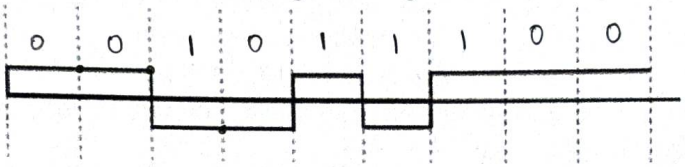
Winter Mid-Semester Examination, Session 2023-24

Examination & Semester: **B.Tech (Computer Science & Engineering) VI Semester**
Subject: **Computer Networks (CSC305)**
Time: **2 Hour**
Max. Marks: **60**

Instructions:

(a) Answer the questions serially and to the point.
(b) Make suitable assumption, if required. Also give the justification for the same.

Q. No.	Question	Marks
1. (a)	Consider the following bit stream that has been encoded using VRC, LRC and even parity. Locate the error if present and re-write the complete bit stream (after correction, if any) : 11000011 11110011 10100010 00001010 00101011 00101011 10100011 00101011	3
(b)	Draw the Differential Manchester Encoding for the given NRZ-I signal: 	2
(c)	We need a three-stage space-division switch with N=100. We use 10 crossbars at the first and third stages and 4 crossbars at the middle stage. Draw the complete layout (configuration) of such a switch [*Atleast show all connections between crossbars no 1, 2 and 10 of stage 1 & stage 3 through stage 2*] and respond to the following question: (i) Calculate the total number of cross points. (ii) Find the possible number of simultaneous connections. (iii) Find the possible number of simultaneous connections if we use a single crossbar (100 x 100). (iv) Find the blocking factor with respect to part (ii) and (iii).	5
2. (a)	Plot a composite signal (in time-domain) having following components (i to iii): (i) A periodic signal having Amplitude: 15 volts and Frequency: 0 Hz. (ii) A periodic signal having Amplitude: 10 volts and Frequency: 4 Hz (iii) A periodic signal having Amplitude: 5 volts, Frequency: 4 Hz and Phase: 90^0. Also plot a frequency-domain representation of a composite signal having only first two components (i & ii).	3
(b)	The loss in a cable is usually defined in decibels per kilometer (dB/km). If the signal at the beginning of a cable with - 0.3 dB/km has a power of 2mW, what is the power of the signal at 5 km? 1.8025	2
(c)	What is a pulse stuffing TDM? Two channels, one with a bit rate of 190 kbps and another with a bit rate 180 kbps are to be multiplexed using pulse stuffing TDM with no synchronization bits. Answer the following questions: (i) What is the size of a frame in bits? (ii) What is the frame rate? (iii) What is the duration of a frame? (iv) What is the date rate?	5

3. (a)	Explain, with a suitable diagram, the various possible propagation modes in a fiber-optic cable.	**3**
(b)	A channel has a bit rate of 4 kbps and propagation delay of 20 msec. For what frame size does stop-and-wait gives an efficiency of at least 50%.	**2**
(c)	Discuss, with a proper diagram, the efficiency of link in error free sliding window flow control process.	**5**
4. (a)	A seven bit Hamming Code is received as 1100101(→). What is the correct code and original data? Make suitable assumption, if required.	**3**
(b)	The following character encoding is used in a data link protocol: A = 01000111; B = 11100011; FLAG = 01111110; ESC = 11100000 Show the bit sequence transmitted (in binary) for the four-character frame: **A B ESC FLAG** when each of the following framing methods are used: (i) Character count (ii) Bit Stuffing	**2**
(c)	Suppose we want to transmit the message (←)1011001001001011 and protect it from errors using the CRC8 polynomial $x^8 + x^2 + x^1 + 1$. (i) Determine the message that should be transmitted. (ii) Suppose the leftmost bit of the message is inverted due to noise on the transmission link. What is the result of the receiver's CRC calculation? How does the receiver know that an error has occurred?	**5**
5. (a)	Shows the operation along with type of frames involved in the following activities, handled by HDLC, with a suitable example: (i) Two-way Data Exchange (ii) Busy Condition	**4**
(b)	Frames of 1000 bits are sent over a 1 Mbps channel using a geostationary satellite whose propagation time from the earth is 270 msec. Acknowledgements are always piggybacked onto data frames. The headers are very short. Three bit sequence numbers are used. For efficient performance, consider the window size is just one less than that of total number of sequence numbers for Go-back N and just half of the sequence numbers for selective reject. What is the maximum achievable channel utilization for: (i) Stop-and-Wait (ii) Go Back N (iii) Selective Reject	**6**
6. (a)	What is the need of a Delta Modulation? Explain its process with a suitable diagram.	**4**
(b)	Following are the parameters for a switching network: N = Number of hops between two given end systems = 4 L = Message length = 3200 bits B = Data rate on all links = 9600 bps P = Fixed packet size including header = 1024 bits H = Overhead (header) = 16 bits/packet S = Call setup time = 0.2 sec D = Propagation delay per hop = 0.001 sec Compute the end-to-end delay for: (i) Circuit Switching. (ii) Datagram Packet Switching (assume waiting time & processing time at each hop is negligible and all datagrams are following the same path).	**6**

