

2019/2020 SEMESTER ONE EXAMINATION

Diploma in Engineering with Business
Diploma in Engineering Systems
Diploma in Computer Engineering
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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A1. Which one of the following IEEE 802 wireless standards is able to provide higher bitrate and lesser interference?

- (a) IEEE 802.15.4
- (b) IEEE 802.11a
- (c) IEEE 802.11b
- (d) IEEE 802.15.1

A2. A wireless system was shown in Figure A2. If the received power, P_{rx} , at the output of the receiver is -24 dBm, what is the required power, P_{in} , at the input of the transmitter?

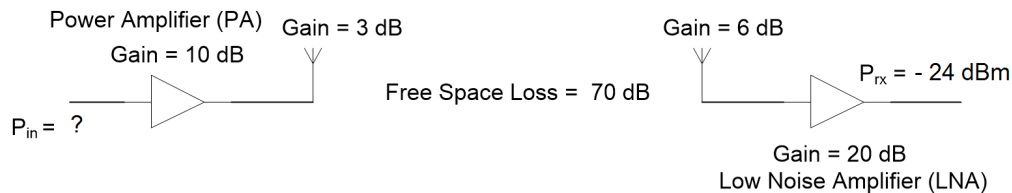


Figure A2

- (a) 7 dBm
 - (b) 26 dBm
 - (c) 27 dBm
 - (d) 13 dBm
- A3. Which one of the following options is one of the **limitations** of the RFID technology?
- (a) Unlimited life span of passive tags.
 - (b) Susceptible to electromagnetic interference.
 - (c) Able to read multiple tags at very short time.
 - (d) Able to detect errors.
- A4. Which one of the following options is the advantage of Mutual Symmetrical Authentication in RFID security?
- (a) Secret keys are transmitted over the airwaves.
 - (b) The token can be encrypted using any algorithm.
 - (c) All transponders and readers in an application possess the same secret cryptological key K.
 - (d) Each transponder is secured with a different cryptological key.

- A5. Which one of the following services is used to enable data encryption between different STAs in IEEE 802.11 standard?
- (a) De-authentication
 - (b) Association
 - (c) Authentication
 - (d) Privacy
- A6. Which one of the following statements about the ZigBee technology is **TRUE**?
- (a) CSMA/CA multiple access method with RTS/CTS is used in ZigBee technology.
 - (b) There are two types of logical devices in ZigBee technology.
 - (c) There are 27 frequency channels in ZigBee technology.
 - (d) ZigBee can be used in an active RFID asset tracking application.
- A7. Which one of the following is the maximum transmit power of Bluetooth Class 1 radio?
- (a) 1 mW
 - (b) 0 dBm
 - (c) 20 dBm
 - (d) 4 dBm
- A8. Which one of the following cellular systems has lower capacity and low interference to cover the same geographical area?
- (a) Cluster size of “7” and “42” channels
 - (b) Cluster size of “3” and “63” channels
 - (c) Cluster size of “7” and “63” channels
 - (d) Cluster size of “3” and “42” channels
- A9. Which one of the following options is enabled by **cloud adoption** in 5G system?
- (a) Supporting the higher data rate of 5G without carrier aggregation.
 - (b) Reducing the transmission power and the interference on the base stations.
 - (c) End to end network slicing.
 - (d) Minimizing the received signal energy at the mobile in a certain direction to improve coverage.

A10. Which one of the following steps requires the organization to send out a request for information (RFI) to vendors for building a Wireless Infrastructure for Business?

- (a) Developing the sensible work plan.
- (b) Collection of information for new wireless infrastructure.
- (c) Request for proposal (RFP).
- (d) Performing a limited trial.

SECTION B [80 Marks]

- B1.** Figure B1 shows a bit sequence of $(111001101)_2$ which was received by an RFID reader in 0.5 msec for an RFID system used in an asset tracking system.

