NAMIBIA UNIVERSITY
OF SCIENCE AND TECHNOLOGY

FACULTY OF COMPUTING AND INFORMATICS

DEPARTMENT OF COMPUTER SCIENCE

QUALIFICATION: BACHELOR OF COMPUTER SCIENCE HONOURS	
QUALIFICATION CODE: 08BCSH	**LEVEL:** 8
COURSE: WIRELESS DATA NETWORKS AND SYSTEMS	**COURSE CODE:** WDS820S
DATE: NOVEMBER 2019	**SESSION:** 1
DURATION: 3 HOURS	**MARKS:** 100

FIRST OPPORTUNITY EXAMINATION QUESTION PAPER	
EXAMINER(S)	**PROF GUY-ALAIN ZODI LUSILAO**
MODERATOR:	**MR. JULES ATUMBE BARUANI**

INSTRUCTIONS
1. Answer ALL the questions. 2. Write clearly and neatly. 3. Number the answers clearly.

THIS QUESTION PAPER CONSISTS OF 6 PAGES (Including this front page)

Part A QUESTION I [10 marks] – Multiple Choice 1 point for each question

1) 802.15 falls into the category of:

   (A) fixed and wired (B) mobile and wired (C) fixed and wireless (D) mobile and wireless

2) Which band is used for cellular phone systems?

   (A) VHF (B) UHF (C) SHF (D) none of above

3) The antenna size for a GSM device which uses the 1800 MHz frequency band is

   (A) 8.33 cm (B) 2.08 cm (C) 4.16 cm (D) none of above

4) The propagation effect that occurs when a radio wave hits an impenetrable object and bends at the edges of the object.

   (A) blocking (B) diffraction (C) reflection (D) refraction

5) Which modulation is used in both 802.11b and 802.16?

   (A) QPSK (B) QAM-16 (C) QAM-64 (D) none of the above

6) Which is not the advantage of cellular systems?

   (A) higher capacity (B) robustness (C) less transmission power (D) none of the above

7) The maximum data rate over a 1 MHz channel whose signal to noise ratio is 20 dB.

   (A) 2.16 Mbps (B) 3.33 Mbps (C) 6.66 Mbps (D) none of above

8) Which statement about Bluetooth is incorrect?

   (A) It operates in the ISM band. (B) Two kinds of links (ACL and SCO) exist. (C) Bluetooth 2.0 can offer the transfer rate up to 12 Mbps. (D) none of above

9) Which defines an extension of the 802.11 standard for QoS?

   (A) 802.11c (B) 802.11d (C) 802.11e (D) 802.11h

10) Which statement is false?

   (A) HSCSD is Packet-switched. (B) GPRS offers data rates up to 171.2 Kbps.

   (C) EDGE can achieve a higher transfer rate than GPRS. (D) none of above

Part-B-(27 marks): BASICS

QUESTION II [12 marks]

Using relevant diagram(s), show the sequence of interactions between the various elements required to setup a voice call from a mobile station in MTC/NAMIBIA GSM network to another mobile station in VODACOM/SOUTH_AFRICA GSM network. Explain the role of each of the elements in the interaction.

QUESTION III [6 marks]

1) Tv channels are 6 MHz wide. How much data can be sent per second, if four-level digital signals are use? Assume a noiseless channel [3 marks].

2) What signal to noise ratio is needed to get a bit rate of 2 Mbps (megabits per second) on a channel with 1MHz bandwidth? [3 marks]

QUESTION IV [4 marks]

State four reasons why power control is essential in wireless communication?

QUESTION V [5 marks]

a) In today telecommunication system, gives two reasons why digital modulation is preferred to analog modulation? [2 marks]

b) Give three reasons explaining why a baseband signal cannot be directly transmitted in a wireless system? [3 marks]

Part C (38 marks)-CELLULAR NETWORKS AND MOBILE IP

QUESTION VI [12marks]

We consider a cellular system in which total available voice channels to handle the traffic are 960. The area of each cell is 6 km^2 and the total coverage area of the system is 2000 km^2. Calculate

(a) the system capacity if the cluster size, N (reuse factor), is 4 [3 marks]
(b) the system capacity if the cluster size is 7. [3 marks]
(c) How many times would a cluster of size 4 have to be replicated to cover the entire cellular area? [3 marks]
(d) Does decreasing the reuse factor N increase the system capacity? Explain [3 marks]

QUESTION VII [12 marks]

A mobile terminal samples signals from four BSs as a function of time. The times and signal strengths (in dBm) from the samples are given in the table below. Assume the mobile terminal is initially attached to BS 1 (BS1). The mobile makes handoff decisions by considering the signals from the BSs after each sampling time. For example, if just RSS is used, just after t=12.5s, the mobile terminal would be connected to BS3. On a plot, show the handoff transitions between BSs for each of the following algorithms as a function of time. If a condition is met for more than one BS, assume the best one (strongest RSS) is selected.

