



**UNIVERSITI KUALA LUMPUR**  
**MALAYSIAN INSTITUTE OF MARINE ENGINEERING TECHNOLOGY**

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**FINAL EXAMINATION**  
**SEPTEMBER 2016 SEMESTER**

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**COURSE CODE** : LEB 40903  
**COURSE NAME** : WIRELESS COMMUNICATION  
**PROGRAMME NAME** : BACHELOR OF MARINE ELECTRICAL ELECTRONIC  
(FOR MPU: PROGRAMME LEVEL)  
**DATE** : 23<sup>rd</sup> JANUARY 2017  
**TIME** : 9.00AM  
**DURATION** : 3 HOURS

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**INSTRUCTIONS TO CANDIDATES**

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1. Please **CAREFULLY** read the instructions given in the question paper.
2. This question paper has information printed on both sides of the paper.
3. This question paper consists of **TWO (2)** sections; Section A and Section B.
4. Answer **ALL** questions in Section A. For Section B, answer **THREE (3)** questions **WITH AT LEAST ONE (1)** question from question 4 or question 5.
5. Please write your answers on the answer booklet provided.
6. Answer all questions in English language **ONLY**.
- 7.

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**THERE ARE 8 PAGES OF QUESTIONS, INCLUDING THIS PAGE.**

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## SECTION A (Total: 40 marks)

**INSTRUCTION: Answer ALL questions.**

**Please use the answer booklet provided.**

## Question 1

(a) Wireless data transmission system has various techniques to encode its signal to be transmitted. Determine the operation of the following types of data coding techniques:

- i. Non-Return Zero Level (NRZ-L)
- ii. Non-Return Zero Invert (NRZ-I)
- iii. Manchester Encoding (Biphase Code)

(CLO 1)

(6 marks)

(b) According to the Shannon's Channel Capacity theorem, bandwidth,  $B$  has the relationship with Signal-to-Noise Ratio ( $S/N$ ). Determine the effect of increasing the following:

- i. Bandwidth to the channel
- ii. Signal-to-Noise Ratio

(CLO 1)

(4 marks)

(c) Suppose that the spectrum of a channel is between 10MHz and 12 MHz and an intended capacity of 8Mbps. Calculate the following:

- i. Signal-to-Noise Ratio in order to obtain this capacity.
- ii. The signaling levels required to obtain this capacity.

(CLO 1)

(6 marks)

(d) Distinguish a proper channel capacity available in a wireless system with a 15MHz frequency channel and signal to noise ratio of 28dB. (CLO 1)

(4 marks)

Question 2

- (a) Space Time Trellis Code (STTC) has been developed to improve multipath signal transmission. Analyze the performance of STTC by looking at its advantages and disadvantages to transmit signals. (CLO 2)

(5 marks)

- (b) A simple approach of frequency division multiplexing (FDM) shows its operation that shares the available bandwidth of a communication channel among the signals to be transmitted as shown in Figure 1. Determine the total bandwidth available in 5 channels that has a limited of 100 kHz per channel. Include the 20 kHz guard band to avoid channel interference. (CLO 2)

(5 marks)

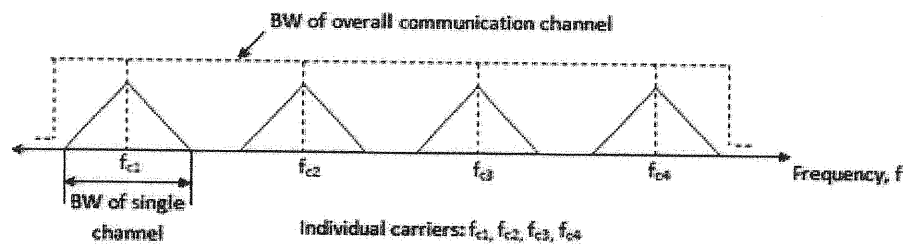


Figure 1

- (c) Space Time Block Codes (STBC) is a technique used in wireless communications to transmit multiple copies of a data stream across a number of antennas. Discuss the theory of S Alamouti that has multiple transmitting and receiving antenna. Include the general equation of the theory to support your answer. (CLO 3)

(5 marks)

- (d) In digital system model wireless transmission become more efficient with multiple antenna. Discuss the main function of Inverse Fast Fourier Transform (IFFT) and Cyclic Prefix (CP) shown in Figure 2.

