SECTION A : 80 MARKS

BAHAGIAN A : 80 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) State **FOUR (4)** components in waveguide system.
*Nyatakan **EMPAT (4)** komponen dalam sistem pemandu gelombang.*

[4 marks]
[*4 markah*]

CLO1
C2

(b) Explain the propagation of electromagnetic wave for Transverse Electric (TE) and Transverse Magnetic (TM) with the aid of vector diagram.
Terangkan perambatan gelombang elektromagnet untuk Elektrik Melintang dan Magnet Melintang dengan bantuan gambar rajah vektor.

[8 marks]
[*8 markah*]

CLO1
C2

(c) Explain **THREE (3)** characteristics of Gunn Diodes and Tunnel Diodes with appropriate symbol for each semiconductor source.
*Jelaskan **TIGA (3)** ciri-ciri Diod Gunn dan Diod Tunnel beserta symbol yang bersesuaian bagi setiap sumber separa pengalir tersebut.*

[8 marks]
[*8 markah*]

QUESTION 2

SOALAN 2

CLO1
C1

(a) List **FOUR (4)** types of Waveguide.
*Senaraikan **EMPAT (4)** jenis Pandu Gelombang.*

[4 marks]
[*4 markah*]

CLO1
C3

(b) An air filled rectangular waveguide with inside dimension 7 cm x 3.5 cm operates in the TE_{10} and TE_{11} mode. Calculate the cut-off frequency of the guide for both modes.

Sebuah pandu gelombang segiempat berisi udara yang mempunyai dimensi dalaman 7cm x 3.5 cm beroperasi pada mod TE_{10} and TE_{11}. Kirakan frekuensi potong pandu gelombang bagi kedua-dua mod tersebut.

[8 marks]
[*8 markah*]

CLO1
C3

(c) A waveguide with inner dimension of 0.5cm x 1cm is transmitting a signal with operating frequency 20 GHz in dominant mode. Calculate the group velocity in the waveguide.

Sebuah pandu gelombang yang mempunyai dimensi dalaman iaitu 0.5cm x 1cm telah memancarkan isyarat dengan frekuensi operasi 20GHz di dalam mod dominan. Kirakan halaju kumpulan di dalam pandu gelombang.

[8 marks]
[8 *markah*]

QUESTION 3

SOALAN 3

CLO1 C2

(a) Visualize the aid of Transmission Equivalent diagram, then locate the following parameters:

Gambarkan dengan bantuan gambar rajah Persamaan Penghantaran, kemudian, lokasikan parameter-parameter berikut:

i. Characteristic of line impedance, Z_0
Galangan Ciri Talian, Z_0

ii. Different Termination (Load), Z_L
Penamat Beban,, Z_L

iii. Length, L
Panjang, L

iv. Input Impedance, Z_{in}
Galangan Masukan, Z_{in}

[4 marks]

[*4 markah*]

CLO1 C3

(b) Calculate normalized impedance for the following load impedances below with 50 Ω of characteristic impedance.

Kirakan nilai galangan normal bagi galangan beban yang berikut dengan ciri galangan 50 Ω.

i. $Z_{L1} = (25 + j50)\Omega$ / $Z_{L1} = (25 + j50) \Omega$

ii. $Z_{L2} = (125 - j75)\Omega$ / $Z_{L2} = (125 - j75) \Omega$

iii. $Z_{L3} = (100 + j50)\Omega$ / $Z_{L3} = (100 + j50)\Omega$

iv. $Z_{L4} = (75 - j100)\Omega$ / $Z_{L4} = (75 - j100)\Omega$

[8 marks]

[*8 markah*]

CLO1
C3

(c) A load impedance of (150 + j75)Ω is connected to a line that has characteristic impedance equal to 75Ω. Using Smith Chart, show the value of voltage standing wave ratio (VSWR), angle of reflection coefficient and reflection coefficient.

Satu galangan beban (150 + j75)Ω disambungkan dengan satu talian yang mempunyai galangan ciri bersamaan 75Ω. Dengan menggunakan Smith Chart, Tunjukkan nilai nisbah gelombang voltan pegun (VSWR), nilai sudut pekali pantulan dan nilai magnitud pekali pantulan.

[8 marks]

[*8 markah*]

QUESTION 4

SOALAN 4

CLO1
C3

(a) A parabolic antenna with a dish diameter of 4.5m operates at frequency of 2.5 GHz (assumed uniform illumination). Calculate the beamwidth angle and the antenna gain in dB.

