Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESI 2015/2016

COURSE NAME	:	WIRELESS AND MOBILE COMMUNICATION
COURSE CODE	:	BEB 41203
PROGRAMME	:	BEJ
EXAMINATION DATE	:	JUNE/JULY 2016
DURATION	:	3 HOURS
INSTRUCTION	:	SECTION A: ANSWER **ALL** QUESTIONS SECTION B: ANSWER **THREE (3)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **NINE (9)** PAGES

SECTION A

Q1 Consider for downlink model budget where the necessary parameters are listed as below:

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 categories where it improves or attenuates the overall link budget.

(3 marks)

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

(5 marks)

(c) Propose radius of a cell size for the system operate for IMT2000 at 2100 MHz.

(5 marks)

(d) Predict the number of clusters needed to cover $75km^2$ area of City A when cluster size of 7 is employed. (Hint : An area of hexagon cell is $2.5981R^2$)

(5 marks)

(e) **Figure Q1 (e)** shows the Grade of Service (GOS) for Traffic Intensity in City A. Based on your answer in **Q1(a) – (d),** GOS of 2%, the total traffic intensity of City A is 150 Erlang and the traffic intensity per user is 0.01 Erlang.

(i) Calculate how many number of users can be supported in the City A area.

(3 marks)

(ii) Assume that the traffic intensity per cell in City A is equal, calculate the number of trunking channel available per cell.

(6 marks)

(iii) Calculate the allocated spectrum available to support IMT2000 system.

(5 marks)

(iv) Evaluate whether the designed network is capable of achieving market penetration of 60% if the population City A area is 50,000 residents. If not, propose the possible strategy to increase the market penetration, the procedures that should be taken and highlight important considerations so the network performance is maintained.

(8 marks)

SECTION B

Q2 (a) Three mechanisms of electromagnetic wave propagation are reflection, diffraction and scattering. Differentiate between reflection and scattering mechanism by explaining their properties when microwave signals hit the flat and rough surfaces.

(6 marks)

(b) Okumura's model is one of the most widely used models for signal prediction in urban area. The model can be expressed as;

$$L_{50}(dB) = L_F + A_{m,u}(f,d) - G(h_{te}) - G(h_{re}) - G_{area}$$

Antenna tower of BS1, BS2 and BS3 are placed in different areas as the following;

BS1 : KLCC, Kuala Lumpur
BS2 : Clearwater Sanctuary Golf Resort, Alor Gajah
BS3 : Kampung Parit Kuda, Semerah, Batu Pahat

Assume all base stations (BS) that cover the same size of cell transmit radio signal at 950 MHz. The height of each BS and mobile station (MS) (each has the same electrical parameters at all area) is 200 m and 3 m, respectively. Consider for the case where a MS is located at 5 km away from BS at all three different areas correspondingly.

(i) Analyze the median path loss at the receiver in the THREE (3) different areas (assume a unity gain receiving antenna).

(10 marks)

(ii) Evaluate the answer in **Q2(b)(i)** loss in different type of environment based on possible occurrence of multipath effect.

(4 marks)

Q3 (a) The type of fading experience by a signal propagating through a mobile radio channel depends on the nature of the transmitted signal with respect to the characteristics of the channel. Distinguish between Fast Fading and Slow Fading effects due to Doppler Spread.

(4 marks)

(b) Consider for a GSM transmitter which radiates a radio signal with carrier frequency of 1900 MHz. A digital transmission system is used where the symbol rate is 100 Mbps.

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

(4 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 **(ii)**.

(3 marks)

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

(7 marks)

Q4 (a) Explain why near-far problem occurs in CDMA and how to combat it.

(5 marks)

(b) 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, 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 50%.

(3 marks)

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

(3 marks)

(c) Recommend a technique to increase CDMA capacity in part **Q4(b)**.

(6 marks)

Q5 (a) **Figure Q5(a)** 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.

(8 marks)

(b) 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.

Please support the answer with the necessary network architecture.

