SULIT

BAHAGIAN PEPERIKSAAN DAN PENILAIAN
JABATAN PENGAJIAN POLITEKNIK
KEMENTERIAN PENDIDIKAN TINGGI

JABATAN KEJURUTERAAN ELEKTRIK

PEPERIKSAAN AKHIR

SESI DISEMBER 2015

DEP5303: MICROWAVE DEVICES

TARIKH : 13 APRIL 2016
MASA : 8.30 AM – 10.30 AM (2 JAM)

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

JANGAN BUKA KERTAS SOALAN INI SEHINGGA DIARAHKAN

(CLO yang tertera hanya sebagai rujukan)

SULIT

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) List **THREE (3)** advantages of microwave in broadcasting system.
*Senaraikan **TIGA (3)** kebaikan gelombang mikro dalam sistem penyiaran.*
[3 marks]
[3 markah]

CLO1 C2 (b) With the aid of suitable diagram, explain the electromagnetic wave.
Dengan bantuan gambarajah yang sesuai, terangkan mengenai gelombang elektromagnetik.
[6 marks]
[6 markah]

CLO1 C2 (c) Explain **THREE (3)** types of electromagnetic radiation hazard.
*Terangkan **TIGA (3)** jenis gejala radiasi dalam elektromagnetik .*
[6 marks]
[6 markah]

QUESTION 2
SOALAN 2

CLO1 C2 a) Discusss **THREE (3)** advantages of circular waveguide compared to rectangular waveguide.

*Bincangkan **TIGA (3)** kelebihan pandu gelombang bulat berbanding pandu gelombang segi empat.*

[3 marks]
[3 markah]

CLO2 C3 b) Calculate the attenuation when a waveguide with dimensions 2 x 1cm and 25cm in length is given a signal of 1.5GHz propagates in dominant mode.

Kirakan nilai pelemahan apabila dimensi sebuah pandu gelombang adalah 2 x 1 cm dan 25 cm panjang diberi 1.5GHz isyarat yang merambat dalam mod dominan.

[6 marks]
[6 markah]

CLO2 C3 c) A 10GHz signal propagates in a circular waveguides whose diameter is 4cm. Calculate the cut-off wavelength and the guide wavelength for dominant mode.

Isyarat 10GHz merambat dalam satu pandu gelombang bulat yang berdiameter 4 cm. Kirakan panjang gelombang potong dan panjang gelombang pandu bagi mod dominan.

[6 marks]
[6markah]

QUESTION 3
SOALAN 3

CLO2 C2 (a) The voltage standing caused by a mismatched load has a maximum value of 95V and a minimum value of 80V. Calculate the reflection coefficient, Γ.

Taraf kedudukan voltan yang disebabkan oleh beban berpadanan mempunyai nilai maksimum 95V dan nilai minimum 80V. Kira pekali pantulan, Γ.

[3 marks]
[3markah]

CLO2 C3 (b) By using Smith Chart, locate the following impedance, Za = j200Ω , Zb = 150Ω and Zc = 150 + j200Ω if the characteristic impedance is 50Ω.

Dengan menggunakan Carta Smith, cari galangan Za = j200Ω , Zb = 150Ω dan Zc = 150 + j200Ω *jika galangan ciri ialah 50Ω.*

[6 marks]
[6 markah]

CLO2 C3 (c) Determine the SWR circle and normalized admittance Y'_L for $Z_L = (120 + j150)\Omega$ when $Z_o = 50\ \Omega$ by using Smith Chart.

Dengan menggunakan Smith chart, tentukan bulatan SWR dan nilai lepasan ternomal bagi $Z_L = (120 + j150)\Omega$ apabila $Z_o = 50\ \Omega$.

[6 marks]
[6 markah]

QUESTION 4

SOALAN 4

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

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

[3 marks]

[3 markah]

CLO1 C2 (b) Describe the principle operation of Klystron 2-cavity in the generation of microwave signal.

Terangkan prinsip operasi Klystron 2-rongga dalam penjanaan isyarat gelombang mikro.

[5 marks]

[5 markah]

CLO1 C3 (c) Illustrate **TWO (2)** types of front feeder for parabolic antenna with their characteristics.

*Gambarkan **DUA (2)** jenis suapan hadapan bagi antena parabolik beserta dengan ciri-cirinya.*

[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) A rectangular copper waveguide having an inner dimension of (3.5 × 1.5) cm is used for propagating a microwave signal at mode TE_{11}. If the microwave frequency given is 13.8 GHz, calculate the cut-off frequency (fc), cut-off wavelength (λc), guide wavelength (λg) and velocity inside waveguide (Vg) of this waveguide.

Satu pandu gelombang kuprum berbentuk segi empat mempunyai dimensi dalaman (3.5 × 1.5) cm digunakan untuk merambat pada mod TE_{11} suatu isyarat gelombang mikro. Jika diberi frekuensi gelombang mikro adalah 13.8 GHz, kirakan frekuensi potong (fc), panjang gelombang potong (λc), panjang gelombang pandu (λg) dan halaju dalam pandu gelombang, (Vg) bagi pandu gelombang ini .