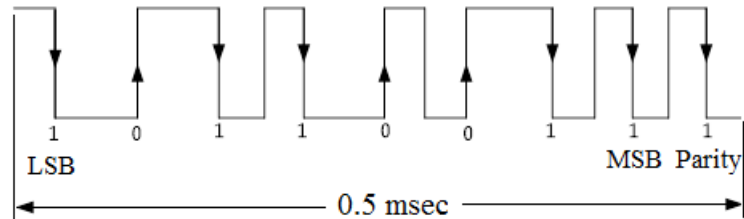


Figure B1

- Which signal coding method is used for the signal waveform shown in Figure B1 with bit sequence of $(111001101)_2$? Give the answer with a suitable reason for using this signal coding from tag to reader. (2 marks)
- Calculate the data transfer rate of this RFID system in kbps. (2 marks)
- If this RFID system uses an **odd parity** for error detection, is there any error in the received data? Provide your answer with a suitable reason. (2 marks)
- State an advantage and a disadvantage of using parity for error detection. (2 marks)
- State two advantages of RFID compared to barcode. (2 marks)

- B2. Figure B2 shows an Extended Service Set (ESS) with Distribution System (DS) which is used in the IEEE 802.11 Wireless LAN standards.

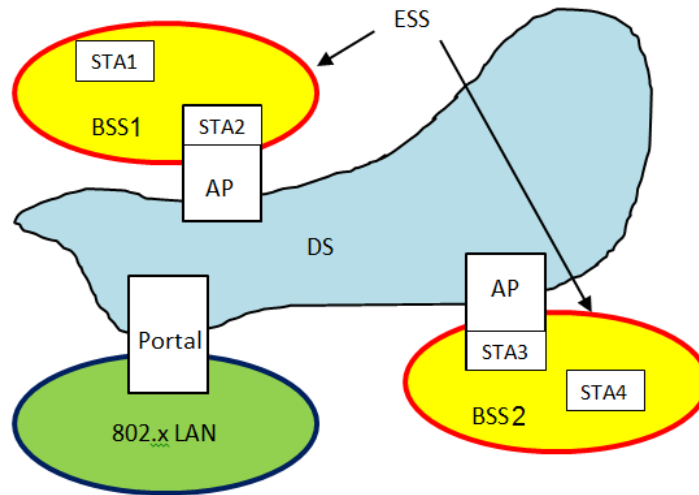


Figure B2

- (a) What ESS configuration is represented by BSS1 and BSS2 in Figure B2? (1 mark)
- (b) Which entity found in Figure B2 is needed to integrate the IEEE 802.11 Wireless LAN architecture to a traditional Wired LAN? (1 mark)
- (c) Which entity found in Figure B2 is needed to interconnect multiple BSSs together? (1 mark)
- (d) Which entity found in Figure B2 is needed to connect a BSS to the DS? (1 mark)
- (e) How many logical services are available for wireless LAN operation? (1 mark)
- (f) Which logical service provides the capability to route a packet from one AP to another AP during wireless LAN operation? (1 mark)
- (g) Which logical service is used to route a packet from a wired LAN to an STA in a BSS during wireless LAN operation? (1 mark)
- (h) Which logical service terminates the existing association between two STAs? (1 mark)
- (i) Which logical service is used to allow an STA to roam around different BSS? (1 mark)
- (j) Of the three IEEE 802.11 variants – IEEE 802.11a, IEEE 802.11b and IEEE 802.11g – which one of them has the shortest range? (1 mark)

- B3. Figure B3.1 shows one of the ZigBee wireless applications used for a home automation system that provides control and monitoring using ZigBee-enabled lights, switches and sensors. Figure B3.2 shows the exchange of packets between a ZigBee PAN coordinator and an end device for an association process in a beacon-enabled network.



