BITS-Pilani Dubai, Dubai International Academic City, Dubai

III Yr. B.E. (Hons.) Second Semester Academic Year 2011 – 2012

COMMUNICATION NETWORKS Comprehensive Examination (Closed Book)

Course No. : ECE C394
Duration : 50 min.

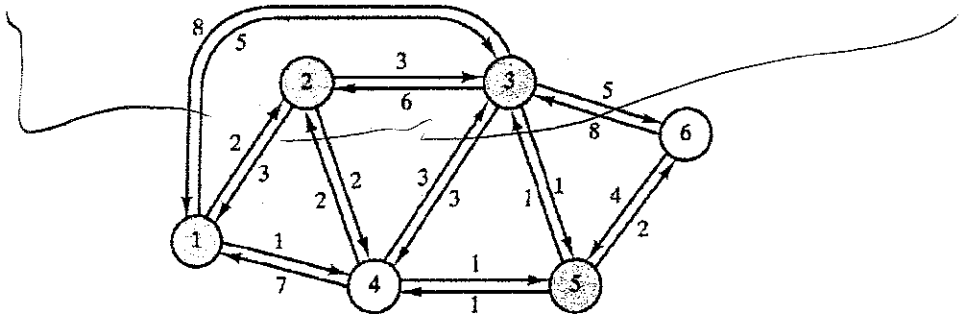
Date : 14.06.2012
Max Marks : 70
Weightage : 35%

Note:- 1. Answer ALL Questions.
2. Please state explicitly the assumptions made, if any.

1) List all the layers of OSI Model and state their functions [5]

2) Summarize the differences in the network layer handling of the following aspects in a (i) connection-oriented and (ii) connectionless packet-switching network [6]
   A) knowledge about a connection
   B) Resource allocation at switches
   C) Whether Admission control exists or not
   D) Routing related aspects (indicate at least two fundamental differences)
   E) How the communication failures, if any, are taken care

3) Figure following illustrates a network in which two arrowed lines between a pair of nodes represent a link between these nodes, and the corresponding numbers represent current link cost in each direction.



   A) From node 1 to node 6, (i) identify the shortest path (i.e., the one with fewest hops) and determine its cost and (ii) identify the least cost path and determine the no. of hops involved. [2]
   B) Stating explicitly the path associated for each cost (or distance) determined in reaching a node from node 1, during each iteration, find the least cost (or distance) from node 1 to all other nodes using Dijkstra's algorithm. [8]

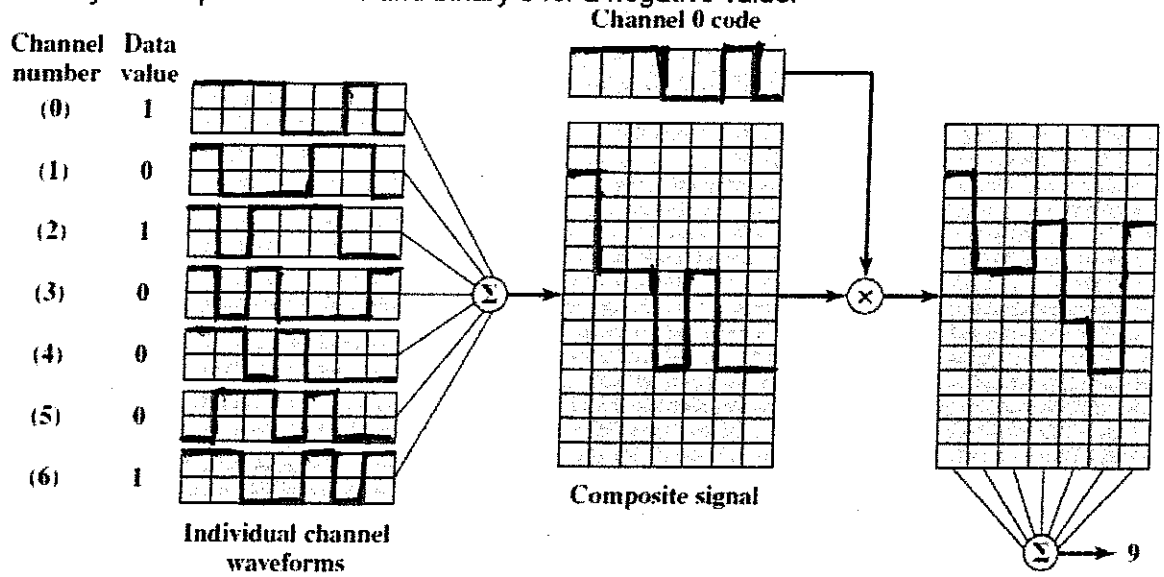
4) Calls arrive to a pool of 50 modems according to a Poisson process. Calls have an average duration of 25 minutes.
   A) Estimate the probability that an arriving call finds all modems busy if the arrival rate is two calls per minute [2]
   B) What is the maximum arrival rate that can be handled if the maximum acceptable blocking probability if (i) 1% (ii)10%? [2]