[10 marks]

[10 marks]

CLO2
C3

(b) An air- filled circular waveguide having an inner radius of 5 cm is used to propagate TE_{11} mode with frequency 13.5 GHz. Calculate the cut-off wavelength (λc), the cut-off frequency (fc), phase velocity, (v_p) and characteristics impedance, Z_0 (TE) of this waveguide.

Satu pandu gelombang bulat berisi udara mempunyai diameter dalaman 5 cm yang digunakan untuk perambatan mod TE_{11}. Kirakan panjang gelombang potong (λc), frekuensi potong (fc), halaju fasa, (Vp) dan galangan ciri, Z_0 (TE) bagi pandu gelombang ini .

[10 marks]
[10 marks]

QUESTION 2
SOALAN 2

CLO2
C4

A load impedance $Z_L = (150 + j100)\Omega$ is connected to a line which $Z_o = 50\Omega$. By using Smith Chart, find the position of normalized load impedance and determine the values for Voltage Standing Wave Ratio (VSWR), angle of reflection (θ), reflection coefficient (Γ), admittance load ($Y'_{L)}$ and input impedance (Zin) when the transmission line is 0.05λ.

Sebuah galangan beban $Z_L = (150 + j100)\Omega$ disambung kepada talian di mana $Z_o = 50\Omega$. Dengan menggunakan Carta Smith, cari kedudukan galangan beban ternormal dan tentukan nilai-nilai bagi nisbah gelombang pegun (VSWR), sudut pantulan (θ), pekali pantulan (Γ), nilai lepasan (Y'_L) dan galangan masukan (Zin) apabila jarak talian adalah 0.05λ.

[20 marks]
[20 markah]

SOALAN TAMAT

APPENDIX DEP5303

$$c = \lambda f = (3\times10^8) ms^{-1}$$

Rectangular Waveguide	Circular Waveguide
Wavelength $\lambda_c = \dfrac{2}{\sqrt{\left(\frac{m}{a}\right)^2+\left(\frac{n}{b}\right)^2}}$	Wavelength $\lambda_c = \dfrac{\pi d}{Smn}$
Frequency, $f_c = \dfrac{c}{2}\sqrt{\left(\frac{m}{a}\right)^2+\left(\frac{n}{b}\right)^2}$ $f_c = \dfrac{1}{2\sqrt{\mu\varepsilon}}\sqrt{\left(\frac{m}{a}\right)^2+\left(\frac{n}{b}\right)^2}$ $\mu_0 = 4\pi \times 10^{-7}$ H/m $\varepsilon_0 = 8.854\times 10^{-12}$ F/m	Frequency, $f_c = \dfrac{cSmn}{\pi d}$ Bessel Equation's Table for Circular Waveguide:

Mode	Smn	Mode	Smn
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

$$\lambda_{guide} = \lambda_{pandu} = \frac{\lambda_o}{\sqrt{\left[1-\left(\frac{\lambda_o}{\lambda_c}\right)^2\right]}} \text{ meter or } \lambda_{guide} = \lambda_{pandu} = \frac{\lambda_o}{\sqrt{\left[1-\left(\frac{f_c}{f_0}\right)^2\right]}} \text{ meter}$$

$$v_{group} = v_{kumpulan} = c\sqrt{\left[1-\left(\frac{\lambda_o}{\lambda_c}\right)^2\right]} ms^{-1} \text{ or } v_{group} = v_{kumpulan} = c\sqrt{\left[1-\left(\frac{f_c}{f_o}\right)^2\right]} ms^{-1}$$

$$v_{phase} = v_{fasa} = \frac{c}{\sqrt{\left[1-\left(\frac{\lambda_o}{\lambda_c}\right)^2\right]}} ms^{-1} \text{ or } v_p = \frac{c}{\sqrt{\left[1-\left(\frac{f_c}{f_0}\right)^2\right]}} ms^{-1}$$

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

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

$Z_{IN} = j\, Z_{TEmn} \tan(\beta l)$; $Z_{IN} = j\, Z_{TMmn} \tan(\beta l)$; $\beta = \dfrac{2\pi f_o}{c}\sqrt{\left(1-\left(\frac{f_c}{f_o}\right)^2\right)}$

APPENDIX DEP5303

$front\ to\ back\ ratio = \frac{front\ lobe\ power}{back\ lobe\ power}$	$front\ to\ side\ ratio = \frac{front\ lobe\ power}{side\ lobe\ power}$
$Reflection\ Coefficient, \Gamma = \left(\frac{Z_O - Z_L}{Z_L + Z_L}\right)$	VSWR= $\left(\frac{1+\lvert\Gamma\rvert}{1-\lvert\Gamma\rvert}\right)$
(Parabolic Antenna) $Beam\ Width, \alpha = \frac{70\lambda}{D}$	Horn Antenna, $Beam\ Width, \alpha = \frac{80\lambda}{W}$
$P_T = \eta\left(\frac{\pi D}{\lambda}\right)^2$	$P_T = (P_R G)$
$G(dB) = 10\ log\frac{4\pi kA}{\lambda^2}$	$Attenuation\ (dB) = \frac{54z}{\lambda c}$

The Smith Chart