



UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 7 Examination in Engineering: August 2015

Module Number: EE7234

Module Name: Advanced Data Communication

[Three Hours]

[Answer all questions, each question carries 10 marks]

- Q1 a) Briefly explain the following terms used in Tele-traffic Engineering.
- Busy Hour Calling Rate (BHCR)
 - Grade of Service (GoS)
 - Pure Chance Traffic
 - Statistical Equilibrium
- [6.0 Marks]
- b) Four junctions are arranged in a full availability group. The full availability implies that there are no restrictions on the way in which calls are allocated to particular trunks. If the traffic offered during a busy hour is $0.8 E$,
- what is the grade of service provided by the group?
 - what is the probability that only one trunk is busy?
- [2.0 Marks]
- c) In a telephone system, the average call duration is 4 minutes. What is the probability that the present call
- continues for another 2 minutes or more?
 - discontinues within the next 2 minutes time interval?
- [2.0 Marks]
- Q2. a) What is the difference between queuing systems and lost call systems?
- [2.0 Marks]
- b) A message switching center sends messages on an outgoing circuit at a rate of 480 characters per second. The average number of characters per message is 24. The messages have a negative exponential distribution. The message input is a Poisson process and they are served in order of arrival. How many messages can be handled per second, if the mean delay (averaged over all the messages) does not exceed 0.5 seconds?
- [4.0 Marks]

- c) In an automatic telegraph switching system, incoming messages are stored in a queue until the retransmitting equipment of an outgoing trunk can send them. The messages arrive at a rate of 120 per hour. The time taken to retransmit the messages is assumed to have an exponential distribution with a mean time of 10 seconds.

How many messages are stored, if the probability of losing a message due to the storage becoming full is less than 10^{-6} ?

[4.0 Marks]

- Q3. a) Briefly discuss the difference between the forward error correction method and the backward error correction method.

[1.0 Mark]

- b) In a data link connection where Cyclic Redundancy Check (CRC) is used, a 10-bit information is given as 1 0 0 1 0 1 1 0 1 1. The generating function used in the CRC is $G(x) = x^4 + x^3 + x + 1$.

- i) Calculate the CRC code.
- ii) Determine the Transmitted polynomial $T(x)$ corresponding to the bit string.
- iii) Determine the conveyed bit string showing the data bits and CRC bits clearly.

[4.0 Marks]

- c) A 12-bit Hamming code word containing 8 data bits and 4 parity bits is read from the memory. What is the original 8-bit data word that is written into the memory, if the 12-bit data word read out from the memory is 010011111000?

[2.0 Marks]

- d) In the Data Link layer, character-oriented framing and character stuffing method is applied. In this method, FLAG characters are used as the starting and ending delimiters.

- i) At the sender, if the character string delivered from the network layer to the data link layer is given as,

A B FLAG ESC C ESC D E F FLAG G

What is the character string used at the data field of the sender's data link layer frame?

- ii) At the receiver, if the character string used at the data field of the receiver's data link layer frame is,

ESC FLAG A ESC ESC B C ESC FLAG ESC ESC

What is the character string that is delivered from the data link layer to the network layer.

Note : part i) and part ii) are independent.

[3.0 Marks]

- Q4. a) Compare and contrast Go-Back-N Automatic Repeat Request (ARQ) and Selective Repeat ARQ mechanisms using appropriate diagrams.

[4.0 Marks]

- b) Explain briefly how the slotted ALOHA scheme is used to overcome the drawbacks in the pure ALOHA scheme.

[2.0 Marks]

- c) If average transmission time for a frame $T_{Fr} = 1\mu s$, in a pure ALOHA network with 100 stations, what is the number of frames per second that each station should send to achieve the maximum efficiency?

[2.0 Marks]

- d) A network which uses Carrier Sense Multiple Access / Collision Detection (CSMA/CD) scheme has a bandwidth of 10 Mbps. If the maximum propagation time is 25.611 s, what is the minimum size of the frame?

[2.0 Marks]

- Q5. a) i) Explain the CIA (Confidentiality, Integrity and Availability) concepts regarding data security using appropriate examples.

- ii) What are the types of access control systems existing in this current era?

[2.0 Marks]

- b) Consider the following encoding scheme which encodes the alphabetical characters into binary digits.

A = 000, C = 001, E = 010, H = 011, I = 100, N = 101, R = 110, U = 111

Once a word is being encoded, the binary output is subjected to the X-OR (Exclusive OR) operation with the repetitive sequence $(010)_x$, where, $x = (\text{length of the bit stream} / 3)$.

- i) If the encrypted word is given by the following letter sequence, "CNIIRHEUA", determine the plaintext of the given cipher.

- ii) If all the operations are bit-wise operations, does this encoding scheme achieve compression?

[3.0 Marks]

- c) i) Explain the terms confusion and diffusion.

- ii) What are the main types of security attacks that information systems subjected to?

- iii) How does malware affect the information systems?

[3.0 Marks]

- d) Consider the data network in a university (which includes several web, email and proxy servers with other networking devices along with Layer 3 switches). As a network security consultant, what would be your approach to secure your system from both internal / external attacks and malware?

Hint : Explain the deployment of firewalls and Intrusion Detection Systems

[2.0 Marks]