BITS-Pilani Dubai, International Academic City, Dubai

II SEM: 2009-2010 III Year EEE

Evaluation Component: Comprehensive examination (Closed Book)

EEE C 433 ELECTROMAGNETIC FIELDS AND WAVES

Date: 25th May 2010 Max. Marks: 80

Duration: 3hrs Weightage: 40%

Instructions:
Assume suitable data if required
Answer questions sequentially

Answer All Questions

1)

a) Let $V = 2xy^2z^3 + 3\ln(x^2 + 2y^2 + 3z^2)$V in free space. Evaluate each of the following quantities at $P(3, 2, -1)$: i) *Voltage at point P and* ii) Electric field at point P. **(4)**

b) Evaluate the magnetic flux density vector $\hat{H}$ at point P(0,0,3) due to a current sheet $\hat{K} = 8\hat{a}_x$ A/m flows in the region $-2 \prec y \prec 2$ in the plane z=0. **(4)**

2)

a) Define propagation constant γ. Obtain the expression for propagation constant γ. **(6)**

b) Derive the expression for the reflection coefficient k in terms of impedance and show that the standing wave ratio $S = \frac{1+|k|}{1-|k|}$. **(6)**

3)

a) Obtain the expression for Open circuited impedance of the line Z_{oc} and short circuited impedance of the line Z_{sc} and also prove that $z_0 = \sqrt{z_{oc}.z_{sc}}$ for any transmission line, Where Z_0 is the characteristics impedance of line. **(6)**

b) The primary constants of a certain line are R=2.6 ohm/Km, L=2.4 mH/Km, C=0.0078 μF/Km and G=0.11 μ mho/Km. The line of 50 km length carries signal of 10 V, 7.5 kHz and is terminated by its characteristic impedance. Find the receiving power **(8)**

4)

a) An antenna of impedance 40+j20 Ω is to be matched to a lossless line having characteristic impedance 100 Ω. Find the parameters of single stub matching **(6)**

b) Derive wave equation for conducting medium and find its solution. **(4)**

5)

a) A plane wave traveling in non magnetic medium has $E = 50\sin(10^8 t + 2z)\hat{a}_y V/m.$ Find the direction of propagation, the wave length, the frequency the relative permittivity and the magnetic field intensity H **(4)**

b) Polystyrene has relative permittivity of 2.7.If a perpendicularly polarized wave incident at an angle of $\theta_i = 30^o$ from air onto polystyrene, find (i) the angle of transmission, the reflection coefficient and transmission coefficient. **(6)**

6) Write the working principle of Yagi - Uda antenna and design it for receiving television channel operating in 54 MHz to 61 MHz. **(6)**

7)

a) The magnetic field intensity along Φ direction is $H_\phi = \frac{I_m.dl\cos\theta}{4\pi}(-\frac{\omega\sin\omega t_1}{cr} + \frac{\cos\omega t_1}{r^2})$ due to a short dipole. Show that the electric field in the direction of propagation 'r' is $E_r = \frac{2I_m.dl\cos\theta}{4\pi\varepsilon_0}(\frac{\cos\omega t_1}{cr^2} + \frac{\sin\omega t_1}{\omega r^3})$. Where $t_1 = t - \frac{r}{c}$,r is the distance, c is the velocity of light **(6)**

b) Derive the expression of Fris Formula. **(4)**

8) Write short notes on

a) Broadside array **(5)**

b) Helical Antenna **(5)**

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SECOND SEMESTER 2009 – 2010

Test2 [Open Book]

Course Code : **EEE C433** **III Year EEE** Date: **02.05.10**
Course Title : **ELECTROMAGNETIC FIELDS AND WAVES** Max Marks: **40**
Duration : 50 **minutes** Weightage: 20%

Instructions: 1. *ANSWER All the questions.*
2. *Make assumptions, if any, but explicitly indicate the assumptions made*

1)

a) A line with characteristic impedance of 70Ω is terminated by open circuit impedance. Determine the sending end impedance for the line having length of (i)λ/8, (ii)λ/4 and (iii)λ/2 **[3]**

b) Write the procedure for finding unknown terminating impedance **[5]**

c) Write the need of stub matching and its various types .Which is the stub preferred? **[3]**

d) A transmission line having characteristic impedance of 50 Ω is connected to a load of 250Ω.Find the parameters of single stub matching **[4]**

2) Show that the input impedance of lossless Quarter wave transformer having length λ/4 has the relation $Zin\infty\frac{1}{Z_L}$ [use the expression $Z_{IN} = Z_o \frac{Z_L + jZ_o \tan \beta y}{Z_o + jZ_L \tan \beta y}$] **[6]**

3) The electromagnetic field in free space has $E_x = 0$, $E_y = E_0 \cos \omega(t - \frac{z}{v})$ and $E_z = 0$. Prove that $\frac{E_y}{H_z} = \sqrt{\frac{\varepsilon_0}{\mu_0}}$ where E_0 is initial magnitude of E field, z is distance in Z direction and v is the velocity of propagation **[6]**

4) A uniform plane wave propagating in free space strikes normally upon a lossy medium having a dielectric constant of 18 with σ=0.The frequency of the wave is 300kHz.If the electric field has an amplitude of 10 V/m at the interface at time t=0.Determine propagation constants of both mediums, wave impedance of both mediums, reflection coefficient and transmission coefficient. **[8]**

