Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2016/2017

COURSE NAME	:	WIRELESS AND MOBILE COMMUNICATION
COURSE CODE	:	BEB 41203
PROGRAMME	:	BEJ
EXAMINATION DATE	:	JUNE 2017
DURATION	:	3 HOURS
INSTRUCTION	:	SECTION A: ANSWER **ALL** QUESTIONS SECTION B: ANSWER **TWO (2)** QUESTIONS ONLY

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

SECTION A

Q1 Batu Pahat district has an area of 1872.56 km^2 with current population 335,368 residents. The signal to interference ratio S/I is 18 dB, path loss exponent, n is 4 and there are 6 co-channels cells in the first tier. Assume the whole district area is covered with constant cellular cell size of 2.6 km^2 and uniform population distribution:

(a) Calculate the cluster size, N.

(3 marks)

(b) Calculate the number of cluster available to cover the whole Batu Pahat district.

(3 marks)

(c) Calculate the total offered traffic intensity for a cluster if the traffic intensity per user is 0.1 Erlang.

(3 marks)

(d) Calculate the number of users that able to communicate simultaneously in a cell if the telecom provider has allocated 25 MHz duplex spectrum bandwidth and 200 kHz duplex channel bandwidth.

(3 marks)

(e) Based on information given in **Q1(c)** and **Q1(d)**, given Grade of Service (GOS) is 2% calculate the number of users can be served in a cluster.

(3 marks)

(f) Evaluate whether the designed network is capable of achieving market penetration of 60%. If not, propose a possible strategy to increase the market penetration, and procedures that should be taken and highlight important considerations so the network performance is maintained.

(10 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 wether 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 height of BS and mobile station (MS) is 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)

SECTION B

Q3 (a) The type of fading experienced 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.

(6 marks)

(b) **Figure Q3(b)** shows the multipath delay profile of GSM signal in an indoor environment with QPSK modulation scheme.

(i) Calculate the mean access delay.

(3 marks)

(ii) Calculate the rms delay spread.

(4 marks)

(iii) Justify whether the system need an equalizer or not.

(3 marks)

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

(4 marks)

(c) As an engineer, you are required to investigate the small scale fading using small scale multipath measurement. Choose **ONE (1)** measurement system and elaborate the working principles of the chosen system with an aid of diagram.

(5 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.

(5 marks)

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

(7 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

(3 marks)

(ii) determine the minimum channel bit rate of the spread spectrum chip sequence 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. Use one scenario to explain your answer.

(3 marks)

Q5 (a) **Table Q5 (a)** shows major mobile radio standard in the world;

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

(3 marks)

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

(3 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.

(5 marks)

(b) Mobile Switching Centre (MSC) is called as the "heart" of cellular network. As the traffic demand increases, the load to the MSC increases as well. Discuss the strategy that have been done to reduce the load to MSC in the recent current cellular network.

(5 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
(ii) the internet streaming.

(9 marks)

-END OF QUESTIONS-

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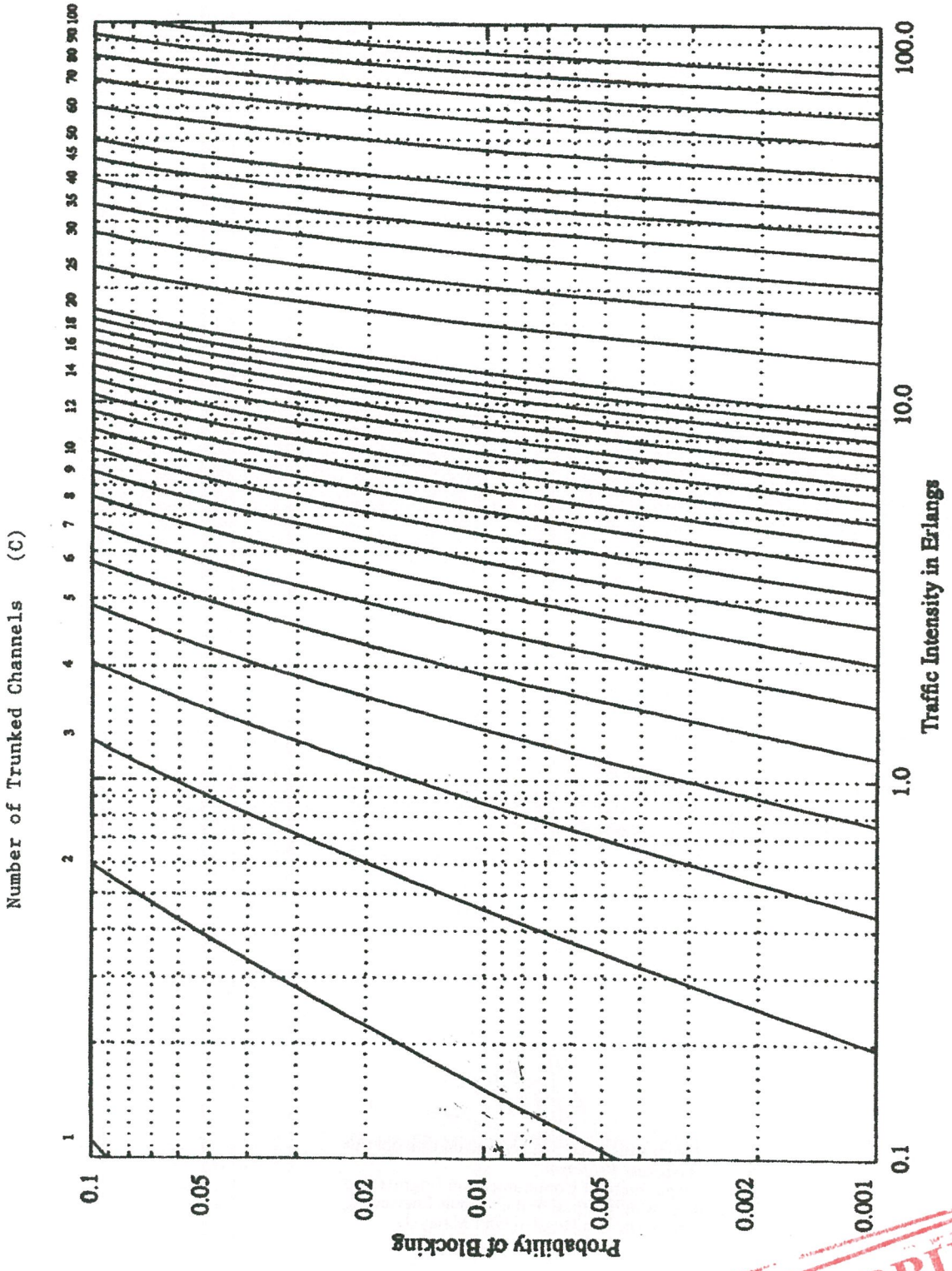

