

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION**SUMMER SEMESTER, 2018-2019****DURATION: 3 HOURS****FULL MARKS: 200****CSE 4405: Data and Telecommunications****Programmable calculators are not allowed. Do not write anything on the question paper.**There are **8 (eight)** questions. Answer any **6 (six)** of them.

Figures in the right margin indicate marks.

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| 1. | a) | What is data communication? Describe the fundamental characteristics of effective data communication system. | 2+6 |
| | b) | Briefly explain the necessity of layering in designing a communication system. Match the following to one or more layers of the OSI model: i. Topology formation ii. Route selection iii. Framing iv. Addressing v. Flow control | 5+5 |
| | c) | What is multiplexing? Describe the goals of multiplexing. How does multiplexing differ from bandwidth spreading? | 2+5+3.33 |
| | d) | A nonperiodic composite signal has a bandwidth of 200 kHz with a middle frequency of 140 kHz and peak amplitude of 20 V. The two extreme frequencies have an amplitude of 0. Draw the spectrum in frequency domain. | 5 |
| 2. | a) | Write short notes on any two of the followings: i. B8ZS ii. Signal-to-Noise Ratio (SNR) iii. MLT-3 | 4×2 |
| | b) | Consider a channel having highest bitrate of 12 Mbps and bandwidth of 2 MHz. Calculate the approximate signal level and needed SNR value for this channel. | 5 |
| | c) | With necessary diagrams and equations, explain the Pulse Code Modulation (PCM) technique for converting an analog signal to a digital signal | 10.33 |
| | d) | Briefly explain the quadrature amplitude modulation (QAM) technique for digital to analog conversion? Give constellation diagram for the following: i. Binary ASK ii. BPSK iii. QPSK iv. 4-QAM v. 16-QAM | 5+5 |
| 3. | a) | What do you mean by switching? Compare the delay and efficiency of a datagram network and a Virtual-circuit network. | 3+6.33 |
| | b) | Mention the major drawback of a crossbar switch? Design a three-stage, 200X200 switch ($N=200$) with $k=4$ and $n=20$ using the Clos criteria. | 2+5 |
| | c) | Compare and contrast the Stop-and-Wait Protocol with the Stop-and-Wait ARQ protocol. Explain the reason for moving from the Stop-and-Wait ARQ Protocol to the Go-Back-N ARQ Protocol. With necessary example, prove that the send window size for 'Selective Repeat ARQ' protocol can be at best 2^{m-1} , where m is the size of sequence number. | 5+4+8 |
| 4. | a) | Write short notes on any two of the followings: i. Checksum ii. Cyclic Codes iii. Two-dimensional parity check. | 4×2 |
| | b) | What do you mean by minimum Hamming distance? Find the minimum Hamming distance for detection of 6 errors and correction of 2 errors. Detect and correct the single error in the received Hamming codeword 10110010111 (assume even parity). | 2+3+6.33 |
| | c) | Illustrate the structure of the CRC encoder and the CRC decoder using block diagrams. Given the dataword 1010011010 and the divisor 10111 , i. Show the generation of the codeword at the sender site (using polynomials). ii. Show the checking of the codeword at the receiver site (using polynomials). | 6+4+4 |

5. a) Explain the co-channel interference and system capacity of a cellular network with appropriate figure and equation. 11.33
- b) Briefly explain the concept of Trunking and Grade of Service (GoS). 8
- c) A small city of 75000 residents has two competing mobile networks company named A and B that provide cellular service to the users. Company A has 50 cells, each with 40 channels and company B has 100 cells, each with 20 channels. Find the number of users that can be supported at 5% blocking probability if each user averages 2 calls per hour at average call duration of 6 minutes. Compute the percentage market penetration of each company assuming that both the companies are operated at maximum capacity. 8
- d) A system has 1000 cells with 25 traffic channels available where a minimum SIR of 15dB must be maintained. Consider that there are 6 channels in the first tier. Find the minimum cluster size with path loss exponent 3. If each user averages two calls per hour at an average call duration of 3 min, how many subscribers can this system support for a 1% GOS ? 6
6. a) Neatly sketch the GSM system architecture and briefly explain the major functional units. 4+6.33
- b) Show the process of constructing a GSM frame of 156.25 bits by using channel coding and interleaving. 11
- c) Explain the following terms with appropriate examples: 4X3
- i. Duplex distance ii. Multipath fading iii. Adaptive equalization iv. Location area
7. a) Give the names of all logical channels available in GSM. Present the tasks of each common control channel (CCCH). 5+6
- b) With the aid of necessary diagram explain how a call to a mobile user initiated by a PSTN subscriber is established. Mention the name of different logical channels used in different stages of call establishment. 10
- c) With necessary diagrams explain the handoff scenario at a cell boundary. Briefly explain different practical handoff considerations. 6+6.33
8. a) Write short notes on any two of the followings: 5×2
- i. Okumura/Hata model ii. Coherence Time iii. Coherence Bandwidth
- b) Why do we need propagation models? How does the 'plane- earth loss model' differ from the 'free-space loss model'? How do empirical path loss models differ from deterministic path loss models? 3.33+5+5
- c) The speech quality for a mobile communication system is just acceptable, when the received power at the terminals of the mobile receiver is -85 dBm. Find the maximum acceptable propagation loss for the system when the transmit power at the base station is 50 W, base station feeder losses are 5 dB, base station antenna gain is 3 dB. Antenna gain of the mobile is 1 dB and feeder losses at the mobile are 2 dB. Calculate the maximum range of the system using a) the free space loss model, and b) the plane earth loss model, assuming a frequency of 900 MHz and antenna heights of 15 m and 1.5 m. 5+5