Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2018/2019

COURSE NAME	:	WIRELESS AND MOBILE COMMUNICATION
COURSE CODE	:	BEB 41203
PROGRAMME CODE	:	BEJ
EXAMINATION DATE	:	DECEMBER 2018 / JANUARY 2019
DURATION	:	3 HOURS
INSTRUCTION	:	SECTION A: ANSWER **ALL** QUESTIONS SECTION B: ANSWER **THREE (3)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **ELEVEN (11)** PAGES

SECTION A
ANSWER ALL QUESTIONS

Q1 (a) In cellular networks, the signal to interference ratio (S/I) is a parameter used to indicate the network performance. Consider for the worst case scenario for forward channel as shown in **Figure Q1 (a).**

(i) Prove that ;

$$\frac{S}{I} = \frac{1}{2\left(\frac{D}{R}-1\right)^{-n} + 2\left(\frac{D}{R}\right)^{-n} + 2\left(\frac{D}{R}+1\right)^{-n}}$$

(5 marks)

(b) Considering for a case where the Grade of Services (GOS) is 2%, the number of channel allocated for a cell is 60 channels and traffic intensity per user, A_u is 0.01 Erlang.

(i) For a cluster size, $N = 7$ and path loss exponent, $n = 3.5$, calculate $\left(\frac{S}{I}\right)$.

(3 marks)

(ii) Prove that $\left(\frac{S}{I}\right)$ can be improved by using sectoring 120°.

(4 marks)

(iii) Calculate the number of user that can be supported in a cluster before and after sectoring is applied.

(7 marks)

(iv) Based on answer in **Q1(b)(ii)** and **Q1(b)(iii)**, if the minimum requirement $\left(\frac{S}{I}\right)$ is 18 dB, suggest a new cluster size, N if sectoring is applied.

(3 marks)

(v) Based on answers in **Q1(b)(i) - Q1(b)(iv)**, evaluate the impact of sectoring to the traffic capacity which is indicating by the number of customer that can be supported by the cellular networks.

(5 marks)

(c) The forward channel model link budget and the necessary parameters are listed as below:

Transmitter Antenna Gain = 12 dBi	Cable Loss = 2 dB
Receiver Antenna Gain = 6 dBi	Other Loss = 1 dB

(i) Classify the above parameters into categories where it improves or attenuates the overall link budget.

(2 marks)

(ii) If the maximum power transmitted, P_t at the Base Station (BS) is 20 dBm and the minimum receiver sensitivity at the Mobile Station (MS) is -60 dBm, calculate the maximum propagation loss.

(4 marks)

(iii) Propose radius of a hexagon cell size for the system operate for Global System for Mobile (GSM) at 950 MHz.

(5 marks)

SECTION B
ANSWER THREE (3) QUESTIONS ONLY

Q2 (a) Discuss the purpose of;

(i) Roaming

(2 marks)

(ii) Reverse Control Channel (RVC)

(2 marks)

(iii) Mobile Assisted Handoff

(2 marks)

(iv) Dynamic Channel Assignment

(2 marks)

(b) Explain the process of the initiating a call requested by a cellular mobile user to another cellular mobile user. Both are located in the same coverage area served by the same Base Station Controller (BSC).

The explanations need to include the terms Mobile Identification Number (MIN), Equipment Serial Number (ESN), and involvement of Forward Control Channel (FCC), Reverse Control Channel (RCC), Forward Voice Channel (FVC) and Reverse Control Channel (RVC).

(8 marks)

(c) Differentiate the terms of duplexing and multiple access. Elaborate the difference in the perspective of cellular mobile system.

(4 marks)

Q3 (a) Suggest the suitable propagation model used in the following environments. Justify your answer;

(i) Satellite communication

(2 marks)

(ii) Outdoor flat earth surface

(2 marks)

(iii) Outdoor urban area

(2 marks)

(b) Elaborate the concept of Fresnel zone to allow microwave signal to propagate in a shadowed region. Support the answer with an aid of diagram.

(4 marks)

(c) **Figure Q3 (c)** shows the layout of a new university building and **Table Q3 (c)** shows the path loss exponent in different environment. Given that the mean path loss at 1 m is 18 dB, using Log Distance Path loss Model, calculate;

(i) The minimum path loss between Router A and Device 1 if both are separated 20 m apart.

