SINGAPORE POLYTECHNIC **ET1205**

2018/2019 SEMESTER TWO EXAMINATION

Diploma in Engineering with Business
Diploma in Engineering Systems
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 used in the IEEE 802.11 WLAN standard to provide more channels, higher bitrate and lesser interference?

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

A2. A wireless system was shown in Figure A2. What is the receive power of the receiver?

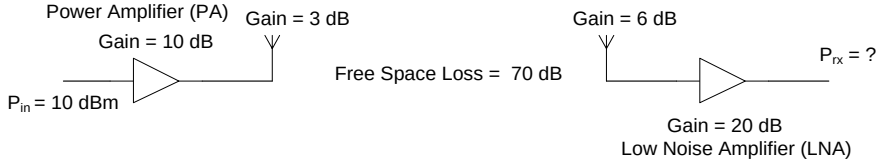


Figure A2

(a) - 21 dBm
(b) -24 dBm
(c) -30 dBm
(d) -27 dBm

A3. Which one of the error detection codes used in RFID technology is reliable to detect error for small amount of data?

(a) Parity
(b) CRC
(c) LRC
(d) PPC

A4. Which one of the following options describes the anti-collision feature of the RFID technology?

(a) Able to read same types of multiple tags without errors.
(b) Able to read different types of multiple tags without errors.
(c) Able to read a tag using another tag without errors.
(d) Able to read a reader using another reader without errors.

A5. Which one of the following entities integrates wired and wireless connection to provide internet access for the users in WLAN IEEE802.11 systems?

(a) DS and ESS
(b) AP and STA
(c) Portal
(d) BSS and ESS

A6. In ZigBee, which one of the following modulation techniques and bitrates are needed for operating in the 915MHz frequency band?

(a) BPSK and 20 kbps
(b) GFSK and 40 kbps
(c) OQPSK and 250 kbps
(d) BPSK and 40 kbps

A7. Which one of the following Bluetooth versions has 2 MHz channel spacing with GFSK modulation to provide the maximum speed of 1 Mbps?

(a) Bluetooth version 1.2
(b) Bluetooth version 2.0
(c) Bluetooth version 2.1
(d) Bluetooth version 4.0

A8. Which one of the following cellular systems has higher capacity and low interference to cover the same geographical area?

(a) Cluster size of "7" and "49" channels
(b) Cluster size of "3" and "51" channels
(c) Cluster size of "7" and "70" channels
(d) Cluster size of "3" and "75" channels

A9. In IEEE 802.16 WiMAX, which feature in the Physical layer provides the widest choice of frequency band selection based on the channel condition?

(a) Dynamic frequency selection
(b) Flexible channel bandwidth
(c) Used licensed and unlicensed frequency band
(d) Support TDD and FDD

A10. Which one of the following options is an important factor to be included in wireless site survey for building a Wireless Infrastructure for Business?

(a) Developing the sensible work plan.
(b) Determining the existence of interference sources.
(c) Implementing the user training.
(d) Performing a limited trial.

SECTION B [80 Marks]

B1. Figure B1 shows the partially completed diagram for secure transfer of data between a transponder and a reader in RFID security. The RF carrier frequency used in this system is 920 MHz.

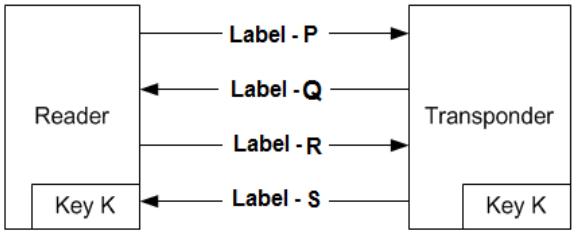


Figure B1

Serial No.	Description
1	Token 1
2	Token 2
3	GET_CHALLENGE
4	Random Number R_A
5	Random Number R_B
6	Key K

Table B1

(a) Determine all the labels (P) to (S) in Figure B1 using the list of possible words found in Table B1.

(4 marks)

(b) What is the security method that can overcome the limitation of the above RFID security?

(1 mark)

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

(1 mark)

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

(1 mark)

(e) Name one of the RFID applications that uses the above frequency band.

(1 mark)

(f) If Manchester code and Modified Miller code are available, which code is suitable for data transmission from the reader to the tag? Why?

(2 marks)

B2. Figure B2 shows the communication between the access point (AP) and STA B with the improved access mechanism in the IEEE 802.11g for Wireless LAN.

