SULIT

POLITEKNIK MALAYSIA

BAHAGIAN PEPERIKSAAN DAN PENILAIAN
JABATAN PENDIDIKAN POLITEKNIK DAN KOLEJ KOMUNITI
KEMENTERIAN PENDIDIKAN MALAYSIA

JABATAN KEJURUTERAAN ELEKTRIK

PEPERIKSAAN AKHIR

SESI JUN 2018

DEP5303: MICROWAVE DEVICES

TARIKH : 16 NOVEMBER 2018
MASA : 8.30 PAGI - 10.30 PAGI (2 JAM)

Kertas ini mengandungi **TUJUH (7)** halaman bercetak.
Bahagian A: Struktur (4 soalan)
Bahagian C: Esei (2 soalan)
Dokumen sokongan yang disertakan : Formula dan Carta Smith

JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN

(CLO yang tertera hanya sebagai rujukan)

SECTION A: 60 MARKS
BAHAGIAN A: 60 MARKAH

INSTRUCTION:
This section consists of **FOUR (4)** structured questions. Answer **ALL** questions.

ARAHAN:
*Bahagian ini mengandungi **EMPAT (4)** soalan berstruktur. Jawab **SEMUA** soalan.*

QUESTION 1
SOALAN 1

CLO1 C1 (a) Identify **THREE(3)** types of electromagnetic waves.

*Kenalpasti **TIGA(3)** jenis gelombang elektromagnetik.*

[3 marks]
[3 *markah*]

CLO1 C2 (b) Explain the types of electromagnetic radiation hazard.

Terangkan jenis bahaya radiasi elektromagnetik.

[6 marks]
[6 *markah*]

CLO1 C2 (c) Explain briefly with the aid of a diagram the spherical and plane waves of electromagnetic wave in free space.

Terangkan secara ringkas dengan bantuan gambarajah gelombang bulat dan gelombang satah bagi gelombang elektromagnetik di ruang bebas.

[6 marks]
[6 *markah*]

QUESTION 2
SOALAN 2

CLO1 C2 (a) Explain the guide wavelength, λg in waveguide.

Terangkan panjang gelombang terpandu, λg dalam pandu gelombang.

[3 marks]
[3 *markah*]

CLO2 C3 (b) A waveguide with internal dimension of 1cm x 0.5cm, 25cm length, transmit a signal with operating frequency 1GHz in dominant mode. Show that propagation do not exist in that waveguide because of high attenuation from the rule $\lambda o > \lambda c$.

Sebuah pandu gelombang dengan dimensi dalaman 1cm x 0.5cm, 25cm panjang, menghantar isyarat dengan frekuensi operasi 1GHz pada mod dominan. Tunjukkan bahawa perambatan tidak wujud di dalam pandu gelombang tersebut kerana gangguan tinggi berdasarkan syarat $\lambda o > \lambda c$.

[6 marks]
[6 *markah*]

CLO2 C3 (c) A signal with operating frequency of 25GHz propagates in an air filled circular waveguide having an inner diameter 10 cm in dominant mode. Calculate and interpret the cut-off frequency and cut-off wavelength.
(Bessel Equation's, TE_{11}=1.841)

Satu isyarat dengan frekuensi operasi 25GHz merambat dalam pandu gelombang bulat dengan diameter dalam 10cm pada mod dominan di ruang udara. Kirakan dan huraikan frekuensi potong dan panjang gelombang potong. (Bessel Equation's, TE_{11}=1.841)

[6 marks]
[6 *markah*]

QUESTION 3
SOALAN 3

CLO2 C2 (a) Determine the normalized load impedances on the Smith Chart for the following real impedances if the characteristic impedance is 25Ω.