(3 marks)

(ii) Device 2 are located in a separated room made of wall of a concrete. With a wall attenuation factor of 8 dB, calculate the minimum path loss between Router A and Device 2 if both are separated 40 m apart.

(4 marks)

(iii) Predict the impact on the propagation loss between Router A and Device 2 and justify the answer if the wall are made of steel.

(3 marks)

Q4 (a) Elaborate **ONE (1)** small scale multipath measurement system. Support the answer with an aid of diagram.

(4 marks)

(b) Distinguish between Flat Fading and Frequency Selective Fading effects due to Multipath time delay spread.

(4 marks)

(c) Consider for a GSM transmitter which radiates a radio signal with carrier frequency of 950 MHz. A digital transmission system is used where the symbol rate is 120 Mbps.

(i) Calculate the doppler spread for the channel if a mobile station is moving 50 km/hr.

(3 marks)

(ii) Calculate the doppler spread for the channel if a mobile station is moving at 72 km/hr.

(2 marks)

(iii) Conclude your observation based on answer in **Q3(b)(i)** and **Q3(b)(ii)**.

(2 marks)

(iv) Predict the type of fading undergoes by the signal in **Q3(b)(i)** and **Q3(b)((ii)**.

(5 marks)

Q5 (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 type of multiple access which are Frequency Division Multiple Access (FDMA) and Time Division Multiple Access (TDMA) that is employed in GSM System. Discuss how this approach can support more number of subscribers.

(4 marks)

(b) In an omni-directional Code Division Multiple Access (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, determine the minimum channel bit rate of the spread spectrum chip sequence:

(i) when voice activity considerations is ignored, and

(3 marks)

(ii) when voice activity is considered and is equal to 40%.

(2 marks)

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

(3 marks)

(b) Explain how the Discontinuous Transmission Mode (DTX) can help to reduce interference in CDMA.

(4 marks)

Q6 (a) **Table Q6 (a)** shows major mobile radio standard in the world;

(i) Calculate the value of W, X, Y and Z.

(4 marks)

(ii) Discuss the impact of the answer obtained in **Q6(a)(i)** to the number of subscriber that can communicate at one time.

(2 marks)

(iii) Rank the standard in sequence from the standard that has the lowest to the highest impact of adjacent channel interference. Justify your answer.

(4 marks)

(b) **Figure Q6(b)** shows the evolution of wireless cellular standard. Discuss the evolution of the cellular protocol available features by referring to similarity and advancement to its generation.

(4 marks)

(c) Distinguish the network architecture of 3G and 4G networks. Please support the answer with an aid of diagram. Then sketch the route involved when the subscriber requesting the following ;

(i) the voice call;

(3 marks)

(ii) the internet streaming.

(3 marks)

- END OF QUESTIONS -

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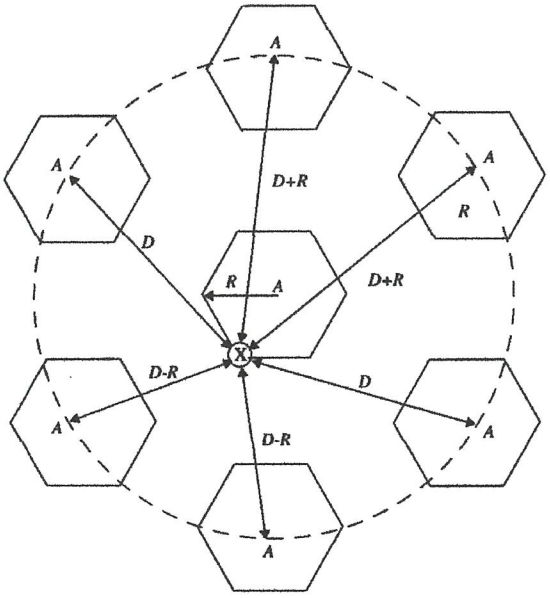

FIGURE Q1(a)