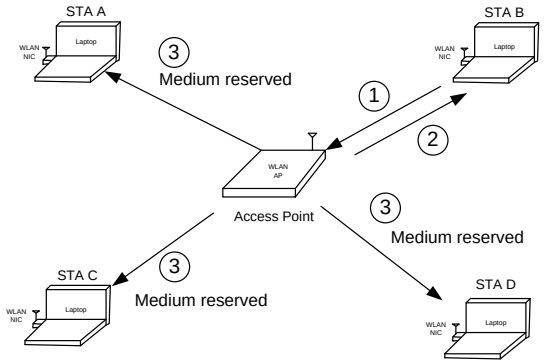


Figure B2

(a) What is the frequency band used in the above standard? Provide answer in GHz.

(1 mark)

(b) How many frequency channels are available for this standard in Singapore?

(1 mark)

(c) There are three commonly known non-overlapping channels in this standard. Name **one** of these channel numbers.

(1 mark)

(d) Which WLAN device found in Figure B2 is used to provide the interconnection between DS and BSS?

(1 mark)

(e) What is the mode of operation for IEEE 802.11g for Wireless LAN in Figure B2?

(1 mark)

(f) Four modulation techniques are used in this IEEE 802.11g. State any one of the modulation techniques used in this standard.

(1 mark)

(g) State the access method of the IEEE 802.11 MAC used in this system.

(1 mark)

(h) What are the frames (frame ① & ②) that were transmitted between STA B and AP?

(2 marks)

(i) Of the three IEEE 802.11 variants – IEEE 802.11a, IEEE 802.11b and IEEE 802.11g – which of them has the lowest bit rate. (1 mark)

B3. The protocol stack of the ZigBee technology is illustrated in Figure B3.1. Figure B3.2 shows the routing of frames/messages when a designated device comes and joins into a ZigBee network with a cluster head.

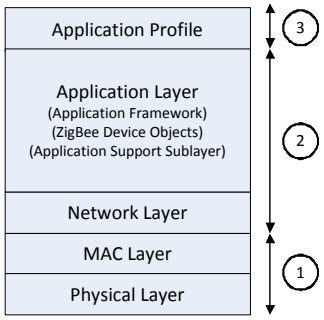


Figure B3.1

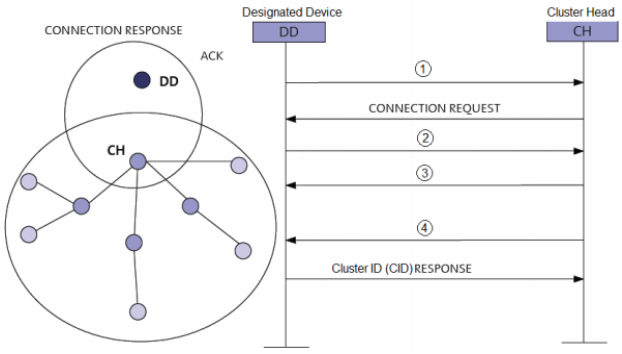


Figure B3.2

(a) Which one of the ZigBee protocol layers shown in Figure B3.1 defines the frequency channels and modulation techniques?

(1 mark)

(b) Which layer defines the channel access mechanism called CSMA/CA in the ZigBee wireless technology?

(1 mark)

(c) What are the bit rate and modulation technique used in the ZigBee technology operating in the 2.4 GHz frequency band?

(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 two types of **hardware devices** in the ZigBee technology. Name the device which is low power, low cost and battery powered.

(1 mark)

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

(1 mark)

(g) What is the packet ① in Figure B3.2?

(1 mark)

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

(1 mark)

(i) There are three network topologies in the ZigBee technology. Name the network topology shown in Figure 3.2.

(1 mark)

B4. Figures B4.1 shows the timing diagram of transmitted packets among a master Bluetooth device and two Bluetooth slaves. Figure B4.2 shows the relationship among Bluetooth profiles used in Bluetooth Classic.

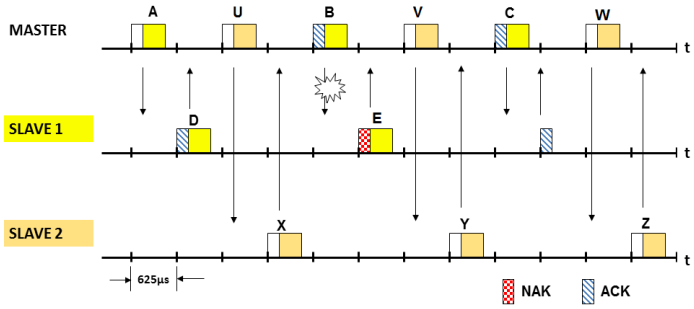
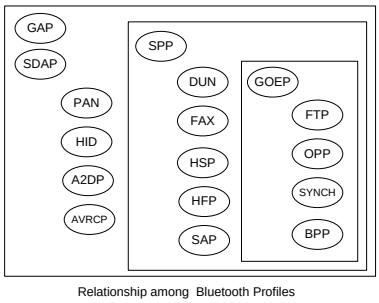


Figure B4.1



Relationship among Bluetooth Profiles

Figure B4.2

(a) What is the packet size (in number of slots) used in the above Bluetooth transmission?

