SINGAPORE POLYTECHNIC **ET1205**

2015/2016 SEMESTER TWO 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.

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1. Which one of the following wireless technologies is under the **WPAN** and is suitable for an application that requires a higher data rate?

   (a) WiMAX
   (b) UWB
   (c) WLAN
   (d) Bluetooth

2. Which one of the multiple access techniques requires a unique digital spreading code for each user to differentiate among multiple transmissions using the same frequency?

   (a) TDMA
   (b) FDMA
   (c) CDMA
   (d) CSMA

3. Which one of the following options is the main reason for using the **active** RFID in container tracking applications?

   (a) Cheaper to manufacture and immune to electromagnetic interference
   (b) No battery is required and able to read at longer range
   (c) Unlimited lifetime of the tag and able to response faster
   (d) Able to read at longer range and no line of sight needed

4. Which one of the following systems is one of the RFID applications to open and lock the doors in a company or an organization to provide securities?

   (a) Asset Control System
   (b) Access Control System
   (c) Assessment Control System
   (d) Article Control System

5. Which one of the following IEEE802.11 WLAN standards has an error correction capability?

   (a) IEEE 802.11a and IEEE 802.11b
   (b) IEEE 802.11b and IEEE 802.11g
   (c) IEEE 802.11a and IEEE 802.11g
   (d) IEEE 802.11b and IEEE 802.11n

6. Which one of the following options is the most suitable reason for using the ZigBee technology for an active RFID asset tracking system?

   (a) Using license free frequency band
   (b) Specifications based on IEEE 802.15.4
   (c) Developed by ZigBee Alliance
   (d) Reliability, simplicity, low power and low cost

7. Which one of the following modulation protocols is used in Bluetooth technology?

   (a) FHSS
   (b) DSSS
   (c) WCDMA
   (d) OFDM

8. In GSM 900, the MS transmit in 890 to 915 MHz frequency range and the BTSs transmit in 935 to 960 MHz frequency range. How much is the total bandwidth required for this Frequency Division Duplex (FDD) system?

   (a) 50 MHz
   (b) 75 MHz
   (c) 150 MHz
   (d) 25 MHz

9. Which one of the following characteristics is implemented in the MAC layer for WiMAX technology?

   (a) Formats SDUs from the upper layers according to MAC PDU format
   (b) QoS requirement
   (c) Provides subscribers with privacy
   (d) Adaptive modulation

10. Which one of the following steps is required to be carried out after receiving the request for proposals (RFPs) and the vendor has been selected for building the Wireless Infrastructure for Business?

    (a) Collection of information for new wireless infrastructure
    (b) Conducting wireless site survey
    (c) Perform a limited trial
    (d) Request for information (RFI)

SECTION B [80 Marks]

B1. Figure B1.1 shows the basic RFID system consisting of a handheld reader and a tag. Figure B1.2 shows the block diagram of an RFID tag.

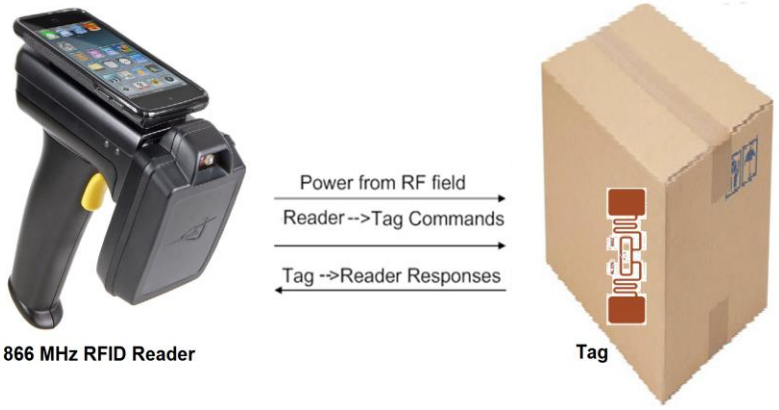


Figure B1.1

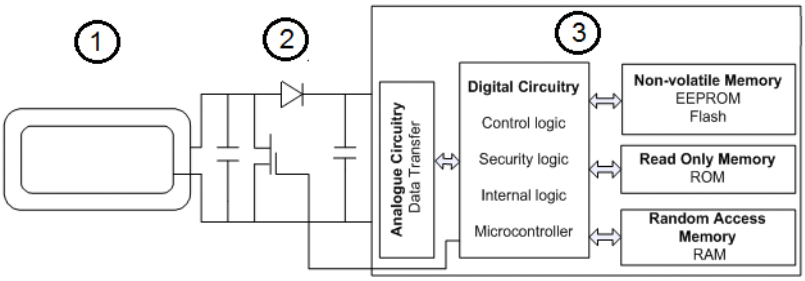


Figure B1.2

(a) There are three types of tags in RFID technology. Name the type of RFID tag used in Figure B1.1.