FIGURE Q1(e)

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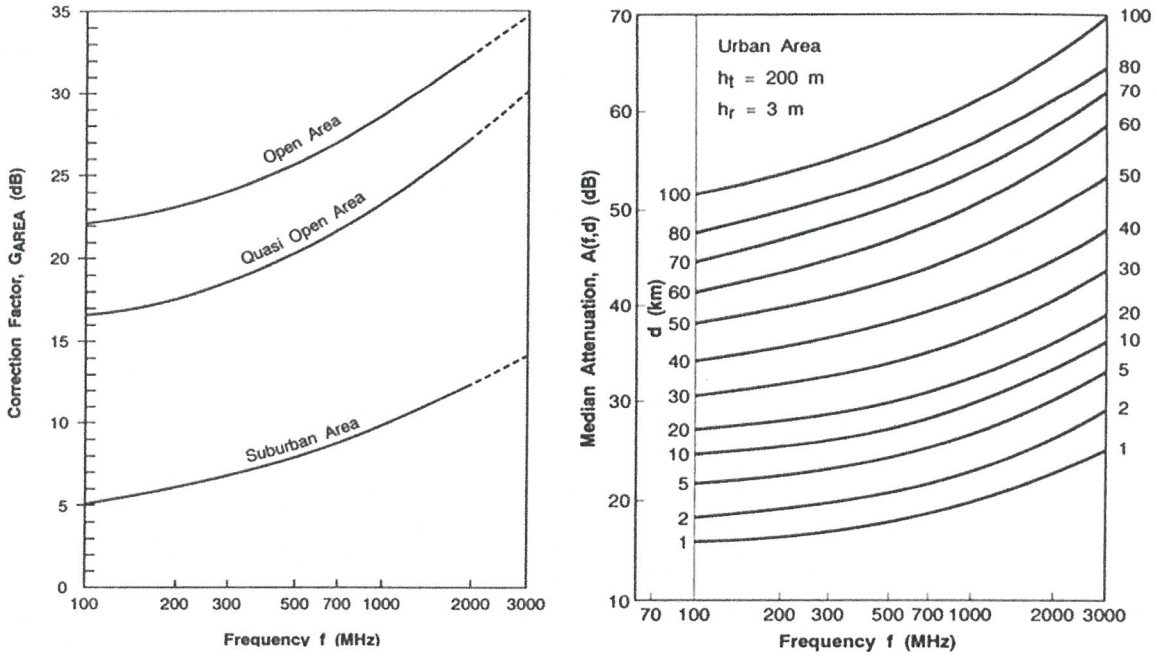

FIGURE Q2(b)

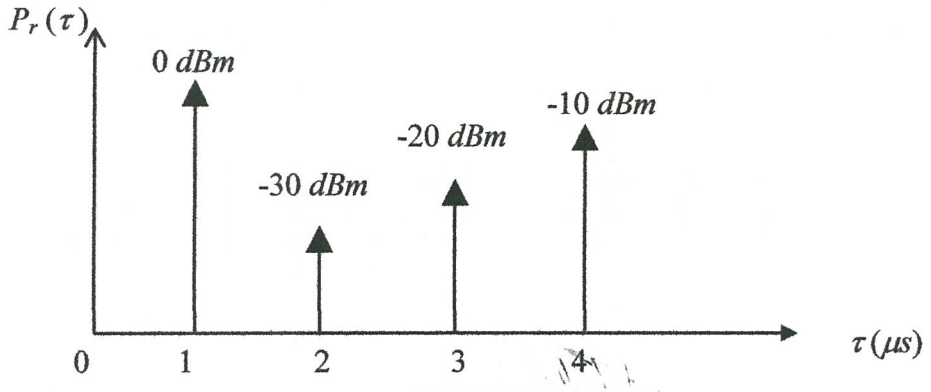

FIGURE Q3(b)

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TABLE Q5 (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**

Miscellaneous Equations

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

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

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

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

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

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

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

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

$$\tau^2 = \frac{\sum_k P(\tau_k)\tau_k{}^2}{P(\tau_k)}$$

$$\tau = \frac{\sum_k P(\tau_k)\tau_k}{P(\tau_k)}$$

$$B_C = \frac{1}{5\sigma_\tau}$$

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