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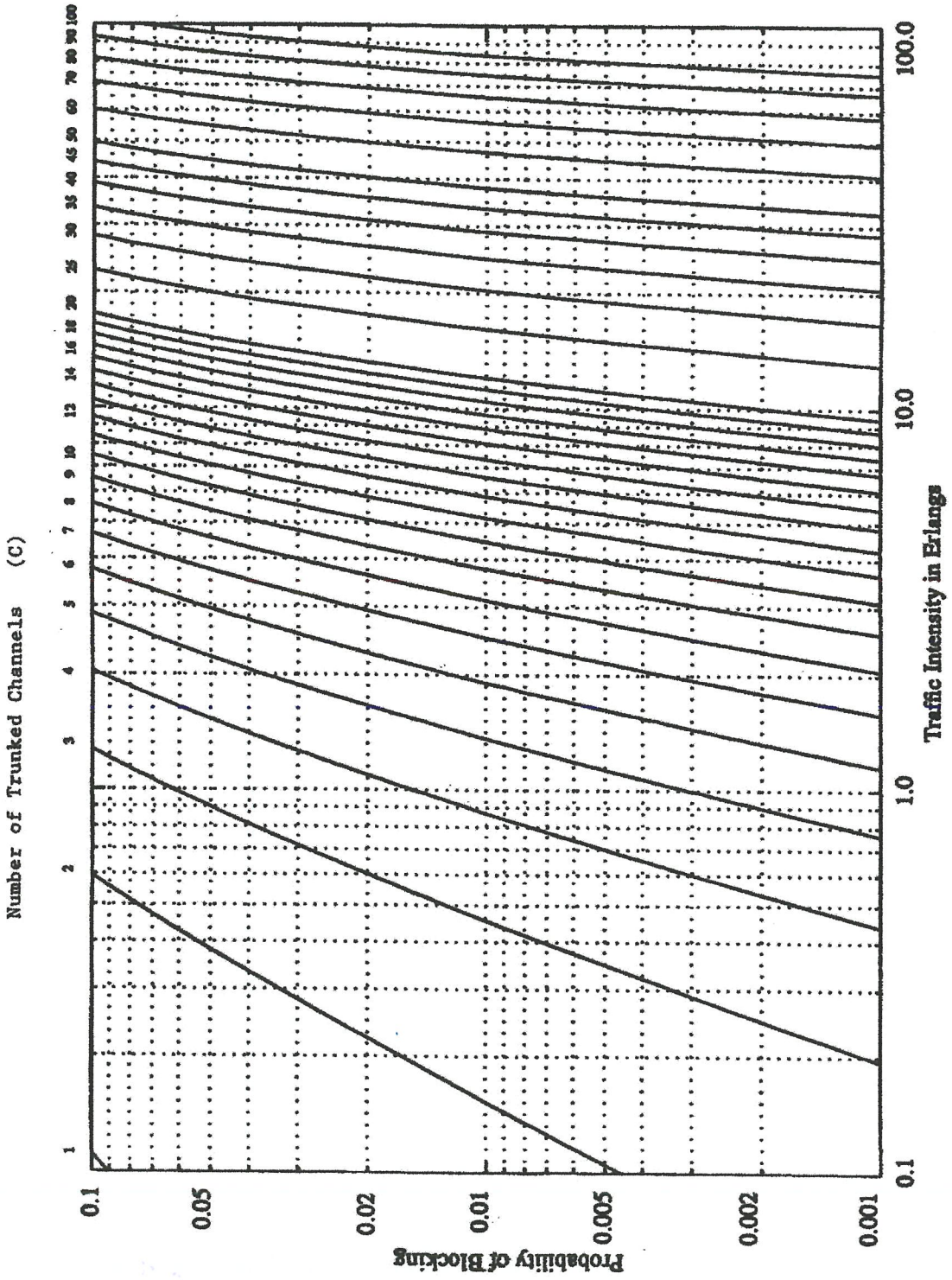

FIGURE Q2

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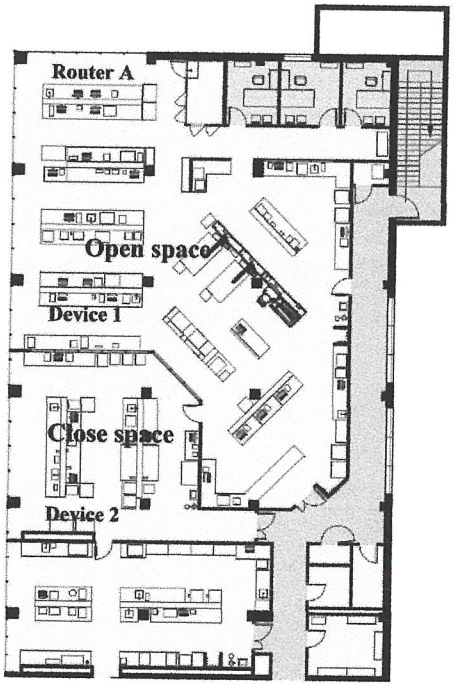

