KOLEJ UNIVERSITI TEKNOLOGI TUN HUSSEIN ONN

PEPERIKSAAN AKHIR
SEMESTER I
SESI 2006/2007

NAMA MATAPELAJARAN	:	ELEKTROMAGNET GUNAAN
KOD MATAPELAJARAN	:	BEE 3223
KURSUS	:	3 BET/BER
TARIKH PEPERIKSAAN	:	NOV 2006
JANGKA MASA	:	3 JAM

ARAHAN :

JAWAB **SEMUA** SOALAN DALAM BAHAGIAN A
JAWAB **SATU(1)** SOALAN DARIPADA BAHAGIAN B
JAWAB **DUA(2)** SOALAN DARIPADA BAHAGIAN C

KERTAS SOALAN INI MENGANDUNGI 13 MUKA SURAT

SOALAN DALAM BAHASA MELAYU

BAHAGIAN A – SOALAN WAJIB

S1 (a) Apakah ciri-ciri gelombang mikro? Berdasarkan setiap ciri-ciri tersebut, nyatakan aplikasi gelombang mikro.

(10 markah)

(b) Satu beban dengan galangan $50 + j150\Omega$ disambungkan dengan 50Ω talian penghantaran tanpa kehilangan. Cari:

(i) Pekali pantulan, Γ
(ii) Nisbah voltan gelombang berdiri (VSWR)
(iii) Lepasan beban, Y_L
(iv) Galangan masukan pada 0.4λ daripada beban.
(v) Lokasi voltan maksima, V_{max}, dan voltan minima, V_{min}, daripada beban sekiranya panjang talian penghantaran itu ialah 0.6λ.
(vi) Galangan masukan, Z_{in}, pada penjana.

(15 markah)

BAHAGIAN B – JAWAB SATU (1) SOALAN DARIPADA BAHAGIAN INI

S2 (a) Kekuatan medan elektrik sebanyak $10\,\mu V/m$ telah diukur pada titik pemerhatian $\theta = \pi/2$ yang terletak pada 450km daripada antena dwikutub setengah gelombang yang beroperasi di udara pada 60MHz.

(i) Berapakah panjang optimum antena dwikutub itu?
(ii) Kirakan arus yang telah dimasukkan pada antena itu.
(iii) Cari kuasa purata yang dipancarkan oleh antena itu.
(iv) Jika talian penghantaran dengan galangan ciri $Z_o = 50\Omega$ akan disambungkan pada antena itu, tentukan pekali pantulan, Γ. Apakah nisbah voltan gelombang berdiri VSWR?

(15 markah)

(b) Satu antena dwikutub setengah gelombang mempunyai kekuatan medan magnet sebanyak $10\mu A/m$ pada titik $\theta = \pi/2$ yang terletak 2.5km daripadanya. Berapakah kuasa yang mesti dipancarkan oleh antena tersebut? Abaikan kehilangan rintangan.

(5 markah)

(c) Terangkan istilah-istilah di bawah dengan bantuan gambarajah dan formula. Labelkan gambarajah anda.

(i) Gerek penglihatan
(ii) Cuping sisi
(iii) Nol
(iv) Kekuatan kearahan
(v) Kecekapan pemancaran

(5 markah)

S3 (a) Senaraikan **TIGA (3)** perbezaan di antara talian penghantaran dan pandu gelombang?

(6 markah)

(b) Berikan definisi istilah-istilah di bawah:

(i) Ragam perusa
(ii) Ragam merosot
(iii) Halaju bahantara
(iv) Halaju fasa
(v) Halaju kumpulan

(10 markah)

(b) Pandu gelombang segiempat yang berdimensi $a = 2b = 4.8\text{cm}$ diisi dengan Teflon yang mempunyai nilai kebertelusan nisbi $\varepsilon_r = 2.11$ dan kehilangan tangen sebanyak 3×10^{-4}. Andaikan bahawa dinding pandu gelombang disalut dengan emas ($\sigma_c = 4.1\times10^{7}\,\text{S/m}$) dan ragam gelombang TE_{10} yang beroperasi pada 4GHz merambat ke dalam pandu gelombang itu, cari:

(i) Pemalar pelemahan yang disebabkan oleh kehilangan dielektrik, α_d

(ii) Pemalar pelemahan yang disebabkan oleh kehilangan pengaliran, α_c

(9 markah)

BAHAGIAN C – JAWAB DUA (2) SOALAN DARIPADA BAHAGIAN INI

S4 (a) Terangkan pemahaman anda tentang ketinggian maya dan jarak langkau. Setiap penerangan mestilah disokong dengan gambarajah dan dilabel dengan jelas.