(1 mark)

(b) Time Division Duplex (TDD) is used to provide two way communications in Bluetooth technology. Which time slot is used by the master Bluetooth device?

(1 mark)

(c) Name the network topology used in Figure B4.1 related to the Bluetooth technology.

(1 mark)

(d) What is the maximum number of links **for data** in Bluetooth that a master device can support?

(1 mark)

(e) Reserved time slots were used between the master and slave 2 as shown in Figure B4.1. Which type of the physical links was used between the Bluetooth master device and slave 2?

(1 mark)

(f) Name the two foundation profiles that is required in a human interface device between two Bluetooth enabled devices in Figure B4.2.

(1 mark)

(g) From Figure B4.2, list all the required Bluetooth profiles required in a Hand Free Car kit application between Bluetooth-enabled devices.

(2 marks)

(h) Which Bluetooth profile is used to synchronize data between a smart phone and a laptop?

(1 mark)

(i) Give an example of an application that uses File Transfer Profile in Bluetooth Technology.

(1 mark)

B5. Figure B5.1 shows all the possible states of the Bluetooth link controller for Bluetooth connection. Figure B5.2 shows one of the network topologies used in Bluetooth technology.

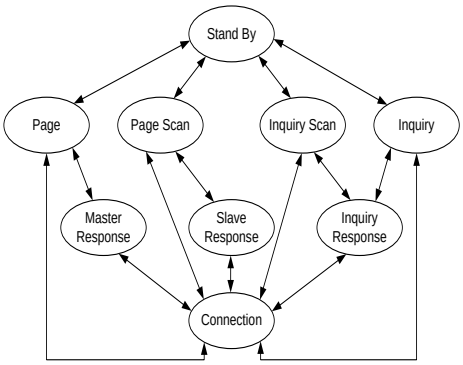


Figure B5.1

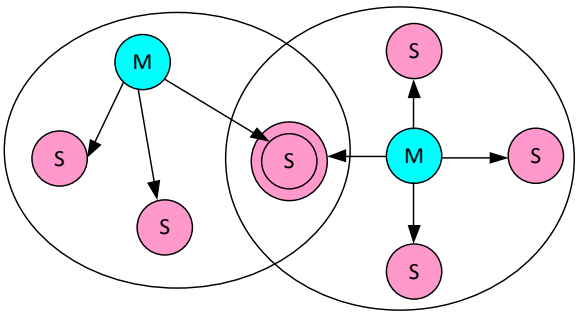


Figure B5.2

(a) What are the three procedures involved in establishing a connection between a Bluetooth master and a Bluetooth slave?

(3 marks)

(b) Which is the state of the Bluetooth-enabled device if it is not connected to any other devices in Figure B5.1?

(1 mark)

(c) If a Bluetooth device can discover other Bluetooth-enabled devices within its RF range, what is the state of the Bluetooth **inquirer** in Figure B5.1?

(1 mark)

(d) If a Bluetooth device can discover other Bluetooth-enabled devices within its RF range, what is the state of the Bluetooth **inquiry scanner** which transmits an FHS packet in Figure B5.1?

(1 mark)

(e) Name any one of the possible modes for the Bluetooth slave in low power.

(1 mark)

(f) Name the network topology given in Figure B5.2 for the Bluetooth technology.

(1 mark)

(g) Is it possible to form a network shown in Figure B5.2 using a Bluetooth-enabled device that acts as a master in both piconets? Give the answer with a suitable reason. (2 marks)

B6. Figure B6 shows the physical layer and MAC sub layers of the WiMAX technology. Table B6 shows the incomplete table for comparison between WiMAX and WLAN wireless technologies.