Figure B3.1

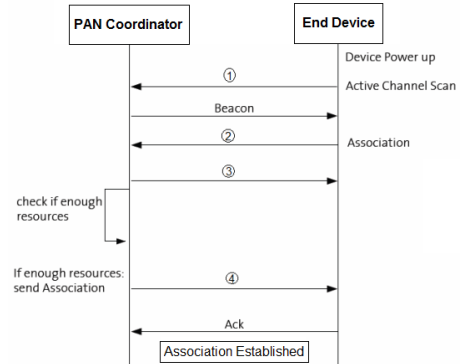


Figure B3.2

- Which one of the IEEE 802 standards specifies the physical layer and media access control for ZigBee technology?
(1 mark)
- There are three network topologies available in the ZigBee technology. Name the network topology used in Figure B3.1.
(1 mark)
- There are two types of **hardware devices** in the ZigBee technology. Which hardware device should be used at “Light” in Figure B3.1?
(1 mark)
- There are three types of **logical devices** in the ZigBee technology. Which logical device should be used at “Motion sensor” in Figure B3.1?
(1 mark)
- Which device is used as a coordinator in Figure B3.1?
(1 mark)
- Which one of the ZigBee protocol layers is represented by the diagram shown in Figure B3.2?
(1 mark)
- What is the packet ① in Figure B3.2?
(1 mark)
- What is the packet ② in Figure B3.2?
(1 mark)
- What is the packet ③ in Figure B3.2?
(1 mark)
- What is the packet ④ in Figure B3.2?
(1 mark)

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

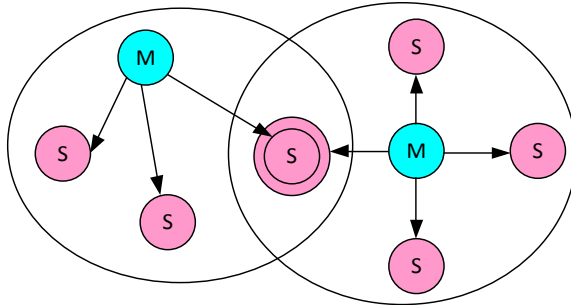


Figure B4.1

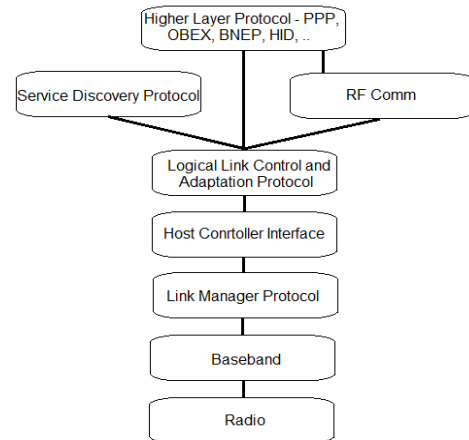
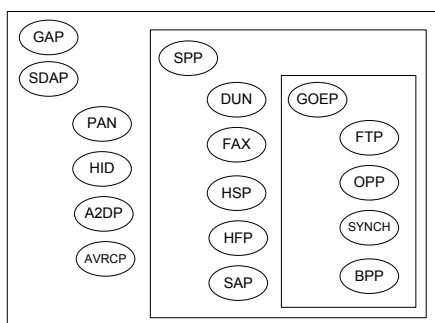


Figure B4.2

- (a) Name the IEEE standard for the Bluetooth technology. (1 mark)
- (b) Which ISM frequency band is used for the Bluetooth technology? (1 mark)
- (c) Name the network topology used in Figure B4.1 related to the Bluetooth technology. (1 mark)
- (d) When a slave Bluetooth device was connected to a master Bluetooth device, it can be in one of the four modes. Name **the mode of a slave device** when it was communicating with the master in the above Bluetooth network topology. (1 mark)
- (e) Is it possible to form a network using a Bluetooth-enabled device that acts as a master on left and a slave on the right as shown in Figure B4.1? Give the answer with a suitable reason. (2 marks)
- (f) What is the maximum number of links **for data** in Bluetooth that a master device can support? (1 mark)
- (g) From Figure B4.2, which layer manages physical channels and links, handles packets and does paging and inquiry to locate other Bluetooth devices in the area? (1 mark)
- (h) From Figure B4.2, which layer services to upper layer protocols with protocol multiplexing capability, segmentation and reassembly operation? (1 mark)
- (i) From Figure B4.2, which layer provides emulation of serial ports over the L2CAP protocol? (1 mark)

- B5. Figure B5 shows the relationship among Bluetooth profiles used in Bluetooth Classic. In Table B5, some of the Bluetooth Low Energy profiles related to Health care, Sports and Proximity sensing are listed respectively.



