SINGAPORE POLYTECHNIC **ET1205**

2018/2019 SEMESTER ONE EXAMINATION

Diploma in Engineering with Business
3rd Year Full Time

WIRELESS TECHNOLOGY APPLICATIONS Time Allowed: 2.0 Hours

Instructions to Candidates

1. The examination rules set out on the last page of the answer booklet are to be complied with.

2. This paper consists of **TWO** sections :

Section A	-	10 Multiple Choice Questions, 2 marks each.
Section B	-	8 Short Questions, 10 marks each.

3. **ALL** questions are **COMPULSORY**.

4. All questions are to be answered in the answer booklet. Start each question in Sections B on a new page.

5. Fill in the Question Numbers, in the order that they were answered, in the boxes found on the front cover of the answer booklet under the column "Question Answered".

6. This paper consists of 12 pages.

SECTION A

MULTIPLE CHOICE QUESTIONS [2 marks each]

1. Please **tick** your answers in the **MCQ box** behind the front cover of the answer booklet.
2. No marks will be deducted for incorrect answers.

A1. Which one of the following frequency bands is commonly used among WLAN IEEE 802.11b/g, Bluetooth and ZigBee standards to provide wireless access for different applications?

(a) VHF
(b) UHF
(c) SHF
(d) EHF

A2. In a FDMA/TDMA system, there are twenty frequency channels and each frequency channel is being divided into eight time slots. How many users can this system support?

(a) 20
(b) 28
(c) 80
(d) 160

A3. Which one of the following options is TRUE for a passive RFID tag?

(a) It contains antenna, display module, power supply circuit and microchip.
(b) It contains antenna, battery, power supply circuit and microchip.
(c) It contains antenna, power supply circuit and microchip.
(d) It contains antenna, interface, power supply circuit and microchip.

A4. Figure A4 shows the signal waveform with the binary bit pattern $(101001101)_b$ which was transmitted from an RFID tag to the reader in an RFID Item Management system. What are the bitrate and parity check used in this system?

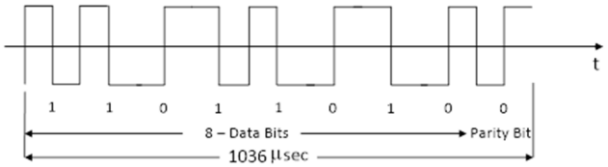


Figure A4

(a) 7722 bps and odd parity
(b) 7722 bps and even parity
(c) 8687 bps and odd parity
(d) 8687 bps and even parity

A5. What is the bit rate if the modulation technique is 16-QAM and the convolutional coding is ¾ for IEEE 802.11a WLAN? Hint: $Rate_b = 0.25 \times R \times 48 \times \log_2 M$, where R and M are the coding rate and order of modulation respectively.

(a) 18 Mbps
(b) 24 Mbps
(c) 36 Mbps
(d) 54 Mbps

A6. Which one of the following ZigBee protocol layers performs the modulation on outgoing signals and demodulation on incoming signals?

(a) Physical (PHY) layer
(b) Medium Access Control (MAC) layer
(c) Network & Security Layer
(d) Application Layer

A7. Which one of the following modulation techniques is used in Bluetooth version 2.1+EDR to provide the maximum speed of 3 Mbps?

(a) 4PSK
(b) 8PSK
(c) G2FSK
(d) GMSK

A8. The frequency spectrum allocated for 3G UMTS-TDD system are 1900 MHz to 1920 MHz and 2010 MHz to 2025 MHz. If each telco is given 5 MHz spectrum, how many telcos can be operated in the above UMTS-TDD system?

(a) 3
(b) 4
(c) 5
(d) 7

A9. Which one of the following frequency spectrums is used to provide point-to-multipoint mobile applications in IEEE 802.16 WiMAX?

(a) 2.4 GHz to 2.835 GHz
(b) 10 GHz to 66 GHz
(c) 2 GHz to 14 GHz
(d) 2 GHz to 6 GHz

A10. Which one of the following options is to be considered as an offset factor for the advantages of the building a Wireless Infrastructure for Business?

(a) Security and mobility
(b) Security and interference
(c) Flexibility and scalability
(d) Scalability and coverage

SECTION B [80 Marks]

B1. Figure B1 shows the block diagram of an RFID reader for a door access system using 135 kHz frequency. The name or description of each block is listed in Table B1.