(8 markah)

(b) Ketinggian maya, h_v, bagi lapisan ionosfera ialah 100km dan ketumpatan elektron maksimanya, N_{max}, ialah 3×10^{11} electrons/m^3. Kirakan bagi dua titik pada jarak 650km pada permukaan bumi melengkung:

700km

(i) Frekuensi kritikal, f_c

(ii) Frekuensi berguna maksimum (MUF)

Anggap jejari bumi ialah 6400km.

(10 markah)

(c) Rumuskan pengetahuan anda tentang penyerapan gelombang ke dalam **SATU (1)** perenggan dengan mengambil-kira semua isi-isi penting.

(7 markah)

S5 (a) Takrifkan istilah di bawah:

(i) Gangguan elektromagnet (EMI)
(ii) Keserasian elektromagnet (EMC)
(iii) Persekitaran elektromagnet
(iv) Sinaran terkonduksi
(v) Sinaran teradiasi

(10 markah)

(b) Huraikan dengan lengkap teknik kawalan EMI berikut. Markah akan juga diberikan kepada formula-formula yang menyokong.

(i) Pembumian
(ii) Perisaian

(10 markah)

(c) Jelaskan perilaku litar yang mengandungi elemen pasif (R, L, C) pada:

(i) Frekuensi rendah
(ii) Frekuensi tinggi

(5 markah)

S6 (a) Terangkan konfigurasi antena dwikutub setengah gelombang terlipat dengan bantuan gambarajah. Nyatakan **DUA (2)** kelebihan antena kegunaan istimewa ini.

(10 markah)

(b) Bincangkan kesan pembumian terhadap antena dwikutub setengah gelombang dengan bantuan gambarajah. Lakarkan corak pancaran yang diperolehi. Gambarajah mesti dilabelkan dengan jelas.

(10 markah)

(c) Antena yang sama boleh digunakan sebagai penghantar dan penerima. Bagi membolehkan perkara ini berlaku, satu peranti gandingan istimewa diperlukan. Sebagai tambahan, antena boleh menjadi aktif atau pasif.

(i) Namakan peranti tersebut.
(ii) Apakah tujuan peranti tersebut bagi membolehkan antena yang sama digunakan sebagai penghantar dan penerima?
(iii) Berikan definisi antena aktif.

(5 markah)

SOALAN DALAM BAHASA INGGERIS

PART A – COMPULSORY QUESTION

Q1 (a) What are the characteristics of microwaves? For each characteristic, describe the application of microwaves.

(10 marks)

(b) A $50 + j150\Omega$ load is connected to a 50Ω lossless line. Find:

(i) Reflection coefficient , Γ
(ii) Voltage standing wave ratio, VSWR
(iii) The load admittance, Y_L
(iv) Input impedance, Z_{in} , at 0.4λ from the load
(v) The locations of voltage maximum, V_{max} , and voltage minimum, V_{min} , with respect to the load if the line is 0.6λ long
(vi) Input impedance, Z_{in} , at the generator

(15 marks)

PART B – ANSWER ONE (1) QUESTION FROM THIS PART

Q2 (a) An electric field strength of $10\,\mu V/m$ is measured at an observation point of $\theta = \pi/2$ which is located at 450km from a half-wave dipole antenna operating in air at 60MHz.

(i) What is the optimum length of the dipole?
(ii) Calculate the current that must has been fed to the antenna.
(iii) Find the average power radiated by the antenna.
(iv) If a transmission line is with characteristic impedance $Z_o = 50\Omega$ is to be connected to the antenna, calculate the reflection coefficient, Γ. What is the voltage standing wave ratio (VSWR)?