Relationship among Bluetooth Profiles

Figure B5

Bluetooth Low Energy profiles		
Health care profiles	Sports and fitness profiles	Proximity sensing
HTP	HRP	FMP
GLP	LNP	PXP
BLP	CSCP	
	RSCP	
	CPP	

Table B5

- (a) Explain with a suitable why there are different profiles in Bluetooth Technology. (1 mark)
- (b) Referring to Figure B5, select the right profile to use in each of the following applications for Bluetooth Classic:
- (i) sending pictures from smartphone to a Bluetooth-enabled PC;
 - (ii) connecting Bluetooth mouse and keyboard to a Bluetooth-enabled laptop;
 - (iii) listening to music from a Bluetooth MP3 player using a Bluetooth stereo headphones.
- (3 marks)
- (c) Referring to Table B5, select the right profile to use in each of the following applications for BLE:
- (i) monitoring the blood glucose level of a person or patient;
 - (ii) measuring the heart rate of a person;
 - (iii) transmitting a Universal Unique Identifier, UUID, to detect whether a proximity reporter is within a close range.
- (3 marks)
- (d) Comparing between Bluetooth Classic technology and Bluetooth Low Energy technology, which technology:
- (i) provides longer transmission range;
 - (ii) has the higher data rate;
 - (iii) has a lower transmit power?
- (3 marks)

B6. Figures B6 shows the three main sections of LTE architecture.

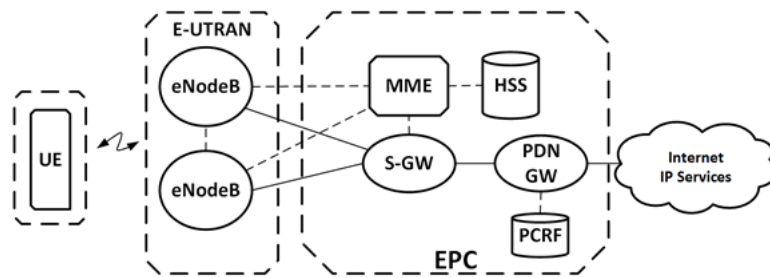


Figure B6

- (a) What is the multiple access technique used in LTE Downlink Transmission Scheme? (1 mark)
- (b) What is the multiple access technique used in LTE Uplink Transmission Scheme? (1 mark)
- (c) Name one of the key features of E-UTRAN in LTE. (1 mark)
- (d) Name one of the key features of EPC in LTE. (1 mark)
- (e) LTE supports six different channel bandwidths. Name one of the channel bandwidths, in MHz. (1 mark)
- (f) Three different modulation techniques are used in LTE to provide different bit rates. Name one of the modulation techniques. (1 mark)
- (g) Identify one of the functions for Enhanced Node-B in LTE. (1 mark)
- (h) Identify one of the functions for Mobility Management Entity in LTE. (1 mark)
- (i) Name one of the functions for Serving Gateway in LTE. (1 mark)
- (j) Name one of the functions for Home Subscriber Server in LTE. (1 mark)

B7. Figures B7 shows the 5G network architecture.