Indian Institute of Technology (Indian School of Mines) Dhanbad

Mid-Semester Examination

Software Engineering (CSC306)

Winter 2023-24

Maximum Marks: 56 Time: 2 Hours

Instructions:

1. Answer the questions precisely. Your answers should be correct, not long.
2. There are a total of 3 pages in this Question Paper. All Questions are compulsory.
3. While there are no marks for handwriting, unreadable answers will not get marks.
4. For questions having multiple parts, see the marks break-up before answering.
5. All the information required for answering is provided in the question. Still, if you need to take any assumptions, state them at the start of your answer before answering.
6. **Do ample Rough Work at the back to collect your thoughts, before writing it in the Answer Space.**

Q1. Your software firm had applied for a Bespoke Software Development Project advertised by a Government Agency. You received a message from them that your project has been rejected due to a poor proposal document. Keeping in view, your deep understanding of Software Development, you've been tasked with reviewing the Proposal Document so that the same mistakes are not repeated in future. You have flagged the first paragraph of the first chapter itself for a change. Your annotations on that part of the document are 'shown' below.

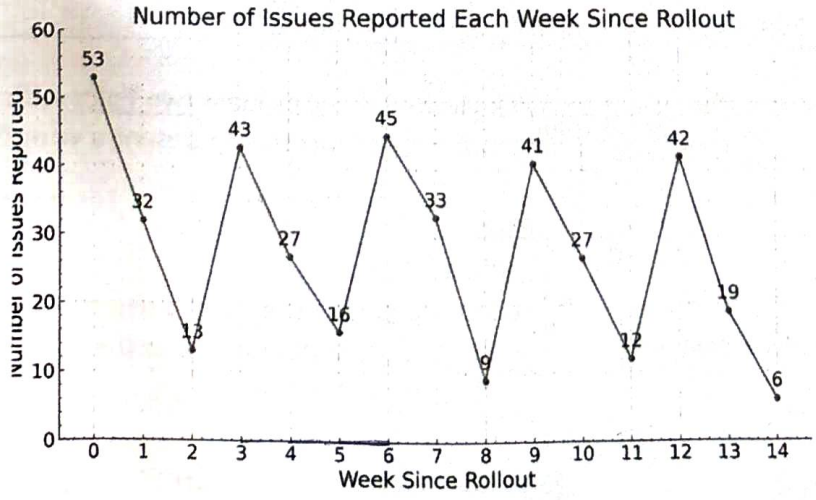
Chapter 1 - Introduction

who wrote this?

A software can be described as a collection of some programs which manipulate information using a set of appropriate data structures. Our firm specialises in building and delivering software solutions. In this project we will be

What is the major problem that I have flagged in this part of the document? Suggest a solution for the same as well. **[2 + 3 = 5 Marks]**

Q2. A Cloud Solutions start-up is struggling with multiple operational problems. They have hired your consultancy firm McKlinsey and Co. to provide them with some solutions. You have been appointed by your firm to consult for the start-up. During your first meeting, you asked the start-up firm about their development cycles, particularly, how often do they put out a major release of their product. The higher administration informed you that they do not have any such data with them. Instead, they have given you access to all company data to find out answers to such questions yourself. You have plotted a graph from the data extracted by their Issue Tracker, shown below:



By looking at the graph, you could deduce the typical period of their development lifecycle in weeks. What is your inference? How can you back your deduction theory based on the body of knowledge available in the Software Engineering domain? **[1 + 4 = 5 Marks]**

Q3. You have been appointed a Judge for a Hackathon arranged by the local District Administration. The event differs from other Hackathons in one major dimension – its duration is 6 Months, instead of 2-3 days. You are going to judge two teams in the event, working on a problem statement to build a Complaint Management System for the people of the District. The major challenge is to experiment with different complaint mediums (e.g., Phone Calls, SMSs, Emails, Web Forms, Mobile Apps etc.) to see which one is the most effective options. While Team A has chosen to use the Waterfall Model for developing the solution, Team B is going to use Scrum. Based on their choice, which of the two teams is more likely to perform better? Provide reasons for your thoughts. **[1 + 5 = 6 Marks]**

Q4. Your web-development start-up is planning to build a website to act as a showcase of your abilities to the prospective investors. After a lot of brainstorming, you have decided to build a SitCom Recommender System (SitCom is a shorthand notation for Situational Comedy Television Series):

The solution aims to deliver a SitCom Recommender System that offers personalized recommendations and integrates social features to enhance user engagement. Key requirements include the ability for users to create (1) profiles, specifying their SitCom preferences and viewing history. The recommendation engine must dynamically generate (2) personalized SitCom recommendations based on user profiles and interactions, continuously refining suggestions through (3) user feedback. Additionally, social integration features such as friend connections, sharing options, and group recommendations are crucial for fostering a collaborative and interactive user experience. Users should be able to connect (4) with friends, share (5) recommendations on social media platforms, and participate in (6) group discussions to discover new SitComs and engage with their social network. Overall, the solution aims to provide a seamless and enjoyable SitCom viewing experience tailored to each user's preferences while fostering social interactions and discovery within the platform.

To initiate the development of the system using an Agile Methodology, prepare two Epics with both the Epics involving precisely four User Stories each. Use the following formats to describe your Epics and User Stories:

User Story:	Epic
◦ Title: ◦ Description: *As a < type of user >, I want < some goal > so that < some reason >.* ◦ Conditions of Satisfaction:	◦ Title: ◦ Description: <2-5 sentences describing the Epic> ◦ Involved User Stories: <List of the Titles of the involved user stories>

[2x2 (for Epics) + 2x8 (for User Stories) = 20 Marks]

Indian Institute of Technology (Indian School of Mines) Dhanbad

Mid-Semester Examination

Software Engineering (CSC306)

Winter 2023-24

Maximum Marks: 56 Time: 2 Hours

Q5. You feel that the existing Competitive Coding Platforms are not the best when it comes to preparation for Placements and Internship Tests. You have taken it upon yourself to create a new, revolutionary Coding Platform for the students to prepare for such events. You have named the platform "Code Veers" and have asked ChatGPT to generate a short description of the platform, which you will use as the Requirements Bible for your development. Based on these requirements, your team is in the process of creating a Software Requirements Specification (SRS) document that can capture the major aspects of the development. Chapter two of the SRS is titled "Functional Requirements" while Chapter three is titled "Quality Requirements". Assuming that each Section of the chapter describes one particular Requirement of the respective type, create the two Chapters of the SRS. Both chapters shall have precisely five sections each. Make sure that no section has more than 3-5 sentences or bullet points. The output generated by ChatGPT is as follows:

Code Veers revolutionizes the coding landscape, providing a dynamic platform for programmers of all levels to hone their skills, engage in friendly competition, and connect with a vibrant community. With seamless user authentication and authorization, individuals can securely create accounts and access personalized features. The platform's diverse language support empowers users to tackle challenges in their preferred programming language, fostering creativity and versatility. Robust contest management functionalities enable administrators to orchestrate thrilling coding contests, complete with configurable parameters and real-time leaderboards, while users can submit their own challenges, contributing to the platform's ever-expanding repertoire. User profiles serve as personalized hubs, allowing individuals to curate their coding journey, track their progress, and interact with peers through intuitive social features. Embracing a commitment to excellence, **Code Veers** prioritizes performance, reliability, security, usability, and scalability, ensuring an unparalleled user experience that propels learners towards coding mastery.

