



UNIVERSITI  
TEKNOLOGI  
PETRONAS

## FINAL EXAMINATION MAY 2024 SEMESTER

**COURSE** : TEB2063 - WIRELESS TECHNOLOGY  
**DATE** : 5 AUGUST 2024 (MONDAY)  
**TIME** : 9:00 AM - 12:00 NOON (3 HOURS)

### INSTRUCTIONS TO CANDIDATES

1. Answer **ALL** questions in the Answer Booklet.
2. Begin **EACH** answer on a new page in the Answer Booklet.
3. Indicate clearly answers that are cancelled, if any.
4. Where applicable, show clearly steps taken in arriving at the solutions and indicate **ALL** assumptions, if any.
5. **DO NOT** open this Question Booklet until instructed.

**Note** :

- i. There are **SEVEN (7)** pages in this Question Booklet including the cover page
- ii. **DOUBLE-SIDED** Question Booklet.

Universiti Teknologi PETRONAS

1. a. Let say a periodic signal has a frequency of 2.5 GHz. The speed of light in free space,  $c = 3 \times 10^8$  m/sec = 300 m/ $\mu$ sec. Compute the wavelength,  $\lambda$  of the signal.

[4 marks]

- b. Given a signal  $s(t) = (1/3) \sin(2\pi(3f)t)$  represented in time domain by the graph in **FIGURE Q1** below. Draw the graph to represent the signal in frequency domain.

[6 marks]

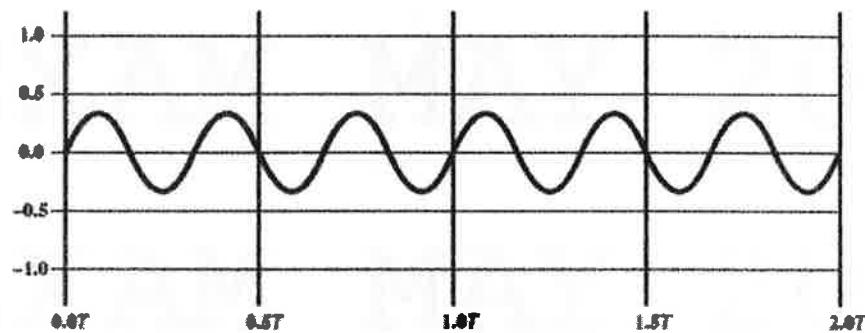


FIGURE Q1

- c. A wireless channel is occupying a spectrum from 3 MHz to 4 MHz. It is to be used for transmitting signal having a Signal-to-Noise Ratio (SNR) of 24 dB. Determine the theoretical maximum signal levels allowed for this channel.

[6 marks]

- d. In a mobile wireless network, describe what happen to the frequency of received signal for each of the following cases:

- i. When the transmitter and receiver move towards each other.

[2 marks]

- ii. When the transmitter and receiver move away from each other.

[2 marks]

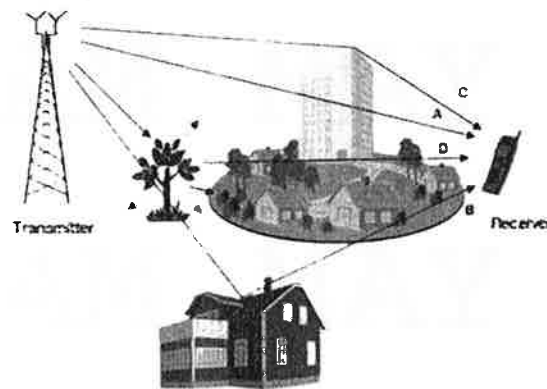
2. a. **FIGURE Q2** sketches the multipath propagation that may be created as the transmitter sends signal to the receiver (mobile user).

- i. Determine the type of propagation for each paths A, B, C, and D.

[4 marks]

- ii. Describe the **TWO (2)** fading phenomena that occur as the mobile user moves around in the urban environment.

[4 marks]



**FIGURE Q2**

- b. Describe the radiation pattern produced by isotropic antenna.

[4 marks]

- c. Determine the range of coverage for each of the following cellular environments. Use a frequency of 1.9 GHz, assume isotropic antennas, transmit power is 2 W and the received power must be above -110 dBW.

- i. Free space between mobiles and base stations.

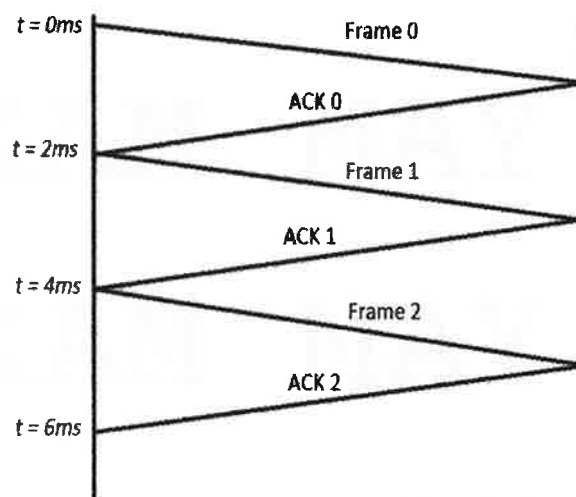
[4 marks]

- ii. Urban area cellular radio with path loss exponent,  $n = 3.1$ .

[4 marks]

3. Assume the following bit stream as the sender's message: **1011 0011 0101 0110**, and it is to be encoded using CRC-8 polynomial.
- a. Express the CRC-8 using the standard polynomial notation. [2 marks]
- b. Express the CRC-8 in binary form. [2 marks]
- c. Compute the transmitted bit-sequence that will be generated. [8 marks]
- d. Assume the 7<sup>th</sup> bit in the transmitted sequence is flipped. Compute the remainder calculated at the receiver. [8 marks]

4. Assume that transmitter and receiver are communicating using the Stop-and-Wait Automatic Repeat Request (ARQ) protocol. Assume that the Round-Trip Time (RTT) for the communication channel is 2 msec, and that the timeout is twice the RTT. Also assume that both transmitter and receiver use sequence numbers on data and ACK frames. Consider the case where the transmitter needs to send 8 frames to the receiver. **FIGURE Q4** illustrates the timing diagram for the first three frames that are sent successfully.



**FIGURE Q4**

- a. Draw the timing diagram, if the 4<sup>th</sup> frame is lost during the first and second transmission but is acknowledged successfully after the third transmission. [6 marks]
- b. Draw the timing diagram, if the 5<sup>th</sup> frame is lost during the first transmission but is acknowledged successfully after the second transmission. [4 marks]

- c. Draw the timing diagram, if the 6<sup>th</sup> frame is acknowledged successfully. The 7<sup>th</sup> frame is received successfully by the receiver, but the acknowledgement is lost during the first transmission and acknowledged successfully in the second transmission.

[6 marks]

- d. Determine the time taken by the protocol for all the frames, if the 8<sup>th</sup> frame is acknowledged successfully.

[4 marks]

5. a. Explain **TWO (2)** of the most important requirements for wireless LAN.  
[4 marks]
- b. IEEE 802.11 defines several services that should be provided by wireless LAN. Describe **TWO (2)** ways of categorizing the services.  
[6 marks]
- c. Describe **TWO (2)** differences between the Point coordination function (PCF) and Distributed coordination function (DCF) Medium Access Control (MAC) layer algorithms used in IEEE 802.11.  
[6 marks]
- d. Explain **TWO (2)** of the performance metrics used in hand-off procedure to change the assignment of a mobile unit from one Base station (BS) to another as the mobile unit moves from one cell to another.  
[4 marks]

– END OF PAPER –