5)
   A) If a crossbar matrix has $n=8$ input lines and $m=4$ output lines, how many crosspoints are required?
   B) Consider a multistage switch with $N = 10$, $n = 5$, $k = 2$
      i) Draw the switch architecture [1]
      ii) What is the maximum number of connections that can be supported at any given time? [1]
      iii) Assuming that an input line is busy 10% of the time, estimate the percent of time p, that a line between first and second stage is busy. [2]
      iv) How is p in (iii) above affected by n and k? [1]
      v) How does this p affect the blocking performance of the intermediate crossbar switch? [1]
      vi) Supposing that the blocking probability of the intermediate crossbar switch is small, what is the proportion of time p' that a line between the second and third stage is busy? [1]

(Please Turn Over)

vii) For a given input and output line, what is the probability that none of the N/n paths between the input and output lines are available? [1]

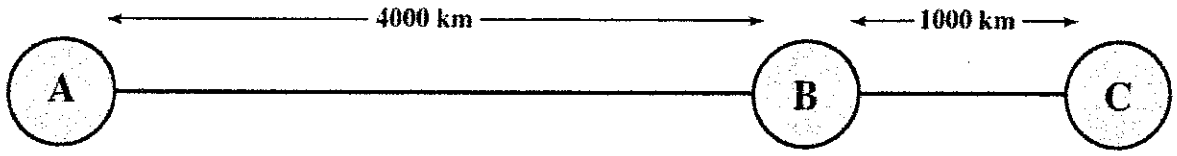
6) Figure below, depicts a simplified scheme for CDMA encoding and decoding as explained herein: There are seven logical channels, all using Direct Sequence Spread Spectrum (DSSS) with a spreading code of 7 bits. Assume that all sources are synchronized. If all seven sources transmit a data bit, in the form of a 7-bit sequence, the signals from all sources combine at the receiver so that two positive or two negative values reinforce and a positive and negative value cancel. To decode a given channel, the receiver multiplies the incoming composite signal by the spreading code for that channel, sums the result, and assigns binary 1 for a positive value and binary 0 for a negative value.



A) Find the spreading codes for all the remaining six channels i.e., Channel 1 through 6. [6]
B) Determine the receiver output measurement for channel 1 and the bit value assigned [2]

7)

A) In Figure shown below frames are generated at node A and sent to node C through node B. Assume the following: (i)The data rate between A and B is 100 kbps; (ii)The propagation delay is 5 ms/km for both lines; (iii)There are full duplex lines between the nodes; (iii)All data frames are 1000 bits long; ACK frames are separate frames of negligible length; (iv)Between A and B, a sliding-window protocol with a window size of 3 is used; (v)Between B and C, stop-and-wait is used; (vi)There are no errors;,



Determine the minimum data rate required between nodes B and C so that the buffers of node B are not flooded. [6]

B) Consider the use of 1000-bit frames on a 1-Mbps satellite channel with a 270-ms delay. What is the maximum link utilization for
i) Stop-and-wait flow control [2]
ii) Continuous flow control with a window size of 7 [2]

(Continued in next page)

8)

A) Suppose that two check bits are added to a group of 2n information bits. The first check bit is the parity check of the first n bits, and the second check bit is the parity check of the second n bits
   i) Characterize the error patterns that can be detected by this code [1]
   ii) Find the error detection failure probability in terms of the error-detection probability of the single parity check code [1]
   iii) Does it help to add a third parity check bit that is the sum of the all the information bits? [1]