(12 marks)

- END OF QUESTIONS -

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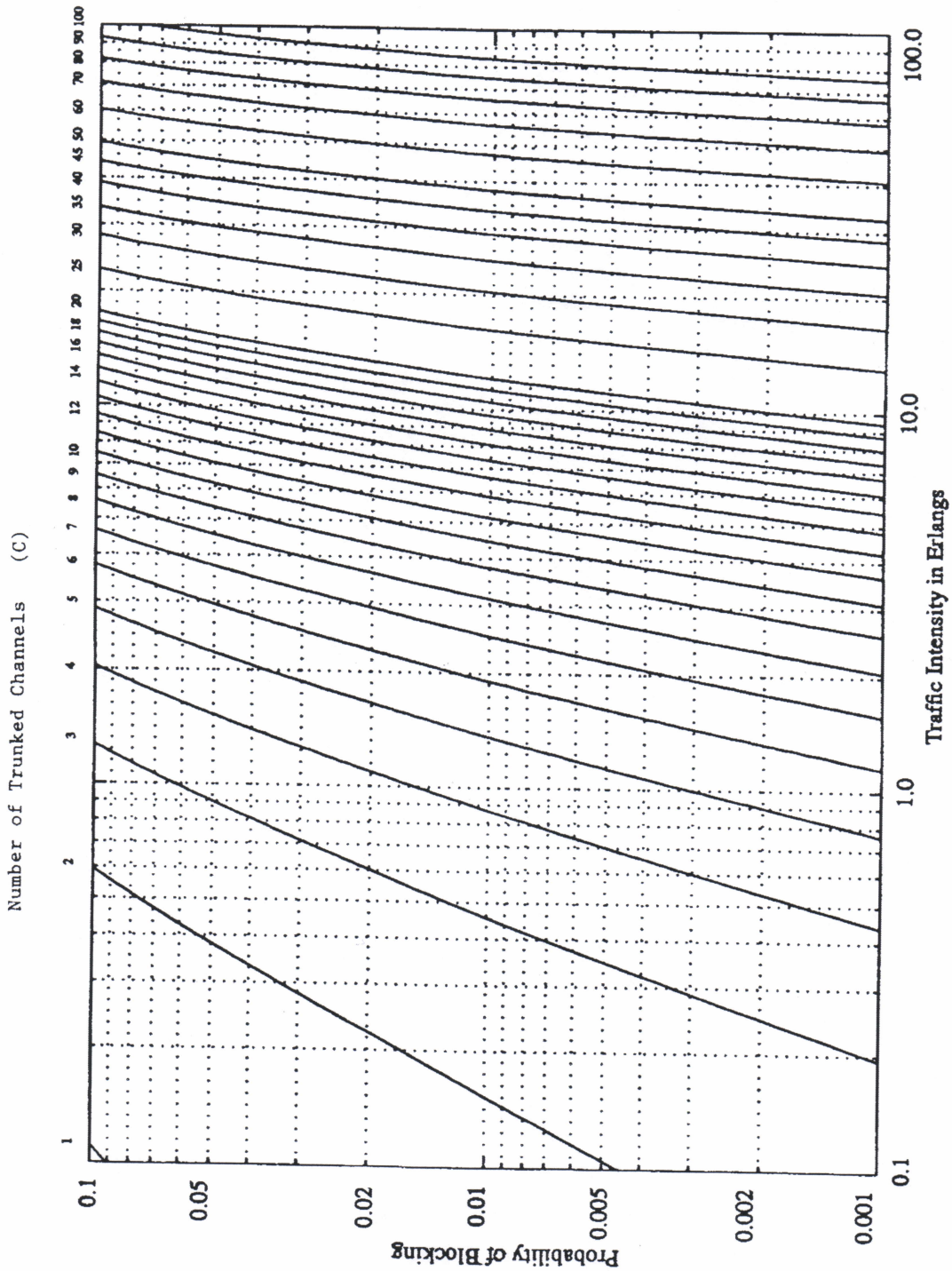

FIGURE Q1(e)