(1 mark)

(b) Name the frequency band of 866 MHz which is used in this system.

(1 mark)

(c) What is the typical reading range of the above frequency band used for passive RFID?

(1 mark)

(d) Describe the two main functions of the antenna used in this RFID tag.

(2 marks)

(e) What are the three main parts of the RFID tag in Figure B1.2?

(3 marks)

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

(1 mark)

(g) There are three methods of security in RFID technology. Which method of RFID security uses a key derived from the tag ID and the master key?

(1 mark)

B2. Figure B2 shows the frequency channels allocated for the IEEE 802.11a WLAN standard.

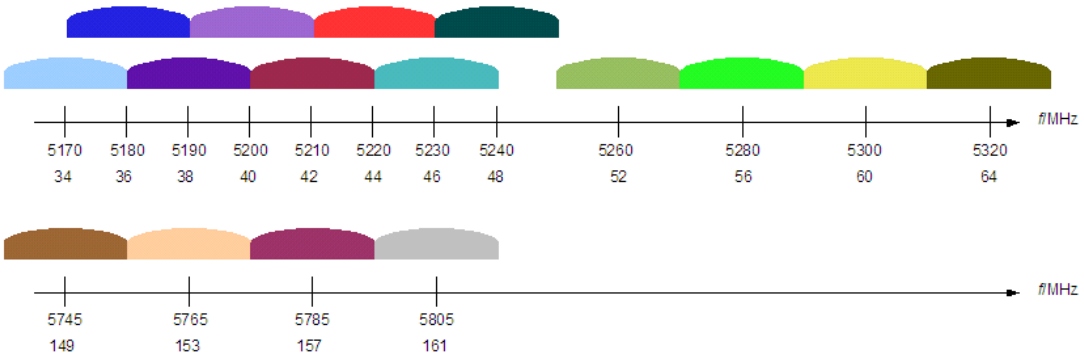


Figure B2

(a) What are the two license-free frequency bands used in this IEEE 802.11 standard in GHz?

(2 marks)

(b) How many non-overlapping channels are available for the above **IEEE 802.11a** standard?

(1 mark)

(c) What are the two advantages of using the above frequency bands for the **IEEE 802.11**standard?

(2 marks)

(d) What type of modulation protocols is used in **IEEE 802.11a** standard?

(1 mark)

(e) How much is the channel bandwidth for **IEEE 802.11a** standard?

(1 mark)

(f) There are nine logical services required for wireless LAN operation. Which one of the station services is used to authenticate between STAs and APs in IEEE 802.11 standard?

(1 mark)

(g) Which one of the station services is used to enable data encryption among different STAs in IEEE 802.11 standard?

(1 mark)

(h) Different interframe spaces (SIFS, DIFS, PIFS, & EIFS) are used in wireless LAN standards to provide priority levels and organize the transmission of frames on the wireless medium. Between DIFS and PIFS, which interframe space is shorter?

(1 mark)

B3. The protocol stack of the ZigBee technology is illustrated in Figure B3.1. Figure B3.2 shows one of the ZigBee applications used for the light and switch application.

