SULIT

BAHAGIAN PEPERIKSAAN DAN PENILAIAN
JABATAN PENDIDIKAN POLITEKNIK DAN KOLEJ KOMUNITI
KEMENTERIAN PENGAJIAN TINGGI

JABATAN KEJURUTERAAN ELEKTRIK

PEPERIKSAAN AKHIR

SESI I : 2022 / 2023

DEP50043 : MICROWAVE DEVICES

TARIKH : 15 DISEMBER 2022
MASA : 8.30 AM – 10.30 AM (2 JAM)

Kertas ini mengandungi **TUJUH (7)** halaman bercetak.
Bahagian A: Subjektif (3 soalan)
Bahagian B: Esei (2 soalan)
Dokumen sokongan yang disertakan : Smith Chart, Formula

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 **THREE (3)** subjective questions. Answer **ALL** questions.

ARAHAN :
*Bahagian ini mengandungi **TIGA (3)** soalan subjektif. Jawab **SEMUA** soalan.*

QUESTION 1

SOALAN 1

CLO1
C2

(a) By using the figure of electromagnetic wave, locate the electric field, magnetic field and wavelength at the correct place.
Dengan menggunakan rajah gelombang elektromagnetik, letakkan medan elektrik, medan magnet dan panjang gelombang pada kedudukan yang betul.

[5 marks]
[*5 markah*]

CLO1
C2

(b) Electromagnetic Waves consist of 3 categories which are Transverse Electromagnetic Wave (TEM), Transverse Electric (TE) and Transverse Magnetic (TM). By using the vector diagram, explain **TWO (2)** categories of those electromagnetic waves.
*Gelombang Elektromagnet terdiri daripada 3 kategori iaitu Gelombang Elektromagnet Melintang (TEM), Elektrik Melintang (TE) dan Magnetik Melintang (TM). Dengan menggunakan gambarajah vektor, terangkan **DUA (2)** kategori gelombang electromagnet tersebut.*

[5 marks]
[*5 markah*]

It is a combination of two types of waveguides which are E-Plane and-Plane
Ia adalah gabungan dua jenis pandu gelombang iaitu E-Plane dan H-Plane

CLO1 C3 (c) Referring to the statement above, write a description of those waveguides by using suitable figure.
Merujuk kepada kenyataan diatas, tulis penerangan tentang pandu gelombang tersebut dengan bantuan rajah yang bersesuaian.

[10 marks]
[*10 markah*]

QUESTION 2
SOALAN 2

CLO1 C2 (a) Permittivity and permeability of the medium inside waveguide. Explain the difference between permittivity and permeability.
Kebolehpercayaan dan kebolehtelapan medium di dalam pandu gelombang Terangkan perbezaan antara kebolehtelapan dan kebolehtelapan.

[5 marks]
[*5 markah*]

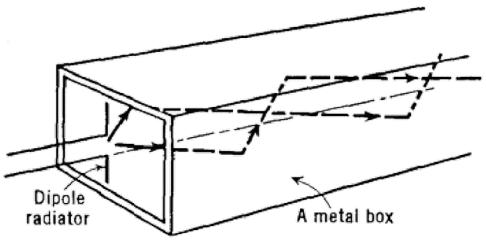

Figure A2(b) / *Rajah A2(b)*

CLO1 C2 (b) Referring to Figure A2(b), elaborate the method of propagation used by electromagnetic waves in a rectangular waveguide.
Merujuk kepada Rajah A2(b), huraikan kaedah perambatan yang digunakan oleh gelombang elektromagnet dalam pandu gelombang segiempat tepat.

[5 marks]
[*5 markah*]

CLO1
C3

(c) A lossless transmission line of 50Ω is having V_{max} = 2.5V and V_{min} = 2V, when terminated by an unknown load. Calculate the value of Voltage Standing Wave Ratio (VSWR), Reflection Coefficient (Γ) and Load Impedance (Z_L).

Talian penghantaran tanpa kehilangan 50Ω mempunyai Vmaks = 2.5V dan Vmin = 2V, apabila ditamatkan oleh beban yang tidak diketahui. Kirakan nilai Nisbah Voltan Gelombang Pegun (VSWR), Pekali Pantulan (Γ) dan Galangan Beban (Z_L).

[10 marks]

[*10 markah*]

QUESTION 3

SOALAN 3

Antennas are made in various shapes and sizes. They are used in radio and television broadcasting, radio wave communication systems, cellular telephones, radar systems and many more. *Antena dibuat dalam pelbagai bentuk dan saiz. Ia digunakan dalam penyiaran radio dan televisyen, sistem komunikasi gelombang radio, telefon selular, sistem radar dan pelbagai lagi.*

CLO1
C2

(a) Referring to the statement above, explain the function of the antenna.

Merujuk kepada kenyataan di atas, terangkan fungsi bagi antena.

[5 marks]

[*5 markah*]

CLO1
C2

(b) Explain the difference between E-Plane Sectoral and H-Plane Sectoral antenna by using an appropriate diagram.

Terangkan perbezaan antara antena E-Plane Sectoral dan H-Plane Sectoral menggunakan rajah yang sesuai.