[2x10 (for each Section) = 20 Marks]

All the Best

Indian Institute of Technology (Indian School of Mines) Dhanbad

End-Semester Examination

Software Engineering (CSC306)

Winter 2023-24

Maximum Marks: 100 Time: 3 Hours

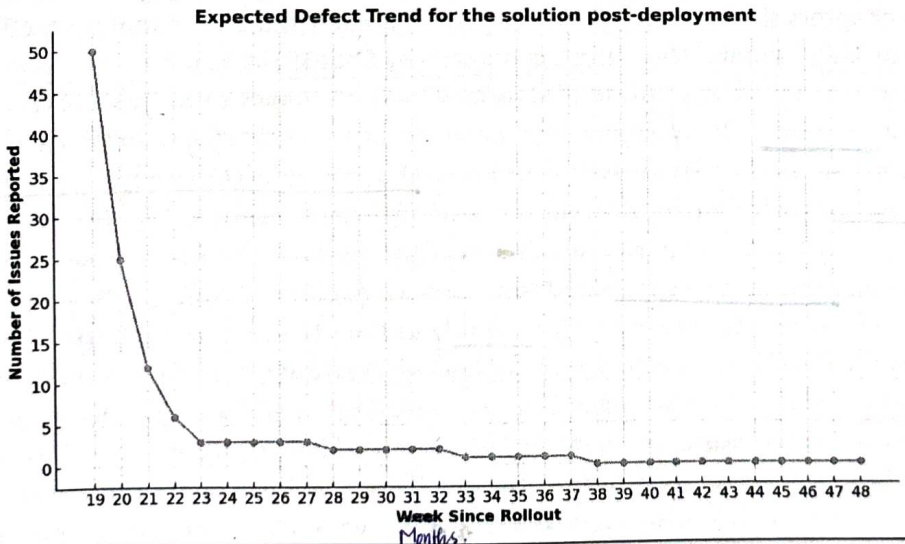
Instructions:

1. Answer the questions precisely. Your answers should be correct, not long.
2. There are a total of 4 pages in this Question Paper. All Questions are compulsory.
3. While there are no marks for handwriting, unreadable answers will not get marks.
4. For questions having multiple parts, see the marks break-up before answering.
5. All the information required for answering is provided in the question. Still, if you need to take any assumptions, state them at the start of your answer before answering.
6. **Do ample Rough Work at the back to collect your thoughts, before writing it in the Answer Space.**

Q1. You have been hired by a newly established private bank as their Chief Technical Officer (CTO), replacing their old CTO. They have entrusted you with this responsibility since you have a fair knowledge of practical challenges with bespoke software projects. An IT firm which has bagged the tender for building the core IT services for the bank have submitted a document detailing their development plans. As the new CTO, you have decided to go through this document, as the tender was awarded when the old CTO was in position. You have flagged a portion of the document to discuss with the representatives of the IT firm. The portion of the document is as shown below ("T" refers to the date of awarding of tender):

Section 4.4 Project Deployment and Maintenance

The project will be deployed by the end of T+18 months. We will also provide complete technical support for the project throughout its lifetime of 48 months. We will make sure that any issues, as reported, are fixed as soon as possible. Any customisations to the solutions will also be performed as required by a dedicated team comprising developers, testers and system administrators. We pledge to bring down the support ticket counts to negligible numbers within six months of deployment (i.e., by T+24 months).



Why have you flagged this part of the document for a discussion? Assuming that the IT firm is open to suggestions from your side, what would you suggest them in this regard? **[3 + 3 = 6 Marks]**

Q2. You have been hired by a start-up for structuring their requirements in a way their technical team can easily consume. You received the following text from them as their brief business requirements:

Shiksha Sahayak is an innovative online platform designed to assist students in selecting the right college for their educational journey. Through comprehensive user profiles and

authenticated login features, registered users can contribute valuable insights and information about various colleges, including reviews on infrastructure, faculty expertise, job placement opportunities, and more. The platform prioritizes user-generated content, allowing students to make informed decisions by accessing authentic and unbiased perspectives shared by their peers. With an intuitive interface and robust search functionalities, **Shiksha Sahayak** empowers students to explore and evaluate their college options based on their unique preferences and academic aspirations, fostering a supportive community dedicated to guiding individuals towards their educational goals.

