



COMSATS University Islamabad (CUI)

Islamabad Campus

Terminal Examination, Spring 2024

Course: MTH 231 - Linear Algebra

Level: BCT-IV, BDS-IV, BAI-IV, BCS-IV, BSE-III

Instructors: Dr. Tanvir Akber Kiani

Dr. Qazi Muhammad Zaigham Zia

Dr. Adeel Ahmed

June 13, 2024

Time Allowed: 3 hour

Total Marks: 50

Instructions:

Answer ALL questions. Show all the work. Answers without explanations will get partial credits only.

Question No. 01: [8 points] Utilize your answer sheet to provide responses as either true or false.

- (i) If a matrix A has a row of zeros, then $\det(A) = 0$.
- (ii) If the rows of a square matrix are linearly dependent, the matrix is not invertible.
- (iii) If $T: \mathbb{R}^2 \rightarrow \mathbb{R}^2$ rotates vectors about the origin through an angle ϕ , then T is a linear transformation.
- (iv) The null space of a matrix A is a subspace of $\mathbb{R}^n$ where n is the number of rows of A .
- (v) The rank of a matrix is the number of non-zero rows in its row echelon form.
- (vi) If A is an $m \times n$ matrix, then the rank of A plus the nullity of A equals m .
- (vii) Two matrices are similar if and only if they have the same eigenvalues.
- (viii) The Gram-Schmidt process can only be applied to linearly dependent vectors.

Question No. 02: [5 points] Find a vector $\mathbf{x}$ whose image under $T(\mathbf{x}) = A\mathbf{x}$ is $\mathbf{b}$, where

$$A = \begin{bmatrix} 1 & -3 & 2 \\ 0 & 1 & -4 \\ 3 & -5 & -9 \end{bmatrix} \quad \text{and} \quad \mathbf{b} = \begin{bmatrix} 6 \\ -7 \\ -9 \end{bmatrix}.$$

Question No. 03: [5 points] Find the inverse of the matrix $A = \begin{bmatrix} 0 & 1 & 2 \\ 1 & 0 & 3 \\ 4 & -3 & 8 \end{bmatrix}$, if it exists.

Question No. 04: [5 points] Find the determinant of $A = \begin{vmatrix} 1 & -1 & -3 & 0 \\ 0 & 1 & 5 & 4 \\ -1 & 0 & 5 & 3 \\ 3 & -3 & -2 & 3 \end{vmatrix}$.

Question No. 05: [5 points] Let H be the set of points inside and on the unit sphere. That is, let $H = \left\{ \begin{bmatrix} x \\ y \\ z \end{bmatrix} : x^2 + y^2 + z^2 \leq 1 \right\}$. Show that H is not a subspace of $\mathbb{R}^3$.

Question No. 06: [5 points] Find the dimension of the subspace spanned by the given vectors

$$\begin{bmatrix} 1 \\ 0 \\ 2 \end{bmatrix}, \begin{bmatrix} 3 \\ 1 \\ 1 \end{bmatrix}, \begin{bmatrix} 9 \\ 4 \\ -2 \end{bmatrix}, \begin{bmatrix} -7 \\ -3 \\ 1 \end{bmatrix}.$$

Question No. 07: [7 points] Diagonalize the following matrix $A = \begin{bmatrix} 5 & -3 & 0 & 9 \\ 0 & 3 & 1 & -2 \\ 0 & 0 & 2 & 0 \\ 0 & 0 & 0 & 2 \end{bmatrix}$.

Also verify $AP = PD$

Question No. 08: [5 points] Show that the set $\left\{ \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix}, \begin{bmatrix} -1 \\ 4 \\ 1 \end{bmatrix}, \begin{bmatrix} 2 \\ 1 \\ -2 \end{bmatrix} \right\}$ is an orthog-

onal basis for $\mathbb{R}^3$. Express $\mathbf{x} = \begin{bmatrix} 8 \\ -4 \\ -3 \end{bmatrix}$ as a linear combination of the basis elements.

