GENERAL SIR JOHN KOTELAWALA DEFENCE UNIVERSITY
Faculty of Engineering
Department of Electrical, Electronic and Telecommunication Engineering

BSc Engineering Degree

Semester 6 Examination – October/November 2020
(Intake 35 – ET)

ET3202 WIRELESS COMMUNICATION I

Time allowed: 2 hours 27 October 2020

ADDITIONAL MATERIAL PROVIDED

Nil

INSTRUCTIONS TO CANDIDATES

This paper contains 5 questions on 7 pages.

Answer ALL 5 questions.

This is a closed book examination.

This examination accounts for 70% of the module assessment. A total maximum mark obtainable is 100. The marks assigned for each question and parts thereof are indicated in square brackets.

If you have any doubt as to the interpretation of the wordings of a question, make your own decision, but clearly state it on the script.

Assume any reasonable values for any data neither given in nor provided with the question paper, clearly make such assumptions made in the script.

All examinations are conducted under the rules and regulations of the KDU.

Question 01

a. Name the basic propagation mechanisms in radio propagation? [04]

b. Explain the term "Brewster Angle" related to reflection in dielectrics and derive an equation for the Brewster Angle.

[06]

c. Briefly explain the Two Ray Ground Reflection Model and derive equations for followings: [06]

i. Path Difference
ii. Phase difference
iii. Time Delay

d. State the Huygen's principle on diffraction. [02]

e. List the factors that influencing small scale fading. [02]

Question 02

a. Explain the frequency reuse concept and state the importance of it. [04]

b. State and briefly explain the basic Channel Assignment Strategies. [06]

c. Name the basic factors influencing the Mobile Handoff? [02]

d. A receiver in an urban cellular radio system detects a 1 mW signal at $d_0 = 1$ m from the transmitter. It is observed the received power at given distance D is –100 dBm. A measurement team has determined that the average path loss exponent in the system is n=3. Determine the major radius of each cell if a 7- cell reuse pattern is used. What is the major radius if a 4 - cell reuse pattern is used?

Where: d_0 – Referance Distance

n – Path loss exponent [04]

e. Following Table 1 shows the capacity of an Erlang B system. How many users can be supported for 0.5% blocking probability for the following number of trunked channels in a Blocked called Cleared - BCC system? (a) 5, (b) 24, (c) 40. Assumed that each user generates 0.1 Erlangs of traffic. [04]

Capacity of an Erlang B System

Number of Channels C	Capacity (Erlangs) for GOS = 0.01	= 0.005	= 0.002	= 0.001
2	0.153	0.105	0.065	0.046
4	0.869	0.701	0.535	0.439
5	1.36	1.13	0.900	0.762
10	4.46	3.96	3.43	3.09
20	12.0	11.1	10.1	9.41
24	15.3	14.2	13.0	12.2
48	29.0	27.3	25.7	24.5
70	56.1	53.7	51.0	49.2
100	84.1	80.9	77.4	75.2

Table 1

Question 03

a. Breifly explain TDMA and state the features of it. [06]

b. Consider GSM, which is a TDMA/FDD system that uses frequency range 1800 - 1880 MHz for the forward link (Down Link), which is broken into radio channels of 200kHz. If 8 speech channels are supported on a single radio channel, and if no guard band is assumed, find the number of simultaneously users that can be accommodated in GSM. [04]

c. If GSM uses a frame structure where each frame consists of eight time slots, and each time slot contains 156.25 bits, and assuming the data are transmitted at 376.833 kbps in the channel, find: [05]

i. Time duration of a bit.
ii. Time duration of a slot.
iii. Time duration of a frame.
iii. How long must a user occupying a single time slot wait between two successive transmissions.

d. If a normal GSM time slot consists of 6 trailing bits, 8.25 guard bits, 10 Synchronous bits ,16 training bits, and two traffic bursts of 58 bits of data, find the frame efficiency. [05]

Question 04

a. Briefly explain the Free Space Path Loss and EIRP? [08]

b. Use Okumura Model to determine the received signal level 3.6 miles from the site in urban terrain operating at 870MHz and evaluate the connection is feasible or not. [12]

Fig Q.4a shows a example diagram of a effective Transmitter Antenna Height of Okumura Model and Fig Q.4b indicate the Basic Median Attenuation values (dB) as a function of frequency and T-R Seperation.

The following numerical data is given:

Radiation centerline of the BTS transmitter: **hbts** = 40m
Height of the mobile receive antenna: **hr** = 3m
Terrain elevation at the location of the BTS: **Ebts** = 340m
Average height of the terrain in the area: **Eterrain** = 312m
Power delivered to the BTS antenna: **PBTS** = 19.5W
BTS antenna gain: 10log (**Gt**) = 10dB
MS antenna gain: 10log (**Gm**) = 0dB
Environmental gain as = 0dB
Sensitivity of the MS antenna = -94.9 dBm
Link Margin = 12 dBm (for a successfull link)

