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B.E / B.Tech (Full Time) DEGREE END SEMESTER EXAMINATIONS, APRIL / MAY 2014

Electronics and Communication Engineering
IV Semester
EC 8402 Electromagnetic Fields and waves
(Regulation 2012)

Time: 3 Hours | Answer ALL Questions | Max. Marks 100

PART-A (10 x 2 = 20 Marks)

1. State Gauss's law and specify its limitation.
2. What are boundary conditions? Give the boundary condition at the interface between a dielectric and a conductor.
3. Draw the hysteresis curve and indicate that it is not linear for ferromagnetic materials.
4. Define Amperes law of forces between two circuits carrying currents.
5. Give the significance of displacement current.
6. Given $\vec{E} = \overrightarrow{E_m} \sin(\omega t - \beta z)\hat{a}_y$ in free space. Determine $\vec{B}$ and $\vec{H}$.
7. Define polarization of an electromagnetic wave.
8. Find the skin depth at a frequency of 1.6 MHz and 60 Hz in aluminium ($\sigma = 38.2 \times 10^6\ S/m$) and compare.
9. Outline the principle of working of an Electromagnetic pump.
10. List the limitations of analytical methods which can be overcome by numerical methods.

Part – B (5 x 16 = 80 marks)

11. (i) Give the physical significance of Gradient, Divergence and Curl. **(6)**
    (ii) Describe the behavior of a uniform plane wave when it is incident obliquely at the interface between two lossless media with material parameters μ_1 ε_1 and μ_2 ε_2 and hence arrive at two laws of optics applicable to wave propagation. **(10)**

12.(a) A thin circular ring of radius '**a**' has a linear charge density of ρ_L C/m. It is centered on the x-y plane. Find,
(a) the electric field intensity at a height **h** meters along z-axis.
(b) find E when **h=0**, (c) find $\bar{E}$ when **a>>h** (d) when **h>>a** and (e) when **a** $\rightarrow$ **0**.

(OR)

12.(b) (i) Find the potential outside and inside a conducting spherical shell of radius $\mathbf{R_0}$ which carries a uniform charge of Q on the outer surface. Assume the reference point is at infinity. Plot the variation of $\bar{E}$ and V. **(8)**

(ii) Given that $\boldsymbol{A} = \frac{10x^3}{3}\mathbf{a}_x$, evaluate both sides of the divergence theorem for the volume of a cube,2m on an edge, centered at the origin and with edges parallel to the axes **(8)**

13.(a) (i) Find the expression for magnetic field intensity $\bar{H}$ at any point in cylindrical co-ordinate system, due to a filamentary conductor carrying current I along the z axis, when
(a) the conductor extends from –L to +L and
(b) the conductor extends from - ∞ to + ∞. **(8)**

(ii) The circular loop conductor having a radius of 0.15 m is placed in the xy plane.This loop consists of a resistance of 20Ω .If the magnetic flux density is **B**=0.5 sin 10^3 t **Tesla** ,find the current flowing through the loop. **(8)**

(OR)

13.(b) (i) Using Amperes circuital law find the magnetic field at a distance ρ from a long straight wire placed along z-axis which carries a steady current I **(6)**

(ii) Determine the magnetic field H inside a coaxial line carrying a steady current I and sketch the variation of D vector within the coaxial line. **(10)**

14.(a) (i) Derive the Maxwell's equation from Ampere circuital law and Faraday's law. Express these equations in phasor form .Give the physical interpretations of the equations derived. **(10)**

(ii) Derive the boundary conditions for tangential component of Electric and magnetic field at the interface of two media. **(6)**

(OR)

14.(b) (i) Derive the expression for pointing vector and physically interpret the expression **(10).**

(ii) Determine the propagation constant γ and intrinsic impedance for a material having μr=1, εr=9 and σ = 0.25pS/m, at a frequency of 2.0MHz. **(6)**

15.(a) (i) Derive the expression for the electrostatic deflection of an electron beam in a cathode ray tube with suitable descriptive sketch. **(10)**

(ii) In a CRO, a potential difference of 500V is maintained between anode and cathode. The deflecting plate each of length 1 cm is separated at a distance of 2mm and 100V is maintained between the plates. The electron travel a distance of 10cm on emerging from the deflecting plates to reach the screen. For the electron released from the anode with zero initial velocity, calculate
(a) The velocity as it enters the vertical deflection plates.
(b) The acceleration and velocity in the vertical direction within the plates.
(c) The exit velocity in the vertical direction. **(6)**

(OR)

15.(b)(i) Obtain the equation for kinetic energy of the charged particle in Cyclotron describing its operation in the course of derivation. **(10)**

(ii) Describe the principle of working of VandeGraf generator with neat sketch **(6)**