

B.E DEGREE EXAMINATIONS: APRIL/MAY 2014

(Regulation 2009)

Third Semester

ELECTRICAL AND ELECTRONICS ENGINEERING

EEE102: Electro Magnetic Theory

Time: Three Hours

Maximum Marks: 100

Answer all the Questions:-

PART A (10 x 1 = 10 Marks)

- The unit vector can be expressed as $\bar{a}_{OA} =$
 - $\frac{|OA|}{\bar{OA}}$
 - $\frac{OA}{|OA|}$
 - $\frac{\bar{OA}}{OA}$
 - $\frac{\bar{OA}}{|OA|}$
- The Stokes theorem can be expressed as
 - $\oint_L \bar{F} \cdot d\bar{l} = \iint_S (\bar{\nabla} \cdot \bar{F}) dv$
 - $\oint_L \bar{F} \cdot d\bar{l} = \iint_S (\bar{\nabla} \times \bar{F}) ds$
 - $\oint_S \bar{F} \cdot d\bar{s} = \iiint_V (\bar{\nabla} \times \bar{F}) dv$
 - $\oint_S \bar{F} \cdot d\bar{s} = \iiint_V (\bar{\nabla} \cdot \bar{F}) dv$
- The field intensity at a point on a sphere of radius 3m, if a positive charge of 2 μC is placed at the origin of the sphere is
 - 2.0997 \bar{a}_r kV/m
 - 1.9972 \bar{a}_r kV/m
 - 1.0972 \bar{a}_r kV/m
 - 2.9972 \bar{a}_r kV/m
- Poisson's equation is given by
 - $\Delta^2 V = 0$
 - $\Delta V = 0$
 - $\Delta^2 V = -\rho_v / \epsilon$
 - $\Delta V = -\rho_v / \epsilon$
- \hat{H} at the centre of a circular conductor of radius R is given by
 - $\hat{H} = \frac{I^2 \sin\theta \bar{a}_N}{2R} A/m$
 - $\hat{H} = \frac{I \sin\theta \bar{a}_N}{2R} A/m$
 - $\hat{H} = \frac{I}{4\pi R} (\sin\alpha_2 - \sin\alpha_1) \bar{a}_\phi A/m$
 - $\hat{H} = \frac{I}{4\pi R^2} (\sin\alpha_2 - \sin\alpha_1) \bar{a}_\phi A/m$

- Force between two current carrying conductors is directly proportional to
 - Diameter of conductors
 - Permittivity
 - Permeability
 - Dielectric strength between the conductors
- Which of the following is true for Maxwell's equation for harmonically varying fields
 - $\nabla \cdot \bar{B} = 0$
 - $\nabla \times \bar{D} = 0$
 - $\nabla \cdot \bar{D} = 0$
 - $\nabla \times \bar{B} = 0$
- In a dielectric medium
 - $J_D = J_C$
 - J_D does not exist
 - $J_D > J_C$
 - $J_D < J_C$
- One Neper is given by
 - 20 dB
 - 7.675dB
 - 8.686 dB
 - 4.202 dB
- For copper $\mu_r = 1$ and $\sigma = 5.8 \times 10^7$ mho / m, Calculate depth of penetration of copper at 1Mhz
 - 66.085 μm
 - 6.6085 μm
 - 5.6085 μm
 - 56.085 μm

PART B (10 x 2 = 20 Marks)

- Define base vector.
- What is a vector and vector field? Give two examples.
- Define dielectric polarization.
- What is meant by energy density?
- State Biot-Savarts law.
- Write the Lorentz force equation.
- Differentiate transformer and motional EMF.
- In a material for which $\sigma = 5s/m$ and $\epsilon_r = 1$ and $\hat{E} = 250 \sin 10^{10} t$ V/m. Find conduction and displacement current densities.
- Define standing wave ratio.
- What is loss tangent?

PART C (5 x 14 = 70 Marks)

21. a) (i) State and prove divergence theorem. (7)
 (ii) Transform the vector $5a_x$ at Q ($x=3, y=4, z=2$) to cylindrical co-ordinates. (7)

(OR)

- b) (i) Consider the two vectors $P = 4a_y + 10a_z$ and $Q = 2a_x + 3a_y$. Find the Projection of P and Q. (7)
 (ii) Find the divergence of A at P ($5, \pi/2, 1$) where $A = r z \sin\phi a_r + 3 r z^2 \sin\phi a_\phi$. (7)

22. a) A circular flat ring of inner radius 1m and outer radius 2m has $\rho_s = (100/r) \mu C/m^2$. Determine \hat{E} on the axis of the ring 10m away from the centre.

(OR)

- b) An electrostatic field is given by $\hat{E} = -8xy a_x - 4x^2 a_y + a_z$ V/m. The charge of 6C is to be moved from B (1,8,5) to A (2,18,6). Find the work done in each of the following cases.
 (i) The path selected is $y = 3x^2 + z, z = x + 4$
 (ii) The straight line from B to A.
 Show that the work done remains same and is independent of the path selected.

23. a) Obtain the expression for \hat{H} in all the regions if the cylindrical conductor carries a direct current I and its radius is "R" m. Plot the variation of \hat{H} against the distance "r" from the centre of the conductor.

(OR)

- b) (i) State and prove the boundary conditions for magnetic fields. (7)
 (ii) In cylindrical co-ordinates $A = 50 r^2 a_z$ Wb/m is a vector magnetic potential in a certain region of free space. Find the vectors H, B and J. Using vector J, find total current I crossing the surface $0 \leq r \leq 1, 0 \leq \phi \leq 2\pi$ and $z = 0$. (7)

24. a) (i) Write Maxwell equation in integral and differential form. (10)
 (ii) Given $\hat{H} = H_m e^{j(\omega t + \beta z)} a_x$ A/m in free space. Find \hat{E} in free space. (4)

(OR)

- b) (i) Write down the relation between field theory and circuit theory. (10)
 (ii) A straight conductor of 0.2m lies on the X – axis with one end at origin. The conductor is subjected to a magnetic flux density $B = 0.04 a_y$ Tesla and velocity $v = 2.5 \sin^3 t a_z$ m/s. Calculate the motional electric field intensity and emf induced in the conductor. (4)

25. a) State and prove Poynting's theorem.

(OR)

- b) Explain the propagation of uniform plane wave in perfect dielectric.