Question No. 09: [5 points] Use the Gram-Schmidt process to find an orthogonal basis for

the column space of $A = \begin{bmatrix} 3 & -5 & 1 \\ 1 & 1 & 1 \\ -1 & 5 & -2 \\ 3 & -7 & 8 \end{bmatrix}$.

Good Luck



COMSATS University Islamabad
Department of Computer Science
Terminal Examination – Spring 2024

Class: (BS) CS

Course Code & Title: CSC307 Graph Theory

Time Allowed: 3 Hours

Instructors: Dr. Malik A. Kamran

Semester: 4th

Date: 03-06-2024

Max Marks: 50

Name: Abdullah

Registration # FA22-BCS-005

Instructions

- Use black or blue ball-pen only. Markers/lead pencils are not allowed.
- All questions are self-explanatory and require no further explanations during exam time.
- Attempt all questions.

Question 1

CLO-1

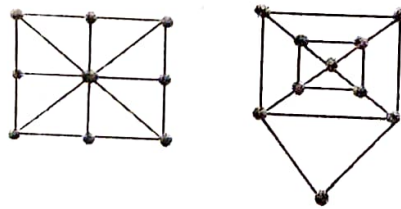
Marks [3+1+1+3+1+4+1+1]

CLO1: Illustrate the basic terminology of graph theory including properties and special cases for each type of graph, trees, and forest.

1. Find and draw the intersection graph of the sets $\{1, 2, 5, 6\}$, $\{1, 7, 9\}$, $\{2, 3, 7, 8\}$, $\{3, 5, 10\}$, $\{4, 6, 8\}$, $\{5, 6, 9, 10\}$.
2. A map has different countries, some of which share borders. The countries are colored with different colors.
 - (i) How can you model this situation using graph theory? Are the edges directed or multiple?
 - (ii) What is a natural question to ask regarding the coloring of the regions?
3. How many vertices a graph contains if it has 12 edges, 3 vertices of degree 2 and other vertices of degree 3.
4. Finding center is considered more useful in trees than in a graph, why? Compare eccentricity and induction methods of finding center in a tree of at least 7 nodes.
5. What is a spanning tree? Find number of spanning trees in K_5 .

Question 2**CLO-2****Marks [2+2+2+2+2]****CLO2: Interpret basic results related with Eulerian and Hamiltonian graphs.**

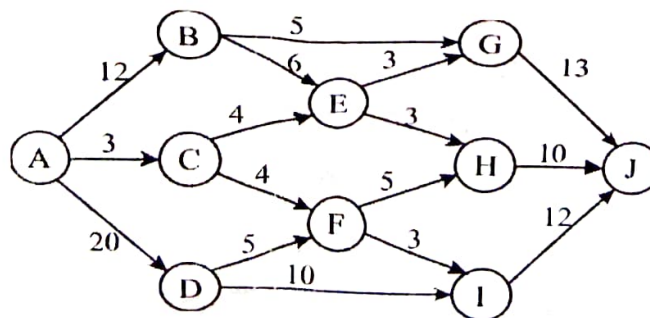
1. Describe sufficient criteria for finding Hamiltonian path/circuit with examples.
2. Degree of the vertices can indicate existence of Eulerian walk and Eulerian circuit. Prove with example graphs.
3. Find Hamiltonian and/or Eulerian path/circuit, if exists, in the following graphs.



4. Finding Hamiltonian circuit is more challenging than Eulerian, why?

Question 3**CLO-3****Marks [5+4+2+2]****CLO3: Apply network flow algorithms to solve graph connectivity problems.**

1. Calculate all possible changes in the number of components by removing a vertex or edge in the following types of graphs:
 - a. P_n
 - b. C_n
 - c. K_n
 - d. E_n
 - e. Disconnected graph
2. Capacity is shown on the following network. Find maximum flow in the following network using Ford-Fulkerson algorithm.