(15 marks)

(b) A half-wave dipole has a magnetic field strength of $10\mu A/m$ at a point $\theta = \pi/2$ which is located at 2.5km from it. How much power must the antenna transmit? Neglect ohmic loss.

(5 marks)

(c) Explain the following terms with an aid of figures and formulas. Labeled your figures accordingly.

(i) Line-of- Shoot
(ii) Sidelobe
(iii) Null
(iv) Directivity
(v) Radiation efficiency

(5 marks)

Q3 (a) List **THREE (3)** differences between transmission lines and waveguides.

(6 marks)

(b) Define the followings:

(i) Dominant mode
(ii) Degenerate mode
(iii) Medium velocity
(iv) Phase velocity
(v) Group velocity

(10 marks)

(b) A rectangular waveguide with $a = 2b = 4.8\text{cm}$ is filled with Teflon with relative permittivity $\varepsilon_r = 2.11$ and loss tangent of 3×10^{-4}. Assume that the walls of the waveguide are coated with gold ($\sigma_c = 4.1\times10^{7}\,\text{S/m}$) and that a TE_{10} wave at 4GHz propagates down the waveguide, find:

(i) Attenuation constant due to dielectric losses, α_d

(ii) Attenuation constant due to conduction losses, α_c

(9 marks)

PART C – ANSWER TWO (2) QUESTIONS FROM THIS PART

Q4 (a) Describe your understanding about virtual height and skip distance. Each description must be supported with a figure and must be labeled clearly.

(8 marks)

(b) The virtual height, h_v, of an ionospheric layer is 100km and the maximum electron density, N_{max}, is 3×10^{11} electrons/m^3. Calculate for two points on the round surface of the Earth that is 700km apart:

(i) Critical frequency, f_c
(ii) Maximum usable frequency (MUF)

Assume the radius of the Earth as 6400km.

(10 marks)

(c) Summarize your understanding about wave absorption in **ONE (1)** paragraph by taking into accounts all the important points.

(7 marks)

Q5 (a) Define the following terms:

(i) Electromagnetic Interference (EMI)
(ii) Electromagnetic Compatibility (EMC)
(iii) Electromagnetic environment
(iv) Conducted emission
(v) Radiated emission

(10 marks)

(b) Explain the **TWO (2)** of the EMI control techniques listed below. Marks will be given for supporting formulas as well.

(i) Grounding
(ii) Shielding

(10 marks)

(c) Explain the behaviours of a circuit that contains passive elements (*R*,*L*,*C*) at:

(i) Low frequency
(ii) High frequency

(5 marks)

Q6 (a) Describe the configuration of a folded dipole with the aid of a diagram. State **TWO (2)** advantages of this type of special purpose antenna?

(10 marks)

(b) Discuss the ground effects on a half-wave dipole with an aid of a figure. Sketch the radiation pattern as well. The figure must be labeled clearly.

(10 marks)

(c) The same antenna can be used as both transmitter and receiver. To make that possible, a special coupling device is needed. In addition, antenna can be passive or active.

(i) Name the device.
(ii) What is the purpose of device in order for the antenna to be used as both transmitter and receiver?
(iii) Define active antenna.

(5 marks)