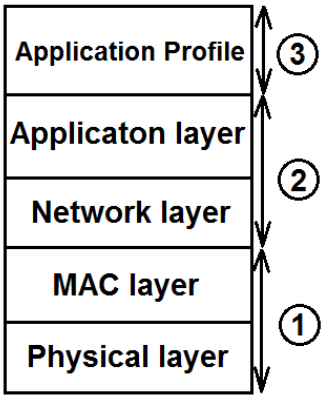


Figure B3.1

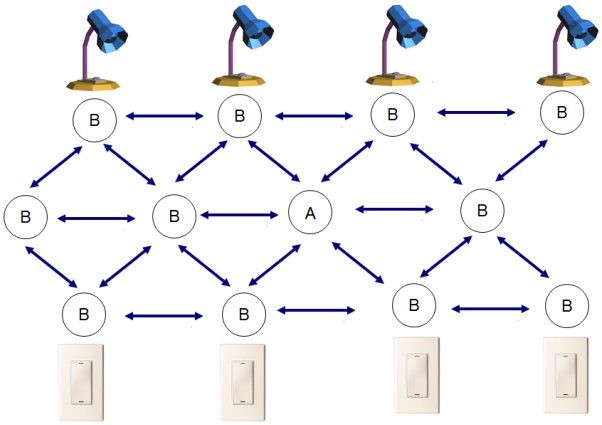


Figure B3.2

(a) Which one of the IEEE 802 standards specifies the physical layer and media access control for ZigBee technology?

(1 mark)

(b) Which one of the layers in ZigBee technology is defined by customer?

(1 mark)

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

(1 mark)

(d) The frequency range for 2.4 GHz ISM band is internationally used for ZigBee technology. How many frequency channels are available in this frequency band and what is the maximum bit rate supported by each channel?

(2 marks)

(e) The bandwidth of each channel is 5 MHz wide for ZigBee wireless technology in 2.4 GHz ISM band. If the frequency of the channel no. 11 is 2.405 GHz, what is the frequency of the **channel no. 18?**

(1 mark)

(f) There are three network topologies in the ZigBee technology. Name the network topology used in Figure B3.2.

(1 mark)

(g) There are two types of **hardware devices** in the ZigBee technology. Identify the two devices (A and B) used in Figure B3.2 with their respective names given in ZigBee technology.

(2 marks)

(h) Name the logical device defined in ZigBee technology which is able to participate in multi-hop routing of messages in ZigBee network.

(1 mark)

B4. Figures B4.1 and B4.2 show one of the network topologies used in Bluetooth technology and the Bluetooth protocol stack respectively.

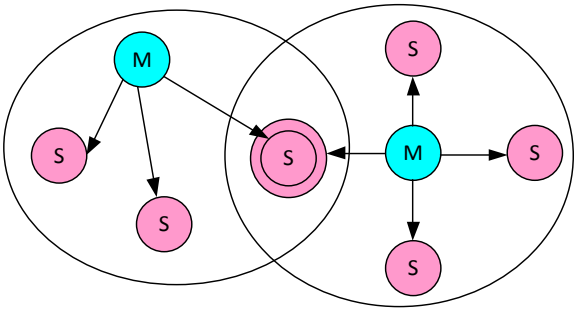


Figure B4.1

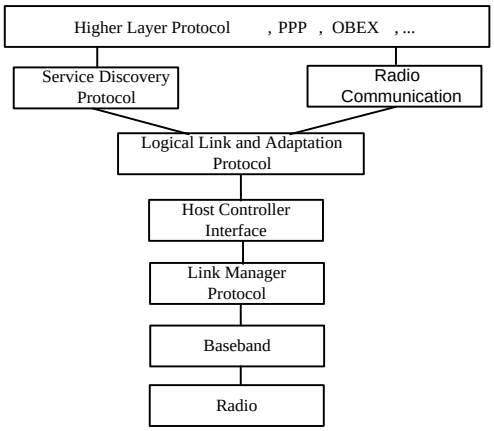


Figure B4.2

(a) Name the organization/promoter that builds on IEEE 802 standard and defines the protocol layers in the Bluetooth technology.

(1 mark)

(b) Name the network topology given in Figure B4.1 for the Bluetooth technology.

(1 mark)

(c) Is it possible to form a network shown in Figure B4.1 using a Bluetooth-enabled device that acts as a master on both piconets? Give the answer with a suitable reason.

(2 marks)

(d) Name another wireless technology that also operates in the same frequency band as Bluetooth technology.

(1 mark)

(e) Which layer in Figure B4.2 manages physical channels and links, handles packets and does paging and inquiry to locate other Bluetooth devices in the area?

(1 mark)

(f) Which layer in Figure B4.2 provides the interface between the lower layer of Bluetooth and the upper layer of Bluetooth which are separately implemented using two different processors?

(1 mark)

(g) There are three types of physical links available in Bluetooth technology. Which physical link is used for data?