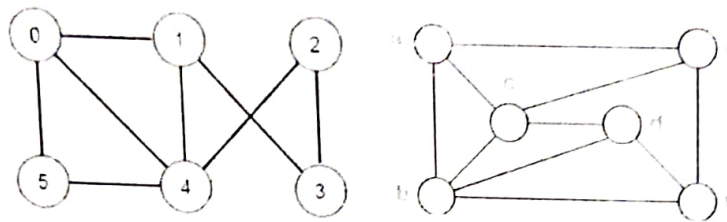


3. Find the types of graphs that exhibit 2-coloring as well as perfect matching?
4. Draw the following bipartite graph B and provide a real-life example for this graph:
 $B=(G, X, Y)$, $G=(\{1,2,3,4,5\}, 14, 15, 25, 34, 35)$, $X=\{1,2,3\}$, $Y=\{4,5\}$

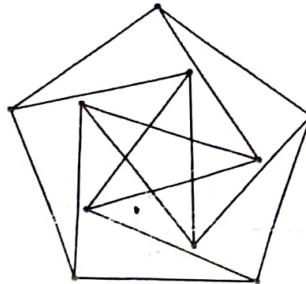
Question 4**CLO-4****Marks [2+3+3+2+2]**

CLO4: Solve a variety of real-world problems in computer science using appropriate forms of graphs.

1. Prove with example that each vertex cover is always a dominating set but not vice versa.
2. Show dominating set, max matching, and min vertex cover in the following graphs:



3. Determine the edge cover, edge coloring, and independence set in the following graph.



4. Draw a Latin square of 3x3 using its formula. Convert it to a doubly Stochastic matrix.
5. How many permutation matrices of size n exist?



COMSATS University Islamabad
Department of Computer Sciences

Final Examination Spring 2024

Subject: **Statistics and Probability Theory**

Program: BCS

Semester: 4th (A & B)

Date: 9th June 24, 08:30

Total Marks: 50

Time Allowed: 180 Minutes

Instructor: Ms. Mudassrah

Instructions:

- Attempt all questions.
- Normal distribution table and calculators are allowed but sharing is strictly prohibited.

Question No. 01: In the November 1990 issue of Chemical Engineering Progress, a study discussed the percent purity of oxygen from a certain supplier. Assume that the mean was 99.61 with a standard deviation of 0.08. Assume that the distribution of percent purity was approximately normal.

- What percentage of the purity values would you expect to be between 99.5 and 99.7?
- What purity value would you expect to exceed exactly 5% of the population? (5.5)

Question No. 02: It is known by researchers that 1 in 100 people carries a gene that leads to the inheritance of a certain chronic disease. In a random sample of 1000 individuals, what is the probability that fewer than 7 individuals carry the gene? Use a Poisson approximation. Again, using the approximation, what is the approximate mean number of people out of 1000 carrying the gene? (5.5)

Question No. 03: The Department of Energy (DOE) puts projects out on bid and generally estimates what a reasonable bid should be. Call the estimate b . The DOE has determined that the density function of the winning (low) bid is;

$$f(y) = \begin{cases} \frac{5}{8b}, & \frac{2}{5}b \leq y \leq 2b \\ 0, & \text{elsewhere} \end{cases}$$

Find distribution function $F(y)$ and use it to determine the probability that the winning bid is less than the DOE's preliminary estimate b . (5.5)

Question No. 04: The potential buyer of a particular engine requires (among other things) that the engine start successfully 10 consecutive times. Suppose the probability of a successful start is 0.990. Let us assume that the outcomes of attempted starts are independent.

- What is the probability that the engine is accepted after only 10 starts?
- What is the probability that 12 attempted starts are made during the acceptance process? (5.5)

Question No. 05: In testing a certain kind of truck tire over rugged terrain, it is found that 25% of the trucks fail to complete the test run without a blowout. Of the next 15 trucks tested, find the probability that;

- a. from 3 to 6 have blowouts;
- b. fewer than 4 have blowouts;
- c. more than 5 have blowouts.

(6)

Question No. 06: Lots of 40 components each are deemed unacceptable if they contain 3 or more defectives. The procedure for sampling a lot is to select 5 components at random and to reject the lot if a defective is found. What is the probability that exactly 1 defective is found in the sample if there are 3 defectives in the entire lot? Find the mean and variance of the random variable and then use Chebyshev's theorem to interpret the interval $\mu \pm 2s$. (5.5)

Question No. 07: The fraction X of male runners and the fraction Y of female runners who compete in marathon races are described by the joint density function;

$$f(x, y) = \begin{cases} 8xy, & 0 \leq y \leq x \leq 1 \\ 0, & \text{elsewhere.} \end{cases}$$

Find the covariance of X and Y .