B) Let $g(x)=x^3+x+1$. Consider the information sequence 1001.
   i) Find the codeword corresponding to the preceding information sequence. [2]
   ii) Suppose that the codeword has a transmission error in the first bit. What does the receiver obtain when it does its error checking? [2]

9) Write short notes on any three of the following: [3x4M= 12]
   A) IEEE 802.11 Frame Structure and Addressing fields as employed in typical Wireless LANs.
   B) Motivation that led to the development of ATM networks & the BISDN reference model.
   C) A critical comparison of TDMA, FDMA and CDMA schemes.
   D) Fibre Distributed Data Interface (FDDI) Standard and its Frame structure
   E) Application of a basic queuing model for the analysis of delays in a typical communication network.

*****) ALL THE BEST(******

BITS-Pilani Dubai, Dubai International Academic City, Dubai

III Yr. B.E. (Hons.) Second Semester Academic Year 2011 – 2012

COMMUNICATION NETWORKS TEST - 2 (Open Book)

Course No. : ECE C394
Duration : 50 min.

Date : 20.05.2012
Max Marks : 40
Weightage : 20%

Note:- 1. Answer ALL Questions.
2. Please state explicitly the assumptions made, if any.

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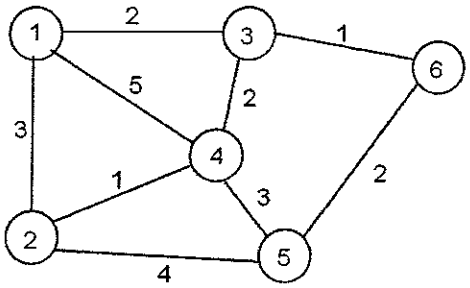
1) Consider the network shown below:

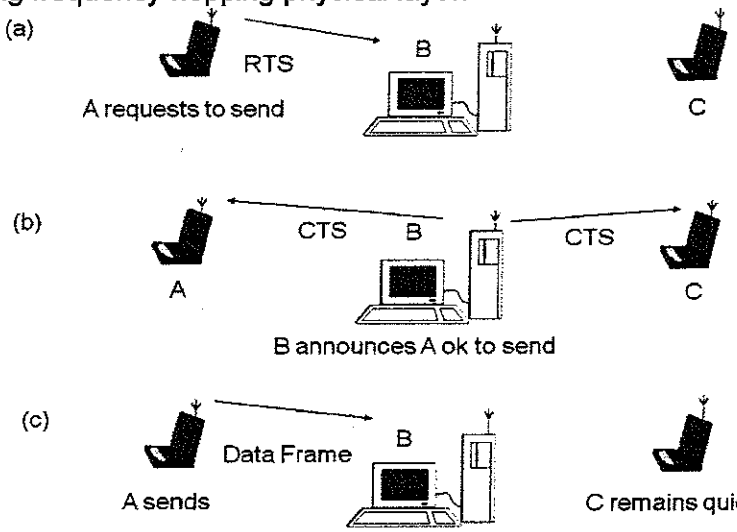


A) Using the Dijkstra algorithm find the set of shortest paths from node 4 to other nodes. [5]

B) Find the set of entries in the associated routing table below: [5]

Destination	Next node	cost

2) Consider the exchange of CSMA-CA frames shown in the figure below. Assume the IEEE 802.11 LAN operates at 2 Mbps using frequency-hopping physical layer.