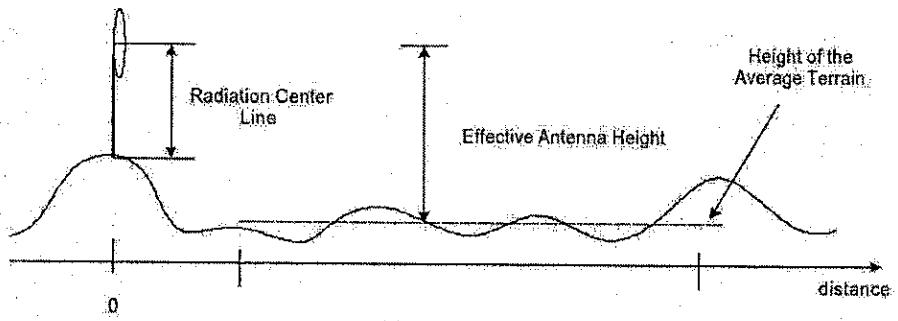

Fig: Q.4a

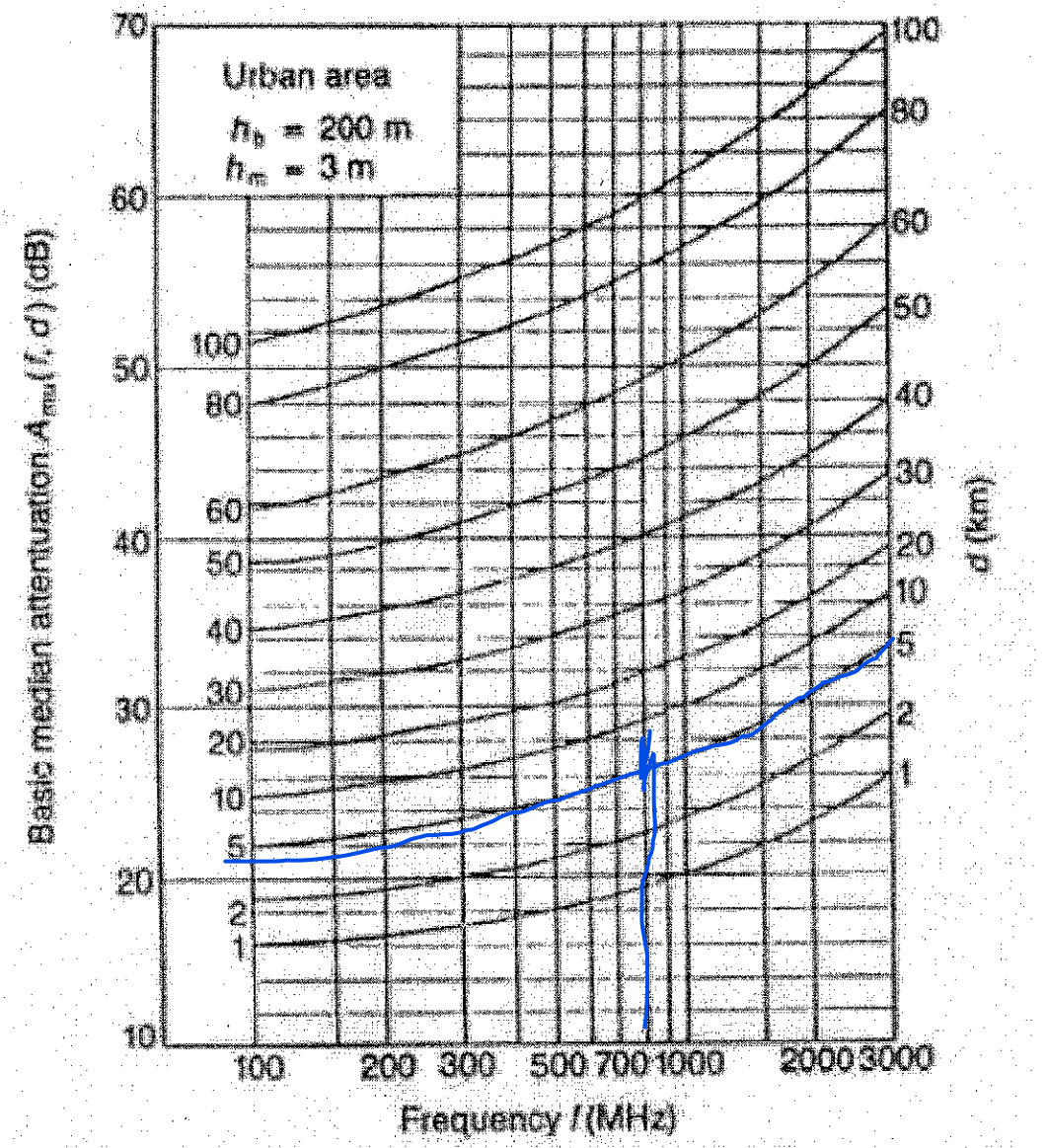
Urban area
h_b = 200 m
h_m = 3 m
Basic median attenuation $A_{mu}(f, d)$ (dB)
Frequency f (MHz)
d (km)
70
60
50
40
30
20
10
100
80
60
50
40
30
20
10
5
2
1
100
200
300
500
700
1000
2000
3000

Fig Q.4b

Question 05

a. State the Characteristics of Spread Spectrum Signals. [04]

b. Draw the Block diagram of FHSS receiver model and breifly explain the process. [06]

c. State the advantages and apllications of FHSS technique. [04]

d. Breifly explain the CDMA? [04]

e. In a CDMA system, If $Eb/I0 = 5$, with the information bit rate $R = 10$ **kbps** and the transmission bandwidth $W = 1.25$ MHz. Find out the **Maximum Numbers of users** per Cell?

Eb - Received signal bit energy

I0 - Power spectral density [02]