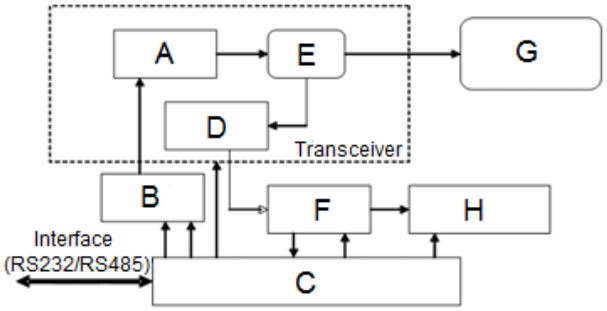


Figure B1

Serial No.	Description
1	Antenna
2	Control Unit
3	Decoder
4	Display Module
5	Encoder
6	Receiver
7	Switch
8	Transmitter

Table B1

(a) Match each of the functional block in Figure B1 with respect to their corresponding description or name in Table B1.

(4 marks)

(b) What is the frequency band used in the above system?

(1 mark)

(c) What is the typical maximum reading range of this frequency band in metres?

(1 mark)

(d) With a valid reason, explain if it is possible to use the above frequency for animal identification system.

(2 marks)

(e) In RFID security, which one of the following: secret keys or encrypted random numbers, is never transmitted over the air?

(1 mark)

(f) Among the passive RFID, active RFID and semi-passive RFID, which RFID category can provide monitoring and control applications at longer range? (1 mark)

B2. Figure B2.1 shows the frequency channels allocated in IEEE 802.11a WLAN standard and Figure B2.2 shows an example of the NAV settings based on the reception of the RTS frame and reception of the CTS frame for source and destination stations, STAs.

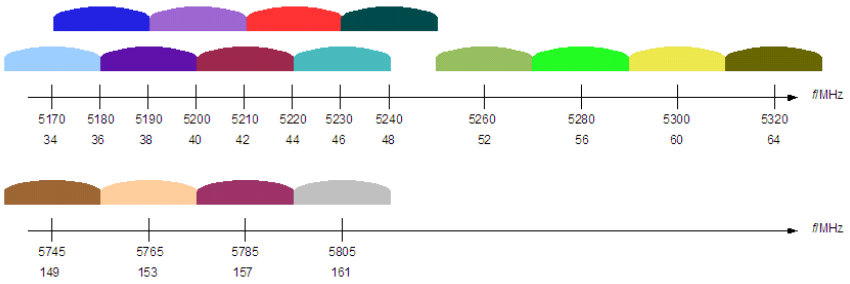


Figure B2.1

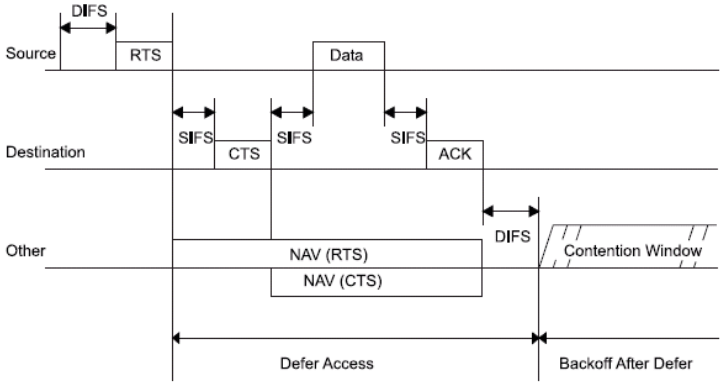


Figure B2.2

(a) How many frequency channels are allocated and what is the bandwidth of each channel for the IEEE standard shown in Figure B2.1?

(2 marks)

(b) What is the center frequency of channel 36 in Figure B2.1?

(1 mark)

(c) State one advantage of using 5GHz frequency band compared to ISM 2.4 GHz band?

(1 mark)

(d) What is the interframe space, IFS use between the Data and ACK in Figure B2.2?

(1 mark)

(e) What is the NAV setting for NAV (RTS) in Figure B2.1?

(2 marks)

(f) What is the NAV setting for NAV (CTS) in Figure B2.2?

(2 marks)

(g) What is the alternative name of the above RTS/CTS mechanism?

