Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

PEPERIKSAAN AKHIR
SEMESTER I
SESI 2016/2017

TERBUKA

COURSE NAME	:	WIRELESS AND MOBILE COMMUNICATION
COURSE CODE	:	BEB 41203
PROGRAMME	:	BEJ
EXAMINATION DATE	:	DECEMBER 2016 /JANUARY 2017
DURATION	:	3 HOURS
INSTRUCTION	:	SECTION A: ANSWER **ALL** QUESTIONS SECTION B: ANSWER **THREE (3)** QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** 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) Criticise the drawback of sectoring in terms of the number of user can be supported in the area. Support your answer with mathematical calculations.

(8 marks)

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SECTION B

Q2 (a) Discuss the importance of specifying a few of the available channels into control channel, forward channel and reverse channel.

(8 marks)

(b) Draw the architecture of a terresterial based mobile phone network and explain the function of all components inside it.

(6 marks)

(b) Explain the condition where an unnecessary handoff occurs and how this can reduce the efficiency of the cellular network.

(4 marks)

(c) Ground 2 Ray Reflection Model provides a better prediction on the received signal power based on the line of sight (LOS) and ground reflected path (NLOS). The model prediction is based on the distance, d between mobile station (MS) and base station (BS), the height of BS, h_t and MS, h_r. Prove that the path loss, $PL(dB)$ is given by;

$$PL(dB) = 70\log d(km) - 20\log h_t(m) - 20\log h_r(m)$$

(7 marks)

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.

(4 marks)

(b) Consider 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 at 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)

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

(7 marks)

(c) A binary spread spectrum sliding correlator multipath measurement system has the following parameters:

Transmitter chip period = 100 ns
PN sequence length = 1023

(i) Calculate the time between maximal correlation and the slide factor if the receiver uses a PN sequence clock that is 60 kHz slower than the transmitter.
(3 marks)

(ii) Determine the required intermediate frequency (IF) passband bandwidth for the system.
(2 marks)

Q4 (a) Using suitable figure, explain Code Division Multiple Access (CDMA).
(6 marks)

(b) Explain the occurrence of near-far problem that occurs in CDMA and suggest a way to overcome it.
(6 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, determine the minimum channel bit rate of the spread spectrum chip sequence:

(i) when voice activity considerations is ignored, and
(ii) when voice activity is considered and is equal to 40%.
(6 marks)

(d) Compose a technique to increase CDMA capacity in part **Q4(c)**.
(7 marks)

Q5 (a) Draw the allocation of bits in the United State Digital Cellular (USDC) TDMA half-rate time slot from mobile to base station.

(4 marks)

Then, determine:

(i) the air interface channel data rate,
(ii) the time duration for each slot,
(iii) the number of symbols per frame, and
(iv) the frame efficiency.

(5 marks)

(b) **Figure Q5(b)** shows the evolution of wireless cellular standard. Discuss the evolution of the available features in cellular protocol by referring to the similarity and the advancement to their generation.

(6 marks)

(c) 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.

(10 marks)