Time	0	2.5	5	7.5	10	12.5	15	17. 5	20
BS1	-47	-57	-56	-65	-60	-62	-60	-62	-56
BS2	-59	-56	-57	-61	-53	-56	-54	-52	-57
BS3	-70	-72	-75	-70	-58	-50	-55	-62	-75
BS4	-72	-71	-65	-59	-56	-53	-62	-63	-70

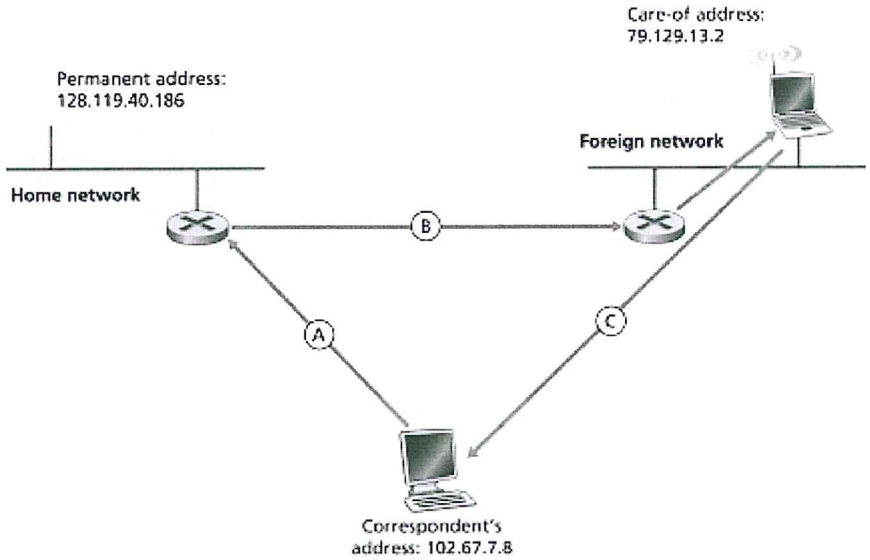
(a) Received signal strength (RSS) [4 marks]
(b) RSS + threshold of -54dBm [4 marks]
(c) RSS + hysteresis of 10dB [2 marks]

QUESTION VIII [6 marks]

Consider an area of 1260 square Km2 covered by a cellular network. If each user requires 200KHz for communication, and the total available spectrum is 40MHz.

(a) How many user can be supported without frequency reuse? [3 marks]
(b) if cells of area 30 square Km2 are used, how many users can be supported with cluster sizes of 7 cells?[3 marks]

QUESTION IX [6 marks]



Consider the scenario above in which a mobile node whose permanent address in its home network is 128.119.40.186, is visiting a foreign network and has received a care-of-address of 79.129.13.2. A correspondent with address 102.67.7.8 sends a UDP segment to the mobile host using Mobile IP. Consider the IP datagrams A, B, and C (see Figure VIII.1).

(a) What are the source and destination IP addresses of A and the contents of the payload (data) part of datagram A? [2marks]
(b) What are the source and destination IP addresses in datagram B and the contents of the payload (data) part of datagram B? [2 marks]
(c) What are the sources and destination IP addresses in the datagram C and the contents of the payload (data) part of datagram C? [2marks]

Part D (9 marks)-Bluetooth

QUESTION X [4 marks]

A Bluetooth device can be in two piconets at the same time. Is there any reason why one device cannot be the master in both of them at the same time?

QUESTION XI [5 marks]

Consider two independent Bluetooth piconets deployed at the same site. A slave in piconet 1 is sending packet to the master with DM3 packet format. What is the supported maximum rate of the user from slave to master direction?

Part E (16 marks)-Wireless LAN

QUESTION XII [6 marks]

Consider five wireless stations, A, B, C, D, and E. Station A can communicate with all other stations. B can communicate with A, C and E. C can communicate with A, B and D. D can communicate with A, C and E. E can communicate A, D and B.

(a) When A is sending to B, what other communications are possible? [2 marks]

(b) When B is sending to A, what other communications are possible? [2 marks]

(c) When B is sending to C, what other communications are possible? [2 marks]

QUESTION XIII [10 marks]

Consider a situation in which you enter a Wi-Fi jungle in a café with your laptop, a blueberry muffin, and many Wi-Fi networks with which your laptop's wireless interface can associate. Suppose that your laptop associates with the access point with the strongest signal. Suppose also that the signal strengths of the access points vary over time, so your association will also change over time. We are interested in the effects of a changing link-level association, and the consequent change of IP address when an association changes.

a. Suppose that initially your access point association changes relatively slowly over time, and that you are browsing the web using HTTP 1.0, and only occasionally downloading Web pages. Is the changing link-layer association and change of IP address likely to be a problem for you? [5 marks]

b. Now suppose that you want to perform a file transfer over TCP that is so large that it is likely that your laptop's link-level association will change during the file transfer. Is the changing link-layer association and consequent change of IP address likely to be an issue for you? [5 marks]

GOOD LUCK!