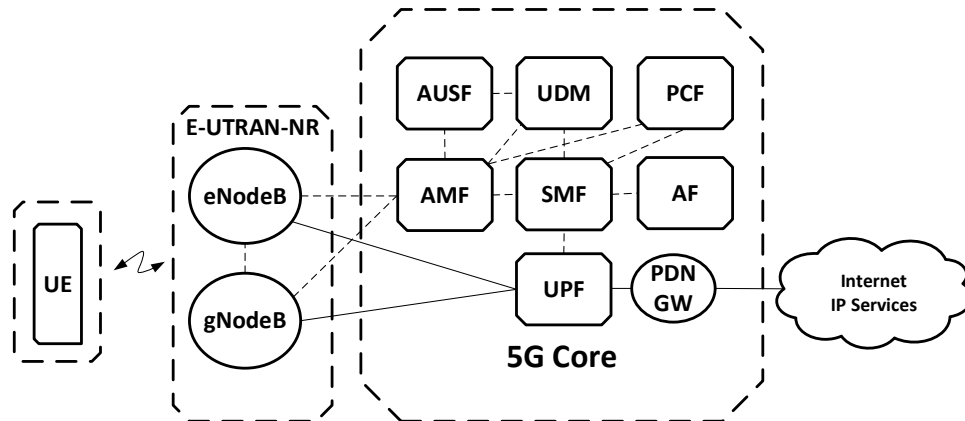


Figure B7

- (a) What are the three important key areas addressed in 5G wireless access technology? (3 marks)
- (b) Which functional block in 5G network architecture is responsible for mobility management? (1 mark)
- (c) Which functional block in 5G network architecture is responsible for packet routing and forwarding? (1 mark)
- (d) Which functional block in 5G network architecture is responsible for UE IP address allocation and management? (1 mark)
- (e) Which functional block in 5G network architecture is responsible for storing of subscription information? (1 mark)
- (f) Which functional block in 5G network architecture is responsible for authentication process with UE? (1 mark)
- (g) Which functional block in 5G network architecture is responsible for policy rules to control plane function? (1 mark)
- (h) Which functional block in 5G network architecture is responsible for dynamic policies and charging control? (1 mark)

- B8. There is a need to set up a **wireless infrastructure** for a **smart vehicles and transport system** to allow cities, transportation and infrastructure to transmit real-time data for improved maintenance and greater operational efficiency. Figure B8 shows the **sample** architecture of the **proposed system**.

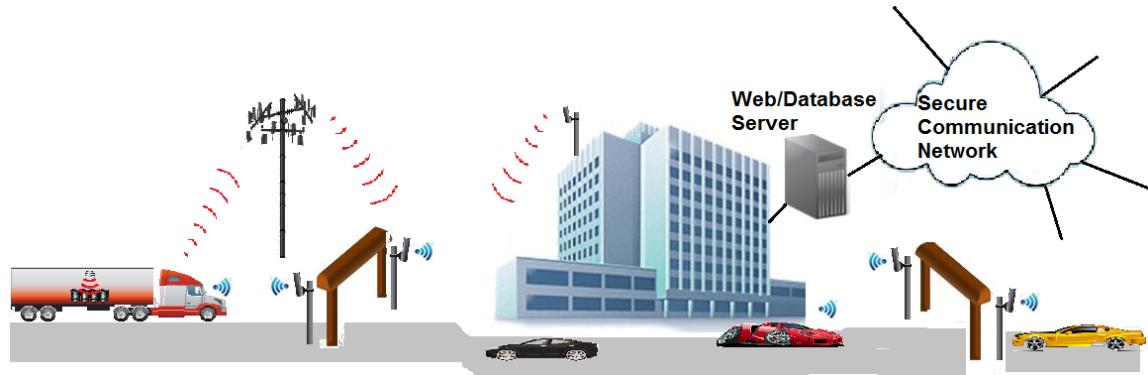


Figure B8

- (a) Name one of the suitable wireless technologies to be used for providing vehicle-to-vehicle and vehicle-to-infrastructure communication will make roads safer. (1 mark)
- (b) **Different industries** often have different network requirements. What should be the major network requirement for the real time monitoring, transportation and smart mobility to implement this wireless system? (1 mark)
- (c) After the assessment of existing network infrastructure, what is the next step needed to determine suitable wireless technologies for the current business strategy? (1 mark)
- (d) When should the wireless site survey be done to set up a wireless infrastructure for the organization? (1 mark)
- (e) Name one of the suitable people to perform the wireless site survey. (1 mark)
- (f) Name any two factors that can be identified during the wireless site survey for the potential implementation of the wireless system. (2 marks)
- (g) 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)
- (h) Which type of important tables should be included in the request for proposal (RFP)? (1 mark)

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