(1 mark)

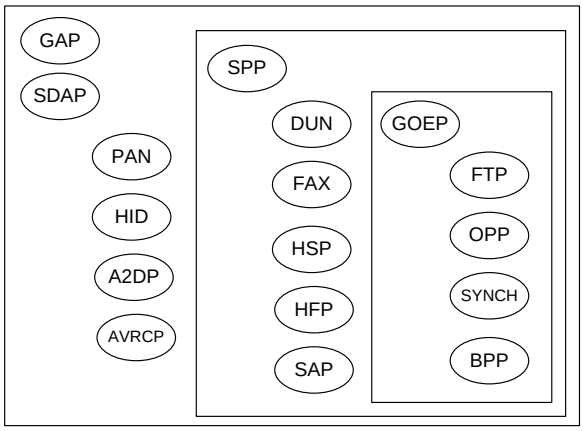
(h) What is the maximum number of slaves that a master device can connect by using voice link?

(1 mark)

(i) In Bluetooth technology, the master Bluetooth device transmits at even slots and the slave Bluetooth device transmits at odd slots to provide two way communications. What is the name given to this type of transmission?

(1 mark)

B5. Figure B5 shows the relationship among Bluetooth profiles as listed in the Bluetooth Classic.



Relationship among Bluetooth Profiles

Figure B5

(a) Select the right profile to use in each 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) Table B5 shows some of the Bluetooth specifications related to Bluetooth Classic and Bluetooth Low Energy (BLE). Determine from (i) to (v) whether the specification refers to Bluetooth Classic or Bluetooth Low Energy.

	Specifications		Bluetooth Mode
(i)	Over the air data rate	1–3 Mbit/s	**?**
(ii)	Voice capable	No	**?**
(iii)	Frequency channel	40 channels with 2-MHz BW	**?**
(iv)	Modulation techniques	GFSK, 4PSK, 8PSK	?
(v)	Maximum Transmit Power	100 mW	?

Table B5

(5 marks)

B6. Figure B6.1 and Table B6.1 show the network architecture of the WiMAX technology and the four physical layer implementations of the WiMAX technology.

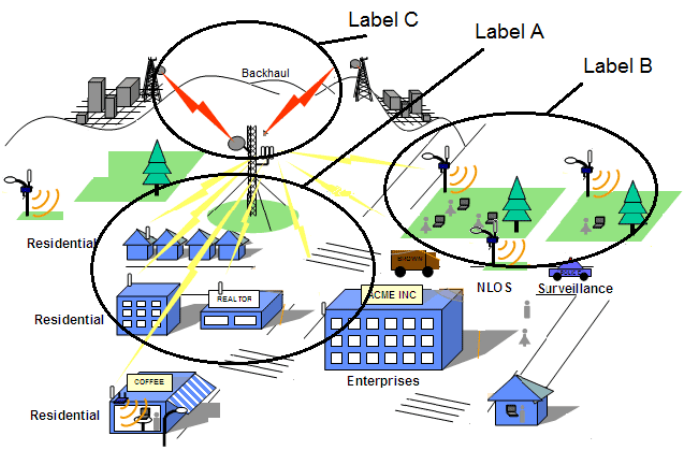


Figure B6.1

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

Table B6.1

(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 with **their respective label** shown in Figure B6.1?

(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 provides the widest choice of frequency band selection depending on the channel condition?

(1 mark)

B7. Figures B7 shows the architecture of 3G UMTS (Universal Mobile Telecommunications System).