The development team has expressed their intent to use some Agile Process for the development. Prepare two Epics with both the Epics involving precisely three User Stories each for building the **Shiksha Sahayak** platform. Use the following formats to describe your Epics and User Stories:

User Story:
- Title:
- Description:
  As a < type of user >, I want < some goal > so that < some reason >.
- Conditions of Satisfaction:

Epic
- Title:
- Description: <2-5 sentences describing the Epic>
- Involved User Stories: <List of the Titles of the involved user stories>

[2x2 (for Epics) + 2x6 (for User Stories) = 16 Marks]

Q3. You feel that the existing Interview Preparation Platforms are not the best when it comes to preparation for Placements and Internship Tests. You have taken it upon yourself to create a new, revolutionary Interview Preparation Platform for the job aspirants to prepare for such events. You have named the platform "Youth For Employment" and have asked ChatGPT to generate a short description of the platform, which you will use as the Requirements Bible for your development. Based on these requirements, your team is in the process of creating a Software Requirements Specification (SRS) document that can capture the major aspects of the development. Chapter two of the SRS is titled "Functional Requirements" while Chapter three is titled "Quality Requirements". Assuming that each Section of the chapter describes one particular Requirement of the respective type, create the two Chapters of the SRS. Both chapters shall have precisely four sections each. Make sure that no section has more than 2-3 sentences or bullet points. The output generated by ChatGPT is as follows:

Youth For Employment is an ambitious online platform aimed at empowering job seekers with invaluable insights and resources to navigate the complex landscape of job interviews and company evaluations. Central to its mission is the seamless sharing of interview experiences and candid reviews of employers, fostering a transparent and informed community. The platform prioritizes user engagement and satisfaction, providing intuitive features for users to submit their interview experiences and rate companies based on various factors. Emphasis is placed on performance, ensuring swift access to resources and reliable uptime to accommodate users' needs. Security measures are meticulously implemented to safeguard user data and instill trust in the platform, while usability enhancements prioritize an intuitive interface for users of all backgrounds to effortlessly access and contribute to the wealth of knowledge available. As **Youth For Employment** strives to be the go-to destination for job seekers worldwide, its commitment to both functional excellence and quality assurance underpins its success in empowering individuals on their career journeys.

[2x8 (for each Section) = 16 Marks]

Q4. You are the Project Lead for a new *To-Do App* being designed by your organisation. You have been asked to estimate the effort for the project using the Function Points approach. You have come up with the following table after discussing it with different stakeholders:

Function Type[1]	Function Description	Complexity	Function Points
EI	Add a new task	Medium	4
EI	Update task details	Medium	4
EI	Delete a task	Low	3
EO	Task added confirmation	Low	3
EO	Task update confirmation	Low	3
EO	Task deletion confirmation	Low	3
EQ	View tasks	Medium	4
EQ	Search tasks by date	Medium	4
ILF	Task database	High	7
EIF	User authentication via external API	Medium	5

Assuming that the app will be built in C# for which the estimates are around 53 LOC per Function Point, estimate the size of the project in KLOC. Also, assuming that an average developer can deliver 10 Function Points per month, estimate the effort required for the project in Person-Months.

[8 + 2 = 10 Marks]

Q5. You are designing the architecture for an Online Chess Playing website using the Service-Oriented Design method. You have come up with brief Description of the services as shown in the table below:

A. Chess Board Service
***Purpose**: This service is responsible for rendering the user interface of the chess board. It displays the positions of all pieces on the board, handles user interactions (like piece movements), and updates the board based on game state received from other services.*
B. Game Logic Service
***Purpose**: Manages the core chess rules and mechanics. This service validates all moves made by players, checks for game-ending conditions, and maintains the state of the game.*
C. Authentication Service
***Purpose**: Handles user authentication and security. This service is responsible for user registration, login, and ensuring that users are authenticated during their game sessions.*
D. Matchmaking Service
***Purpose**: Responsible for pairing players for games. This service can match players randomly, by skill level (using a rating system), or allow users to join public/private games.*
E. AI Engine Service
***Purpose**: Provides an AI opponent for players who prefer to play against the computer. This service utilizes chess algorithms and possibly machine learning models to make strategic decisions.*

Write (in not more than 3-5 sentences) the key responsibilities of each Service in the overall system. Create a Process View of the system to depict their interrelationships. **[5 + 5 = 10 Marks]**

Q6. You are offering a tutorial on an Online Tutoring Website over Class Diagrams. For an Assignment, you asked a junior to create a use case for designing a Class Diagram as well as a sample Class Diagram representing the same. While the junior did write the use case, she could not do anything further. The use case she created is provided below.