(5.5)

Question No. 08: In a certain assembly plant, three machines, B_1 , B_2 , and B_3 , make 30%, 45%, and 25%, respectively, of the products. It is known from past experience that 2%, 3%, and 2% of the products made by each machine, respectively, are defective. Now, suppose that a finished product is randomly selected.

- a. What is the probability that it is defective?
- b. If a product was chosen randomly and found to be defective. What is the probability that it was made by machine B_3 ?

(5.5)

Question No. 09: Suppose that an antique jewelry dealer is interested in purchasing a gold necklace for which the probabilities are 0.22, 0.36, 0.28, and 0.14, respectively, that she will be able to sell it for a profit of \$250, sell it for a profit of \$150, break even, or sell it for a loss of \$150. What is her expected profit? Also find expected variance.

(5.5)



COMSATS University Islamabad (CUI)

Islamabad Campus
Midterm Examination, Spring 2024

Course: MTH 231 - Linear Algebra

Level: BCT-IV, BDS-IV, BEI-IV, BCS-IV, BSE-III

Instructors: Dr. Tanvir Akber Kiani

Dr. Qazi Muhammad Zaigham Zia

Dr. Adeel Ahmed

April 16, 2024

Time Allowed: 90 minutes

Total Marks: 25

Instructions:

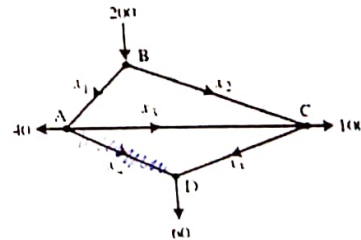
Answer ALL questions. All questions carry equal marks. Show all the work. Answers without explanations will get partial credits only.

Question No. 01: [5 points] Utilize your answer sheet to provide responses as either true or false.

- A basic variable in a linear system is a variable that corresponds to a pivot column in the coefficient matrix.
- If the coefficient matrix A has a pivot position in every row, then the equation $Ax = b$ is inconsistent.
- If A is a 3×5 matrix and T is a transformation defined by $T(x) = Ax$ then the domain of T is $\mathbb{R}^3$.
- LU factorization of a matrix A is possible only if the matrix A is a square matrix.
- If A and B are $n \times n$ and invertible, then $A^{-1}B^{-1}$ is the inverse of AB .

Question No. 02: [5 points]

- Find the general traffic pattern of the freeway network shown in the figure. (Flow rates are in Cars/minutes).
- Describe the general traffic pattern when the road whose flow is x_4 is closed.
- When $x_4 = 0$, what is the minimum value of x_1 ?



Question No. 03: [5 points] Let $T: \mathbb{R}^2 \rightarrow \mathbb{R}^2$ be the linear transformation that first performs a horizontal shear that transforms e_2 into $e_2 + 2e_1$ (leaving e_1 unchanged) and reflects points through the line $x_2 = -x_1$. Find the standard matrix of T .

Question No. 04: [5 points] Find an LU factorization of the following matrix

$$A = \begin{bmatrix} 1 & 3 & -5 & -3 \\ -1 & -5 & 8 & 4 \\ 4 & 2 & -5 & -7 \\ -2 & -4 & 7 & 5 \end{bmatrix}$$

Question No. 05: [5 points] Determine if the vectors $(4, 6, -7)$, $(-7, 0, 2)$ and $(-3, -5, 6)$ are linearly independent or linearly dependent.



