BITS-Pilani Dubai, International Academic City, Dubai

II SEM: 2008-2009 III Year EEE

Evaluation Component: Comprehensive examination (Closed Book)

EEE C 433 ELECTROMAGNETIC FIELDS AND WAVES

Date: 1ST JUNE 2009 **Max. Marks: 80**

Duration: 3hrs **Weightage: 40%**

Instructions:
Assume suitable data if required
Answer sequentially

Answer All Questions

1)

a) A If the electric flux density $\hat{D} = 2yz\hat{a}_x$ C/m², find the total electric flux leaving the surface of the cube, $0 \le y, z \le 0.4$. **(4)**

b) Evaluate the current density if the magnetic flux density vector $\hat{H} = 0.2z^2\hat{a}_x$. **(4)**

2)

a) Derive the equation for voltage and current at any point on the transmission line having infinite length. Explain the meaning of the real and imaginary parts of propagation constants. **(6)**

b) An open wire line of 200 km long is correctly terminated. The generator at the sending has open circuit voltage Voc=10V, frequency of 1 KHz and internal impedance of 500 Ω. The characteristic impedance of the line is 683-j138 Ω and the propagation constant P=0.0074+j0.0356 per Km. Determine the terminating end voltage, current and power of the line. **(6)**

3)

a) Show that the input impedance of the line is $Z_{in} = Z_0 \frac{1 + Ke^{-2Pl}}{1 - Ke^{-2Pl}}$ where Z_o is the characteristic impedance of the line, K is the reflection coefficient of the line, l is the length of the line and P is the propagation constant of the line. **(6)**

b) Derive the distortion less condition $\frac{R}{L} = \frac{G}{C}$ for the transmission line and prove that it establishes distortion less condition. **(8)**

4)

a) A 100 Ω coaxial line is terminated in a load impedance Z_L=400+j200 Ω with two stub tuners .Find the length of the both stubs with proper assumption of location. Also find the VSWR on the location first stub and second stub. Write the procedure for find the length of the stubs. **(6)**

b) If the electric field strength of a plane wave is

$E_x = 0; E_z = 0; E_y = A.e^{j\omega(t-\frac{z}{v})}$ .Find the magnetic field components in vector form. **(4)**

5)

a) In free space it is given that $E = 30\pi e^{j(10^8+\beta x)} a_z$ V/m and $H = H_0 e^{j(10^8 t+\beta x)} a_y$ A/m. Calculate the value of β and H_0, $\beta \succ 0$ **(4)**

b) In free space defined by in the region $z \leq 0$,a plane wave with $H = 10\cos(10^8 t - \beta z) a_x$ mA/m is incident normally on a lossless medium having parameters $\varepsilon_r = 2\varepsilon_0; \mu_r = 8\mu_0$ defined in the region $z \geq 0$ .Determine the reflection coefficient and transmission coefficient **(6)**

6) Obtain the expression for total electric field due to linear array with n isotropic point sources of equal Amplitude and spacing. **(6)**

7)

a) The electric field due to short dipole in θ direction is $E_\theta = \frac{I_o l.e^{j(\omega t-\beta r)} \sin\theta}{4\pi\varepsilon_0}(\frac{j\omega}{c^2 r}+\frac{1}{cr^2}+\frac{1}{j\omega r^3})$ .Identify the regions established by this field. **(6)**

