

**SCHOOL OF ELECTRICAL & ELECTRONICS ENGINEERING**

**BACHELOR OF ENGINEERING**  
**(Telecom & Networking)**

**EEE794 – MOBILE AND PERSONAL COMMUNICATION SYSTEMS**

**SEMESTER 2, 2016**

**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. Answer **ALL** questions in Section A and in Section B
3. **Begin** the answer to each Question on a fresh page and use both sides of the sheet.
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 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.
8. Where ever possible, draw clear neat diagrams
9. Erlangs B Table is attached at the end of this paper

Total number of pages - 6

## Section A

### Answer ALL Questions

- A1. In the layout provided (end of paper), identify a cluster (A) of cells defined by shift parameters 1,1. Mark the cells with A and appropriate numbers. For this cluster of cells, identify all the contiguous **first tier** co-cells. Identify these cells with appropriate alphabets and numerals. (Attach this paper with your answer sheet)  
(4 marks)
- A2. Define the co-channel reuse ratio  $Q$  and prove that for a hexagonal geometry,  $Q$  is given by  $Q = \sqrt{3N}$  where  $N = i^2 + ij + j^2$   
(5 marks)
- A3. Draw a block diagram of a mobile communication network. Explain the functions of each of the blocks. Indicate and name the different RF links associated with the network.  
(6 marks)
- A4. Give a brief description of *Fixed Channel Allocation* (FCA) and *Dynamic Channel Allocation* (DCA)  
(4 marks)
- A5. In a cellular system, 200 channels are allocated to a cell. Suppose during a busy hour 4 calls re blocked. What is the grade of service (GoS) of the system?  
(4 marks)
- A6. In an effort to analyze signal quality and co-channel interference, as a service engineer, you have been provided a channel scanning mobile receiver. Explain what measurements you will take. Also explain how you would interpret the measurements  
(7 marks)
- A7. The access technology which is used in GSM all over world is TDMA/FDMA. Giving suitable diagram to illustrate, explain this access technology.  
(5 marks)
- A8. Briefly explain what the following concepts refer to in mobile technology.
1. Vertical and horizontal handoffs
  2. Network Controlled Handoff (NCHO)
  3. Mobile Assisted Handoff (MAHO)
  4. Mobile Controlled Handoff (MCHO)

(5 marks)

[Total 40 marks]

PTO

**Section B**  
**Answer ALL questions**

B1 i) a) A cellular system uses  $N$  cell cluster and omnidirectional antennas. Assume that a mobile unit is at the boundary of a cell (worst case scenario), the distance of some of the transmitter of the co-channel cells vary by  $\pm 0.7 R$  where  $R$  is the cell radius. Write down the expression for the Signal to Interference Ratio (*SIR*).

(6 marks)

b) The path loss exponent for RF in an area is estimated as 3.1. If for a cellular system to operate satisfactorily, the minimum *Signal to Interference Ratio (SIR)* is 7.5 dB, calculate the minimum cluster size  $N_m$ .

(4 marks)

c) Explain why systems operators generally choose  $N_m$  as the operating cluster size.

(2 marks)

ii) The area of Nadi city, Fiji is about 7565.5 km<sup>2</sup>. To provide cellular communication, assume that the area is divided into approximate hexagonal cells of radius 2 km and clusters with shift parameters (1, 2). A total of 35 MHz of bandwidth is allocated to a particular FDD cellular telephone system which uses two 25 kHz simplex channels to provide full duplex voice and control channels. Assume that only the minimum number of channels is allocated as control channels; Compute:

a) The number of traffic channels available per cell.

b) The total number of users in a cluster who can be served for 2% GoS in an Erlang B system.

c) If each user generates 0.3 Erlangs of traffic, the total number of users in the city.

(3, 2, 3 marks)

B2. i) Define modulation spectral efficiency  $\eta_m$ , both in terms of the **channels** and **the carried traffic**.

(3 marks)

Assume that a GSM – digital channelized cellular system covers Suva area of  $\sim 2080$  km<sup>2</sup> with cells of area  $\sim 8$  km<sup>2</sup> and cluster size 4. The system is operating on TDMA/FDMA. One-way bandwidth of the system is 12.5 MHz. The RF channel spacing is 200 kHz and the **total** band gap is 100 kHz. Using TDMA, eight (8) users share **each** RF channel. The stipulated grade of service in the area is 2%.

a) With TDMA, calculate the number channels available in a cluster.

b) If three channels per cell are used for control channels, how many channels are available for traffic in a cluster?

c) Calculate the modulation efficiency in terms of *i*) channels and *ii*) carried traffic.