COMSATS University Islamabad

Department of Computer Science

Mid-Term Examination BS(CS) SPRING-2024

Instructor: Dr. Mariam Akbar, Dr. Zulfiqar Ali, Dr. AbdulRahman Al-Salehi, Mr. Shakeel

Course Title: CSC340 Computer Networks

Maximum Marks: 50

Dated: 17-04-2024

Time Allowed: 90 Min

Name: _____ Reg no. _____

-----CLO-1-----

--(Summarize the fundamental concepts of computer networks)

Q (1) = (6+6+3=15 Marks)

Part A. divide speed of light with optical fibre

There is a user of Facebook who wants connectivity to the nearest Facebook server which has 15 routers on the way. The entire length of optical fiber cable is 6543 Km between two host entities. The average processing delay at each router is 2 msec and there is no congestion on the link. The propagation delay is subject to refractive index of optical fiber equal to 1.5, The speed of light is universal constant of 3×10^8 m/sec. Calculate the end-to-end delay of data in one direction. Ignore transmission delays.

Part B.

Consider the car-caravan analogy and assume a propagation speed of 100 km/hour.

1. Suppose the caravan travels 175 km, beginning in front of one tollbooth, passing through a second tollbooth and finishing just after a third tollbooth. What is the end-to-end delay?
2. Repeat (a), now assuming that there are eight cars in the caravan instead of ten.

Part C.

In wireless system, user can be located anywhere in coverage area and the behavior of system is to reduce the user bandwidth to half after going away from tower for each 1 Km due to signal weakening. The bandwidth at the tower is 10 Mbits per second. How much time is required to transfer 1 GByte data at 2.9 Km location from tower.

-----CLO-2-----

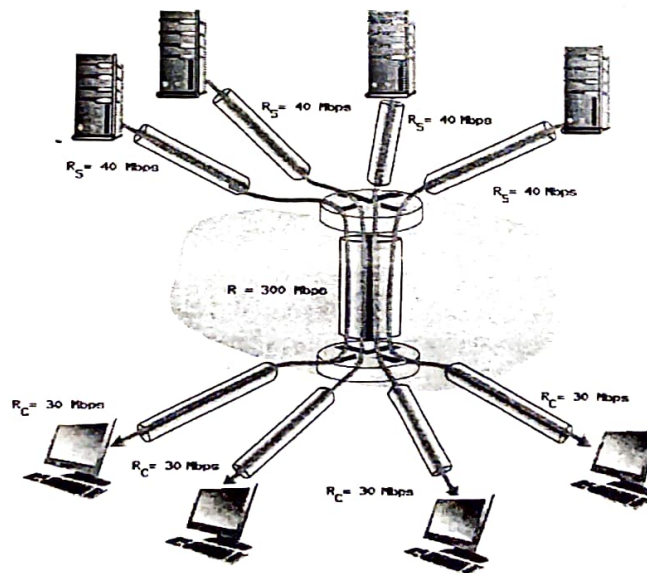
(Apply the concepts of computer networks to solve their related problems)

Q (2) = (7+7+6= 20 Marks)

Part A.

Consider the scenario shown below, with four different servers connected to four different clients over four three-hop paths. The four pairs share a common middle hop with a transmission capacity of $R = 300$ Mbps. The four links from the servers to the shared link have a transmission capacity of $R_S = 40$ Mbps. Each of the four links from the shared middle link to a client has a transmission capacity of $R_C = 30$ Mbps.

1. What is the maximum achievable end-end throughput (in Mbps) for each of the four client-to-server pairs, assuming that the middle link is fairly shared?
2. Which link is the bottleneck link for each session?



Part B.

Suppose that the five measured SampleRTT values are 106 ms, 120 ms. Compute the EstimatedRTT after each of these SampleRTT values is obtained, using a value of $\alpha = 0.125$ and assuming that the value of EstimatedRTT was 100 ms just before the first of these five samples were obtained. Also compute the DevRTT after each sample is obtained, assuming a value of $\beta = 0.25$ and assuming the value of DevRTT was 5 ms just before the first of these five samples was obtained. Last, compute the TCP TimeoutInterval after each of these samples is obtained.

Part C.