A) Sketch a time diagram showing the frames transmitted including the final ACK frame. [3]

B) Show the appropriate interframe spacings and NAV values. Use the Table, below, to obtain the appropriate time parameters. Assume that the data frame is 2000 bytes long. [4]

Parameter	**Value in μs**	**Definition**
Air propagation time	1	Time for transmitted signal to go from transmitter to receiver
RxTx turnaround time	20	Time for a station to transmit symbol after request from MAC
CCA assessment time	29	Time for receiver to determine the state of the channel
Slot time	50	Time used by MAC to determine PIFS and DIFS periods =CCA assessment + RxTx turnaround+air propagation
SIFS time	28 {+2/-3}	Time required by MAC and physical sublayers to receive the last symbol of a frame at the air interface, process the frame, and respond with the first symbol of a preamble on the air interface
Preamble length	96	Time to transmit the PLCP preamble
PLCP header	32	Time required to transmit the PLCP header

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BITS-Pilani Dubai, Dubai International Academic City, Dubai
III Yr. B.E. (Hons.) Second Semester Academic Year 2011 – 2012

Test-2 (Open Book) – COMMUNICATION NETWORKS

Course No.: ECE C394
Duration : 20 min.

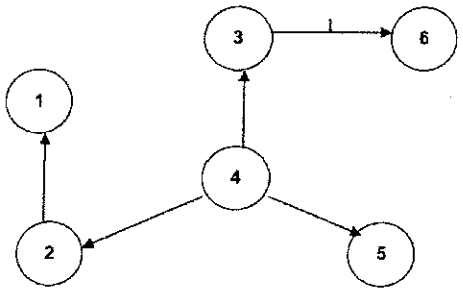
1/4

Date : 20.05.2012
Max Marks : 40
Weightage : 20%

Q. No.	Solution / Key / Marking Scheme	Marks

1 A.

Iteration	N	D_1	D_2	D_3	D_5	D_6
Initial	{ 4 }	5	1	2	3	∞
1	{ 2, 4 }	4	**1**	2	3	∞
2	{ 2, 3, 4 }	4		**2**	3	3
3	{ 2, 3, 4, 5 }	4			**3**	3
4	{ 2, 3, 4, 5, 6 }	4				**3**
5	{1, 2, 3, 4, 5, 6}	**4**				



B.

Destination	Next Node	Cost
1	2	4
2	2	1
3	3	2
5	5	3
6	3	3

2 A, Assume the data frame includes the MAC header and the CRC field.

$X_{frame} = (2000 \times 8) / 2M = 8 \times 10^{-3}$ sec

Data frame transmission time

$X_{data} = X_{frame} + X_{preamble} + X_{PLCPheader} = 8 \times 10^{-3} + (96 + 32) \times 10^{-6} = 8.128 \times 10^{-3}$ sec

$X_{rts} = (20 \times 8) / 2M = 80$ µsec

$X_{cts} = (14 \times 8) / 2M = 56$µsec

The ACK frame consists of the MAC header (30 bytes) and the CRC field (4 bytes). Its total length is 34 bytes.

$X_{ack} = (34 \times 8) / 2M = 136$ µs

slot time = 50 µs

SIFS = 28 µs

PIFS = SIFS + 1 slot time = 78 µs

DIFS = PIFS + 1 slot time = 128 µs

BITS-Pilani Dubai, Dubai International Academic City, Dubai

III Yr. B.E. (Hons.) Second Semester Academic Year 2011 – 2012

TEST - 1 (Closed Book)

COMMUNICATION NETWORKS

Course No. : ECE C394
Duration : 50 min.

Date : 01.04.2012
Max Marks : 50
Weightage : 25%

Note:- 1. Answer ALL Questions.
2. Please state explicitly the assumptions made, if any.

- - -

1)

A) List all the layers of OSI Model and state their functions. [3+2=5 M]

B) Which OSI layer is responsible for the following? [3x1M=3M]
   i) Determining the best path to route packets.
   ii) Providing end-to-end communication with reliable service
   iii) Providing node-to-node communications with reliable service

C) State two features that the data link layer and transport layer have in common. Also state two features in which they differ? [2+2=4M]

D) State where the following fit in the OSI reference model. Also justify your answer. [3x2M=6M]
   i) A 4 kHz analog connection across the telephone network
   ii) A 33.6 kbps modem connection across the telephone network
   iii) A 64 kbps digital connection across the telephone network

2)

A) Draw a multistage switch with N=16, n=4 and k=2. [1 M]
   i) Find the maximum number of connections that can be supported at any given time? [1 M]
   ii) Is the switch is a blocking switch or non-blocking switch? And, if it is blocking switch, identify at which stage there is a bottleneck. [2 M]
   iii) Comment on the switch's blocking/non-blocking feasibilities, if
   (1) k is made 4 (instead of 2) [1 M]
   (2) k is further increased, say, to a value k=10. [1 M]