(4, 2, 3 marks)

**(B2 continued in next page)**

ii) a) Obtain the Friis equation:  $P_r = P_t \left( \frac{\lambda}{4\pi d} \right)^2 G_T G_R$   
 where;  $P_r$  = received power,  $P_t$  = transmitter power,  $G_T$  = gain of the transmitter antenna and  $G_R$  = gain of the receiver antenna.  $d$  = antenna separation distance between the antenna and  $\lambda$  = RF wave length.

(4 marks)

b) A wireless communication transmitter has an output power of 165 W at a carrier frequency of 325MHz. It is connected to an antenna of gain 12 dBi. The receiving antenna is 15 km away and has a gain of 6dBi. Assuming there are no other losses in the system, calculate the received power in mW.

(4 marks)

B3. i) a) Draw a typical TDMA frame structure and explain the functions of each component in the frame. In your diagram allocate different times for the different components (example:  $t_g$  – guard time).

(5 marks)

b) Define the *Frame Efficiency* and write down an expression for it in terms of *overhead* bits.

(2 marks)

c) The duration of a TDMA frame is 2 ms and it carries a total of 120800 bits. The parameters of the transmission are: It has two reference bursts/frame, each 512 bits and the preamble bursts have 275 bits. The guard interval is 1.82  $\mu$ s. It transmits data from 8 stations. Calculate the frame efficiency of the system.

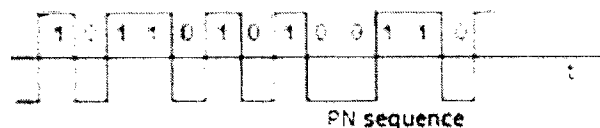
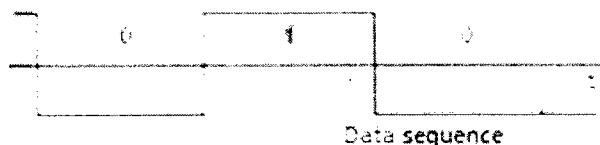
(5 marks)

ii) a) A simple way of producing CDMA stream is to have *bit multiplication* of data with PN bits. State a simple *digital gate* that would perform bit multiplication and write down the *truth table* for the gate

(4 marks)

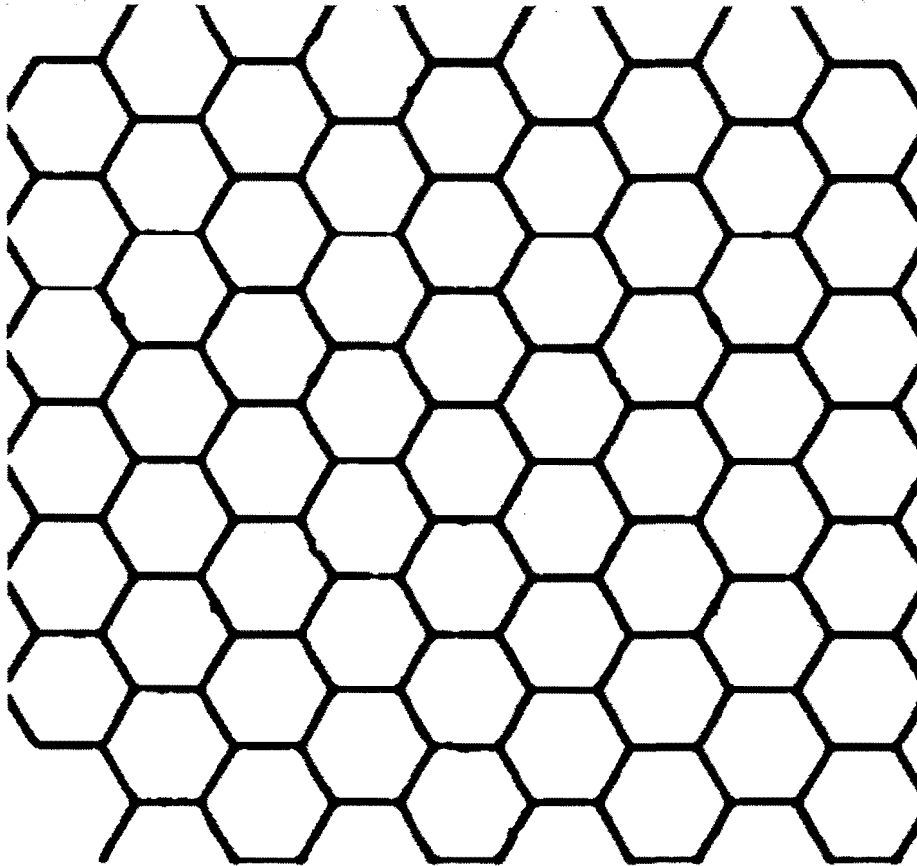
b) The figure shows a data sequence and PN sequence used for CDMA transmission. Draw on the sheet provided (end of paper), the stream that would be produced. (Attach this paper with your answer sheet)

(4 marks)



THE END

A1.



B3.