[5 marks]

[*5 markah*]

(c) A parabolic reflector with a diameter of 3.5m is used to transmit a power of 25W using a feeder operating at a frequency 9GHz and an antenna aperture efficiency of 50%. Calculate the Wavelength of the signal (λ), Beamwidth of the Antenna (θ), Effective Aperture Area (A_e), Antenna Gain (G in dB) and Power Transmission (P_T in dB).

Reflektor parabola dengan diameter 3.5m digunakan untuk menghantar kuasa 25W menggunakan penyuap yang beroperasi pada frekuensi 9GHz dan kecekapan apertur antena sebanyak 50%. Kirakan Panjang Gelombang isyarat (λ), Lebar Pancaran Antena (θ), Kawasan Apertur Berkesan (Ae), Gain Antena (G dalam dB) dan Penghantaran Kuasa (P_T dalam dB)

[10 marks]

[*10 markah*]

SECTION B : 40 MARKS

BAHAGIAN B :40 MARKAH

INSTRUCTION:

This section consists of **TWO (2)** essay questions. Answer the question.

ARAHAN:

*Bahagian ini mengandungi **DUA (2)** soalan esei. Jawab soalan tersebut.*

QUESTION 1

SOALAN 1

CLO1
C3
DP1
DP3
DP4

The mode TE_{11} is propagated in an air-filled rectangular waveguide which has dimensions of a = 6cm and b = 4cm. The signal frequency is 6GHz . Calculate the Cutoff Frequency (f_c), Wavelength in the waveguide (λ_g), Phase Velocity (V_p), Group Velocity (V_g) and Characteristic impedance (Zo_{TE}).

Mod TE_{11} disebarkan dalam pandu gelombang segiempat tepat berisi udara yang mempunyai dimensi a = 6cm dan b = 4cm. Frekuensi Isyarat ialah 6GHz. Kira Frekuensi Potong (f_c), Panjang Gelombang dalam pandu gelombang (λ_g), Halaju Fasa (V_p), Halaju Kumpulan (V_g) dan Galangan Ciri (Zo_{TE}).

[20 marks]

[*20 markah*]

QUESTION 2

SOALAN 2

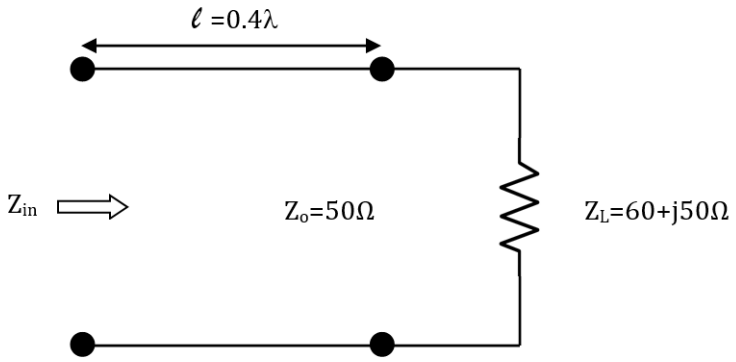

Figure B2 / Rajah B2

CLO1
C4
DP1
DP3
DP4

Figure B2 is a transmission line circuit. By using a Smith Chart, determine the Voltage Standing Wave Ratio (VSWR) on the line, the Reflection Coefficient (Γ), the Load Admittance (Y_L), the Input Impedance (Z_{in}) at the line, the distance from the load to the first voltage minimum (d_{Vmin}) and the distance from the load to the first voltage maximum (d_{Vmax})

Rajah B2 merupakan suatu litar talian penghantaran. Dengan menggunakan Carta Smith tentukan Nisbah Voltan Gelombang Pegun (VSWR) pada talian, Pekali Refleksi (Γ), Penerimaan Beban (Y_L), Galangan Masukkan (Z_{in}) pada talian, jarak dari beban ke minimum voltan pertama (d_{Vmin}) dan jarak dari beban ke maksimum voltan pertama (d_{Vmaks})

[20 marks]

[*20 markah*]

SOALAN TAMAT

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

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

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

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

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

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

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

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

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

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

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

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

W/d > 1

$$\varepsilon_{eff} = \frac{\varepsilon_r+1}{2} + \frac{\varepsilon_r-1}{2}\left(1+\frac{12d}{W}\right)^{-1/2}$$

$$Z_o = \frac{376.7}{\sqrt{\varepsilon_{eff}}\left[\frac{W}{d}+1.4+0.667\ln\left(\frac{W}{d}+1.444\right)\right]}$$

$$v_p = \frac{c}{\sqrt{\varepsilon_{eff}}}$$

$$|\Gamma| = \frac{Z_L-Z_o}{Z_L+Z_o} \quad , \quad VSWR = \frac{1+|\Gamma|}{1-|\Gamma|}$$

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

$$A(dB) = \frac{54.5z}{\lambda_c} \qquad \lambda = \frac{Vc}{f}$$

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

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

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

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

Effective Aperture Area, $A_e = \eta A$

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

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

$P_T = P_R\,G$

The Complete Smith Chart

Black Magic Design