Tentukan galangan beban ternormal pada Smith Chart bagi galangan sebenar berikut jika galangan ciri adalah 25 Ω.

i) $Z_1 = 75 - j100$

ii) $Z_2 = j200$

iii) $Z_3 = 7.5$

[3 marks]
[3 *markah*]

CLO2 C3 (b) The transmission line has a characteristic impedance of 50Ω and is terminated by load of 100+j50Ω. Calculate Reflection coefficient and the Voltage Standing Wave Ratio (VSWR). Prove the calculation by using Smith Chart.

Talian penghantaran mempunyai galangan 50Ω dan ditamatkan dengan beban 100+j50Ω. Kirakan pekali pantulan dan Nisbah Voltan Gelombang Pegun "Voltage Standing Wave Ratio (VSWR)". Buktikan pengiraan menggunakan Carta Smith.

[6 marks]
[6 *markah*]

CLO2 C3 (c) Demonstrate how to construct VSWR circle for the complex load, Z_L=28-j60Ω, Z_0=20Ω using the Smith Chart. Then determine the location of normalized impedance (z') and location of normalized admittance (y').

Demonstrasikan cara melukis bulatan VSWR bagi beban komplek, Z_L=28-j60Ω, Z_0=20Ω dengan menggunakan Carta Smith. Seterusnya, tentukan lokasi galangan ternormal (z') dan lokasi lepasan ternormal (y').

[6 marks]
[6 *markah*]

QUESTION 4
SOALAN 4

CLO1 C1 (a) List **THREE(3)** types of microwave tube source.

*Senaraikan **TIGA(3)** sumber tiub gelombang mikro.*

[3 marks]
[3 *markah*]

CLO1 C2 (b) Explain E-plane T-junction in waveguide system.

Terangkan simpang-T satah-E di dalam system pandu gelombang.

[5 marks]
[5 *markah*]

CLO1 C3 (c) Show and elaborate with an illustration the Cassegrain feed type for parabolic antenna.

Huraikan dengan bantuan gambarajah bagi penyuap jenis Cassegrain antenna parabola.

[7 marks]
[7 *markah*]

SECTION B: 40 MARKS
BAHAGIAN B: 40 MARKAH

INSTRUCTION:
This section consists of **TWO (2)** essay questions. Answer **ALL** questions.

ARAHAN:
*Bahagian ini mengandungi **DUA (2)** soalan esei. Jawab **SEMUA** soalan.*

QUESTION 1
SOALAN 1

CLO2
C3

(a) An air-filled rectangular waveguide with dimension of (2.3 x 1.1) cm is used for propagating a microwave signal at mode TE_{11}. If the microwave frequency given is 18 GHz, calculate the cut-off frequency, guide wavelength, phase velocity and characteristic impedance.

Sebuah pandu gelombang empat segi berisi udara mempunyai dimensi dalaman (2.3 x 1.1) cm digunakan untuk merambat satu isyarat gelombang mikro pada mod TE_{11}. Jika diberi frekuensi gelombang mikro adalah 18 GHz, kirakan frekuensi potong, panjang gelombang pandu, halaju fasa dan galangan ciri.

[10 marks]
[10 *markah*]

CLO2
C3

(b) TE_{11} mode is propagated through a circular waveguide. The radius of the guide is 4 cm. If the operating frequency is 3 GHz, calculate the cut-off frequency, wavelength guide and characteristic impedance.

Mod TE_{11} merambat melalui sebuah pandu gelombang bulat. Jejari bagi pandu gelombang adalah 4 cm. Jika frekuensi operasi adalah 3 GHz, kirakan frekuensi potong, panjang gelombang pandu dan galangan ciri.

[10 marks]
[10 *markah*]

QUESTION 2
SOALAN 2

CLO2
C4

A load impedance $Z_L = (70 + j50)\ \Omega$ is connected to a line which $Z_o = 100\ \Omega$. By using Smith Chart, locate the normalized load impedance and determine the values for Voltage Standing Wave Ratio, angle of reflection, reflection coefficient, admittance load and input impedance when the transmission line is 0.055λ.