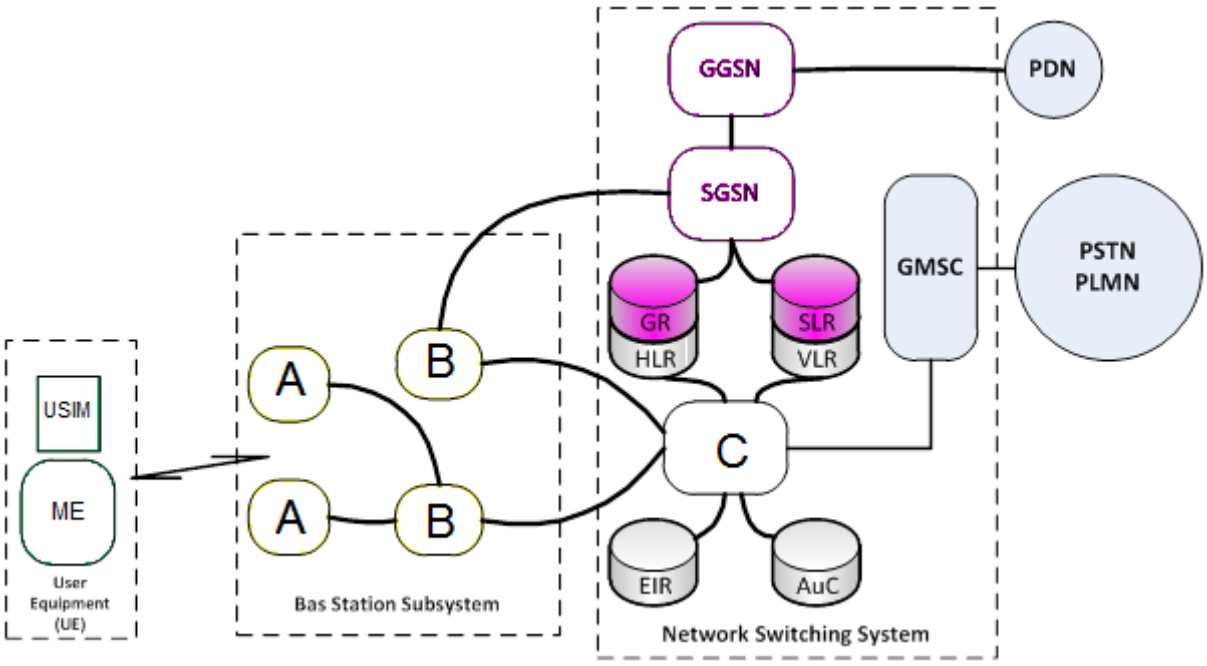


Figure B7

(a) Name the block A in the above "UMTS" system and describe one of its functions.

(2 marks)

(b) Name the block B in the above "UMTS" system and describe one of its functions.

(2 marks)

(c) Name the block C in the above "UMTS" system and describe one of its functions?

(2 marks)

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

(1 mark)

(e) What is the air interface used in 3G UMTS?

(1 mark)

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

(1 mark)

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

(1 mark)

B8. There is a need to setup a smart healthcare system using wireless technologies to provide the following applications such as a fall prevention of wheelchair bound patients, zero medication error for every patient and secure access of the operation theatres and medical equipment of the hospitals etc. Figure B8 shows the **part of** a 600 bedded hospital as **a sample** layout.

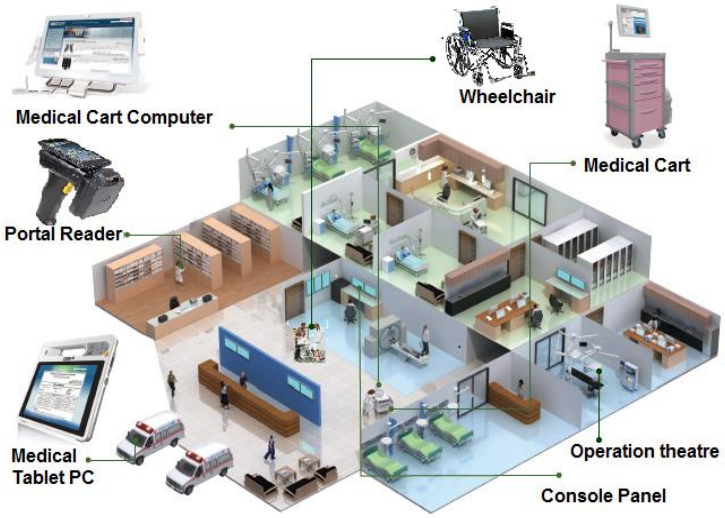


Figure B8

(a) Name one of the wireless technologies which is suitable to be used to monitor from preventing the fall of wheelchair bound patients.

(1 mark)

(b) Name one of the wireless technologies which is suitable to be used for secure access of the operation theatres and medical equipment of the hospital.

(1 mark)

(c) When it is required to setup a wireless infrastructure for the organization, what is the first step?

(1 mark)

(d) If the expertise to gather the information is beyond that of current IT staff in this organization, who are the suitable people that can be approached and what document is required to be sent?

(3 marks)

(e) Name two important measurements done in the wireless site survey that can help determine the existence of interference sources?

(2 marks)

(f) The request for proposal (RFP) should include some of the key elements such as Statement of values, Description of operations, Current network & applications and Timetable etc. Which one of these key elements describes the ability of vendors that understands the philosophy of their business and clearly identifies its priorities?

(1 mark)

(g) What is the cost that user may continue to pay over an extended period of time in ROI calculation?

(1 mark)

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