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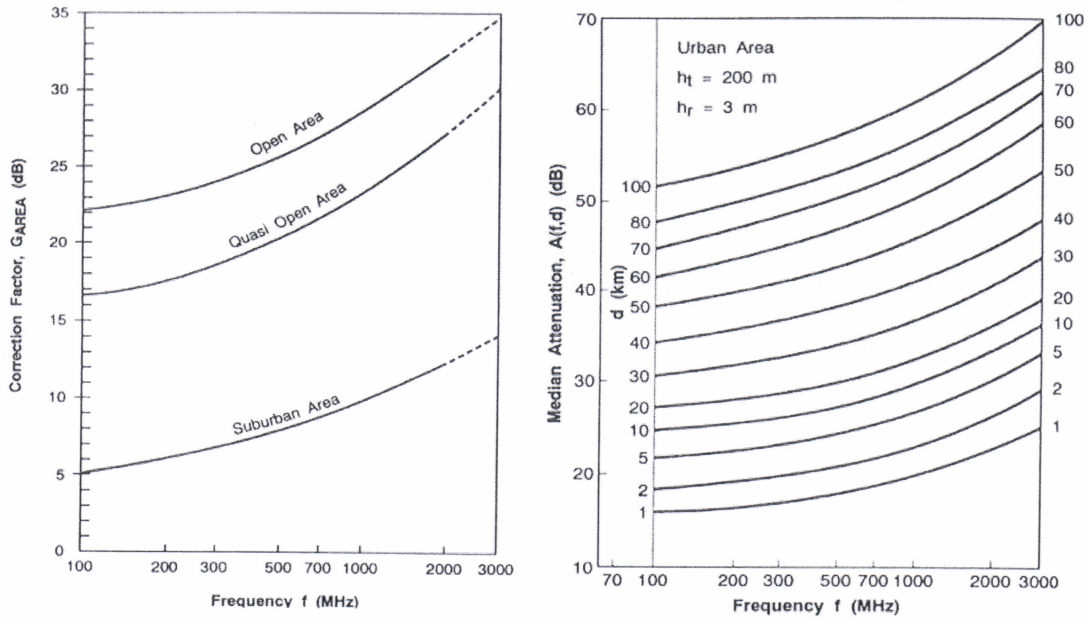

FIGURE Q2(b)

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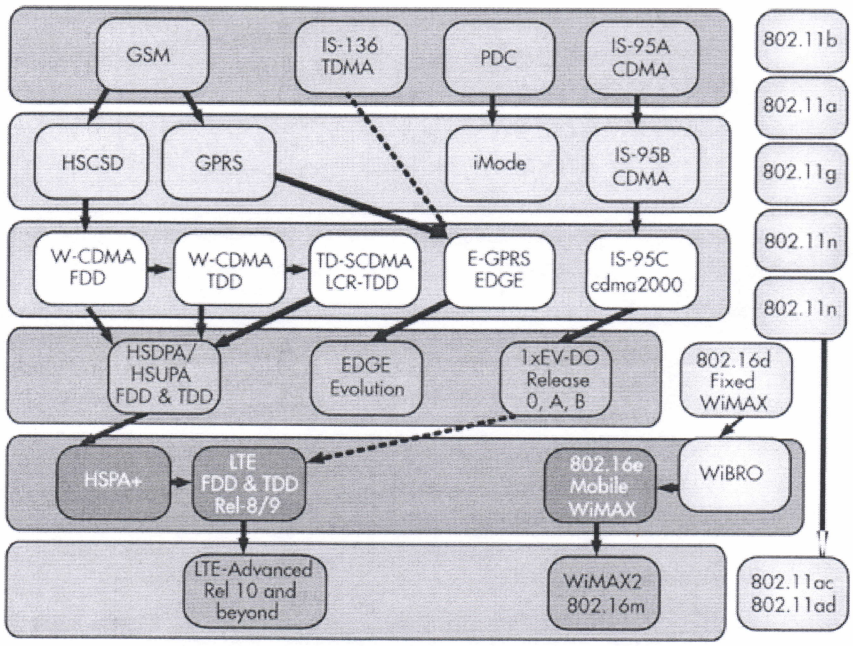

FIGURE Q5(a)

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Miscellaneous Equations

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

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

$$L_{50}(dB) = L_F + A_{m,u}(f,d) - G(h_{te}) - G(h_{re}) - G_{area}$$

$$G(h_{te}) = 20\log\left(\frac{h_{te}}{200}\right)$$

$$G(h_{re}) = 10\log\left(\frac{h_{re}}{3}\right) \quad h_{re} \le 3m$$

$$G(h_{re}) = 20\log\left(\frac{h_{te}}{3}\right) \quad 3m \le h_{re} \le 10m$$

$$L_{hata} = 46.3 + 39.00\log f - 13.82\log h_{te} - a(h_{re}) + (44.9 - 6.55\log(h_{te}))\log d$$

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

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

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

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