BITS, PILANI – DUBAI CAMPUS

I SEMESTER 2011 – 2012

Course Code: ECE C452 COMPREHENSIVE EXAMINATION Date: 12.01.2012

Course Title: ELECTROMAGNETIC FILEDS AND MICROWAVE ENGG. Max.Marks:80

Duration: 3 HRS Weightage: 40%

Instructions: 1.ANSWER all questions in sequence of their order.
2. Make assumptions, if any, but explicitly indicate the assumptions made
3. Attach graph sheets with answer book

1.	A) Find electric field intensity at point P (1, 0, 0) in free space due to a point charge of magnitude $0.008nC$ located at point (0, 0, 0).	**3**
	B) Find current density $\hat{J}$ in static magnetic filed $\hat{H} = r.\sin\phi.\hat{a}_r$ mA/m at point $P(r = 1m, \theta = 45^o, \phi = 45^o)$.	**5**
2.	A) Derive differential form of Maxwell's equation for time varying field.	**6**
	B) A TM wave travelling in z-direction has electric field in x-direction and magnetic field in y-direction. Derive its wave equation and find its solution for conducting medium.	**6**
3.	An electric vector E of an electromagnetic wave in free space is given by Ex=Ez=0 : $\hat{E}_y = E_0 e^{j\omega(t-\frac{Z}{C})}\hat{a}_y$ V/m.	
	i. Derive the expression for the magnetic fields	**4**
	ii. show that the electric field is perpendicular to the direction of propagation	**2**
	iii. Find electromagnetic power at a point300 m from transmitting point if f=1Mhz,t=2μs and E_0=5 mV/m	**4**
4.	A) Derive transmission line equation for an infinite length transmission line.	**4**
	B) A transmission line having characteristic impedance Z_0=100 Ω is to be matched with terminating load impedance of Z_R=150+j120 Ω for a range of frequencies. Find required single stub matching parameters using smith chart	**6**
	A transmission Line has following constants $Z_{sc} = 1500\angle -10^o$ Ω , $Z_{oc} = 240\angle 30^o\,\Omega$ and the propagation. $P = 0.0067\angle 70^0$ Find resistance R, conductance G, inductance L and capacitance C if ω=5000 radians/sec.	**5**
	B) The input impedance of line is given $Z_{in} = Z_0 \frac{Z_R \cosh Pl + Z_o \sinh Pl}{Z_o \cosh Pl + Z_R \sinh Pl}$ .Show that the input impedance of the line is $Z_{in} = Z_0 \frac{1 + Ke^{-2Pl}}{1 - Ke^{-2Pl}}$ where Z_0 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.	**5**

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6.	A) The electric field due to short dipole in θ direction is $E_\theta = \frac{I_o l.e^{j(\omega t-\beta r)}\sin\theta}{4\pi\varepsilon_0}(\frac{j\omega}{c^2 r}+\frac{1}{cr^2}+\frac{1}{j\omega r^3})$. What are the regions established by this field. Explain them.	5
	B) Obtain the expression for E field due to two point sources in a broadside antenna array. The distance between point sources is λ/2 m. Assume Eo=10 mA/m . Derive the expression for E field and draw its radiation pattern in polar chart given	7
7.	Write short notes on a) Parabolic Dish antenna b) Log Periodic Antenna	 5 5
8.	A) Draw block diagram of klystron amplifier and explain its principle of operation.	4
	B) Draw Travelling wave tube amplifier and explain its principle of operation	4

BITS, PILANI – DUBAI CAMPUS

I SEMESTER 2011 – 2012

Course Code: **ECE C452** **TEST-2 [OPEN BOOK] – III yr ECE** Date: **22.12.2011**

Course Title: **ELECTROMAGNETIC FILEDS AND MICROWAVE ENGG.** Max.Marks:**40**

Duration: **50 minutes** Weightage: **20%**

Instructions: 1.ANSWER all questions in sequence of their order.
2. Make assumptions, if any, but explicitly indicate the assumptions made

1.	a.A transmission line having characteristic impedance Z_o=100 Ω is to be matched with terminating load impedance of Z_R=220+j200 Ω for a range of frequencies. Find the double stub matching parameters required using smith chart. b.Using Smith chart, find the unknown terminating impedance of line if input impedance of the transmission line is Z_{in}=100+j100 Ω and the characteristic impedance of line is Z_o=100 Ω. The first maximum is located at a distance 8.30λ from the load.	**[8 M]** **[4 M]**
2.	a. A short dipole radiates TM waves. Tm wave has following three components E_r, E_θ and H_ϕ.The magnetic field component of the wave is $\lvert H_\Phi \rvert = \frac{\omega . I_m . dl . \sin(\omega t - \omega . r / c).\sin\theta}{4\pi c r} A/m$. Finds the electric field component of the wave along θ direction. b. Using polar chart, draw radiation pattern of $\lvert H_\Phi \rvert$ if current element =20 A-m, f=500 kHz, r=3.14x10^2 m	**[5M]** **[5M]**
3.	Design Yagi antenna for the frequency range from 61 MHz to 68 MHz [4]	**[4M]**
4.	Obtain the expression for E field due to array containing two point sources carrying opposite phase current. The distance between array elements is λ/2 m distance apart in an antenna array. Draw its radiation pattern.	**[10M]**
5.	An earth station receives signal from satellite at frequency of 4Ghz.Design parabolic antenna for receiving the signal with gain 30 dB.	**[4M]**