Assign IP addresses for your new MAN (Metropolitan Area Network), which consists of 8 different buildings, each building will have 255 workstations. Your administrator tells you to only use as much of the 164.10.0.0 network as you need. Your administrator will assign the IP addresses to the serial interfaces

using a different network. You will need to determine the following four items for each of the eight buildings:

1. Subnet masks
2. Network addresses.
3. Broadcast address for each subnet.
4. Valid host ranges on each subnet

-----CLO-3-----

(Analyze various protocols, algorithms, and their functions in a network)

Q (3) = (6+ 5+ 4= 15 Marks)

Part A.

Consider sending a 2600-byte datagram into a link that has an MTU of 700 bytes. Suppose the original datagram is stamped with the identification number 422. How many fragments are generated? What are the values in the various fields in the IP datagram(s) generated related to fragmentation?

Length	Id	More Fragment Flag	Offset

Part B.

Host A and B are directly connected with a 100 Mbps link. There is one TCP connection between the two hosts, and Host A is sending to Host B an enormous file over this connection. Host A can send its application data into its TCP socket at a rate as high as 120 Mbps but Host B can read out of its TCP receive buffer at a maximum rate of 50 Mbps. Describe the effect of TCP flow control.

Part C.

Compare GBN, SR, and TCP (no delayed ACK). Assume that the timeout values for all three protocols are sufficiently long such that 5 consecutive data segments and their corresponding ACKs can be received (if not lost in the channel) by the receiving host (Host B) and the sending host (Host A) respectively. Suppose Host A sends 5 data segments to Host B, and the 2nd segment (sent from A) is lost. In the end, all 5 data segments have been correctly received by Host B.

1. How many segments has Host A sent in total and how many ACKs has Host B sent in total? What are their sequence numbers? Answer this question for all three protocols.
2. If the timeout values for all three protocols are much longer than 5 RTT, then which protocol successfully delivers all five data segments in the shortest time interval?



COMSATS UNIVERSITY ISLAMABAD (CUI)

DEPARTMENT OF COMPUTER SCIENCE

TERMINAL EXAMINATION SPRING-2024

Class: B.S.(C.S.) - 4th Semester

Subject: CSC312-Theory of Automata

Instructor: Taimur Shahzad

Dated: 5th June, 2024

Time Allowed: 180 Minutes

Maximum Marks: 50

- All questions are self-explanatory and require no further explanations during exam time.
- Make sure that you have signed the attendance sheet before leaving the examination room.
- Attempt all questions.

Question No.01:

[Marks= 5+5]

- Differentiate between Kleen Star Closure and Positive Closure with a suitable example.
- Whether Halting Problem is Decidable or Undecidable? Justify your answer by proving it.

Question No.02: Give pushdown automata that recognizes the following languages. Give both a drawing and 6-tuple specification for each PDA:

[Marks= 5+5]

- $L_1 = \{a^i b^j c^k \mid i, j, k \geq 0 \text{ and } i + j = k\}$.
- $L_2 = \{ab^n acab^n a \mid n \geq 0\}$.

Question No.03: Design a Finite Automata and Language of given Regular Expressions. [Marks= 2+2+2+2+2]

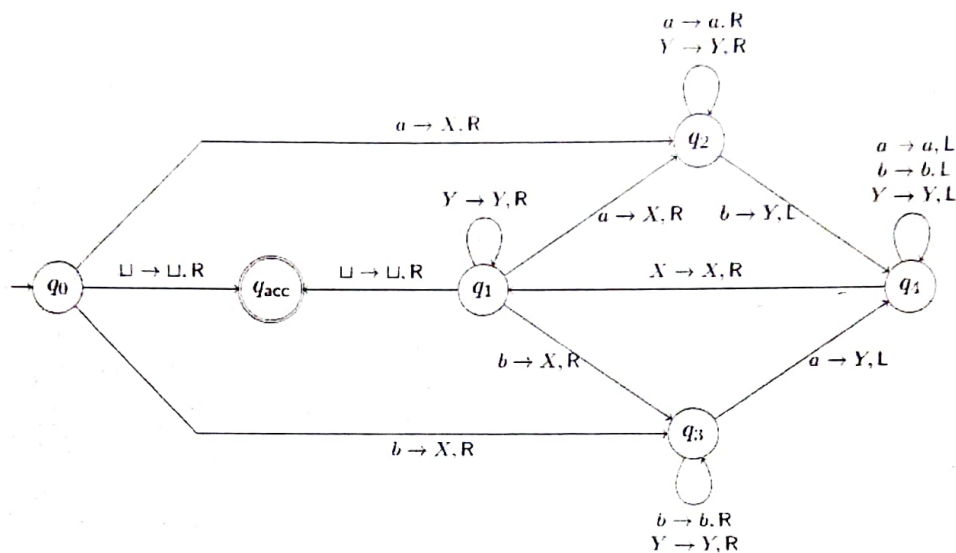
- $E_1 = a(a+b)^*$
- $E_2 = (a(a+b)^*b) + (b(a+b)^*a)$
- $E_3 = (a(a+b)^*a) + (b(a+b)^*b) + a + b + \epsilon$
- $E_4 = (a+b)^*a(a+b)^*$
- $E_5 = (a+b)^*a$