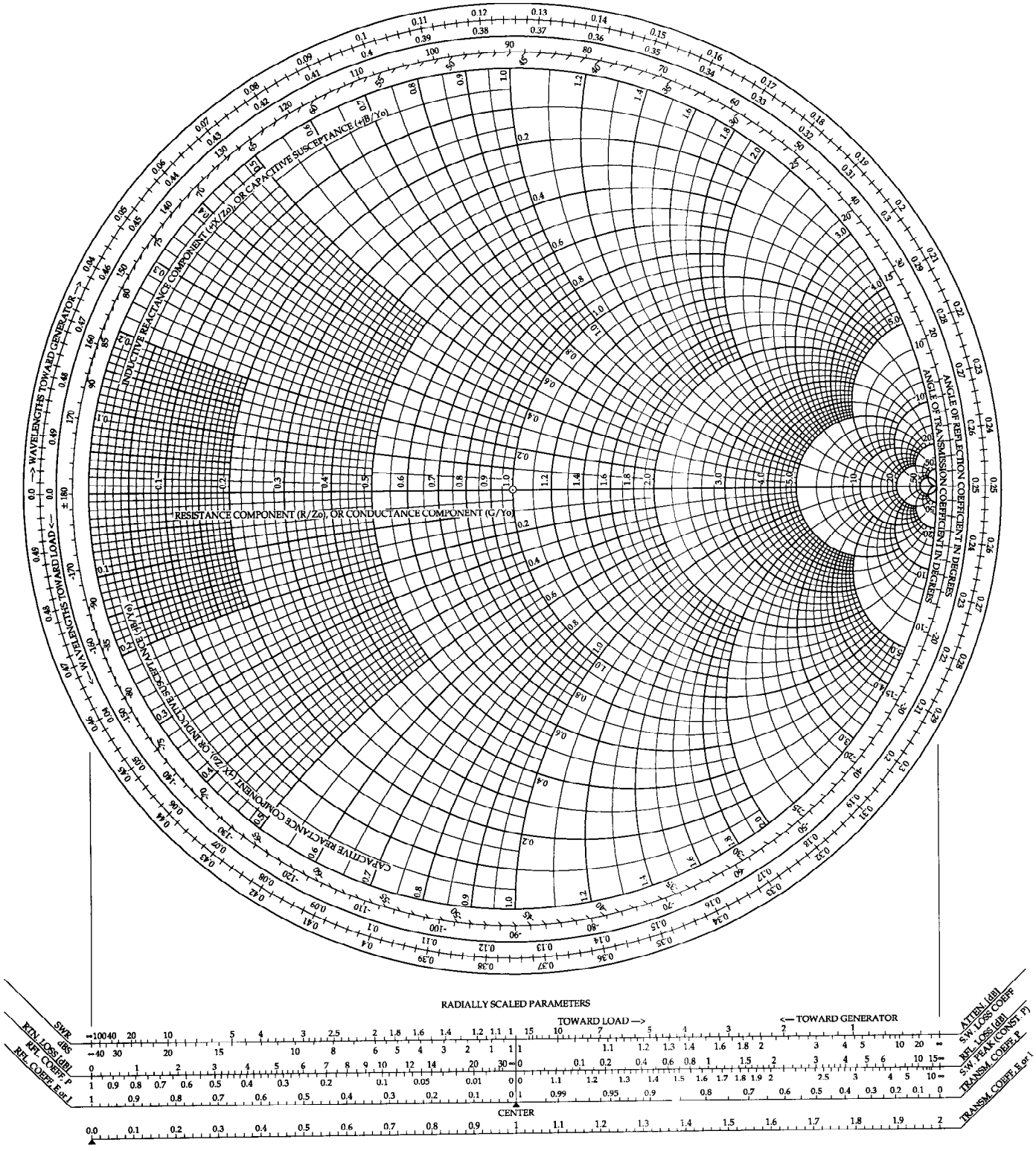
b) Derive the expression of Fris Formula. **(4)**

8) Write short notes on

a) Parabolic Dish antenna **(5)**

b) Log Periodic Antenna **(5)**

Smith Chart



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II SEMESTER 2008-2009

Test-II [Open Book]

Course No: EEE C433: Electromagnetic Fields and Waves

Section: III yr -EEE **30-04-2009**

Answer All question **Max.Marks:40** **Time: 50 Min**

1. Obtain the expression for R circles of smith chart and draw them. The transmission line has following parameters the characteristics impedance of the line $Z_0 = 200\angle 0^0 \Omega$, the propagation constant $P = \alpha + j\beta$, the length of the line l=24.25λ, the first minima from the load is $l_{\min} = 0.125\lambda$ and the SWR = 5.Find the input impedance of the line using smith chart. (15 Marks)
2. Write the advantages and disadvantages of single stub matching. (05 Marks)

3. The electric field intensity associated with a plane wave traveling in a perfect dielectric medium is given by $E_x(z,t) = 10\cos(2\pi.10^7.t - 0.1\pi x)$ V/m. Find the phase constant, velocity of propagation, the relative permittivity, the intrinsic impedance and the magnetic field intensity. (09 Marks)

4. 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 $\frac{E_y}{H_z} = \sqrt{\frac{\varepsilon_0}{\mu_0}}$ (06 Marks)

5. The uniform plane wave in air $E = 8\cos(\omega t - 4x - 3z)$ V/m is incident on a dielectric slab at ($z \le 0$) with $\mu_r = 1.0, \varepsilon_r = 2.5, and \sigma = 0$ .Find the polarization of the wave and the reflection coefficient if the angle of incidence is $\theta_i = 53.13^0$ and $\theta_t = 30.39^0$ (05 Marks)

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II SEMESTER 2008-2009

Test-I

Course No: EEE C433: Electromagnetic Fields and Waves

Section: III yr -EEE **22-03-2007**

Answer All question Max.Marks:50 Time: 50 Min

1. a) Find the electric field intensity at point $(1, 90^{o}, 90^{o})$ due to potential field $V = 10r\sin^2\theta\cos\phi$. (5 Marks)

   b) Find the charge per unit volume at point (1,-2, 3) if the electric field intensity $\hat{E} = yz\hat{a}_x + 4xyz\hat{a}_y + y\hat{a}_z$ V/m (5 Marks)

   c) A thin ring of radius 5cm is placed on plane z=1 cm so that its centre is at (0, 0,1cm).If the ring carries 50mA current along $\hat{a}_\phi$, find the magnetic field intensity at (0, 0,10cm) (5 Marks)

