Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESI 2017/2018

COURSE NAME	:	WIRELESS AND MOBILE COMMUNICATION
COURSE CODE	:	BEB 41203
PROGRAMME	:	BEJ
EXAMINATION DATE	:	JUNE/JULY 2018
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 A Metropolitan has an area of 1872.56 km^2 with current population 2 Milion residents. The GSM cellular networks is served by 5 MHz spectrum with a duplex channel bandwidth of 200 kHz operates at frequency 2100 MHz. **Figure Q1** shows the topology of hexagonal cells deployed in the area. Consider for the forward link free space propagation loss (FSPL) model;

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

(3 marks)

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

(3 marks)

(c) 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)

(d) Conclude your finding in **Q1(b)** and **Q1(c)** related to large scale propagation loss.

(4 marks)

(e) Based on answer in **Q1(c),** calculate the number of clusters needed to cover the area when cluster, N= 7 is employed. (Hint : An area of hexagon cell is $2.5981R^2$)

(4 marks)

(f) Based on answer in **Q1(d),** calculate the traffic intensity in Batu Pahat area based on the Grade of Service (GOS) = 2%. Refer to **Figure Q1(f)** for Erlang B table.

(7 marks)

(g) 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.

(3 marks)

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

(5 marks)

(i) Suggest possible techniques that can be taken by the telcos to further improve the capacity of the network serving in the area.

(5 marks)

SECTION B

Q2 (a) Define the following terms
(i) Micro cell
(ii) Internet Gateway
(iii) Forward Voice Channel (FVC)
(iv) Roaming
(v) Visitor Location Register (VLR)

(10 marks)

(b) Criticize the impact of the co-channel interference and adjacent channel interference into the cellular system and possible solutions.

(5 marks)

(c) Discuss the importance of WIFI compliance certification. Give your answer by highlighting **ONE (1)** device.

(5 marks)

Q3 **Table Q3** shows the path loss exponent in different environment.

(a) Given that the mean path loss at 1 m is 30 dB and wall attenuation factor is 13 dB, calculate the minimum path loss 30 m from the transmitter through two concrete walls rooms in an obstructed building.

(5 marks)

(b) Repeat question **Q3(a)** for the same building environment but with line of sight.

(4 marks)

(c) From your answer in **Q3(a)** and **Q3(b)**, discuss the influence of propagation mechanism to the path loss exponent in the different environments.

(5 marks)

(d) Predict the impact on the propagation loss for the following cases and justify your answer.
(i) The concrete wall are wet.
(ii) The wall made of steel

(6 marks)

Q4 (a) **Figure Q4(a)** shows the multipath delay profile of GSM signal in an indoor environment with QPSK modulation scheme symbol rate is 0.1μs.

(i) Calculate the mean excess delay.

(3 marks)

(ii) Calculate the rms delay spread.

(4 marks)

(iii) Predict whether the system needs an equalizer to operate. Please justify your answer.

(3 marks)

(iv) Predict the type of fading undergoes by the signal in **Q4(a) (i)-(iii)**.

(4 marks)

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

(6 marks)

Q5 (a) The capacity of FDMA and TDMA is bandwidth limited, whilst CDMA is interference limited. Elaborate the meaning of the statement.

(5 marks)

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

(4 marks)

(c) In an omni-directional CDMA cellular system, a minimum E_b/N_0 of 10 dB is required for each user. If the baseband rate is 13kbps and the bandwidth is 15 MHz, determine the maximum number of users that can be supported in a single-cell;

(i) when voice activity considerations is ignored,

(4 marks)

(ii) when voice activity is considered and is equal to 10%.

(4 marks)

(iii) summarise your finding in **Q5(c) (i)** and **(ii)** and how it can affect the capacity in CDMA system

(3 marks)

-END OF QUESTIONS-

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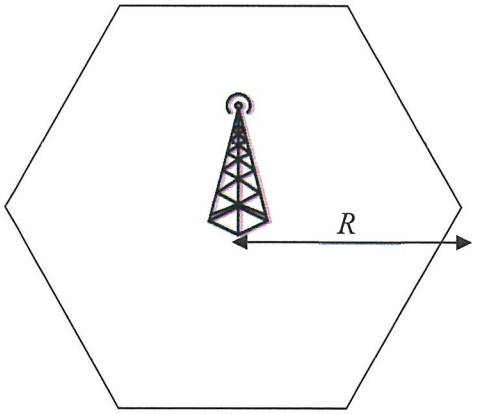

Parameters	Value
Power transmitted, Pt	15 dBm
Antenna Gain at transmitter, Gt	8 dB
Antenna Gain at receiver, Gr	5 dB
Cable Loss Lcable	1.5 dB
Frequency	2100 MHz

