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

BSc Engineering Degree

Semester 6 Examination – August 2021
(Intake 36 – ET)

ET3202 WIRELESS COMMUNICATION I

Time allowed: 2 hours   11 August 2021

ADDITIONAL MATERIAL PROVIDED

Nil

INSTRUCTIONS TO CANDIDATES

This paper contains 5 questions on 5 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.

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Question 01

a.   Name basic propagation mechanisms in Radio Propagation?   [03]

b.   Explain the term "Brewster Angle" related to reflection in dielectrics and derive an equation for the Brewster Angle.   [06]

c.   Explain the term diffraction in Radion Propegatrion and indicate the importance of it.   [05]

d.   Considering the following geometry (Fig: Q.1d) determine following: [04]

   i.   Loss due to knife – edge diffraction.

   ii.   Height of the obstacle required to induce 6dB diffraction loss.

   (Assume f = 900 MHz)

Fig: Q.1d

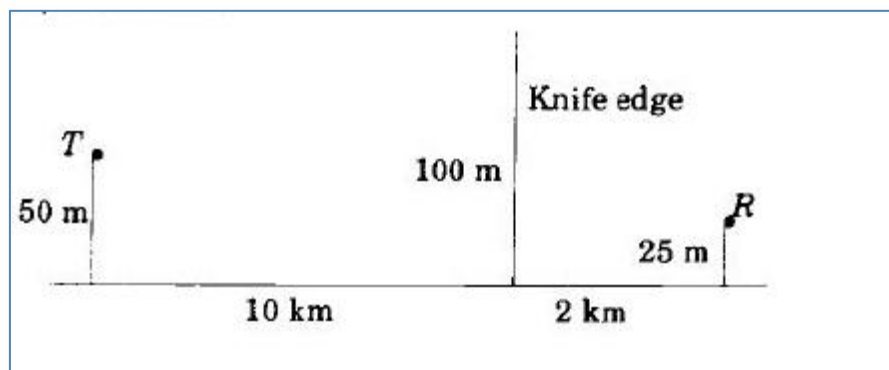e.   List out the most important small scale fading effects.   [02]

Question 02

a.   Briefly explain the Free Space Path Loss and EIRP?   [06]

b.   i.   If a transmitter produces 60 watts of power, express the transmit power in units of dBm, and dBW.

   ii   If 60 watts is applied to a unity gain antenna with a 900 MHz carrier frequency, find the received power in dBm at a free space distance of 100 m from the antenna and determine the received power at 10 km distance? (Assume unity gain for the receiver antenna)   [08]

c.   Estimate the feasibility of a 50 km link, with one Access Point (AP) and one client radio and consider only AP to Client direction. The AP is connected to an half wave dipole antenna with 21.85 dBd gain, with a transmitting power of 15 dBm. The client is connected to an half wave antenna with 21.85 dBd gain, with a transmitting power with a receive sensitivity of -85

dBm. The cables in both systems are consisted a loss of 3dB at each side at the 2.4 GHz frequency of operation with 134 dB total path loss. [06]

Question 03

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

b. Compare Fix Channel Assignment Stratergy and Dynamic Channel Assignment Stratergy. [04]

c. Explain the Term "Mobile Handoff" and name basic two types of Handoffs. [02]

d. Breifly explian Basic Types of Interferences. [04]

e. If a Signal to Interferance ratio of 20 dB is required for satisfactory forward Channel performance of a Cellular System, findout a frequency reuse factor and Cluster size that should be used for maximum capacity, if the path loss exponenet is: [06]

(i) n = 4

(ii) n = 3

Use suitable approximations. (Assume that there are six co-channel cells in the first tier and all of them are the same distance from the mobile)

Question 04

$$N = \left(\frac{12.5 \times 2 \times C}{30\sqrt{16}}\right)$$

a. Breifly explain FDMA and state the main features. [06]

b. If the total spectrum allocation is 12.5 MHz and the Channel Bandwidth is 30 kHz, find the number of channels available in a FDMA System. 416.14 [02]

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: [04]

i. time duration of a bit. 2.65×10^{-6}
ii. time duration of a slot. 4.14×10^{-4} 3.31×10^{-6}
iii. time duration of a frame. 3.7×10^{-5}
iv. 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. [04]

$BCH = 8.25 + 10 + 6 + 16$

$Bit = + 8$

$B_p = 55.11$ ...

e. Briefly explain Space Division Multiple Access. [04]

Question 05

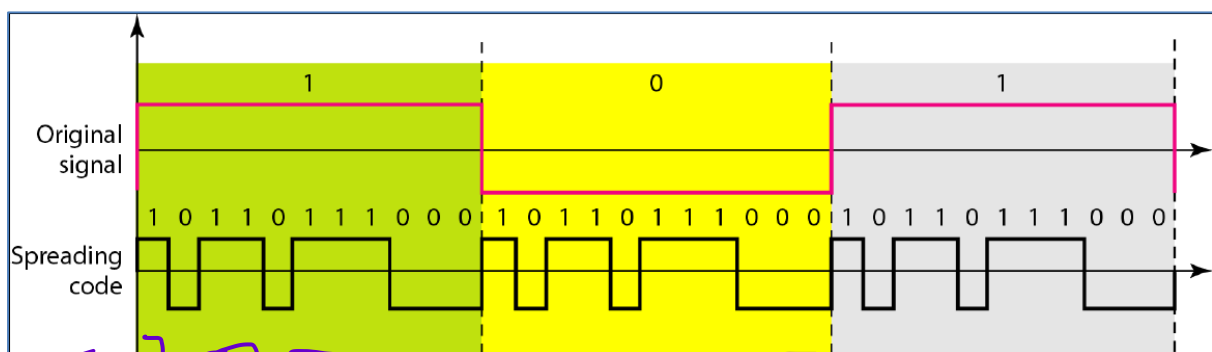a. State the Characteristics of Spread Spectrum Signals. [04]

b. Explain the Direct Sequence Spread Spectrum technique and name three applications. [06]

c. Draw the spreaded Signal for the below indicated original signal and spreading code (Fig: Q.5c). [04]

c. Breifly explain the distingushing features of CDMA, that are useful in Spread Spectrum transmission technologies? [04]

d. In a CDMA system, If $E_b/I_0 = 5$, 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?

E_b - Received signal bit energy

I_0 - Power spectral density [02]

$$E_b = \frac{PR}{R}$$

$$I_0 = \frac{P_r(K-1)}{W}$$

$$\frac{E_b}{I_0} = \frac{W}{R(K-1)}$$