FIJI NATIONAL UNIVERSITY
College of Engineering, Science & Technology

SCHOOL OF ELECTRICAL & ELECTRONICS ENGINEERING

BACHELOR OF ENGINEERING

EEB862 – MOBILE AND PERSONNEL COMMUNICATION

SEMESTER 1, 2018

DAY/DATE: As timetabled DURATION : Three hours
ROOM: As timetabled

INSTRUCTION TO STUDENTS

1. You are allowed 10 minutes extra reading time during which you are **NOT** to write.
2. **Begin the answer to each Question** on a fresh page and use both sides of the sheet.
3. Answer **ALL** questions
4. Write clearly the number of the question attempted on the top of each sheet.
5. Write your candidate number at the top of each additional sheet & attach them.
6. Insert all written foolscaps, graph paper etc. in their correct sequence and secure with a string.
7. All sheets of paper on which rough/draft work has been done, cross it through and attach all of them to your answer scripts.
7. Where ever possible, **draw clear neat diagrams**

Total number of pages including instruction page = 4

Answer ALL questions

Q1. In a 1G mobile system,

i) *a)* Explain why a frequency split is maintained in the two links of the above system?
b) Explain the functions of "control channels" in the system
c) What are the major drawbacks of this system?
d) In mobile communication, show that the area of a cell is $(3\sqrt{3}/2)\,R^2$
(5 marks)

ii) To provide 1G cellular service to an area of 320.81 km^2, a network provider was allocated bands of 872 – 905 MHz and 917 – 950 MHz for the uplink and downlink respectively. In each band, 0.5 MHz was dedicated as control channels. The provider uses simplex channels of 24 kHz, each with a guard band of 2 kHz to provide full duplex communication. The area was demarcated by cells of radius 1.3 km with shift parameters $i = 1, j = 2$.

a) Determine an equitable distribution of control channels and voice channels in each cell in the system.
(8 marks)

b) Calculate the capacity of the system (3 marks)

c) If the system switches to a cluster size of 9, calculate the new capacity
(4 marks)

Q2. *i)* In a cellular system with regular hexagonal cells and of cluster size N, show that the frequency reuse ratio Q is $\sqrt{3N}$.
(4 marks)

ii) Assume that the transmitters are omnidirectional and co – channel interference at the mobile unit is due to the first tier which are **equidistant** with the path loss exponent of the system $\nu = 4$

a) Determine the minimum cluster size for a cellular system designed with an acceptable value of signal to co – channel interference ratio(S/I) of 18dB.
(4 marks)

b) If the acceptable S/I has changed to 20 dB. Stating the reason determine the **optimum** cluster size?
(5 marks)

iii) A cellular service provider decides to use a digital TDMA scheme which operates with a signal -to-interference ratio of 20 dB in the **worst case scenario**. For $\nu = 4$ find the optimal value of N for (b) 120° sectoring. In the layout provided *in page 5*, indicate the 120° sectoring and 60° sectoring of antennas separately and the corresponding cells contributing to interference and **ALL** relevant distances.
(7 marks)

Q3. *a*) Draw the GSM reference architectural model indicating and naming the different components in the constituent subsystems.

(5 marks)

b) State the functions of the two data bases HLR and VLR in the NSS in the GSM structure.

(4 marks)

c) GSM uses FDD/FDMA/TDMA multiple access scheme for data communication. Explain, with suitable diagram, this multiple access scheme. Considering GSM 800, stating the reasons, obtain the number of channels available

(4 marks)

d) The normal data burst at a frequency which contributes to the GSM transmission frame is shown in Fig Q3.

Start bits	Data bits	Training bits	Data bits	Stop bits	Guard bits

Fig Q3

Start bits = 3 bits

Data bits = 58 bits

Training bits = 26 bits

Stop bits = 3 bits

Guard bits = 8.25 bits

If the data is transmitted over a channel at 270.833 kbps, calculate:

i) total duration of the GSM frame

ii) the frame efficiency

(4, 3 marks)

Q4. *i*) Giving the mathematical expressions explain the basic types of different digital modulation schemes. Represent each of the modulated waveform graphically.

(6 marks)

ii) *a*) State how Hamming code differs from a simple parity code.

(2 marks)

b) Given an 4 bit data byte 1 0 0 1, explain the procedure of applying the Hamming codes, write down the coded word for transmission. (you may use the chart given in page 5

(6 marks)

Q4 continued

Q4 continued

c) The coded word that was received in a channel is $0\,1\,1\,1\,0\,0\,1\,0\,1\,1$.

Using Hamming codes, verify whether the received word is correct. If it has errors what is the correct word?

(4 marks)

d) Calculate the code rate of the block encoder used.

(2 marks)

Q5. *i*) *a*) The Friis free space path loss equation is $\frac{P_r}{P_t} = G_t\, G_r \left(\frac{\lambda}{4\,\pi\, d}\right)^2$ where all the symbols have their usual meanings. Assume that distance are measured in kilometers and frequency is measured in megahertz, obtain an expression for the free space path loss in *dB*

b) In a wireless communication base station transmits at a carrier frequency of 800 MHz. The receiver mobile phone is 5 km away from the base station. Assuming free space transmission, calculate the free space path loss in dB.

(3,4 marks)

ii) *a*) Considering the two ray model of propagation, show $\frac{P_r}{P_t} = G_t\, G_r\, h_t^2\, h_r^2\, /d^4$ where all the symbols have their usual meanings and h_t h_r are the heights of the transmitter and receiver respectively. Derive an expression for the received power relating the base station antenna height and the mobile unit height.

(6 marks)

b) In the wireless communication described in Q5 *i*) *b*) above . if the transmitting antenna height is 30m and the receiver height is 2 m, find the path loss assuming two ray propagation model. (f = 800 MHz; d = 5 km as above).

(4 marks)

c) Compare the results of *i*) *b*) and *ii*) *b*) and comment.

(3 marks)

END

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	2
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