Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2022/2023

COURSE NAME	:	RF & MICROWAVE ENGINEERING
COURSE CODE	:	BEJ 41803
PROGRAMME CODE	:	BEJ
EXAMINATION DATE	:	JULY/ AUGUST 2023
DURATION	:	3 HOURS
INSTRUCTION	:	1. ANSWERS **ALL** QUESTIONS. 2. THIS FINAL EXAMINATION IS CONDUCTED VIA CLOSED BOOK. 3. STUDENTS ARE PROHIBITED TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK.

THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** PAGES

Q1 Impedance along a transmission line will define the pattern behavior of the signals that propagates through it. Knowledge in analyzing the signal pattern helps in understanding the system as whole.

(a) **Figure Q1(a)** shows the reflection coefficient plot of a terminated transmission line observed using a time domain reflectometer.

(i) What is the possible termination condition at the load that results in signal profile as seen from the plot observed by Channel 2. (2 marks)

(ii) Calculate the value of VSWR for the system observed by Channel 2. (2 marks)

(iii) Based on your observation in **Q1(a)(i)** and **Q1(a)(ii)**, by using the general input impedance Z_{in} formulation for lossless transmission line, devise the input impedance formula of this system. (5 marks)

(b) **Figure Q1(b)** shows the frequency response of an antenna. Assume that Z_o is 50 Ω. At the frequency of 9.75 GHz, calculate:

(i) the load impedance, Z_L of the antenna (4 marks)

(ii) the voltage signal wave ratio ($VSWR$), and (3 marks)

(iii) the percentage of power transmitted, (P_T) (4 marks)

Q2 (a) Based on the circuit illustration in **Figure Q2 (a)**, what will happen to the bulb when the operating frequency is increased from 50 Hz to 1500 MHz?. Give your explanation. (5 marks)

(b) A power transmission system is illustrated in a schematic diagram as in **Figure Q2 (b)**,

(i) What is the amount of attenuation for the attenuator in dB. (3 marks)

(ii) Calculate the loss of the circulator (in dB) if the output power is only 20% of the power input. (4 marks)

(iii) Suggest a solution so that the output power can be increased to 1 W. State clearly what component to be added and the parameter value. Draw the new schematic diagram.

(8 marks)

Q3 (a) Refer to **Figure Q3 (a)**, find the S-parameter of the system if l is $\frac{\lambda}{4}$

(10 marks)

(b) Consider a two-port network as illustrated in **Figure Q3 (b)**. Calculate the S-parameter of the system.

(10 marks)

Q4 (a) Microwave resonator forms the basic element for various devices including filters and amplifiers

(i) Sketch the circuit and label the response ($Z_{in}(\omega)$ vs ω/ω_o) for the series resonant resonator.

(4 marks)

(ii) Calculate the resonant frequency if the inductance, L is given as 2.5 nH and capacitance, C is 0.6 pF.

(4 marks)

(iii) If at any given time, the frequency measured is 200 MHz below the resonant frequency (as calculated in **Q4(ii)**), calculate the input impedance Z_{in} of the resonant circuit. Assume the resistance, R is 200 Ω.

(4 marks)

(b) Consider a mixer circuit having RF input of 10 GHz with lower sideband of 9.995 GHz and upper sideband of 10.005GHz. A frequency source of 10.07 GHz is connected to the local oscillator port of the mixer. Find the intermediate frequency and sketch the spectrum

(8 marks)

Q5 (a) A satellite downlink has a frequency of 10 GHz, a bandwidth of 40 MHz, and uses a cryogenic pre-amplifier receiver. If antenna's noise power density is given as 0.00015 pW/MHz and receiver's noise power density is 0.0003 pW/MHz,

(i) calculate the antenna's noise power.

(4 marks)

(ii) calculate the reciever's noise power.

(4 marks)

(ii) calculate power recieved if SNR is to be maintained at 20 dB.

(6 marks)

(iv) what is the gain of the receiver if the received power output is 0 dBm.

(4 marks)

(iv) calculate the amplifier's directivity if the amplifier has isolation of 40dB and gain of 37dB

(2 marks)

-END OF QUESTIONS –

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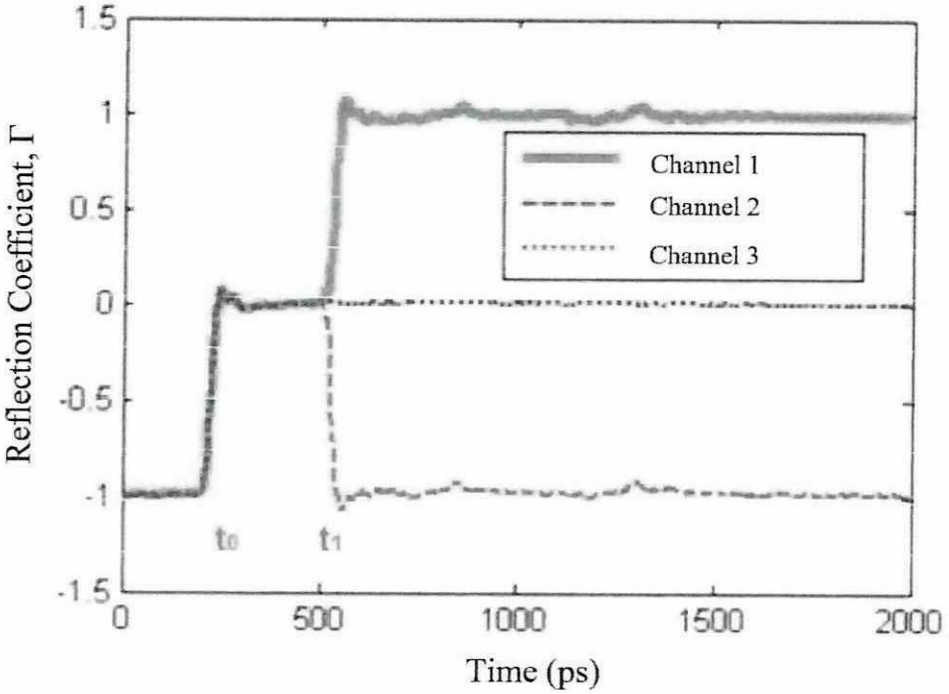

