Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
(TAKE- HOME)
SEMESTER II
SESSION 2020/2021

COURSE NAME	:	RF & MICROWAVE ENGINEERING
COURSE CODE	:	BEB 40803/BEJ 41803
PROGRAMME CODE	:	BEE / BEV
EXAMINATION DATE	:	JULY 2021
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWERS **ALL** QUESTIONS. **OPEN BOOK EXAMINATION**

THIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

Q1 A transmission line is a distributed parameter network, where voltages and currents can vary in magnitude$_o$ and phase over its length

(a) Sketch and label the lumped-element equivalent circuit of a transmission line.

(4 marks)

(b) Show that, for a transmission line terminated with a load Z_L , with characteristic impedance of Z_o , and length $l = \frac{\lambda}{4}$, the input impedance Z_{in} is,

$$Z_{in} = \frac{Z_o^2}{Z_L}$$

(4 marks)

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

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

(ii) the voltage signal wave ratio (VSWR) (4 marks)

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

Q2 (a) Based on the circuit illustration in **Figure Q2 (a)**, what would 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 as illustrated in a schematic diagram as in **Figure Q2 (b)**,

(i) what is the parameter value of the attenuator.

(3 marks)

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

(4 marks)

(iii) Suggest a solution so that the output power can be increased to 1 W. State clearly what component you need to add 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 filter and amplifier

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

(4 marks)

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

(4 marks)

(iii) If at any given time, the frequency measured is 200 MHz below the resonance frequency, calculate the input impedance Z_{in} of the resonance circuit. Assume the resistance value R is 200 Ω.

(4 marks)

(b) Consider a microstrip substrate with thickness, $h = 0.127$ cm, and relative permittivity value of $\varepsilon_r = 2.20$,

(i) calculate the width of the microstrip transmission line with $Z_o = 50$ Ω at 5 GHz.

(4 marks)

(ii) find the length of the microstrip transmission line if the output signal is having 45° phase shift.

(6 marks)

Q5 (a) Low pass filter can be found in many applications in radio frequency and microwave systems. Sketch the binomial low pass filter response, and clearly label your diagram.
(4 marks)

(b) A microstrip substrate with thickness h=0.127 cm and effective permittivity of ε_r = 2.20 is used to fabricate a binomial response low pass filter. The cut off frequency of the filter f_c = 2.5 GHz with minimum inserion loss of 20 dB at 4.0 GHz. If the filter prototype realization is using the Hi-Lo impedance technique, and given that Z_{High} = 150 Ω and Z_{Low} = 10 Ω,

(i) sketch the filter response. Label the diagram clearly.
(4 marks)

(ii) Sketch the low pass lump element circuit prototype and state the element values.
(6 marks)

(iii) Calculate the electrical length of each element. Leave your answer in radians.
(6 marks)

-END OF QUESTIONS –

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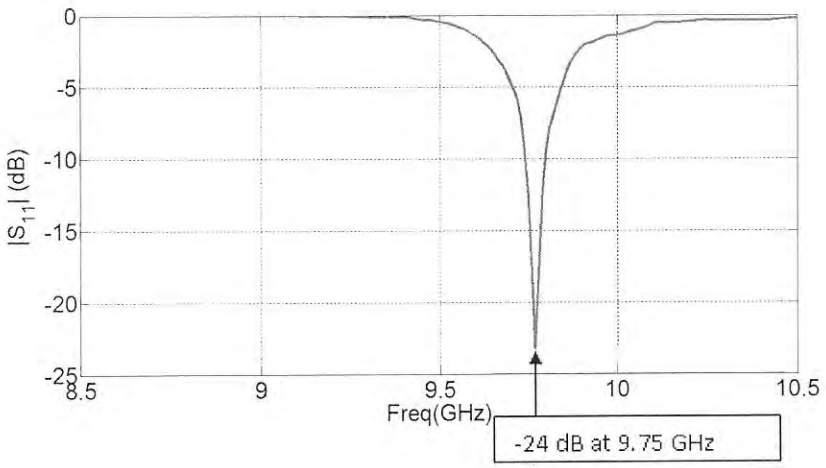

Figure Q1(c)

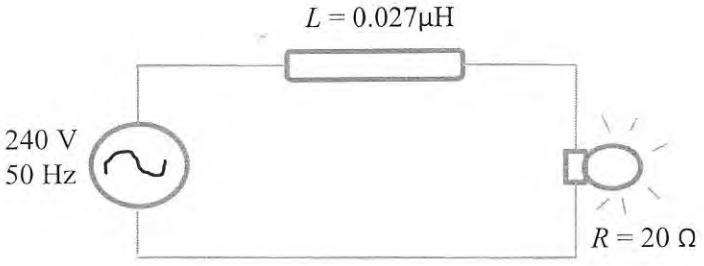

Figure Q2(a)

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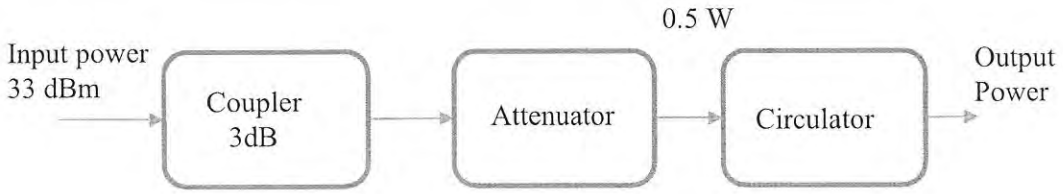

Figure Q2(b)

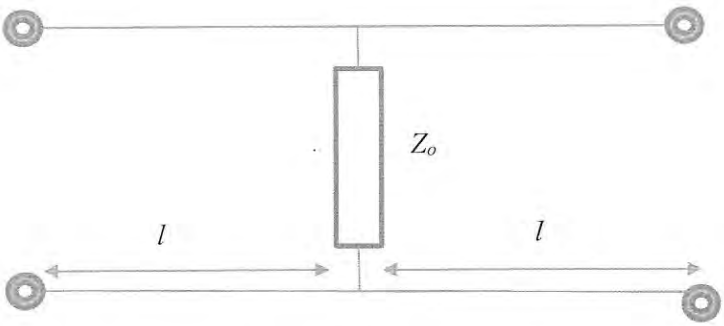

Figure Q3(a)

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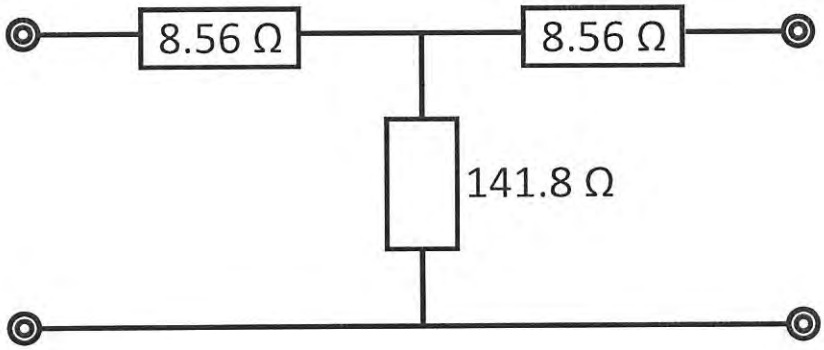

Figure Q4(b)