- END OF QUESTIONS -

FINAL EXAMINATION

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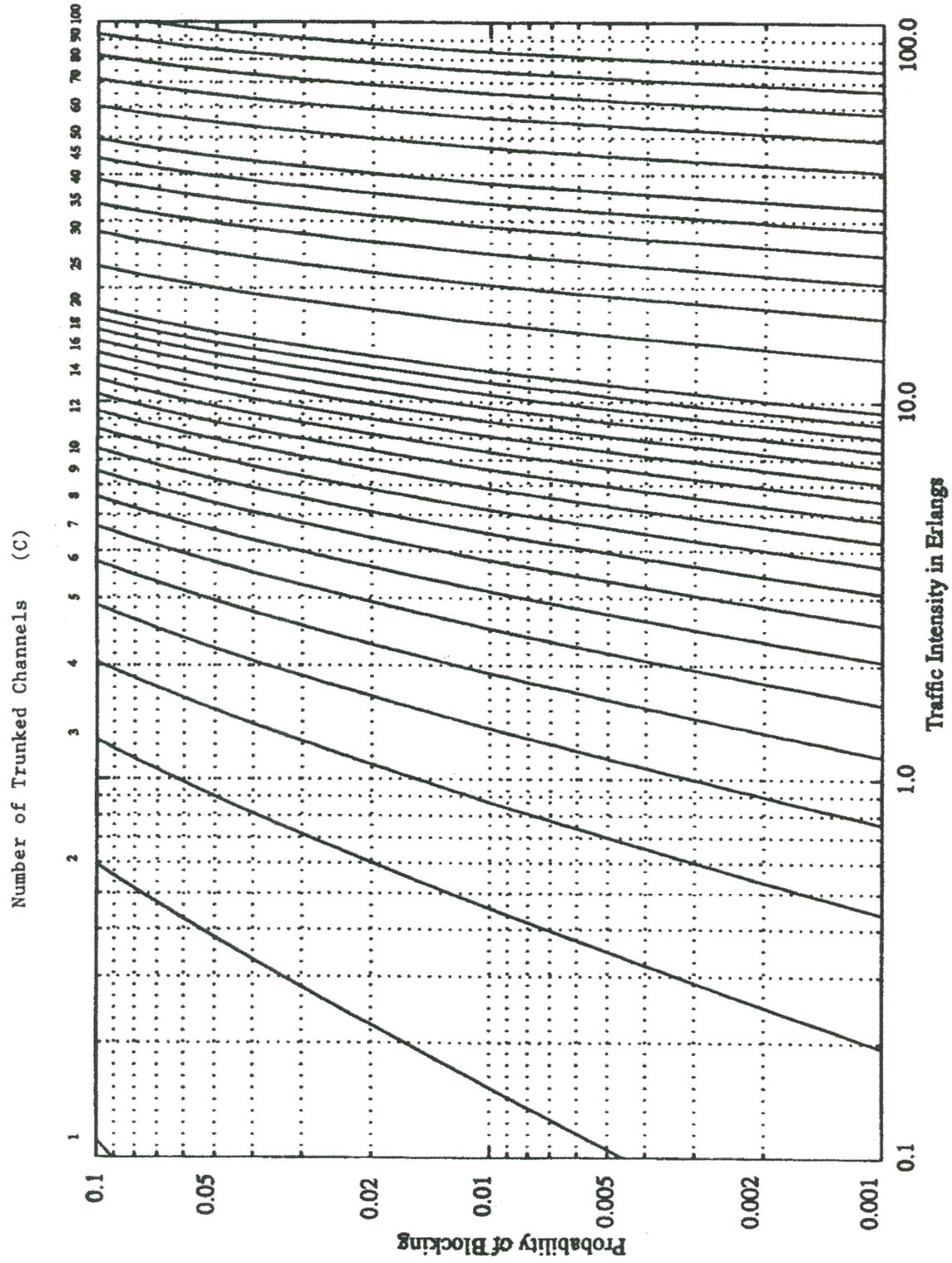

FIGURE Q1

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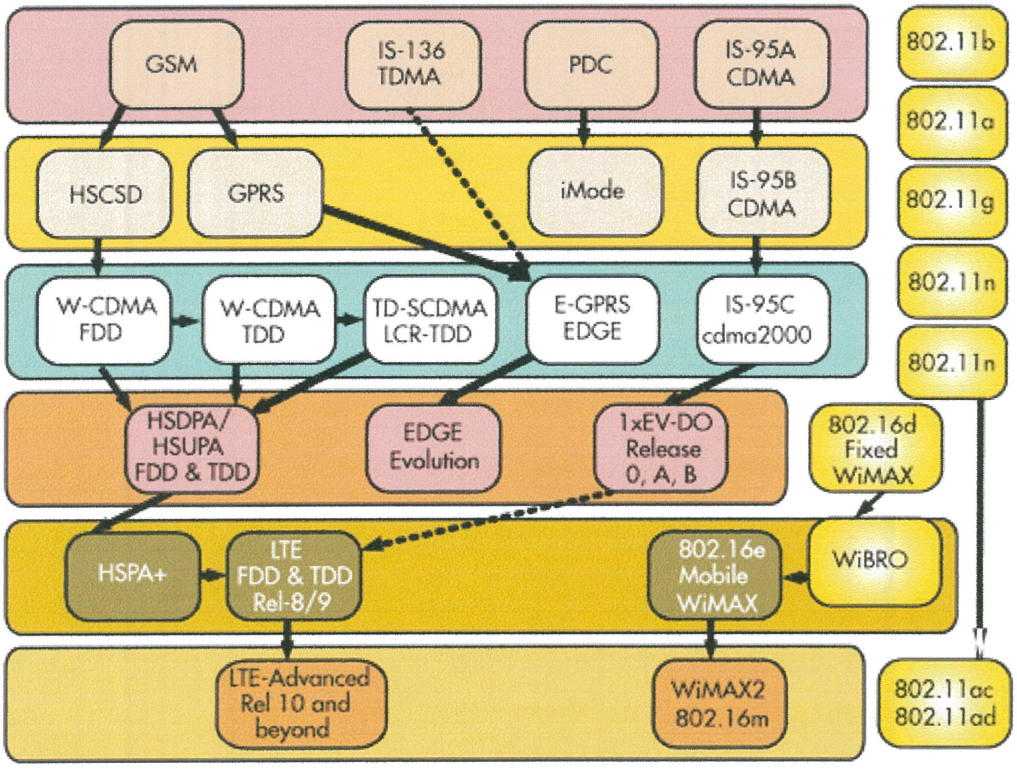

FIGURE Q5(b)

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Miscellaneous Equations

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

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

$$\frac{S}{I} = \frac{(D/R)^n}{\sum_{i=1}^{io} I_i}$$

$$P_r = P_t G_t G_r \frac{h_t h_r}{d^4}$$

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

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

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

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

$$BW = 2(\alpha - \beta)$$