Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2021/2022

COURSE NAME	:	WIRELESS AND MOBILE COMMUNICATION
COURSE CODE	:	BEJ 41203
PROGRAMME CODE	:	BEJ
EXAMINATION DATE	:	JULY 2022
DURATION	:	3 HOURS
INSTRUCTION	:	1. ANSWER **ALL** QUESTIONS 2. THIS FINAL EXAMINATION IS A ONLINE ASSESSMENT AND CONDUCTED VIA **CLOSED BOOK.** 3.STUDENTS ARE PROHIBITED TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

Q1 **(a)** Discuss the importance of an Umbrella Cell and how the channel assignement is performed with different cell size covers the same area.

(5 marks)

(b) A Metropolitan has an area of 1872.56 km^2 with current population 2 million residents. The = 2% Grade of Service (GOS) GSM cellular networks is served by 15 MHz spectrum with a duplex channel bandwidth of 200 kHz. The network exploits cluster size of N= 7.

(i) Calculate the number of clusters needed to cover the area when the radius of a cell is 1.34km. (Hint : An area of hexagon cell is $2.5981R^2$)

(3 marks)

(ii) Calculate the traffic intensity in metropolitan area. Refer to **Figure Q1(b)** for Erlang B table.

(6 marks)

(iii) Calculate the number of users that can be served in the area, if each user is predicted to make 3 calls per hour with average holding time of 2 minutes.

(2 marks)

(iv) Criticize whether the answer obtained in **Q1(iii),** is in line with the actual population in the metropolitan area.

(3 marks)

(v) Predict the number of users that can be supported in the metropolitan area if the telecommunication provider implement sectoring of 120°. Support your answer with calculations and declare your assumptions.

(6 marks)

Q2 **(a)** Predict the impact to the indoor propagation loss for the following case and justify your answer.

(i) the concrete wall are wet.
(ii) the wall made of steel
(iii) the wall are covered with wallpaper

(6 marks)

(b) A cellular network deployes hexagonal cells in the Batu Pahat area. Consider for the forward link free space propagation loss (FSPL) model where Power transmitted, Pt = 15 dBm, Antenna Gain at transmitter, Gt = 8 dB, Antenna Gain at receiver, Gr = 5 dB, Cable Loss L_{cable} = 1.5 dB and frequency, f = 2100 MHz

(i) Given, $P_r = \frac{P_t G_t G_r \lambda^2}{(4\pi d)^2 L}$. Derive FSPL so that is can be formulated as 32.45 + 20log f (MHz) +20log d (km)

(3 marks)

(ii) Calculate the FSPL at distance, d = 1 km from the Base Station (BS)

(3 marks)

(iii) Calculate the power received signal at mobile station (MS) at d=1 km from the BS

(3 marks)

(iv) If the minimum signal strength (RSS) at the edge of the hexagonal cell is -75 dBm, calculate the optimum radius, R of the cell.

(6 marks)

(v) Conclude your finding in **Q1(b)(ii) –(iv)** related to large scale propagation loss.

(4 marks)

Q3 **(a)** Discusses the factors that contributes toward small scale fading in a cellular networks.

(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.

(5 marks)

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

(4 marks)

(c) 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 30 Mbps.

(i) Calculate the doppler spread for the channel if a mobile station is moving 90 km/hr.

(3 marks)

(ii) Calculate the doppler spread for the channel if a mobile station increases the speed to 140 km/hr.

(2 marks)

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

(4 marks)

Q4 (a) Global System for Mobile Communication (GSM) is a standard developed to describe the protocols for second generation digital cellular network. Explain the features of digital modulation technique that is employed in GSM 1800 system.

(5 marks)

(b) The capacity of Frequency Division Multiple Access and Time Division Multiple Access is bandwidth limited, whilst Code Division Multiple Access is interference limited. Elaborate the meaning of the statement.

(6 marks)

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

(4 marks)

(d) 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%.

