer any *three* of the following) 3 x 15 = 45

			Marks	CO No
7.	a.	Derive and state Poynting theorem.	7	CO2
	b.	Explain the transformer emf and motional emf with example.	5	CO2
	c.	Establish a relation among magnetic flux density B, magnetic intensity H and intensity of magnetization M.	3	CO2
8.	a.	An electron revolves round a nucleus with frequency 4×10^{15} Hz in an orbit of radius of 0.53 Å. Calculate (a) the electric current due to moving electron. The magnetic moment of the orbital electron.	4	
	b.	If the radius of hydrogen atom is 0.053 nm, find its electronic polarizability.	2	CO3
	c.	Find out the relations corresponding to the unit vector between Cartesian and cylindrical coordinates.	4	CO2
	d.	Write down the mathematical expression of Gauss divergence and Stokes theorem.	2	CO2
	e.	Show that curl grad f = 0, where $f = x^2y + 2xy + z^2$.	3	
9.	a.	What is meant by the term 'Loss Tangent/Loss Angle' of a dielectric? Explain physical significance of Loss Tangent considering equivalent phasor diagram.	7	CO3
	b.	The polarizability of neon is 0.35 x 10-40 F-m^2. If the gas contains 2.7×10^{25} atoms/m^3 at 0°C and 1 atm. pressure, calculate its relative dielectric constant.	3	CO3
	c.	Define electric flux density or electric displacement vector and atomic polarizability. Hence derive $\mathbf{D} = \epsilon_0\mathbf{E} + \mathbf{P}$, where symbols have their usual meaning.	5	CO3

10.	a.	What do you mean by Hysteresis effect? Draw & Explain Ferromagnetic Hysteresis curve identifying coercive force and remanent flux density.	5	CO3
	b.	How do you compare the behavior of soft and hard magnetic materials using Hysteresis Curves.	3	CO3
	c.	The magnetization for a metal alloy is 1.2×10^6 A/m when the magnetic field is 200 A/m. Calculate the magnetic susceptibility and magnetic induction or flux density within the alloy.	4	CO3
	d.	Give some applications of Ferrites.	3	CO3
11.	a.	Applying Maxwell's equation, derive the expression of electromagnetic wave equation in free space for electric field. Hence find out the velocity of the wave.	6	CO4
	b.	How the wave equation will be modified for loss-less dielectric? Hence obtain the velocity of an e.m. wave propagating through such a medium with relative permittivity 3 and relative permeability 5.	4	CO1,CO4
	c.	Explain Skin Effect in relation to e.m. wave propagation through source-free conducting medium and hence obtain an expression of Skin Depth.	5	CO1, CO4