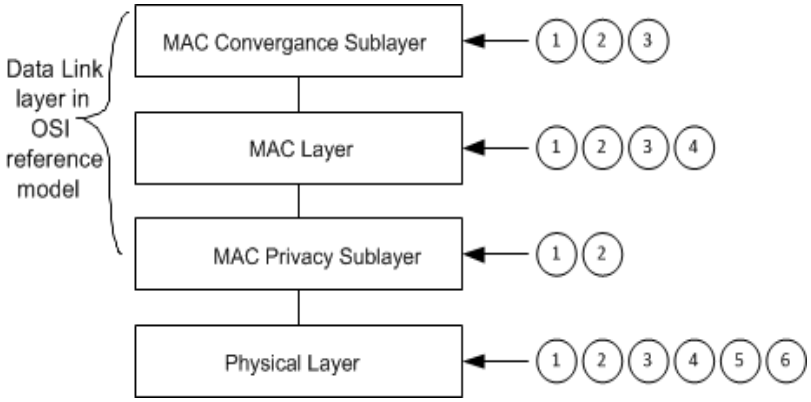


Figure B6

		WiMAX	WLAN
(i)	IEEE standard	IEEE 802.___ (Mobile Applications)	IEEE 802. ___(up to 54 Mbps)
(ii)	Bandwidth	____MHz	____MHz (Any one of the bandwidth supported)
(iii)	Spectrum	___ GHz (Any one of the ISM Unlicensed bands)	___ GHz (Any one of the ISM Unlicensed bands)
(iv)	Maximum Range	____(in meters)	____(in kilometre)
(v)	Bit rate (Maximum)	__ Mbps for IEEE 802.11a/g	__ Mbps

Table B6

(a) Name any two functions of the Physical layer in Figure B6. (2 marks)

(b) Name any two functions of the MAC layer in Figure B6. (2 marks)

(c) Which relevant layer performs the authentication of a legitimate user in WiMAX network? (1 mark)

(d) Copy the Table B6 into your answer booklet and complete the specifications from (i) to (v) in Table B6 corresponding to their respective technologies. (5 marks)

B7. Figures B7.1 and B7.2 show the cellular network diagram and the three main sections of 2.5G, "GPRS" architecture.

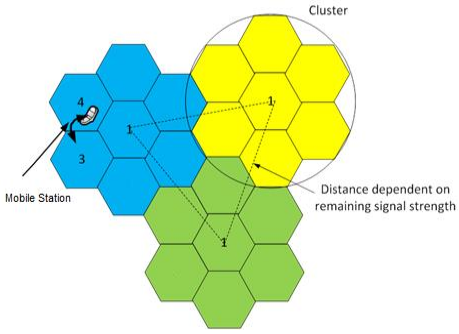


Figure B7.1

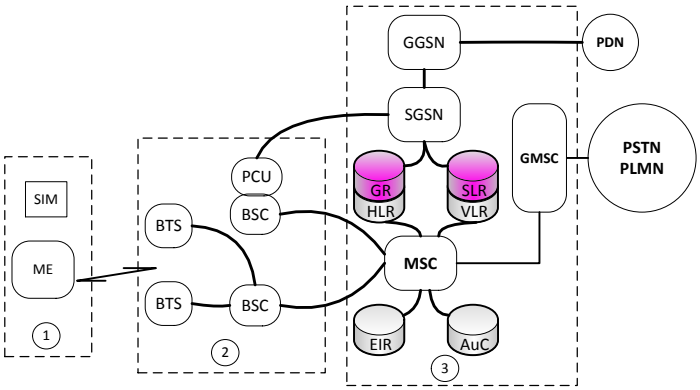


Figure B7.2

(a) What is the size of one cluster in Figure B7.1? Give the answer in no. of cells per cluster.

(1 mark)

(b) If a mobile user moves from a cell to other during a phone call, the connection will be passed to the neighbour cell as shown in Figure B7.1, what is the term used to describe this?

(1 mark)

(c) What is the main advantage of using more cells per cluster compared to lesser cells per cluster?

(1 mark)

(d) What is the third section of 2.5 G, "GPRS" architecture as shown in Figure B7.2?

(1 mark)

(e) What is the function of Mobile Switching Centre (MSC)?

(1 mark)

(f) State one of the tasks managed by the BSCs in 2.5G.

(1 mark)

(g) What is the function of Base Transceiver Station (BTS) or base station?

(1 mark)

(h) What is the main function of Packet Control Unit (PCU)?

(1 mark)

(i) What is the air interface used in 2.5G between MS and BTS?

(1 mark)

(j) 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 **a wireless infrastructure** for a **Healthcare Industrial IoT System** to monitor the health status of patients and the workflow in each hospital for the healthcare industry. 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 health status of a patient using smart phones.

(1 mark)

(b) Name one of the most suitable wireless technologies to be used to transfer health data to the centralize data center.

(1 mark)

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

(1 mark)

(d) List any two possible questions to find out the information of the present system.

(2 marks)

(e) Which type of important tables should be included in the request for proposal (RFP)?

(1 mark)

(f) Which group of people should be involved in the planning process to get their unbiased perspective view?

(1 mark)

(g) When should a limited trial or a pilot project be performed?

(1 mark)

(h) State any two possible types of training that are required by all users and support specialists in order for them to effectively operate the system.

(2 marks)

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