(5 marks)

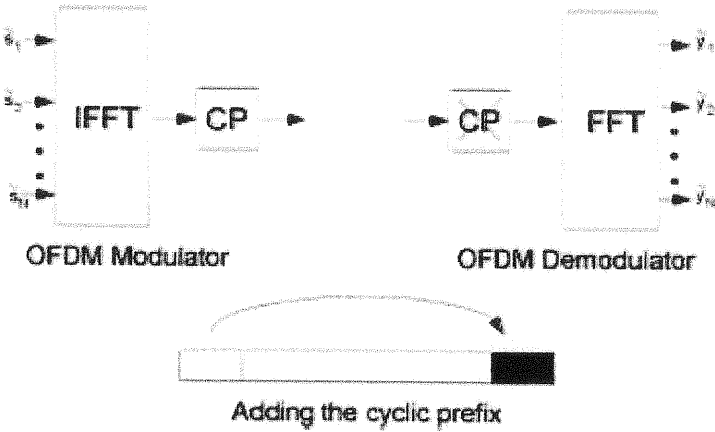


Figure 2

## SECTION B (Total: 60 marks)

**INSTRUCTION: Answer THREE (3) ONLY from FOUR (4) questions.**

**Please use the answer booklet provided**

**Question 3**

(a) Modulation methods are developed for wireless communications that can also adapted for underwater acoustic communications (UAC). Discuss in details the modulation methods used for UAC below:

- i. Frequency Hopped Spread Spectrum
- ii. Direct Sequence Spread Spectrum

(CLO 2)

(6 marks)

(b) Assuming the channel capacity of 265 kbps need to send over a noiseless channel with a bandwidth of 20 kHz. Calculate the number of signal levels needed to show the effect of reducing the bit rate. (CLO 2)

(5 marks)

(c) In telecommunication and radio communication, spread-spectrum techniques are methods by which a signal (e.g. an electrical, electromagnetic, or acoustic signal) generated with a particular bandwidth is deliberately spread in the frequency domain, resulting in a signal with a wider bandwidth. Determine the advantages and disadvantages of Spread Spectrum Techniques. (CLO 2)

(5 marks)

- (d) Consider a mobile communication system operating at 5.9GHz band. Assuming the free space loss model for signal attenuation, the gain of both transmitting and receiving antenna to be 1dB and a noise level of -85dBm. Calculate the following:
- The range of communication if the transmission power is 100mW,
  - The approximate range if the frequency was 900MHz.
- (CLO 2)

(4 marks)

**Question 4**

- (a) The physical coordinates in a group of sensor nodes in a wireless sensor network (WSN) is important to determine its position and location. Referring to Figure 4, calculate the distance to anchor nodes of the following: (CLO 3)
- Sum Distance for Node P, Q and R,
  - Distance Vector (DV) Hop P-to-Q

(6 marks)

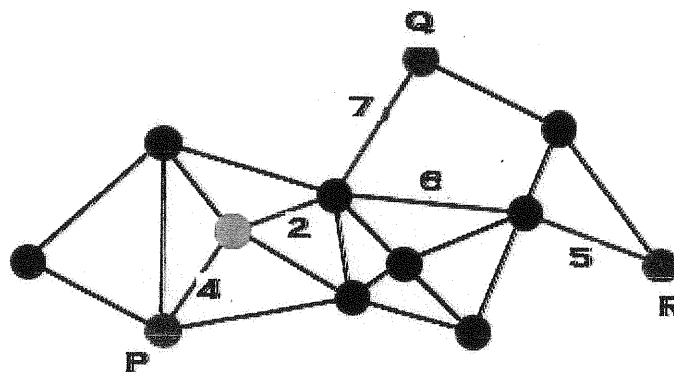


Figure 4

- (b) There are THREE (3) areas defined for the IEEE 802.11 standard managed by International Telecommunication Union (ITU). Discuss all areas covered in the wireless standard mentioned earlier. (CLO 3)

(6 marks)

(c) In Positioning Wireless Network, the node for its physical coordinate or symbolic location can be determined by using Multihop Scheme Estimation and Trilateration. Discuss to compare both methods mentioned earlier. (CLO 4)

(4 marks)

(d) IEEE 802.11n is a wireless standard that developed high speed data transmission. Describe the technology that uses the standard with its data rate and distance coverage. (CLO 3)

(4 marks)

### Question 5

(a) Ultra Wide Band (UWB) radio in wireless applications has the characteristic of simple radio frequency (RF) architecture. Explain briefly its characteristics and support your answer with example of UWB applications. (CLO 4)

(5 marks)

(b) Differentiate between range-free and range-based methods that deployed in classification of localization method. (CLO 4)

(5 marks)

(c) Produce the THREE (3) generic steps in calculating node positions using anchor nodes in positioning wireless network. (CLO 4)

(6 marks)

(d) The actual sampling rate depends on the application and complexity channel bandwidth. Describe the theory of Nyquist sampling rate with a signal broadcast at 10 kHz.

(4 marks)

**Question 6**

(a) With alternative technology of Ultra Wide band (UWB) Radio, discuss the advantages and disadvantages that makes them popular. (CLO 5)

(4 marks)

(b) By using Pulse Position Modulation (PPM), derive the basic transmitter model of ultra wide band radio which produces typical time hopping format.

(6 marks)

(c) Fading and multi-path distortion are the two main problems that occur in space wave propagation method. In your own sentence: (CLO 5)

- i. Discuss the cause of each problem.
- ii. Suggest solutions to overcome the problems.

(6 marks)

(d) By using a wireless physical layer, 802.11 standard is Direct Sequence Spread Spectrum, determine its idea that produce at least 4-bits chipping sequence of the following: (CLO 5)

- i. Data stream 1010 with random sequence 0100
- ii. Data stream 1001 with random sequence 1011

(4 marks)

End of question paper.