Question No.04: Let $T = \{0, 1, (,), \cup, *, \emptyset, \epsilon\}$. We may think of T as the set of symbols used by regular expressions over the alphabet $\{0, 1\}$; the only difference is that we use ϵ for symbol ϵ , to avoid potential confusion in what follows.

[Marks= 3+3+4]

- Your task is to design a CFG G with set of terminals T that generates exactly the regular expressions with alphabet $\{0, 1\}$.
- Using your CFG G , give a derivation and the corresponding parse tree for the string $(0 \cup (10)^*1)^*$.
- Your task is to design a CFG G with set of terminals T that generates exactly the regular expressions with alphabet $\{0, 1\}$.

Question No.05: Consider the following Turing Machine M with input alphabet $\Sigma = \{a, b\}$. The reject state q_{rej} is not shown, and if from a state there is no transition on some symbol then: [Marks= 3+3+4]



As per our convention, we assume it goes to the reject state.

- Give the formal definition of M as a tuple.
- Describe each step of the computation of M on the input **baabab** as a sequence of instantaneous descriptions.
- Describe the language recognized by M . Give an informal argument that outlines the intuition behind the algorithm used by M justifies your answer.

Best of Luck



COMSATS University Islamabad

Department of Computer Science

Terminal Examination SPRING-2024

Instructor: Dr. Mariam Akbar, Dr. Zulfiqar Ali, Dr. AbdulRahman Al-Salehi

Course Title: CSC339 Data Comm. & Computer Networks
Dated: 4th June 2024

Maximum Marks: 50
Time Allowed: 3 Hours

Note: All questions are self-explanatory and require no further explanations during exam time.

- Make sure that you have signed the attendance sheet before leaving the examination room.
- Return the question paper along with the answer sheet.
- Attempt all questions.

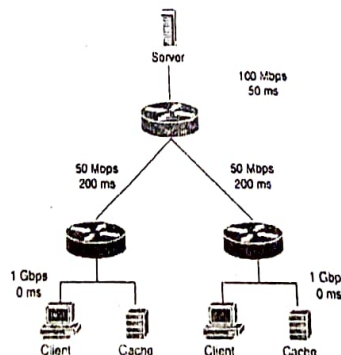
Name: _____

Reg no: _____

CLO-01 (8 Marks) Summarize the fundamental concept of Computer Networks

Question 1:

- [3 points] Suppose two hosts, A, and B, are separated by 20,000 kilometers, and are connected by a direct link of $R = 2$ Mbps. Suppose the propagation speed over the link is 2.5×10^8 meters/sec. Consider sending a file of 800,000 bits from Host A to Host B. Suppose the file is sent continuously as one large message. What is the maximum number of bits that will be in the link at any given time?
- [3 points] What is the end-to-end delay from; when a packet is transmitted by the server to, when it is received by the client? In this case, we assume there are no caches, there's no queuing delay at the routers, and the packet processing delays at routers and nodes are all 0. $b = 20000$



- [2 points] Briefly describe why the actual bandwidth on your cable access network connection on, e.g., a Saturday evening, could be significantly lower than what has been advertised by the provider (Comcast, Charter, etc.)? Would you see the same with a DSL-based provider?