BITS, PILANI – DUBAI CAMPUS

I SEMESTER 2011 – 2012 — III yr ECE

Course Code: **ECE C452** **TEST-1** Date: **03.11.2011**

Course Title: **ELECTROMAGNETIC FILEDS AND MICROWAVE ENGG.** Max.Marks:**50**

Duration: **50 minutes** Weightage: **25%**

Instructions: 1.ANSWER all questions in sequence of their order.
2. Make assumptions, if any, but explicitly indicate the assumptions made

1.	i. Find current density $\hat{J}$ in static magnetic filed $\hat{H} = \rho.\cos\theta.\hat{a}_\rho$ mA/m at point $P(\rho = 1m, \theta = 30^o, \phi = 30^o)$. ii. Apply gauss law and find electric flux density at point P (0, 1, 0) due to the point charge of magnitude $4\Pi\mu C$ located at (0, 0, 0).	**[6 M]**
2.	Write Maxwell equation in differential form. Obtain wave equation and its solution for free Space.	**[6M]**
3.	A Plane wave travelling in y direction in a lossy medium ($\varepsilon_r = 4, \mu_r = 1, \sigma = 10^{-2}$ mho/m) has $\hat{E} = 60.\sin(10^9.\pi.t + \pi/2)\hat{a}_z$ V/m. Find a) E at y=1m and t=2ns b)Distance travelled by the wave to have phase shift of 20^0 c) distance travelled by the wave to have amplitude reduced by 50% d) $\hat{H}$ at y=2m and t=2ns	**[8M]**
4.	An EM wave incident normally on medium2 (conductor) with impedance Zc from medium 1(air) with impedance Zo. Find reflected and transmitted components of electric field for following conditions.(i) Zo >>Zc and (ii) Zo and Zc=0 with $\sigma = \infty$	**[6M]**
5.	i. When does finite length line become infinite length line? Reason out ii. A transmission line has following primary constants $R = 6.5\Omega/km, L = 1.6mH/km$, $C = 0.1\mu F/km$ and $G = 0.1\mu mho/km$ .Find Characteristic impedance ,propagation constant , attenuation constant and phase constant at $\omega = 5000 radians/\sec$.	**[6M]**
6.	i. Write condition for lossless transmission line. Also prove that line is lossless on this condition. ii. Find Z_{oc} and Z_{sc} .Prove that $Z_o = \sqrt{Z_{sc}.Z_{oc}}$	**[8 M]**
7.	i. Show that input impedance of transmission line $Z_{in} = Z_o \dfrac{Z_R + Z_o \tanh Pl}{Z_o + Z_R \tanh Pl}$. ii. Calculate the input impedance for a lossless line having characteristic impedance $Z_o = 50\angle 0^o\,\Omega$ and terminating impedance $Z_R = 600\angle 0^o\,\Omega$ .The length of the line is 1000λ.	**[10M]**

NAME: _____; ID NO: _____;

BITS, PILANI – DUBAI CAMPUS

I SEMESTER 2011 – 2012

Version A

Course Code: **ECE C452** **Quiz-2** Date: **14.12.2011**

Course Title: **ELECTROMAGNETIC FIELDS AND Microwave Engg.** Max Marks: **14**

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

Instructions: 1.ANSWER all 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. Find reflection coefficient if incident voltage component is 10 V and reflected voltage component is 3 V if Z_R=100Ω.

$$K = \frac{V_r}{V_i} = \frac{3}{10} = 0.3 \qquad (1)$$

2. Find Voltage standing wave ratio if voltage component is 10 V and reflected voltage component is 3 V if Z_R=100Ω

$$S = \frac{V_{max}}{V_{min}} = \frac{V_i + V_r}{V_i - V_r} = \frac{13}{7} = 1.86 \qquad (1)$$

3. Find the value of reflection coefficient for open circuited transmission line.

$$V_r = V_i$$
Hence $K = 1$. (1)

4. Find the value of Voltage standing wave ratio for open circuited transmission line.

$$S = \frac{V_{max}}{V_{min}} = \frac{V_i + V_r}{V_i - V_r} = \infty \qquad (1)$$

5. Find terminating impedance value if refection coefficient K=0.6 and Zo=100Ω.

$$K = \frac{Z_R - Z_o}{Z_R + Z_o}$$

$$0.6 = \frac{Z_R - 100}{Z_R + 100}$$

$$0.6Z_R + 60 = Z_R - 100 \qquad (2)$$

$$0.4Z_R = 160$$

$$Z_R = 400$$

NAME: _____; ID NO: _____;

BITS, PILANI – DUBAI CAMPUS

I SEMESTER 2011 – 2012

Version A

Course Code: **ECE C452** **Quiz-1** Date: **05.10.2011**

Course Title: **ELECTROMAGNETIC FIELDS AND Microwave Engg.** Max Marks: **16**

Duration: **20 minutes** Weightage: **8%**

Instructions: 1.ANSWER all 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. Find the force vector due to a reference point charge 0.3mC at (1,2,3) on the test charge 0.1mC at (2,2,3) [2 M]

2. Write the solution for $\oint \hat{E}.\hat{dl}$ in static and time varying fields [2 M]

3. Solve the following expression for any in time varying field $\nabla X(\nabla X\hat{E})$,where E is electric field intensity [2 M]

4. The magnetic field component of EM wave in non magnetic medium ($\mu = \mu_0$, $\sigma = 0$) has $\hat{H}_x = 25.Sin(2.10^8 t + 6y)\hat{a}_x$ .Find the direction of propagation and permittivity of the medium. [3M]

5. Write the assumptions to be made for solving problems in Gauss's law [1]

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

7. Find the velocity of propagation of EM wave in free space [2 M]

8. In free space, $\hat{E}(z,t) = 10^{-3} \sin(\omega t - \beta z)\hat{a}_y$ V/m. Find H(z,t) [2 M]