2. Derive Maxwell's equation in Differential Form. (5 Marks)
   Given $E_m = \sin(\omega t - \beta z)\hat{a}_y$ V/m in free space. Find D, B, H. Sketch E and H at t=0 (6 Marks)

3. a) Write the condition at which an infinite line is equivalent to the finite line terminated by its characteristic impedance (6 Marks)

   b) Open wire line having characteristic impedance $692\angle -12^{o}\ \Omega$ is terminated in 200 Ω Resistor. The line is 100 km long and is connected to power by a generator of 1.0 V at 1000Hz.Determine the reflection co efficient (6 marks)

4. a) Write conditions at which the line becomes lose less and distortion less and prove the above conditions. (6 marks)

   b) Show that for small R and G but non zero $\alpha = \frac{R}{2}\sqrt{\frac{C}{L}} + \frac{G}{2}\sqrt{\frac{L}{C}}$ and $\beta = \omega\sqrt{LC}$ $\beta = \omega\sqrt{LC}$.

   (6 marks)

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II SEMESTER 2008-2009

Quiz-3

Course No: UC433: Electromagnetic Fields and Waves

Section: EEE **29-04-2009**

Answer All question Max.Marks:10 Time:20 Min

A plane wave traveling in non magnetic medium has $E = 50\sin(10^8 t + 2z)a_y V/m.$

(i)Find a) the direction of propagation

b) the wave length, the frequency

c) the relative permittivity

d) the magnetic field intensity H.

(ii) Find α and β if the wave travels in the medium is characterized by

$\varepsilon_r = 1, \mu_r = 20$ *and* $\sigma = 3$

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II SEMESTER 2008-2009

Quiz-2

Course No: UC433: Electromagnetic Fields and Waves

Section: EEE **17-03-2009**

Answer All question Max.Marks:10 Time:20 Min

The primary constants of a certain line are R=2.6 ohm/Km, L=2.4 mH/Km, C=0.0078μF/Km and G=0.11 μmho/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.

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III Year EEE-II Sem 2008-2009
EEE C433 ELECTROMAGNETIC FIELDS AND WAVES

QUIZ-1

Date: 04/03/09 **Time: 20 Min**

Max.Marks:10 **Weigtage: 5%**

Answer All questions

1. If the electric field E is 100 Vm^{-1} at a distance of 2 m from a point charge Q, find the magnitude of the charge Q located in free space.

   A) 44.5nC B) 44.5μC

   C) 30nC D) 30μC

2. The closed line integral of E in electrostatic field is

   A) Always 0 B) Always 1

   C) Infinity D) 10

3. Identify the correct relation

   A) $\nabla.D = 2C$ B) $\nabla.D = \rho$ C/m^3

   C) $\nabla.D = V$ D) $\nabla.D = E$

4. Find out the value of E if V =3. e^{-2x}

   A) 5.7 X 10^{-6} V/m B) 5.7 X 10^{-7} V/m

   C) 6. e^{-2x}V/m D) 3. e^{-2x} V/m

5. A long straight wire carries a current I =10A.The distance at which the magnetic field H = 1 A/m is

   A) 30m B) 2.5μm

   C) 5m D) 1.59m

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6. The expression finds $\nabla.\hat{D} = 40\ \text{pC/m}^3$ .The total charge in the volume specified by $0 \le x \le 10cm, 5cm \le y \le 15cm, 0 \le z \le 12cm$

A) 10fC B) 0 C

C) 48fC D) 40pC

7. Identify the incorrect Statement

A) The closed surface integral of $\hat{B}$ is equal to zero
B) The Gauss law for Magnetic field finds the charge associated with the system
C) The Ampere law finds the current passing through the wire

8. Identify the Lorentz force Equation

A) $F = \frac{Q_1 Q_2}{4\pi\varepsilon_0 R^2}$ B) $F = (IxB)L$

C) $V = \int E.dl$

9. How many turns are required for a 30-cm long solenoid to have an inductance of 10mH.The solenoid diameter is 4cm.Assume the medium is air

A) 1234 B) 2000

C) 5000 D) 1380

10. The differential form Maxwell Equation from Ampere's Law is

A) $\nabla x\hat{H} = J + \frac{\partial D}{\partial t}$ B) $\nabla.\hat{D} = \rho$

C) $\nabla x\hat{B} = -\frac{\partial B}{\partial t}$