Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
ONLINE
SEMESTER II
SESI 2020/2021

COURSE NAME	:	WIRELESS AND MOBILE COMMUNICATION
COURSE CODE	:	BEB 41203 / BEJ 41203
PROGRAMME CODE	:	4 BEJ
EXAMINATION DATE	:	JULY 2021
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS **OPEN BOOK EXAMINATION**

TIIIS QUESTION PAPER CONSISTS OF **SEVEN (7)** PAGES

SECTION A

Q1 The main idea behind the Global System Mobile (GSM) cellular radio system is frequency reuse. Due to the increasing demand in the cellular radio, there is a need to increase the capacity of the system. Consider a case where initially, a cluster size of N=7 hexagonal cells is employed by the network planning engineer in Batu Pahat in year 2000. The area is covered by 6 clusters to support full coverage in Batu Pahat area. The allocated spectrum is 35 MHz and the traffic intensity of each subscriber is estimated to be 0.1 Erlang.

(a) Calculate the number of users that can communicate simultaneously in Batu Pahat area.

(4 marks)

(b) Given a Grade of Service (GOS) of 2%, calculate the number of users that can be supported in the Batu Pahat area.

(6 marks)

(c) Consider only the first layer of interefering cells, and path loss exponent (n) is 4; calculate the signal to interference ratio (S/I) of the co-channel cells in dB.

(4 marks)

(d) After 5 years, the engineer has proposed a new topology of cluster where a 120° sectoring is employed in all cells.

(i) Predict the improvement of S/I of the cellular network.

(3 marks)

(ii) If the S/I shall be maintained at 18dB, proposed a new cluster size

(3 marks)

(iii) Analyse the new capacity the celluar network. Support your answer with mathematical calculations.

(5 marks)

Q2 Consider for downlink model budget where the necessary parameters are listed as following:

Transmitter Antenna Gain = 14 *dBi*
Interference Margin = 0.5 *dB*
Receiver Antenna Gain = 10 *dBi*
Slow Fading Margin = 0.5 *dB*
Cable Loss = 2 *dB*
Other Gain = 1 *dB*

(a) Classify the above parameters into two categories whether it improves or attenuates the overall link budget.

(3 marks)

(b) Consider for Okumura Propagation Model in an urban area, the base stations (BS) operate at 950 MHz, the heights of BS and mobile station (MS) are 250 m and 1.8 m, respectively. Based on the plot given in **Figure Q2 (c),**

(i) Estimate the propagation loss occurs at distance within 1 to 3 km range.

(5 marks)

(ii) Plot the calculated values in **Q(b)(i)** in the graph sheet.

(3 marks)

(c) Repeat question **Q2(b)** for a suburban area.

(4 marks)

(d) If the maximum transmitted power at the Base Station (BS) is 20 dBm and all link budget parameters above are considered, estimate the received power level at distance within 1 to 5 km range for case **Q2(b)** and **Q2(c)**.

(3 marks)

(e) If the receiver sensitivity at the Mobile Station (MS) is -70 dBm, determine the maximum radius of a cell for an urban area. Justify your finding

(3 marks)

(f) Repeat question **Q2(e)** for suburban area.

(2 marks)

(g) Evaluate the effect at multipath propagation on the received power in **Q2(e)** and **Q2(f).**

(2 marks)

Q3 (a) **Figure Q3(a)** shows the multipath delay profile of GSM signal in an indoor environment with QPSK modulation scheme symbol rate is 0.1μs.

(i) Calculate the mean excess delay.

(2 marks)

(ii) Calculate the rms delay spread.

(3 marks)

(iii) Predict whether the system needs an equalizer to operate. Please justify your answer.

(3 marks)

(iv) Predict the type of fading undergoes by the signal in **Q3(a) (i)-(iii)**.

(4 marks)

(b) In general, the cellular network is not available in the sea area. In order to improve the network coverage for the maritime users, you are required to investigate the possibility of extending the terrestrial network from the coast area to the sea area.

(i) Choose ONE measurement system for determining small scale fading for this Situation and justify your answer.

(3 marks)

(ii) Discuss the measurement setup in terms of the placement of transmitter and receiver and the step-by step procedure.

(6 marks)

(iii) Highlight the possible nature factors that influence the small scale fading in the maritime environments.

(4 marks)

Q4 (a) Global System for Mobile Communication (GSM) is a standard developed to describe the protocols for second generation digital cellular network.

(i) Explain the features of digital modulation technique that is employed in GSM system.

(4 marks)

(ii) Elaborate the combination of two different types of multiple access which are FDMA and TDMA that is employed in GSM System. Discuss how this approach can support more number of subscribers.

(3 marks)

(b) Explain why near-far problem occurs in CDMA and how to combat it.

(5 marks)

(c) In an omni-directional CDMA cellular system with single-cell and single-sector antenna, a minimum E_b/N_0 of 18.5 dB is required for each user. If 280 users with a baseband data rate of 13 kbps are to be accommodated;

(i) determine the minimum channel bit rate of the spread spectrum chip sequence when voice activity considerations is ignored, and

(2 marks)

(ii) determine the minimum channel bit rate of the spread spectrum chip sequence when voice activity is considered and is equal to 50%.

(2 marks)

(iii) summarise your finding in **Q4(b) (i)** and **(ii)** and how it can affect the channel bit rate per user. Use one scenario to explain your answer.

(2 marks)

(d) Based on the current network available in Malaysia, differentiate the operation of 3G and 4G networks when they handle the following services

(i) the voice call
(ii) the internet streaming.

Support the answer with the necessary network architecture.

(7 marks)

-END OF QUESTIONS-

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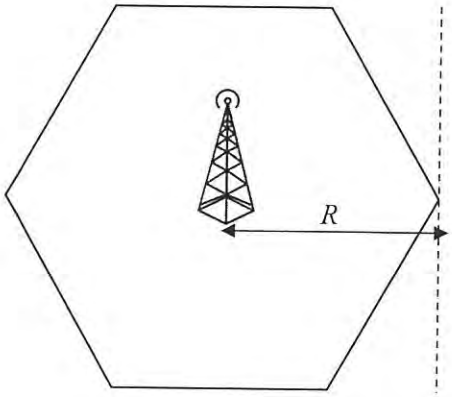

Parameters	Value
Power transmitted, Pt	15 dBm
Antenna Gain at transmitter, Gt	8 dB
Antenna Gain at receiver, Gr	5 dB
Cable Loss Lcable	1.5 dB
Frequency	2100 MHz

FIGURE Q2(c)

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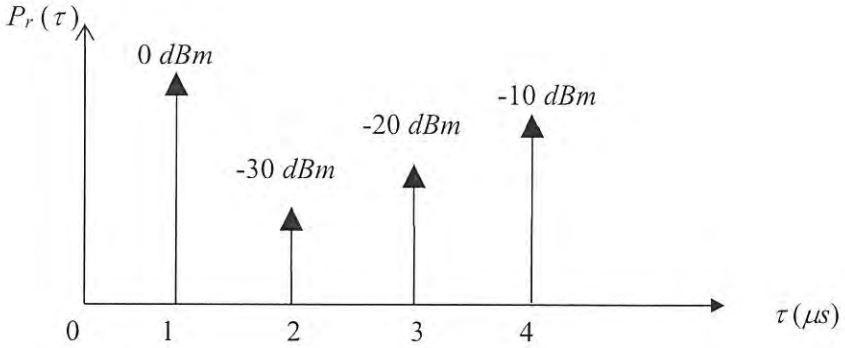

FIGURE Q3(a)