(1 mark)

B3. The frequency channels for the ZigBee technology is illustrated in Figure B3.1. Figure B3.2 shows the data transmission between two ZigBee devices in a beacon-enabled network.

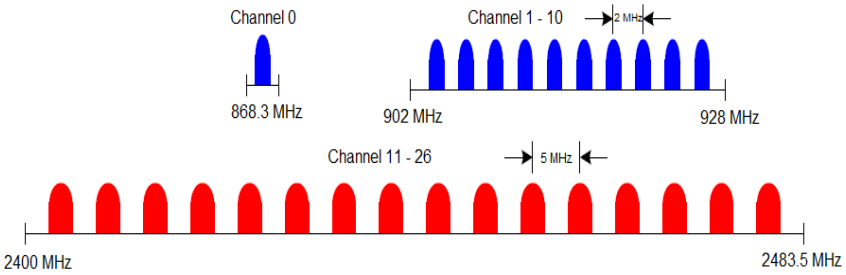


Figure B3.1

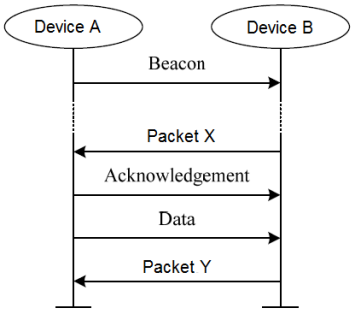


Figure B3.2

(a) Which one of the ZigBee protocol layers defines the frequency band shown in Figure B3.1?

(1 mark)

(b) What is the IEEE 802 standard for the ZigBee wireless technology?

(1 mark)

(c) What are the bit rate and modulation technique used in the ZigBee technology operating in the 915 MHz frequency band shown in Figure B3.1?

(2 marks)

(d) Which one of the ZigBee protocol layer is represented by the diagram shown in Figure B3.2?

(1 mark)

(e) There are three types of **logical devices** in the ZigBee technology. Name the device which has only one found in every ZigBee network and also is able to start the ZigBee network.

(1 mark)

(f) In Figure B3.2, which one is the coordinator? Device A or Device B?

(1 mark)

(g) What is the packet X in Figure B3.2?

(1 mark)

(h) What is the packet Y in Figure B3.2?

(1 mark)

(i) There are three network topologies in the ZigBee technology. Name the network topology which has multiple paths to route a message if one of the path fails?

(1 mark)

B4. Figures B4.1 shows the Bluetooth protocol stack and Figure B4.2 shows the frequency channels for Bluetooth Basic Rate or Bluetooth Classic.

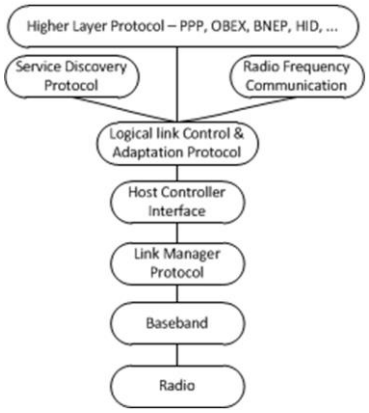


Figure B4.1

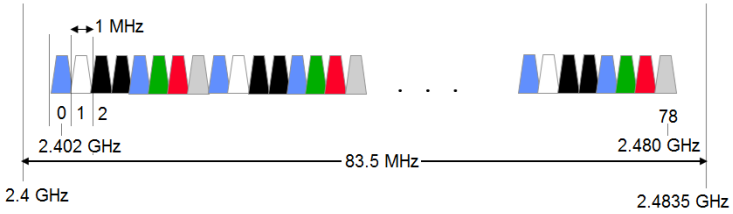


Figure B4.2

(a) In Figure B4.1, which layer of Bluetooth protocol stack manages the physical links and handles packets?

(1 mark)

(b) What are the packet size (in number of slots) and physical link that should be used to transmit data every 1875 μsec?

(2 marks)

(c) Which layer of Bluetooth protocol stack manages the piconet and performs security in Bluetooth technology in Figure B4.1?

(1 mark)

(d) Which layer of Bluetooth protocol stack separates between the upper layer and lower layer of Bluetooth in order to lower the cost of Bluetooth chip in Figure B4.1?

(1 mark)

(e) Which feature was introduced in Bluetooth version 1.2 to improve the coexistence of WLAN with other wireless technologies?

(1 mark)

(f) What is the frequency of channel 36 in Figure B4.2?