B) Consider a typical multi-stage switch
   i) For a given set of input-output pairs, is there more than one way to arrange the connections over any the multistage? If yes, find the no. of ways? Else, justify your answer. [2 M]
   ii) Assuming that a typical "n x k" switch is employed in a 3-stage, and if an input line is busy 10% of the time, estimate the percent of time (say, p) that a line between the first and second stage is busy. [2 M]
   iii) How is "p", as defined in (B) above, is affected by n and k? [1 M]
   iv) How does this *p* affect the blocking performance of the intermediate crossbar switch? [2 M]
   v) Supposing that the blocking probability of the intermediate crossbar is small (or negligible), what is the proportion of time, say *p'*, that a line between the second and third stage is busy? [2 M]
   vi) For a given input and output line, what is the probability that none of the *N/n* paths between the input and output lines are available? [2 M]

3) An early code used in radio transmission involved using codewords that consist of binary bits and contain the same number of 1s. Thus, the 2-out-of-5 code only transmits blocks of 5 bits in which 2 bits are 1 and the others 0.

A) List the valid codewords [5 M]

B) Suppose that the code is used to transmit blocks of binary bits. How many bits can be transmitted per codeword? [2 M]

C) What pattern does the receiver check to detect errors? [1 M]

D) What is the minimum number of bit errors that cause a detection failure? [1 M]

[Please Turn Over]

4) A 1 Mbyte file is to be transmitted over a 1 Mbps communication line that has a bit error rate of $p = 10^{-6}$.
   A) What is the probability that the entire file is transmitted without errors? Note for n large and p very small, $(1 - p)^n \approx e^{-np}$. [2M]
   B) The file is broken up into N equal-sized blocks that are transmitted separately. What is the probability that all the blocks arrive correctly without error? Does dividing the file into blocks help? [1.5M]
   C) Suppose the propagation delay is negligible, explain briefly how Stop-and-Wait ARQ can help deliver the file in error-free form. On the average how long does it take to deliver the file if the ARQ transmits the entire file each time? [2.5]

***) ALL THE BEST(****

Name: _____ ID No. _____

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BITS-Pilani Dubai, Dubai International Academic City, Dubai

III Yr. B.E. (Hons.) Second Semester Academic Year 2011 – 2012

QUIZ - 2 (Closed Book)

COMMUNICATION NETWORKS

Course No. : ECE C394
Duration : 20 min.

Date : 01.05.2012
Max Marks : 16
Weightage : 8%

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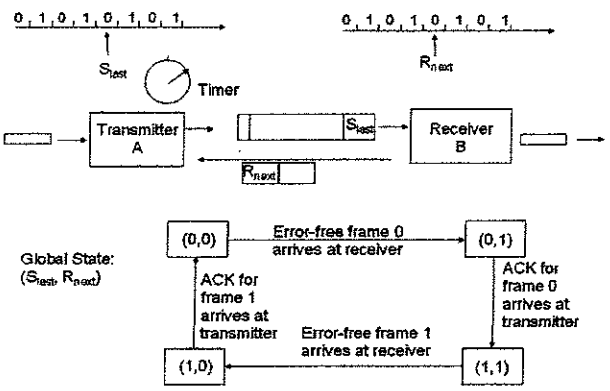
1) Consider the Stop-and-Wait protocol. If the protocol is modified so that each time a frame is found in error at either the sender or receiver, the last transmitted frame is immediately resent, answer the following:

A) Will the protocol still operates correctly? State Yes or No and Justify your answer. [0.5+1=1.5M]

Answer:

B) In view of this modification/the new operation, does the Stop-and-Wait ARQ's state transition diagram (as in the figure below) which you learnt during our class-work, undergo any modification? State Yes or No. If yes, indicate the changes if any. [0.5+0.5=1.0M]



Answer:

C) State the main consequence in error recovery process by introducing the suggested modification i.e., the immediate-retransmission feature? [0.5 M]