(2 marks)

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

(5 marks)

-END OF QUESTIONS-

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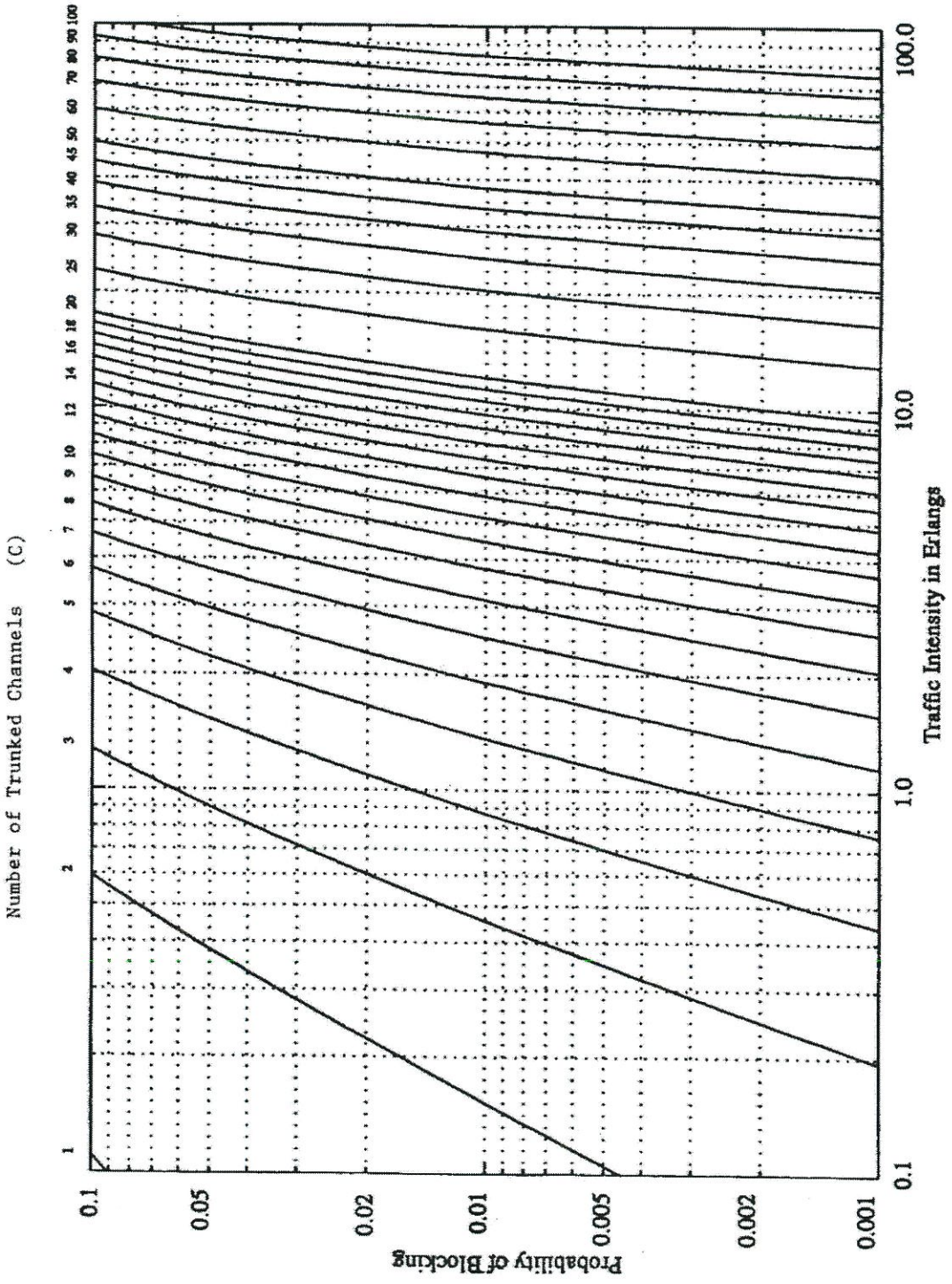

FIGURE Q1(b)

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Miscellaneous Equations

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

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

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

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

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

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

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