5) Explain about how the radiation of electromagnetic waves takes place in Antenna. **[5]**

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SECOND SEMESTER 2009 – 2010

Test1 [Closed Book]

Course Code : **EEE C433** **THIRD YEAR** Date: 21.**03.10**
Course Title : **ELECTROMAGNETIC FIELDS AND WAVES** Max Marks: **50**
Duration : 50 **minutes** Weightage: 25%

Instructions: 1. *ANSWER All the questions.*
2. *Make assumptions, if any, but explicitly indicate the assumptions made*

1. A) If the electric field E is 100 V/m at a distance of 2 m from a positive point charge Q, find the magnitude of charge Q by assuming the relative permittivity of the medium $\varepsilon_r = 1$. How will be the direction of the electric field? [3]

   B) A uniform line charge of 2μC/m is located on z axis. Find the electric field intensity E in rectangular coordinates at P(1,2,3),if the exist from (i) $-\infty \le z \le \infty$ (ii) $-4 \le z \le 4$ [5]

   C) Calculate the volume charge density ρ_v if the electric flux density at point P(3,45°,-45°) is given by $D = 2r\sin\theta\sin\phi\hat{a}_r + r\cos\theta\sin\phi\hat{a}_\theta + r\cos\phi\hat{a}_\phi$ [5]

2. A) A ring of radius 9cm is placed on plane z=0 and has its center at (0, 0, 0) .If the ring carries current 10 A along a_ϕ find magnitude and direction of magnetic field intensity. [3]

   B) Find the magnitude and direction of magnetic field intensity at a distance of 1 m due to infinite length conductor carrying current of 2π A. [3]

3. A) Derive the transmission line equation for the line terminated by its characteristic impedance. Write its unique characteristics. [5]

   B) Derive the condition $\frac{R}{L} = \frac{G}{C}$ for the transmission line. Write its significance and prove the same [6]

4. The transmission line of length 500 m has open circuit impedance and short circuit impedance $Z_{oc} = 2000\angle -80^0\,\Omega$ and $Z_{sc} = 20\angle 20^0\,\Omega$ respectively. Calculate the value of the characteristic impedance, the attenuation constant, phase constant and velocity of propagation constant if ω =10000 radians. [10]

5. Write the following in short answer [10]
   i) Skin effect
   ii) Reflection coefficient
   iii) Standing Wave ratio
   iv) The propagation constant
   v) Lossless line

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quiz-2

NAME: _____; ID NO:_____; Sec.: _____; Prog.:B.E. (Hons.) _____

Version A

BITS, PILANI – DUBAI

SECOND SEMESTER 2009 – 2010

Course Code: **EEE C433** **THIRD YEAR EEE** Date: 19.**04.10**

Course Title: Electromagnetic field and waves Max Marks: 14

Duration : **20 minutes** Weightage: 7%

Instructions: 1.ANSWER All the questions **with most appropriate answer(s)**, at the space provided.
2. Make assumptions, if any, but explicitly indicate the assumptions made

1. Write the procedure for finding the reflection coefficient using smith chart [2]

2. Write the location of open circuit impedance point and short circuit impedance point in smith [1]

3. Why is stub matching required? Write the function of stub for matching. [2]

4. Write the limitations of single stub matching [1]

NAME: _____; ID NO:_____; Sec.: _____; Prog.:B.E. (Hons.) _____

Version A

5. The electric field of E_y of a TEM wave equals $100vm^{-1}$ rms. Find (a) velocity of propagation in free space(b) velocity of propagation in the medium with ε_r=9 [2]

6. If the power density of a TEM wave =100 W/m^2 in a lossless medium with ε_r =4.Find the magnitude of (a) electric field intensity (b) magnetic field intensity [2]

7. Write maxwell's equation in differential form from Faraday's law and from Ampere's law [2]

8. Obtain the value of intrinsic impedance of free space [2]

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NAME: _____; ID NO: _____; Sec.: _____;
Prog.B.E. (Hons.) _____

Version A

BITS, PILANI – DUBAI

SECOND SEMESTER 2009 – 2010

Course Code: **EEE C433** **Quiz-1** Date: **08.03.2010**
Course Title: **ELECTROMAGNETIC FIELDS AND WAVES** Max Marks: **16**
Duration: **20 minutes** Weightage: **8%**

Instructions: 1.ANSWER All the questions **with most appropriate answer(s)**, at the space provided.
2. Make assumptions, if any, but explicitly indicate the assumptions made
3. Write on back side if the space is insufficient.

1. Write the expression for transforming a point in Cartesian coordinate system to a point in a Spherical coordinate system [1.5 M]

2. Find the force vector due to a reference point charge 0.3mC at (1,2,3) on the test charge -0.1mC at (2,0,5) [2 M]

3. Write the assumptions to be made for solving problems in Gauss's law [1.5]

4. Find the electric field intensity E in the scalar potential field given by the expression $V = 2x^2y - 5z$ at a point P(-4,3,6) [2M]

5. Write Maxwell's equation for static field. [2 M]

6. Determine current density J if magnetic field $\hat{H} = 0.2z^2\hat{a}_x$. [2 M]

7. Write a proof for $\nabla X\hat{E} = \hat{0}$,where E is electric field intensity [2 M]

8. Derive Laplace equation for static electric field [3M]