*In our vehicle ecosystem, the **Vehicle** class is the cornerstone, capturing essential details like the manufacturer, design, and production date. From this class, two specific classes are derived, each enhancing the Vehicle with unique traits. The **Car** class adds elements typical of personal road vehicles, including storage capabilities, while the **Motorcycle** class incorporates characteristics unique to two-wheeled transportation, potentially with an add-on for a passenger. These subclasses exemplify the extension of the base Vehicle class attributes and capabilities. Concurrently, the **Fleet** class manages a collection of Vehicle instances. It serves as a composite entity that can encompass an assortment of*

[1] EI: External Inputs; EO: External Outputs; EI: External Inquiries; ILF: Internal Logical Files; ELF: External Logical Files

Vehicle objects, providing mechanisms to modify its composition. This association signifies that the Fleet is a separate entity that simply organizes Vehicle instances under one collective identity, emphasizing that the existence of individual Vehicle objects is not contingent upon their inclusion in the Fleet.

Write down some plausible attributes and methods for each class. Also, create a class diagram to represent their associations. **[2 (for attributes / methods) x 4 + 4 (for diagram) = 12 Marks]**

Q7. For each of the following C code snippets, prepare the Control Flow Graph and calculate the Cyclomatic Complexity.

a.
```
void greet(int hour) {
    if (hour < 12) {
        printf("Good morning!");
    } else {
        printf("Hello!");
    }
}
```

b.
```
void countToN(int N) {
    for (int i = 0; i < N; i++) {
        printf("%d\n", i);
    }
}
```

c.
```
void classifyGrade(int score) {
    if (score > 90) {
        printf("Grade: A");
    } else if (score > 75) {
        printf("Grade: B");
    } else {
        printf("Grade: C or below");
    }
}
```

d.
```
void processInput(int input) {
    switch (input) {
        case 1:
            printf("Option 1");
            break;
        case 2:
            printf("Option 2");
            break;
        case 3:
            printf("Option 3");
            break;
        default:
            printf("Invalid option");
            break;
    }
}
```

[4 (for Control Flow Graph) x 4 + 2 (for Cyclomatic Complexity) x 4 = 24 Marks]

Q8. A start-up that builds custom websites for its clients over the Drupal Content Management System is struggling with a project that involves building the website over the MERN stack. You work as a consultant who helps firms with getting Process Maturity Certificates. The firm plans to manage its workforce based on the levels of the People Capability Maturity Model (PCCM). Their previous consultant had given them a short note as shown below:

To enhance workforce management, an organization should focus on defining and standardizing processes across all departments. Developing comprehensive competency frameworks and aligning them with structured career development programs is essential. Standardizing training, performance management, and recruitment processes is also crucial. It's important to foster a culture of active employee participation in decision-making and continuous improvement efforts. Establishing clear communication channels and feedback mechanisms will help ensure that workforce efforts are aligned with organizational goals, facilitating a cohesive and efficient management approach.

Based on the note, deduce the current PCCM level of the organisation, and the level that they intend to reach. Provide reasons for your deductions. **[2 (for deduction) + 4 (for reasons) = 6 Marks]**

