Fifth Semester B.Tech Degree Examination

(2013 Scheme) Model Paper

13.505 APPLIED ELECTROMAGNETIC THEORY (T)

Time:3Hours **Max.Marks:100**

Part A (Answer all Questions;Each carries 2Marks)

1. Transform the vector $10a_y$ at M(r=4,θ=135°,φ=120°)

2.A=e^{-y} (cosx a_x-sinxa_y). Find $\nabla . A$

3.Derive the capacitance of a coaxial cable.

4.In region 1 defined by z<0 μ_{r1}=3 and $H_1=1/\mu_0(0.2a_x+0.5a_y+1a_z)$.Find H_2

If θ_2=45°.

5.In free space $D=D_m\sin(\omega t+\beta z)a_x$. Find H

6.Determine the γ(propagation constant) for a given material having

μ_{r1}=1,ε_{r1}=8 & σ=0.25pS/m .Wave frequency is 1.6 MHz.

7.Differentiate between lossless & distortionless line.

8.Why at high frequencies we go for distributed elements.

9.Sketch the field patterns inside WR 90 for TM_{21} mode.

10.Derive the relationship between λ_g,λ_c& λ_0

(10x2=20Marks)

Part B (Answer one Question from Each Module ;carrying 20Marks)

Module 1

11a)Find E & V for the region between 2 concentric cylinders where V=0 V at

r=1mm & V=150V at r=20mm (10 Marks)

b) Derive the inductance of 2 wire line (5 Marks)

c)For r>2 $D=(20/r^2)a_r$ in spherical co-ordinates. Find the charge density (5Marks)

12a)For a line charge $\rho_l=(10^{-9}/2)$C/m on z axis. find VAB where A(2m,π/2,0) & B(4m,π,5m) (5Marks)

b) Find the work done in moving a charge Q=-20μC from the origin to (4,2,0)m in the field $E=2(x+4y)a_x+8xa_y$ V/m along the path $x^2=8y$ (7 Marks)

c)State Biot-Savart's law. Show that Ampere's law is a special case (8 Marks)

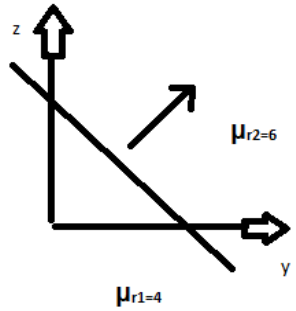
Module 2

13 a)In a material for which σ=5 S/m and εr=1; Find conduction and Displacement current densities and the frequency at which they have equal magnitudes (7 Marks)

b)A square coil 0.6m rotates about x axis at ω=60πrad/s in a field $B=0.8a_z$ T assuming initially coil is in x-y plane

and rotate about x-axis while making α with y-z plane. Find induced voltage (5 Marks)

c)Region 1 where $\mu_{r1}=4$ is the side of the plane y+z=1 containing the origin



In the region 2 $\mu_{r2}=6$ $B_1=2a_x+1a_y$ (T).Find B_2 & H_2 (8 Marks)

14a)A travelling wave is described by $y=10\sin(\beta z-\omega t)$.Sketch the wave at T=0

And T=t1 when advanced by λ/8 if velocity is c and $\omega=2x10^6$rad/s (10 Marks)

b)A wave propagates from a dielectric medium to the interface with free space. If the angle of incidence is the critical angle of 20°.find ε_r (5marks)

c)Define the terms phase velocity and group velocity (5Marks)

Module 3

15 a)If $E=100/r*\sin\theta\cos(\omega t-\beta r)a_\theta$ (V/m) ;$H=0.265/r*\sin\theta\cos(\omega t-\beta r)a_\varphi$ A/m

Represents field at a large distance from an antenna in free space .Find the average power crossing hemispherical shell at r=1km $0 \leq \theta \leq \pi/2$ (7Marks)

b)Show that a linearly polarized wave is a combination of 2 circular polarized waves

(5Marks)

c)A free space conductor interface has H^i_0= 1A/m on the free space side

Frequency is 31.8 MHz and constants are $\varepsilon_r = \mu_r = 1$ σ=1.26 MS/m. Find H^r_0, H^t_0 and depth of penetration H^t.

(8Marks)

16a)A 600 Ω transmission line is 150m long operates at 400kHz with$\alpha = 2.4 \times 10^{-3}$ Np/m and β=0.0212 rad/m and supplies a load impedance of $Z_L = 424.3 \angle 45^\circ$

Find length of the line in wavelengths Γ_L,Γ_s and Z_S.For a received voltage $50 \angle 0^\circ$

Find Vs,position on the line where voltage is maximum and its magnitude

(12 Marks)

b) For a "twin lead " transmission line 2 copper wires (σ_c=50MS/m)are

embedded 0.625 in. apart in a dielectric with ε_r =2.4.Neglecting losses determine diameter of conductors

for a characteristic impedanceZ_0=300Ω. Find dc and AC resistance at 100MHz. (8 Marks)

Module 4

17. A lossless line 70Ω with ε_r =2.1 is terminated at Z_L=50<30° at 320 MHz.

The load is to be matched to a 50Ω shorted line with ε_r =2.3 connected in Parallel .Stub must be at least 5cm from the load. If a match is possible find The distance from the load and length of stub . Use Smith chart

(20 Marks)

18a)A lossless air dielectric waveguide has a=7.214cm and b=3.404cm.For TM11

Mode propagating at a frequency 1.1 times cutoff frequency of the mode

Calculate a)critical wavenumber b)cutoff frequency c)operating frequency

d)propagation constant e)guide wavelength,f)phase velocity g)wave impedance (14 Marks)

b) Show that E and H are mutually perpendicular in any TE or TM wave (6 Marks)