FNU FIJI NATIONAL UNIVERSITY

COLLEGE OF ENGINEERING, SCIENCE AND TECHNOLOGY

SCHOOL OF ELECTRICAL AND ELECTRONICS ENGINEERING

BACHELOR OF ENGINERING PROGRAMME, YEAR 4

EEB 862 MOBILE AND PERSONNEL COMMUNICATION

FINAL EXAMINATION (SEMESTER 1, 2019)

DATE/TIME/ROOM – Refer to Timetable

INSTRUCTIONS TO CANDIDATES

1. You are allowed 10 minutes extra reading time during which you are NOT to write.
2. Begin each answer on a fresh new page and use both sides of the sheets.
3. Write your candidate number on the top of each attached sheet.
4. The paper contains two sections, Sec A & Sec B.
5. For all sheets of paper in which rough work has been done, cross it through and you must attach to your answer script.
6. Write clearly the number(s) of the question(s) attempted on the top of each sheet.
7. Good handwriting and way of representation of answers has weight with respect to marks.
8. **Draw diagrams if any with pencil only and label it and show all working where necessary.**
9. Always check your work before you leave the exam room.
10. **The paper is of 100 marks.**

Section A (Each question carry 10 marks)

1. Global System for mobile communication is a 2G cellular radio network. Answer below questions related to it.
   a) Define the subsystems in GSM structure? Draw the diagram showing all the three parts.[3 marks]
   b) Analyze the channel structure of GSM.[3 marks]
   c) Explain the primary tasks for SGSN and GGSN? [4 marks]

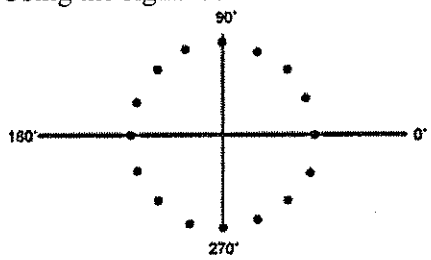
2. a) Communication between the base station and mobiles is defined by the standard common air interface (CAI). Name four channels and their function. [4 marks]
   b) Demonstrate the concept of frequency reuse? [2 marks]
   c) Define Hand-off and Roamer. [4 marks]

3. A new service provider acquired the license to provide full duplex voice communication using GSM technology in certain city. The city has an area of 450 Km^2 and each cell has radius of 1.5 Km. the license allowed the provider to use a bandwidth of 25 MHz in GSM systems each channel has a bandwidth of 200 KHz and supports 8 time slots. Each subscriber full duplex voice call requires 2 of these time slots. In such systems it can be assumed that the carrier to interference ratio $C/I = 3N/n$ where N is the reuse factor and n is the number of co-channel interferences. To satisfy the system carrier to interference requirements the service provided decided to use Omni directional antennas (no sectoring) and a reuse pattern of 13. For this network calculate:
   a) The number of cells required to cover this city. [2 marks]
   b) Calculate the simultaneous subscriber calls that can be supported by each cell. [2 marks]
   c) Assuming that each subscriber generates an average of 10 calls /day while the average call duration is 1 min. Calculate the offered load for each subscriber. [2 marks]
   d) Assuming that users are uniformly distributed across the cells and the offered load calculated in part c, calculate the total number of subscribers that can be supported in this city given that blocking probability is 2%. [2 marks]
   e) If the service provider uses a 120° sectoring and adjusts the reuse factor such as to ensure the satisfaction of the system C/I requirements, what would be the maximum number of subscribers in the city. [2 marks]

4. a) A400W, 1MHz carrier is amplitude-modulated with a sinusoidal signal 0f 2500Hz. The depth of modulation is 75%. Calculate the sideband frequencies, bandwidth, and power in sidebands and the total power in modulated wave. [5 marks]

   b) A rectangular air-filled waveguide has a cross section of 4 cm x 10 cm. Calculate the minimum frequency that can propagate through waveguide. [5 marks]

5. Using the signal constellation shown, provide response to the following questions.



a) Analyse the modulation it represents? [2 marks]
b) How many symbols are represented (M)? [2 marks]
c) How many bits per symbol are used (N)? [2 marks]
d) If the Baud Rate is 10,000 symbols/second, what is the bit rate (R_b)? [2 marks]
e) Would 16-QAM be more or less susceptible to noise than this type of modulation? [2 marks]

Section B: (Each question carry 10 marks)

1. a) Explain the Block Ciphers and name its two mode of operation. [3 marks]
   b) Document the challenges related to ECB? [2 marks]
   c) Elaborate the two mode of operation related to Stream Cipher? [1 mark]
   d) Draw the diagram showing Cipher-Feedback operation related to Stream Cipher. [4 marks]

2. a) Define the Symmetric and Asymmetric key cryptography. [4 marks]
   b) Elaborate the pros and cons of Asymmetric key Cryptography? [2 marks]
   c) Explain the full operation of Public-Key cryptography mechanism for secure Communication. [4 marks]

3. A particular cellular system has following characteristics: cluster size= 7, uniform cell size, user density= 100 users/sq. km, allocated frequency spectrum= 900-949 MHz, bit rate required per user = 10 kbps uplink and 10 kbps downlink, and modulation code rate = 1 bps/Hz.
   A. Using FDMA/FDD:
      a) How much bandwidth is available per cell using FDD? [2 marks]
      b) How many users per cell can be supported using FDMA? [1 mark]
      c) Calculate the cell area? [1 mark]
      d) What is the cell radius assuming circular cells? [1 mark]

   B. If the available spectrum is divided into 35 channels and TDMA is employed within each channel:
      a) Calculate the bandwidth and data rate per channel? [2 marks]

      b) How many time slots are needed in a TDMA frame to support the required number of users? [1 mark]
      c) If the TDMA frame is 10ms, how long is each user slot in the frame? [1 mark]
      d) How many bits are transmitted in each time slot? [1 mark]

4. Today wireless communication uses advanced modulation techniques due to number of advantages.
   a) Define the factors influenced the choice of digital modulations? [2 marks]
   b) Name two performance measures for modulation schemes and explain it. [5 marks]
   c) Analyze the concept of channel impairments? [3 marks]

5. With respect to waveguides answer below questions.
   a) Why waveguides are important? [2 marks]
   b) Name four types of modes related to waveguides. [4 marks]
   c) Explain the wave paths in a waveguide at various frequencies. [4 marks]

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