PEPERIKSAAN AKHIR

SEMESTER/SESI : SEMESTER I SESI 2006/2007 KURSUS : 3 BET / 3 BER
MATA PELAJARAN : ELEKTROMAGNET GUNAAN KOD MP : BEE 3223

FORMULAS

IMPORTANT EQUATIONS FOR TM AND TE MODES

TM Modes	TE Modes
$Exs = -\frac{j\beta}{h^2}\left(\frac{m\pi}{a}\right)E_o \cos\left(\frac{m\pi x}{a}\right)\sin\left(\frac{n\pi y}{b}\right)e^{-\gamma z}$	$Exs = \frac{j\omega\mu}{h^2}\left(\frac{n\pi}{b}\right)H_o \cos\left(\frac{m\pi x}{a}\right)\sin\left(\frac{n\pi y}{b}\right)e^{-\gamma z}$
$Eys = -\frac{j\beta}{h^2}\left(\frac{n\pi}{b}\right)E_o \sin\left(\frac{m\pi x}{a}\right)\cos\left(\frac{n\pi y}{b}\right)e^{-\gamma z}$	$Eys = -\frac{j\omega\mu}{h^2}\left(\frac{m\pi}{a}\right)H_o \sin\left(\frac{m\pi x}{a}\right)\cos\left(\frac{n\pi y}{b}\right)e^{-\gamma z}$
$Ezs = E_o \sin\left(\frac{m\pi x}{a}\right)\sin\left(\frac{n\pi y}{b}\right)e^{-\gamma z}$	$Ezs = 0$
$Hxs = \frac{j\omega\varepsilon}{h^2}\left(\frac{n\pi}{b}\right)E_o \sin\left(\frac{m\pi x}{a}\right)\cos\left(\frac{n\pi y}{b}\right)e^{-\gamma z}$	$Hxs = \frac{j\beta}{h^2}\left(\frac{m\pi}{a}\right)H_o \sin\left(\frac{m\pi x}{a}\right)\cos\left(\frac{n\pi y}{b}\right)e^{-\gamma z}$
$Hys = -\frac{j\omega\varepsilon}{h^2}\left(\frac{m\pi}{a}\right)E_o \cos\left(\frac{m\pi x}{a}\right)\sin\left(\frac{n\pi y}{b}\right)e^{-\gamma z}$	$Hys = \frac{j\beta}{h^2}\left(\frac{n\pi}{b}\right)H_o \cos\left(\frac{m\pi x}{a}\right)\sin\left(\frac{n\pi y}{b}\right)e^{-\gamma z}$
$Hzs = 0$	$Hzs = H_o \cos\left(\frac{m\pi x}{a}\right)\cos\left(\frac{n\pi y}{b}\right)e^{-\gamma z}$
$\eta = \eta'\sqrt{1-\left(\frac{f_c}{f}\right)^2}$	$\eta = \frac{\eta'}{\sqrt{1-\left(\frac{f_c}{f}\right)^2}}$

α_c for TE_{mn} modes where $n \neq 0$:

$$\alpha_c|_{TE} = \frac{2R_S}{b\eta'\sqrt{1-\left[\frac{f_c}{f}\right]^2}}\left[\left(1+\frac{b}{a}\right)\left[\frac{f_c}{f}\right]^2 + \frac{\frac{b}{a}\left(\frac{b}{a}m^2+n^2\right)}{\frac{b^2}{a^2}m^2+n^2}\left(1-\left[\frac{f_c}{f}\right]^2\right)\right]$$

α_c for TE_{10} mode:

$$\alpha_c|_{TE_{10}} = \frac{2R_S}{b\eta'\sqrt{1-\left[\frac{f_c}{f}\right]^2}}\left(\frac{1}{2}+\frac{b}{a}\left[\frac{f_c}{f}\right]^2\right)$$

α_c for the TM_{mn} modes:

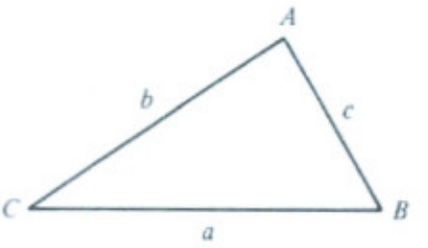
$$\alpha_c|_{TM} = \frac{2R_S}{b\eta'\sqrt{1-\left[\frac{f_c}{f}\right]^2}}\frac{(b/a)^3m^2+n^2}{(b/a)^2m^2+n^2}$$

$$\alpha_d = \frac{\sigma\eta'}{2\sqrt{1-\left(\frac{f_c}{f}\right)^2}}$$

Trigonometric Identities

$$\sin A \sin B = \frac{1}{2}[\cos(A-B) - \cos(A+B)]$$

$$\cos A \cos B = \frac{1}{2}[\cos(A-B) + \cos(A-B)]$$



For any plane triangle ABC:

$$c^2 = a^2 + b^2 - 2ab(\cos C)$$

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$