FIGURE Q3 (c)

TABLE Q3 (c)

Environment	Path loss Exponent
Free space	2
Urban cellular radio	2.7 to 3.5
Shadowed Urban cellular radio	3 to 5
In building line of sight	1.6 to 1.8
Obstructed building	4 to 6
Obstructed in factories	2 to 3

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Table Q6(a)

Standard	Year of Introduction	Multiple access	Frequency band (MHz)	Channel Bandwidth	No of trunked channel
PDC	1993	TDMA	810 – 1501	25 kHz	W
GSM	1990	TDMA	890 – 960	200 kHz	X
NAMPS	1992	FDMA	824 – 894	10 kHz	Y
NMT-900	1986	FDMA	890 – 960	12.5 kHz	Z

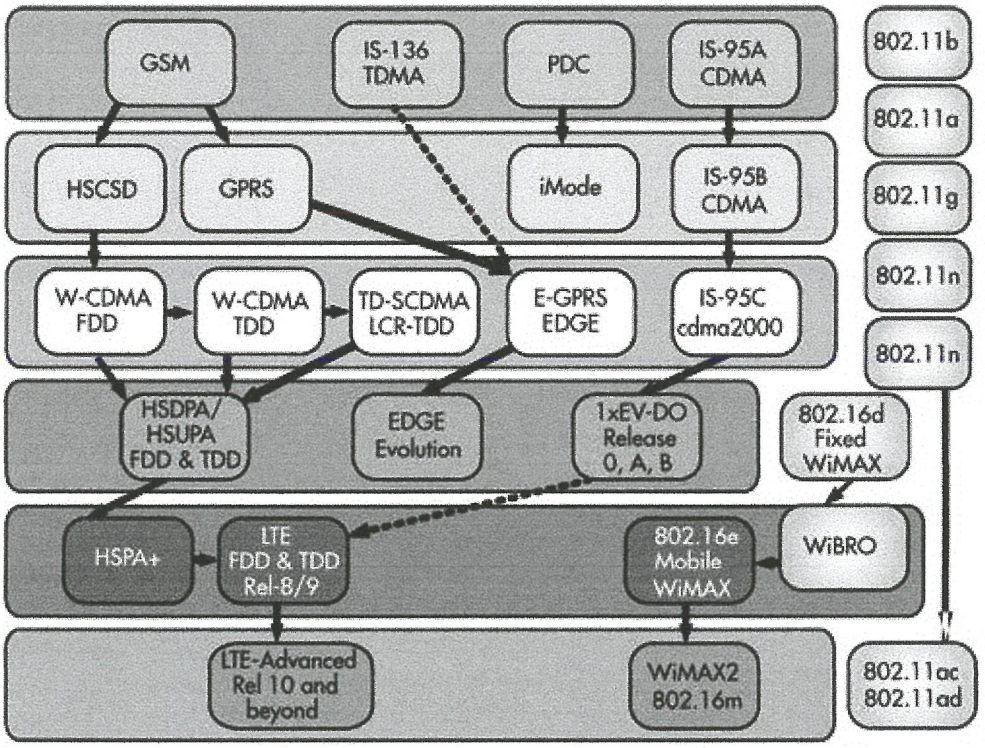

FIGURE Q6(b)

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Miscellaneous Equations

$$P_r = \frac{P_t G_t G_r \lambda^2}{(4\pi d)^2 L}$$

$$PL(d) = PL(d_o) + 10n\log\left(\frac{d}{d_o}\right)$$

$$\frac{S}{I} = \frac{(D/R)^n}{\sum i_o}$$

$$f_d = \frac{1}{2\pi}\left(\frac{\Delta\phi}{\Delta t}\right) = \frac{v\cos\theta}{\lambda}$$

$$\frac{W/R}{(N-1)\alpha} = \frac{E_b}{N_0}$$

$$T_c \approx \frac{9}{16\pi f_m} = \frac{9c}{16\pi v f_c}$$

$$\Delta T = \gamma L T_c$$