Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
(ONLINE)
SEMESTER II
SESSION 2020/2021

COURSE NAME	:	ELECTROMAGNETIC WAVES PROPAGATION
COURSE CODE	:	BEJ 31103
PROGRAMME CODE	:	BEJ
EXAMINATION DATE	:	JULY 2021
DURATION	:	3 HOURS
INSTRUCTION	:	1. ANSWER **ALL** QUESTIONS. 2. ANSWERS MUST BE HANDWRITTEN. 3. MERGE ALL ANSWER SHEETS IN **ONE (1) FILE** AND SUBMIT IN **PDF** FORMAT. 4. **OPEN BOOK EXAMINATION**.

THIS QUESTION PAPER CONSISTS OF **THREE (3)** PAGES

Q1 A transmission line of 50 Ω is terminated by (30 + j60) Ω load impedance. To match the line, a shorted stub is attached to the line. Using the Smith Chart, shows how matching is done, and provides all the values for the relevant parameters.

(8 marks)

Q2 (a) A waveguide with dimensions 2 cm × 1 cm is used at 6 GHz. Determine the wave impedance for the dominant mode if the waveguide is filled with polyethylene.

(8 marks)

(b) An air-filled rectangular cavity with the width, a, height, b, and depth, c has the resonant frequency of 1 GHz for the TE's lowest mode. Design the cavity by taking into consideration that $a = 3b = 2c$. Note that $a > b < c$.

(6 marks)

Q3 (a) Discuss the importance of polarization matching of transmit and receive antennas.

(4 marks)

(b) Discuss the effect of rainfall on a wireless communication system operating at 10 GHz.

(4 marks)

Q4 A 75-Ω transmission line of 1 m length is connected to a half-wave dipole antenna at the transmitting station. The system is operating at 60 MHz. The distance between the transmitter and receiver is 20 km. The half-wave dipole is made of copper and has a diameter of 3 mm. A magnetic field strength of 20 μA/m is measured at a point of $\theta = \pi/2$ at the receiver site. There is a building with a height of 7 m at a distance of 10 km from the transmitter. Transmit and receive antennas are reciprocal.

(a) Sketch the scenario for the communication system described above.

(2 marks)

(b) Determine the quality of the transmission based on the SWR of the transmission line.

(6 marks)

(c) Calculate the input impedance of the transmission line at the distance of 0.5 m from the antenna.

(5 marks)

(d) Calculate the length of the dipole in meters.

(1 mark)

(e) Calculate the percentage of efficiency of the antenna.

(4 marks)

(f) Calculate the radiated power (in dBm) of the antenna.

(5 marks)

(g) Calculate the transmit power (in dBm) of the antenna.

(2 marks)

(h) Calculate the EIRP (in dBm) of the antenna.

(4 marks)

(i) Calculate the power density at the receiver site.

(4 marks)

(j) Calculate the received power (in dBm) by the antenna at the receiver site.

(4 marks)

(k) Based on the Fresnel zone, determine the suitable range required to keep the obstacle clear between the transmitter and the receiver.

(4 marks)

(l) Illustrate your answer to part **Q4 (k)**.

(2 marks)

(m) Based on your understanding of the Fresnel zone, discuss how the building between the transmitter and receiver affects your system's communication quality and how you can improve (if required).

(6 marks)

(n) Calculate the free space path loss (in dB) for the system.

(2 marks)

(o) Propose a suitable radiowave propagation mode for this system.

(4 marks)

(p) Is it feasible to use a waveguide as the transmission line in this communication link?

(4 marks)

(q) Is the impedance matching technique needs to be implemented in this communication link?

(4 marks)

(r) State at least **THREE** (**3**) assumptions you used to answer **Q4**.

(3 marks)

(s) Conclude your findings based on your answers for **Q4**.

(4 marks)

END OF QUESTIONS