Figure Q1(a)

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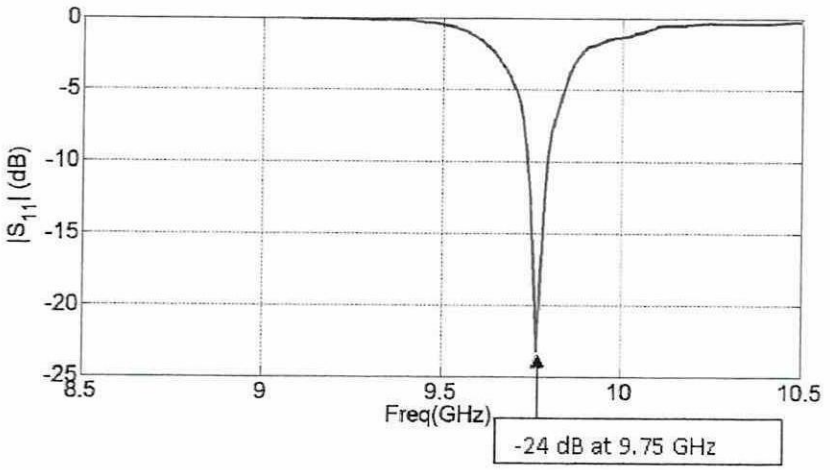

Figure Q1(b)

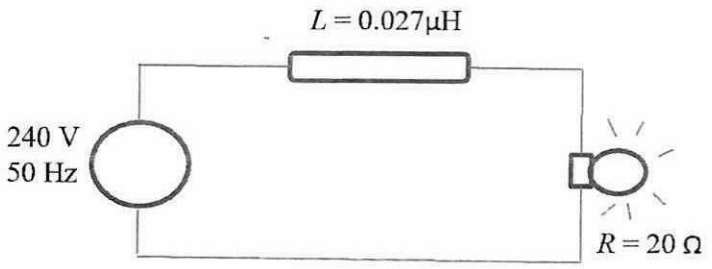

Figure Q2(a)

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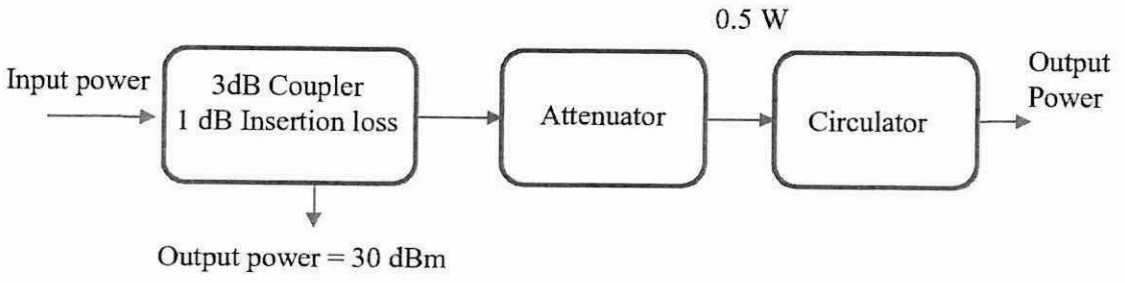

Figure Q2(b)

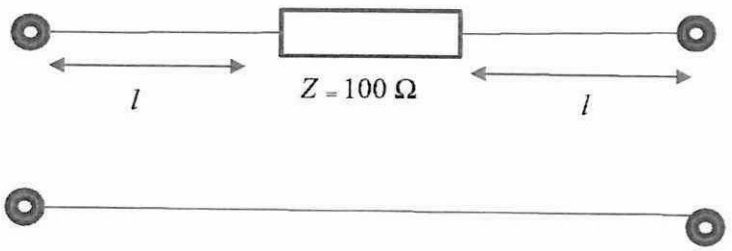

Figure Q3(a)

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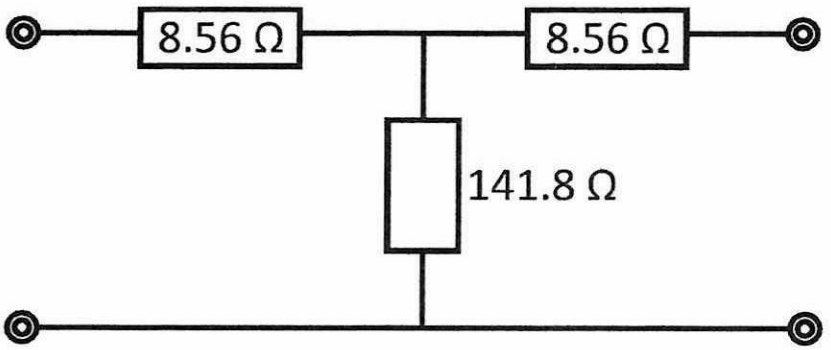

Figure Q3(b)