FIGURE Q1

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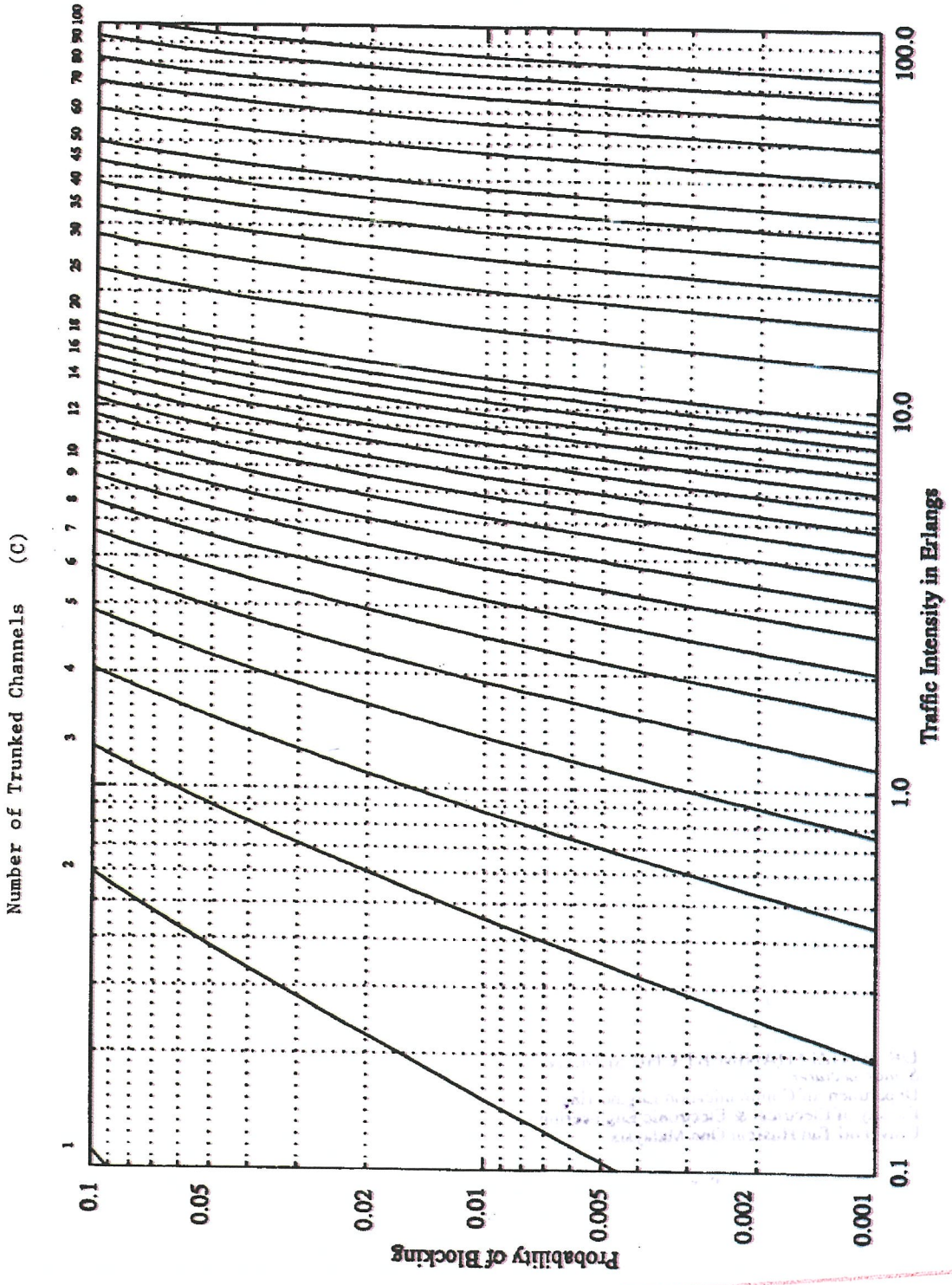

FIGURE Q1 (f)

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TABLE Q3

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

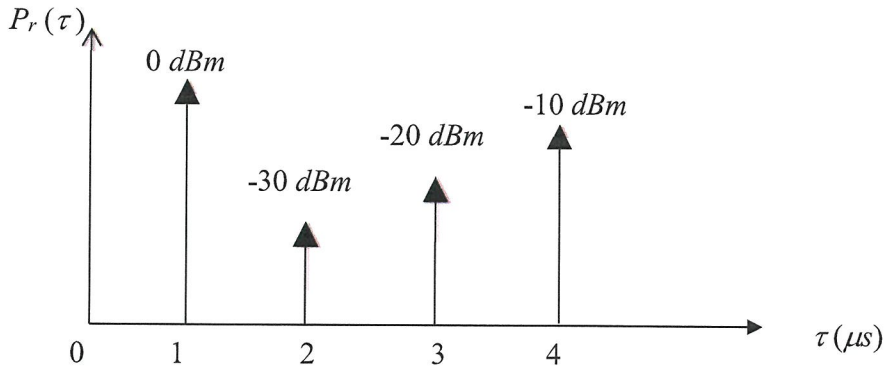

FIGURE Q4(a)

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Miscellaneous Equations

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

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

$$\frac{W/R}{(N-1)\propto} = \frac{E_b}{N_o}$$

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

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

$$\sigma_\tau = \sqrt{\tau^2} - (\tau)^2$$

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