Ref. No: Ex/ET/PC/B/T/211/2024(S)

B.E.Tel.E. 2nd YEAR SUPPLEMETARY EXAMINATION, 2024

(1st Semester)

ELECTRO MAGNETIC THEORY

Time: Three hours | Full Marks 100

No. of questions		Marks

Answer any *five* questions.

Consider $\varepsilon_0=8.854X10^{-12}F/m$ and $\mu_0=4\pi X10^{-7}H/m$

Values of other universal physical constants may be assumed, if necessary.

All symbols carry their usual meanings.

1.(a)	Prove that $\nabla \times (a\vec{B}) = \nabla a \times \vec{B} + a\nabla \times \vec{B}$	10
(b)	Convert $3\hat{x} + 4\hat{y} + 5\hat{z}$ to spherical co-ordinates.	10
2.(a)	Define electrostatic potential and equipotential surfaces. What is the nature of equipotential surfaces due to a point charge?	6
(b)	What is the difference between conservative and dissipative fields? Site one example of each.	4
(c)	Derive the fields due to an infinitesimal static electric dipole.	10
3.(a)	State and prove Gauss' Law of electrostatics.	8
(b)	Derive an appropriate expression for density of stored energy in electric field.	12
4.(a)	Define an irrotational field. Is a magnetic field rotational or irrotational?	4
(b)	Justify why a magnetic potential is vector rather than a scalar.	2
(c)	Consider $\varphi=\pi/4$ plane defined in cylindrical coordinates. Find the amount of magnetic flux crossing the portion between $0.01<\rho<0.05$m and $0<z<2$m due to a current filament of 2.5A along the z-axis in +z direction.	14
5.(a)	For a time harmonic field propagating through a good dielectric, determine the attenuation constant and phase velocity.	8
(b)	Repeat the same for a good conductor.	8
(c)	How do you demarcate between a good dielectric and a good conductor?	4
6.(a)	What are parallel and perpendicular polarizations?	4
(b)	For both of them, find an appropriate expression for the reflection coefficient at a dielectric-dielectric interface.	8+8
7.(a)	Prove Snell's law for electromagnetic fields.	8
(b)	A current sheet $K = 9\hat{y}$ a/m is located at z=0. Region 1 at z<0 has $\mu_{r1}=4$ and region 2 at z>0	
(c)	has $\mu_{r2}=3$. Given that $H_2=14.5\hat{x}+8\hat{z}$A/m, find H_1.	12
8.	Write notes on any *two* of the followings.	
(a)	Total internal reflection	
(b)	Inductance and capacitance	
(c)	Method of images and fundamental problem of electrostatics	10 X 2