Question Paper

Exam Date & Time: 24-May-2023 (02:30 PM - 05:30 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

FOURTH SEMESTER B.TECH. (ELECTRONICS AND COMMUNICATION ENGINEERING) DEGREE EXAMINATIONS - MAY/JUNE 2023

SUBJECT: ECE 2252/ECE_2252 - ELECTROMAGNETIC WAVES

Marks: 50 **Duration: 180 mins.**

Answer all the questions.

Missing data may be suitably assumed.

1A)	State and prove Gauss's law in point form.	(4)
1B)	Calculate the electric flux density at point M(2, –3, 6) produced by (i) a point charge Q = 55 mC located at point N(–2, 3 –6); (ii) a uniform line charge ρ_L = 20 mC/m located on the x-axis.	(3)
1C)	A point charge Q is at the origin of spherical coordinate system. Find the flux that crosses the portion of spherical shell described by $\alpha \le \theta \le \beta$. What is the result if $\alpha = 0°$ and $\beta = 90°$?	(3)
2A)	Consider a portion of sphere given by $r = 4$ m, $0 \le \theta \le 0.1\pi$, $0 \le \phi \le 0.3\pi$. If $\mathbf{H} = 6r \sin\phi\ \mathbf{a}_r + 18r \sin\theta \cos\phi\ \mathbf{a}_\phi$ A/m, evaluate both the sides of Stokes' theorem.	(4)
2B)	The expression for current density is given by $\mathbf{J} = 10\rho^2 z\ \mathbf{a}_\rho - 4\rho\cos^2\phi\ \mathbf{a}_\phi$ mA/m^2. (i) Find the current density at point P(ρ=3, ϕ=30°, z=2). (ii) Find the total current flowing outward through the circular band $\rho = 3$, $0 \le \phi \le 2\pi$, $2 \le z \le 3$.	(3)
2C)	Using Biot-Savart law determine the magnetic field intensity at any point due to an infinite element carrying current along positive z-axis.	(3)
3A)	If $\mathbf{E}$=377cos(10^{9}t-5y)$\mathbf{a_z}$ V/m representing a uniform plane wave propagating in y direction in a dielectric medium, Find (i) the dielectric constant (ii) velocity of propagation (iii) intrinsic impedance (iv) wavelength.	(4)
3B)	What is skin effect? Show the graphical illustration of skin depth.	(3)
3C)	State & prove Poynting theorem.	(3)
4A)	Derive expressions for reflection and transmittance coefficient for oblique incidence of S-polarized uniform plane wave impinging on an interface between two different dielectrics.	(4)
4B)	What is Brewster's law? Derive the expression for Brewster angle.	(3)
4C)	At point P(-3, -4, 5), express that vector that extends from P to Q(2, 0, -1) in: i) Rectangular coordinates ii) Cylindrical coordinates iii) Spherical coordinates	(3)
5A)	A lossless line of characteristic impedance of 50Ω is to be matched to a load whose normalized admittance y_l =2 +j3.732 by means of lossless short circuited stub. The characteristic impedance of the stub is 100Ω. Find the stub position (closest to the load) and length (using smith chart) so that a match is obtained.	(4)
5B)	Derive the expression for input impedance of a lossless quarter wave two wire transmission line. Also explain any two of its applications.	(3)
5C)	Sketch the magnitudes of voltage and current when (a) $Z_l << R_0$ (b) $Z_l >> R_0$ (c) $Z_l = R_0$, for a distance of 2λ from the load on a two wire transmission line at Radio frequencies.	(3)

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