Sebuah antenna parabola dengan diameter piring 4.5m beroperasi pada 2.5 GHz (andaikan iluminasi seragam). Kirakan sudut alur dan gandaan antenna dalam dB.

[6 marks]

[*6 markah*]

CLO1
C3

(b) A group of students conducted an experiment using a horn antenna with 48cm x30cm dimension. The experiment has been set with the 15 dB transmitted power and received power 2W with aperture efficiency of 50%. From the experiment, calculate frequency for the antenna.

Sekumpulan pelajar menjalankan eksperimen menggunakan antenna hon dengan dimensi 48cm x 30cm. Eksperimen itu telah menetapkan 15 dB kuasa penghantaran dan 2W kuasa penerimaan dengan kecekapan bukaan 50%. Daripada eksperimen, kirakan frekuensi bagi antenna.

[7 marks]

[*7 markah*]

CLO1
C3

(c) A parabolic reflector antenna with a diameter of 22 meters operates at a frequency of 5GHz. Calculate the power gain, G (dB) of the antenna if the aperture efficiency is 50%.

Sebuah antenna pemantul parabola yang mempunyai diameter piring 22 meter, beroperasi pada frekuensi 5 GHz. Kirakan gandaan kuasa, G (dB) sekiranya kecekapan bukaan antena adalah 50%.

[7 marks]

[*7 markah*]

SECTION B : 20 MARKS

BAHAGIAN B : 20 MARKAH

INSTRUCTION:

This section consists of **ONE (1)** essay questions. Answer **ALL** question.

ARAHAN:

*Bahagian ini mengandungi **SATU (1)** soalan esei. Jawab **SEMUA** soalan.*

QUESTION 1

SOALAN 1

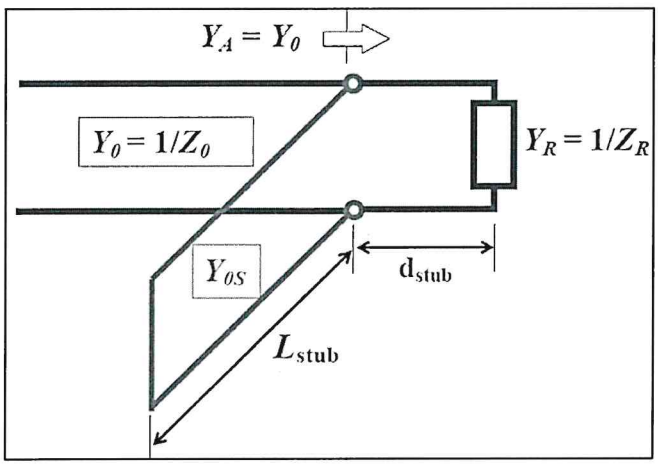

Figure 1: Parallel Single Stub

Rajah 1: Puntung Selari

CLO1
C4

A parallel single stub is located at a point where the reflected wave from the stub and the reflected wave from the load on the main line are completely cancelled by each other, so that no reflected wave beyond that point is returned to generator. Impedance matching can be achieved by inserting another transmission line (stub) as shown in the **Figure 1**. Find the position and length of the short-circuited stub to match the transmission line if a 50Ω transmission line is terminated in an impedance of Z_R = (35 - j47.5)Ω by using Smith Chart.

Satu puntung tunggal selari diletakkan pada satu titik di mana gelombang pantulan dari puntung itu dan gelombang pantulan dari beban pada talian utama memadamkan satu sama lain secara penuh supaya tiada gelombang pantulan yang berlaku selepas titik tersebut yang akan menghala balik ke penjana. Padanan Galangan boleh dicapai dengan memasukkan talian penghantaran (puntung) lain seperti yang ditunjukkan dalam ***Rajah 1****. Carikan kedudukan puntung dan panjang puntung litar yang dipintaskan untuk menamatkan talian penghantaran sekiranya satu talian penghantaran 50Ω ditamatkan dengan satu galangan beban,* $Z_R = (35 - j47.5)\Omega$ *dengan menggunakan Carta Smith.*

[20 marks]

[20 *markah*]

SOALAN TAMAT

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

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

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

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

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

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

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

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

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

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

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

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

W/d > 1

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

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

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

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

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

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

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

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

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

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

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

$$Effective\ Aperture\ Area,\ A_e = \eta A$$

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

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

$$P_T = P_R\,G$$