UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 7 Examination in Engineering: July 2016

Module Number: EE7208 **Module Name: Advanced Data Communication**

[Three Hours]

[Answer **all questions**, each question carries 10 marks]

Q1 a) Compare and contrast CSMA/CD (Carrier Sense Multiple Access with Collision Detection) and CSMA/CA (Carrier Sense Multiple Access with Collision Avoidance) methods.

[2 Marks]

b) i) Briefly explain, "Stop and Wait" Automatic Repeat Request (ARQ) flow control method using suitable diagrams.

ii) Consider a 2.5 Mbps link with a 50 ms round-trip time. Calculate maximum data sending rate assuming that the data sending node uses the "Stop and Wait" ARQ flow control. Assume that the frame size is 1 kB.

iii) With the aids of your calculated results explain the draw backs of Stop and Wait ARQ flow control and propose a suitable Flow Control method to achieve higher data rate.

[4 Marks]

c) In a local airport, arriving aircrafts join a single queue for the runway. Air plane arrivals follow a Poisson distribution with the rate of arrival, $\lambda = 40$ per 2 hours. It is observed that the service time is exponentially distributed and the service rate $\mu = 81$ arrivals/3 hours.

i) Calculate the utilization factor.

ii) Calculate the probability that there are no air planes in the runway.

iii) Calculate the average number of air planes in the runway.

[4 Marks]

Q2 a) i) Explain why full mesh connection is not suitable for an ordinary telephone network.

ii) What is meant by Grade of Service (GoS) in tele-traffic engineering?

[2 Marks]

b) In a telephone exchange during the busy hour, 2200 calls were offered to a group of trunks and twelve calls were lost. The average call duration was 3 minutes. Calculate the following.

i) Offered traffic.

ii) Carried traffic.

iii) Lost traffic.

iv) Grade of service.

v) The total duration period of the congestion.

[4 Marks]

c) On average one call arrives every 10 seconds. Assume that the number of call arrivals in a given time has a Poisson distribution. During a period of 20 seconds, what is the probability that,

i) no calls arrive.

ii) two calls arrive.

iii) more than two calls arrive.

[4 Marks]

Q3 a) In a local telephone exchange a group of 10 trunks is offered 4 E of traffic.

i) Calculate the Grade of Service for the given telephone exchange.

ii) Determine the probability that only one trunk is busy.

iii) Determine the probability that only one trunk is free.

iv) Determine the probability that at least one trunk is free.

[5 Marks]

b) On average, during the busy hour, a company makes 100 outgoing calls of average duration 3 minutes. It receives 120 incoming calls of average duration 2 minutes. This company wishes to obtain the grade of service of 0.002 for both incoming and outgoing calls. [You may use the given Table Q3 for your calculations]

i) Calculate the incoming traffic.

ii) Calculate the outgoing traffic.

iii) If incoming and outgoing calls are handled on separate groups of lines, how many exchange lines should the company rent for incoming and outgoing calls?

iv) If a common group of lines is used for both incoming and outgoing calls, calculate how many exchange lines should the company rent.

[4 Marks]

Q4 a) State three different coding techniques and their purpose.

[1.5 Marks]

b) List the differences between Checksum and Cyclic Redundancy Check (CRC) error detection methods.

[1 Mark]

c) A memory less source emits 7 messages with probabilities 0.32, 0.28, 0.08, 0.05, 0.12, 0.09 and 0.06.

i) Compute the entropy of the memory less source.

ii) Propose a set of code words for the above messages using Huffman coding scheme.

iii) Determine the average word length of the proposed coding scheme.

iv) Verify the validity of the proposed coding scheme.

[5 Marks]

d) A 12-bit Hamming code based Forward Error Correction (FEC) scheme is implemented in a communication channel. The 12-bit code being transmitted contains 4 parity bits located at 1st, 2nd, 4th and 8th bit positions while rest of the 8 bits represent data. If the received bit stream is 010110111001, perform the FEC mechanism to check for any errors that might have occurred during the transmission. [You may use the following parity bit computations]

$$P_1 = B_3 \oplus B_5 \oplus B_7 \oplus B_9 \oplus B_{11}$$

$$P_2 = B_3 \oplus B_6 \oplus B_7 \oplus B_{10} \oplus B_{11}$$

$$P_4 = B_5 \oplus B_6 \oplus B_7 \oplus B_{12}$$

$$P_8 = B_9 \oplus B_{10} \oplus B_{11} \oplus B_{12}$$

[2.5 Marks]

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

ii) Authentication is a main requirement for maintaining access control of information systems. State such authentication techniques and how they function.

[2 Marks]

b) Consider the cryptographic scheme described below.

Step 1 : Encryption based on Caesar's cipher.

Step 2 : A FLAG character '□' is inserted after every 5 characters.

Step 3 : Encryption using a double transposition cipher with the key [3,1,2][3,4,2,5,1]

i) The encrypted word is given by the following character sequence, "FL□KQZOZBXFQAX□". Determine the plaintext of the given cipher.

ii) Relate the confusion and diffusion concepts to the above cryptographic scheme.

[4 Marks]

c) i) Distinguish stream ciphers and block ciphers based on their operation.

ii) Explain how the encrypting and signing is done in asymmetric key cryptographic schemes.

[2 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 the system from both internal / external attacks and malware?
[Hint : Explain the deployment of firewalls and Intrusion Detection Systems]

[2 Marks]

Table Q3 : Erlang-B Distribution

Trunks	Grade of Service 1 in 1000	Grade of Service 1 in 500	Grade of Service 1 in 200	Grade of Service 1 in 100
	Traffic Unit	Traffic Unit	Traffic Unit	Traffic Unit
1	0.001	0.002	0.005	0.01
2	0.05	0.07	0.11	0.15
3	0.19	0.25	0.35	0.46
4	0.44	0.53	0.70	0.87
5	0.76	0.90	1.13	1.36
6	1.15	1.33	1.62	1.91
7	1.58	1.80	2.16	2.50
8	2.05	2.31	2.73	3.13
9	2.56	2.85	3.33	3.78
10	3.09	3.43	3.96	4.46
11	3.65	4.02	4.61	5.16
12	4.23	4.64	5.28	5.88
13	4.83	5.27	5.96	6.61
14	5.45	5.92	6.66	7.35
15	6.08	6.58	7.38	8.11
16	6.72	7.26	8.10	8.87
17	7.38	7.95	8.83	9.65
18	8.05	8.64	9.58	10.44
19	8.72	9.35	10.33	11.23
20	9.41	10.07	11.09	12.03
21	10.11	10.79	11.86	12.84
22	10.81	11.53	12.63	13.65
23	11.52	12.27	13.42	14.47
24	12.24	13.01	14.20	15.29