Sebuah galangan beban $Z_L = (70 + j50)\ \Omega$ disambung kepada talian di mana $Z_o = 100\ \Omega$. Dengan menggunakan Carta Smith, tandakan lokasi galangan beban ternormal dan tentukan nilai-nilai bagi nisbah gelombang pegun, sudut pantulan, pekali pantulan, nilai lepasan dan galangan masukan apabila jarak talian adalah 0.055λ.

[20 marks]
[*20 markah*]

SOALAN TAMAT

$$c = \lambda f = 3\,x10^{8}\ ms^{-1}$$

$$\varepsilon_o = 8.854\times10^{-12}\ F/m$$

$$\mu_o = 4\pi\times10^{-7}\ H/m$$

$$v_c = \frac{1}{\sqrt{\varepsilon_o\varepsilon_r\mu_o\mu_r}}$$

$$Z = 377\sqrt{\frac{\mu_r}{\varepsilon_r}}(\Omega)$$

$$\lambda_c = \frac{2}{\sqrt{\left(\frac{m}{a}\right)^2+\left(\frac{n}{b}\right)^2}}$$

$$\lambda_c = \frac{\pi d}{S_{mn}}$$

$$f_c = \frac{c}{2}\sqrt{\left(\frac{m}{a}\right)^2+\left(\frac{n}{b}\right)^2}$$

$$f_c = \frac{cS_{mn}}{\pi d}$$

$$\lambda_g = \frac{\lambda_o}{\sqrt{1-\left(\frac{\lambda_o}{\lambda_c}\right)^2}} = \frac{\lambda_o}{\sqrt{1-\left(\frac{f_c}{f_o}\right)^2}}$$

$$v_p = \frac{c}{\sqrt{1-\left(\frac{\lambda_o}{\lambda_c}\right)^2}} = \frac{c}{\sqrt{1-\left(\frac{f_c}{f_o}\right)^2}}$$

$$v_g = c\sqrt{1-\left(\frac{\lambda_o}{\lambda_c}\right)^2} = c\sqrt{1-\left(\frac{f_c}{f_o}\right)^2}$$

$$Z_{o(TE)} = \frac{377}{\sqrt{1-\left(\frac{\lambda_o}{\lambda_c}\right)^2}} = \frac{377}{\sqrt{1-\left(\frac{f_c}{f_o}\right)^2}}$$

$$Z_{o(TM)} = 377\sqrt{1-\left(\frac{\lambda_o}{\lambda_c}\right)^2} = 377\sqrt{1-\left(\frac{f_c}{f_o}\right)^2}$$

$$|\Gamma| = \frac{Z_L - Z_o}{Z_L + Z_o}$$

$$VSWR = \frac{1+|\Gamma|}{1-|\Gamma|}$$

$$A(watt) = e^{\propto z} \quad where \quad \propto = \frac{2\pi}{\lambda_c}$$

$$A(dB) = \frac{54.5z}{\lambda_c}$$

$$front\ to\ back\ ratio = \frac{front\ lobe\ power}{back\ lobe\ power}$$

$$front\ to\ side\ ratio = \frac{front\ lobe\ power}{side\ lobe\ power}$$

$$Beam\ width\ (parabolic) = \frac{70\lambda}{d}$$

$$Beam\ width\ (horn) = \frac{80\lambda}{W}$$

$$G_R(dB) = 10log\frac{4\pi kA}{\lambda^2}$$

$$G_T(dB) = 10log\frac{4\pi\eta A}{\lambda^2}$$

$$P_T = P_R\,G$$

Bassel Equation's Schedule for Circular Waveguide:

Mode	S_{mn}	Mode	S_{mn}
TE_{01}	3.832	TM_{01}	2.405
TE_{11}	1.841	TM_{11}	3.832
TE_{21}	3.050	TM_{21}	5.136
TE_{02}	7.016	TM_{02}	5.520
TE_{12}	5.330	TM_{12}	7.016
TE_{22}	6.710	TM_{22}	8.420