(1 mark)

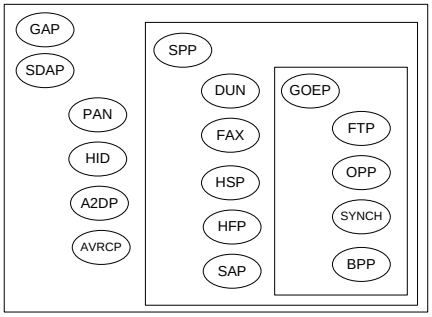
(g) What are the **modulation technique** and **bandwidth** in Bluetooth version 2.1 that provides maximum bitrate of 2 Mbps?

(2 marks)

(h) In Figure B4.2, the frequency spectrums from 2.4 GHz to 2.402 GHz and from 2.480 GHz to 2.4835 GHz are not part of Bluetooth frequency range. What is the purpose of these unused frequency spectrums?

(1 mark)

B5. Figure B5 shows the relationship among Bluetooth profiles used in Bluetooth Classic. Table B5 shows some of the Bluetooth specifications related to different Bluetooth versions.



Relationship among Bluetooth Profiles

Figure B5

	Specifications	Bluetooth	**Answer**
(i)	Maximum bitrate	Version 2.1	___Mbit/s
(ii)	Voice capable	Version 2.1	Yes or No
(iii)	No. of frequency channels	Version 4.0	___ channels
(iv)	Modulation techniques	Version 4.0	___
(v)	Maximum Transmit Power	Version 1.2	____dBm

Table B5

(a) Select from Figure B5 the right profile to use in each of the following applications:

(i) send pictures from smartphone to a Bluetooth-enabled PC
(ii) synchronize data between a laptop and a tablet
(iii) wireless mouse and wireless keyboard
(iv) print from a laptop to a Bluetooth-enabled printer
(v) stream music from a smart phone to a wireless speaker.

(5 marks)

(b) Determine the specifications from (i) to (v) in Table B5 corresponding with their respective Bluetooth version.

(5 marks)

B6. Figure B6 and Table B6 show the network architecture of the WiMAX technology and the four physical layer implementations of the WiMAX technology.

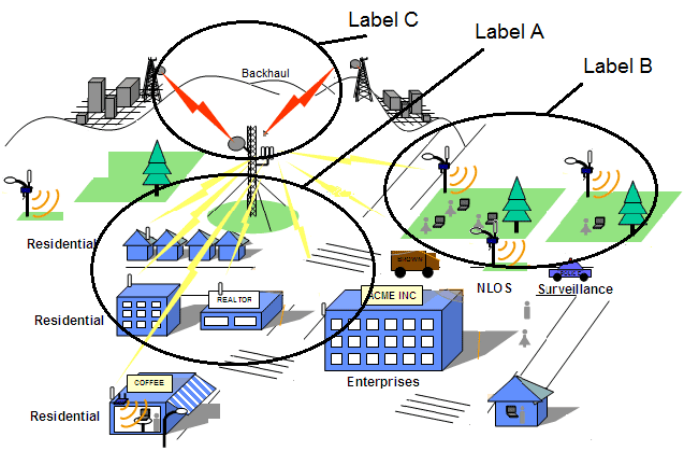


Figure B6

No.	Physical Layer Implementation
1	WirelessMAN-SC
2	WirelessMAN-SCa
3	WirelessMAN-OFDM
4	WirelessMAN-OFDMA

Table B6

(a) What is the maximum bitrate in Mbits/s for the WiMAX technology?

(1 mark)

(b) What is the transmission range in kilometers for the WiMAX technology?

(1 mark)

(c) Name the three IEEE WiMAX standards represented by labels A, B and C shown in Figure B6?

(3 marks)

(d) Name one similar characteristic between the WirelessMAN-**SC** and WirelessMAN-**SCa** physical layer implementations.

(1 mark)

(e) Name one different characteristic between the WirelessMAN-**SC** and WirelessMAN-**SCa** physical layer implementations.

(1 mark)

(f) Name one different characteristic between the WirelessMAN-**SCa** and WirelessMAN-**OFDM** physical layer implementations.

(1 mark)

(g) Name one similar characteristic between the WirelessMAN-**OFDM** and WirelessMAN-**OFDMA** physical layer implementations.