CLO-02 (9 Marks) Apply the concept of computer networks to solve its related problems.

Question 2:

- [4 points] Consider the following network. With the indicated link costs, use Dijkstra's shortest path algorithm to compute the shortest path from x to all network nodes. Show how the algorithm works by computing routes and put the results in the table.

cable access networks often experience significant variations from advertised speeds during peak usage due to shared bandwidth, network congestion, and equipment limitations. While DSL-based providers may offer more stable speeds, they can also be influenced by distance from the service point and line quality, leading to variations in actual performance.



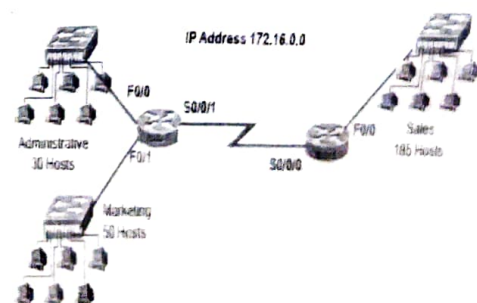
- b. [2 points] Suppose we have a communication channel with a bandwidth of 2 MHz and a signal-to-noise ratio (SNR) of 50. What would be the maximum achievable bit rate and the appropriate signal level for this channel?
- c. [3 points] Suppose a process in Host C has a UDP socket with port number 6789. Suppose both Host A and Host B each send a UDP segment to Host C with destination port number 6789. Will both segments be directed to the same socket at Host C? If so, how will the process at Host C know that these two segments originated from two different hosts?

CLO-03 (17 Marks) Analyze various protocols, algorithms and their functions in a network.

Question 3:

- a. [8 points] Based on the information in the graphic shown, design a classfull network addressing scheme that will supply the minimum number of hosts per subnet, and allow enough extra subnets and hosts for 25% growth in all areas. Circle each subnet on the graphic and answer the questions below.

- Address class: _____
- Custom subnet mask: _____
- Minimum number of subnets needed: _____
- Extra subnets required for 25% growth: _____
- Total number of subnets needed: _____
- Number of host addresses in the largest subnet group: _____
- Number of addresses needed for 25% growth in the largest subnet: _____
- Total number of addresses needed for the largest subnet: _____



- b. [3 points] Suppose a receiver using the CRC generator polynomial $x^4 + x^3 + 1$ receives the sequence of bits 010010101101. Were they received correctly? If so, what was the transmitted message? If not, can you find out how many bit errors occurred? Show your work.

- c. [4 points] Suppose we define a different kind of graph where we have weights on the vertices and not the edges. Does the shortest path problem make sense for this kind of

graph? If so, give a precise and formal description of the problem. If not, explain why not. Note we are not asking for an algorithm, just what the problem is or that it makes no sense.

CLO-04 (16 Marks)

Comprehend the fundamentals of wireless and mobile networks along with the security issues.

Question 4:

- a. [3 points] What are the differences between message confidentiality and message integrity? Can you have confidentiality without integrity? Can you have integrity without confidentiality? Justify your answer. Moreover, what are the principle objectives of cryptography to secure the message.
- b. [5 points] If a periodic signal is decomposed into five sine waves with frequencies of 100, 300, 500, 700, and 900 Hz, what is its bandwidth? Draw the spectrum, assuming all components have a maximum amplitude of 5V.
- c. [3 points] In a wireless network using the RTS/CTS mechanism, if the RTS frame size is 20 bytes and the CTS frame size is 14 bytes, what is the total overhead introduced by the RTS/CTS handshake for each data transmission?
- d. [3 points] Suppose you're designing a new wireless communication protocol for IoT devices operating in a crowded urban environment. Would implementing a handshake mechanism like the RTS (Request to Send) and CTS (Clear to Send) frames in IEEE 802.11 networks be beneficial? Explain the potential advantages and disadvantages of incorporating such a mechanism into your protocol design.
- e. [2 points] Differentiate between:
 - a. Soft handoff vs. Hard handoff
 - b. Visited vs. home networks.