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2) If the Stop-and-Wait ARQ system has a time-out value that is less than the time required to receive an acknowledgment. Sketch the sequence of frame exchanges that transpire between two stations when station A sends five frames to station B and no errors occur during transmission? [1 M]

Answer:

(Please Turn Over)

4) State what do following colon operators (in MATLAB) signify? [0.25+0.5+0.5=1.25M]

A(:,:)	
j:i:k	
A(:,:,k)	

5) If the Stop-and-Wait ARQ system has a time-out value that is less than the time required to receive an acknowledgment. Sketch the sequence of frame exchanges that transpire between two stations when station A sends five frames to station B and no errors occur during transmission? [1 M]

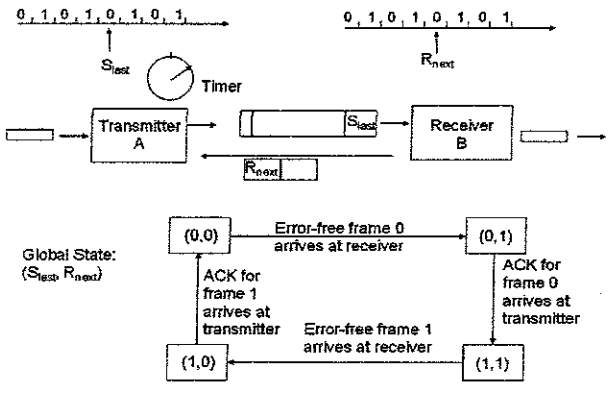
Answer:

6) Consider the Stop-and-Wait protocol. If the protocol is modified so that each time a frame is found in error at either the sender or receiver, the last transmitted frame is immediately resent, answer the following:

A) Will the protocol still operates correctly? State Yes or No and Justify your answer. [0.5+1=1.5M]

Answer:

B) In view of this modification/the new operation, does the Stop-and-Wait ARQ's state transition diagram (as in the figure below) which you learnt during our class-work, undergo any modification? State Yes or No. If yes, indicate the changes if any. [0.5+0.5=1.0M]



Answer:

C) State the main consequence in error recovery process by introducing the suggested modification i.e., the immediate-retransmission feature? [0.5 M]

******) ALL THE BEST(******

Name: _____ ID No. _____

A

BITS-Pilani Dubai, Dubai International Academic City, Dubai

III Yr. B.E. (Hons.) Second Semester Academic Year 2011 – 2012

QUIZ - 1 (Closed Book)

COMMUNICATION NETWORKS

Course No. : ECE C394
Duration : 20 min.

Date : 13.03.2012
Max Marks : 14
Weightage : 7%

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1) Suppose a radio transmission system has a large band of available bandwidth, say 1 GHz that is to be used by a central office to transmit and receive from a large number of users. Compare the following two approaches to organizing the system: [2 M]
Approach A: A single TDM System;
Approach B: A hybrid TDM/FDM system in which the frequency band is divided into multiple channels and the TDM is used within each channel.

2) In a single television channel whose bandwidth is 6 MHz, find the no. of following Channels that can be frequency-division multiplexed? [1 M]

A) two-way 30 kHz analog voice channels:

B) two-way 200 kHz GSM:

3)

A) Describe the step-by-step procedure that is involved from the time you deposit a letter in a mailbox to the time the letter is delivered to its destination. [3.5 M]

Step 1:

Step 2:

Step 3:

(Please Turn Over & continue to answer this question)

Step 4:

Step 5:

Step 6:

Step 7:

B) What role do names, addresses and mail codes (such as ZIP codes or postal codes) play? [0.5 M]

C) How might the letter be routed to its destination? To what extent can the process be automated?. [1 M]

4) What are the advantages and disadvantages of transmitting fax messages over the Internet instead of the telephone network. [2M]

5) Find the propagation delay for a signal traversing the following networks at the speed of light in cable ($2.3x10^8$ m/s).

A) A metropolitan area 150 Km: [0.5 M]

B) A Circuit Board 15 cm: [0.5 M]

6) List all the layers of OSI Model and state their functions. [3 M]

Layer	Name of the Layer	Functionality
1		
2		
3		
4		
5		
6		
7		

****) ALL THE BEST(****