(1 mark)

(h) Which feature in the Physical layer of WiMAX provides the widest choice of frequency band selection based on the channel condition?

(1 mark)

B7. Figures B7 shows the three main sections of 3G, "UMTS" architectures.

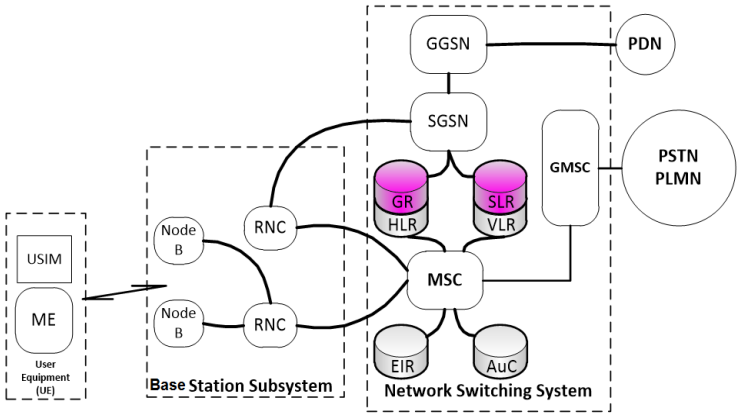


Figure B7

(a) Describe two functions of Node B in the above "UMTS" system.

(2 marks)

(b) Describe two functions of RNC in the above "UMTS" system.

(2 marks)

(c) Describe one function of MSC in the above "UMTS" system.

(1 mark)

(d) What is the air interface used in 3G between UE and Node B?

(1 mark)

(e) What is the main difference between the Home Location Register (HLR) and Visitor Location Register (VLR)?

(1 mark)

(f) Which functional block in UMTS is responsible for encryption of communications between mobile users?

(1 mark)

(g) UMTS system can be implemented using UMTS-FDD or UMTS-TDD. Which UMTS system is required to use only two frequency band for duplex communication?

(1 mark)

(h) State one of the differences between the BSC in 2.5 G and RNC in 3G?

(1 mark)

B8. There is a need to set up **different wireless systems** for a **Connected Smart Factory System** to monitor the status of machines, the workflow in each factory, energy usage of each facility and inventory level of assets for a MNC manufacturing company. Figure B8 shows the **sample** architecture of the **proposed system**.

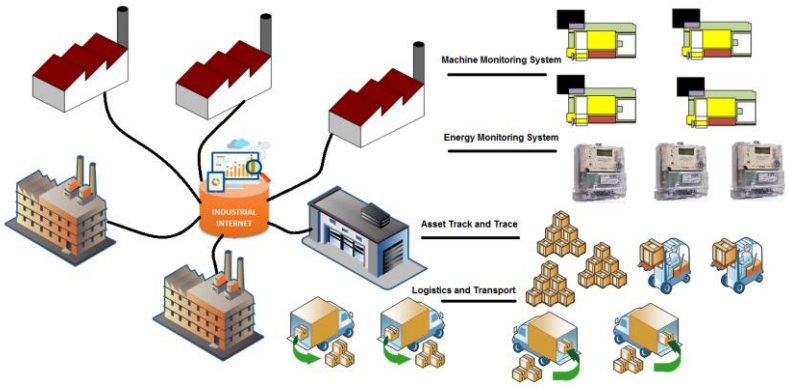


Figure B8

(a) Name one of the most suitable wireless technologies to be used to monitor the status and energy consumption of machines which requires low power, low cost and low data rate.

(1 mark)

(b) Name one of the most suitable wireless technologies to be used to monitor and track the inventory level of assets.

(1 mark)

(c) What is the first step needed when setting up a wireless infrastructure for an organization?

(1 mark)

(d) After the assessment of existing network infrastructure, what is the next step that can be able to determine suitable wireless technologies for the current business strategy?

(1 mark)

(e) When should the wireless site survey be done to set up a wireless infrastructure for the organization?

(1 mark)

(f) In ROI measurement for determining costs, it is important to consider all costs involved. Name the two types of costs involved in ROI calculation.

(2 marks)

(g) If the current IT staff in the institution faces challenges to select among different wireless technologies, who are the right people to get help from and what type of documents need be sent to them for their advice?

(2 marks)

(h) **Different applications** often have different network requirements, what is the network requirement for a connected factory system?

(1 mark)

****** END OF PAPER ******