B.E (Full Time) DEGREE END SEMESTER EXAMINATIONS, NOV/DEC 2011

ELECTRONICS AND COMMUNICATION ENGINEERING

THIRD SEMESTER

EC9201 – ELECTROMAGNETICS FIELDS AND WAVES

(REGULATIONS 2008)

Time: 3Hrs Max Marks: 100

Answer ALL Questions

Part – A (10x2=20)

1. Using gauss law find the electric field intensity for the infinitely long conducting wire.
2. State and prove stokes theorem.
3. Find the divergence for the vector field $\mathbf{A}=\mathbf{a}_r r^2+\mathbf{a}_z 2z$.
4. An electron has a velocity of 1 km/sec along $\mathbf{a}_x$ in a magnetic field whose magnetic flux density is $\mathbf{B}=0.2\ \mathbf{a}_x -0.3\mathbf{a}_y+0.5\ \mathbf{a}_z$ wb/m2. Find the electric field intensity if no force is applied to the electron.
5. When vector magnetic potential is given by $\mathbf{A}= 1/r^3\ (2.0 \cos\theta\ \mathbf{a}_r+ \sin\ \mathbf{a}_\theta)$, find the magnetic flux density.
6. Define ferromagnetism.
7. Define skin depth.
8. Give any four comparisons of circuit theory and electromagnetic theory.
9. Two parallel plates are held 5 cm apart. An electron is released at the surface of the negatively charged plate and strikes the surface of the opposite plate in 12.5 ns. Find the velocity of the electron at the instant it strikes the positively charged plate and the acceleration of the electron.
10. What are the major advantages of FEM

Part – B (5x16=80)

11. (i) An infinitely long straight conductor with a circular cross section of radius 'b' carries a steady current **I**. Determine the magnetic flux density both inside and outside the conductor. (8 Marks)

    (ii) Derive vector magnetic potential from Biot Savart law. (8 Marks)

12a (i) Determine the force on a point charge of 5 nC at (0, 0, 5) m due to uniformly distributed

charge of 5 mC over a circular disk of radius r=1m in z=0 plane. (8 Marks)

(ii) A vector field $\mathbf{D}=\mathbf{a}_r (\cos^2\theta)/R^3$ exists in the region between two spherical shells defined by R=1 and R=2. Verify the divergence theorem. (8 Marks)

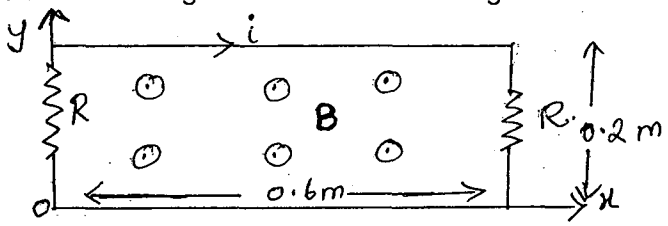
OR

12b. (i) A spherical distribution of charge $\rho= \rho_o[1-(r^2/b^2)]$ exists in the region $0\leq R\leq b$. This charge distribution is concentrically surrounded by a conducting shell with inner radius $R_i(>b)$ and outer radius R_o. Determine E everywhere. (10 Marks)

(ii) A spherical capacitor consists of an inner conducting sphere of radius R_i and another conductor with a spherical inner wall of radius R_o. The sphere in between is filled with a dielectric of permittivity ε. Determine the capacitance. (6 Marks)

13a (i) Derive the time varying Maxwell's equation form the respective experimental law. (10 Marks)

(ii) The circuit shown in figure is situated in a magnetic field $\mathbf{B}=\mathbf{a}_z 3\cos(5\pi 10^7 t-2/3\pi x)$ (μT).



Assuming R=15 (Ω), Find the current i. (6Marks)

OR

13b (i) Discuss the boundary relation for the electromagnetic field s at the interface of the dielectric and conducting boundary. (8 Marks)

(ii) Derive the poynting theorem. (4 Marks)

(iii) The electric vector of a uniform plane wave in free space is given by $\mathbf{E}=\mathbf{a}_y 5\exp\{-j2\pi(0.6x+0.8z)+j\omega t\}$. Evaluate phase constant β, the wavelength λ and angular frequency of electric fields and also find the direction of propagation of the EM waves. (4 Marks)

14a (i) Derive the source free wave equation and discuss its characteristics in lossy dielectric. (8 Marks)

(ii) Calculate the depth of penetration of EM wave at the frequency (a) 25 KHz and (b) 25 MHz for the conductor of conductivity σ=5mho/m, and ε_r=80. The attenuation is 90%. (8 Marks)

OR

14b (i) Discuss the characteristics of the EM wave when it incident normal to the plane conducting boundary. And derive the necessary equation. Sketch the E and H patterns. (8 Marks)

(ii) A uniform sinusoidal plane wave in air with the following phasor expression for electric field intensity $E_i(x,z)=a_y10e^{-j(6x+8z)}$ (V/m) is incident on a perfectly conducting plane at z=0. a) Find the frequency and wavelength of the wave. b) Write the instantaneous expression for $E_i(x,z:t)$ and $H_i(x,z:t)$ using a cosine reference. (c) Determine the angle of incidence. (8 Marks)

15a. (i) Write the procedure for solving the problem using Finite element method. (8 Marks)

(ii) What are the boundary conditions involved in solving the boundary value problems using finite difference method. (8 Marks)

OR

15b. (i) Write about the application of EM fields in CRO. (8 Marks)

(ii) Write short notes on (a) ink jet printer and (b) cyclotron. (8 Marks)