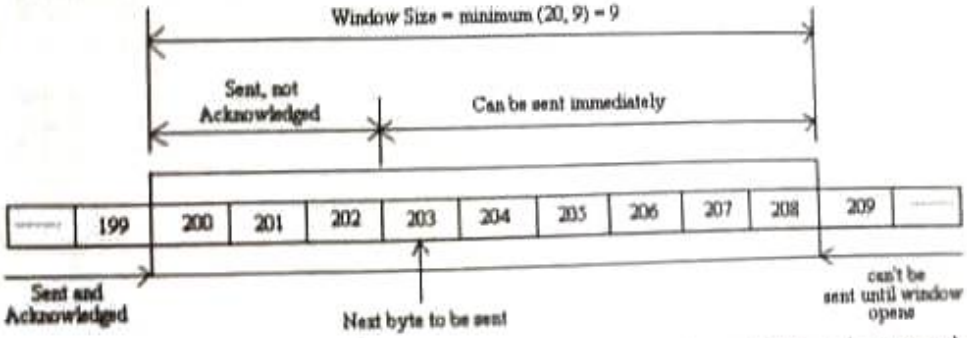
All the Best

Winter Semester Examination, Session 2023-24

Examination & Semester: **B.Tech. (Computer Science & Engineering) VI Semester**
Subject: **Computer Network(CSC305)**
Time: **3 Hours**
Max. Marks: **100**
Instructions:

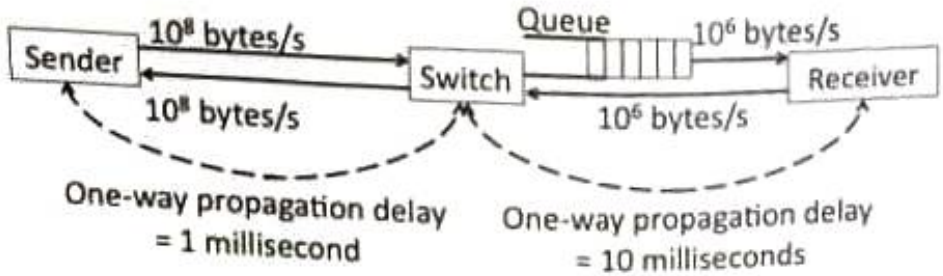
(a) Answer the questions serially and to the point.
(b) Five marks will be deducted from the total marks, if the instruction (a) is not followed.

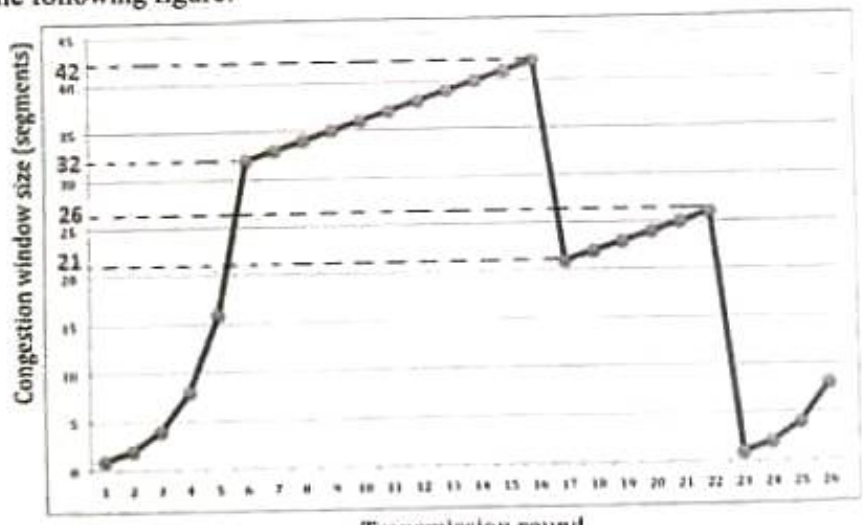
Section A (Marks: 50) – All Questions are COMPULSARY

Q. No.	Question	Marks
1. (a)	A data stream is made of 10 alternating 0s and 1s. Encode this stream using the following encoding schemes: (i) Manchester (ii) Pseudoternary	5
(b)	We need to send 265 kbps over a noiseless channel with a bandwidth of 20 kHz. How many signal levels do we need?	5
2. (a)	A channel has a bit rate of 20 Kbps. The stop and wait protocol with a frame size of 4500 bits is used. The delay for error detection and sending ACK by the receiver is 0.25 sec because of a fault. Find the maximum efficiency of the channel if the destination is 30,000 Km away and the speed of the propagation of the signal is 2.8×10^8 m/s. Find the relative decrease in efficiency due to the fault.	5
(b)	Suppose that the TCP congestion window is set to 18 KB and a time out occurs. Specify the reaction of TCP on time out. How big will the window be if the next four transmission bursts are all successful? Assume that the maximum segment size (MSS) is 1 KB.	5
3. (a)	Network designers generally attempt to deploy networks that don't have single points of failure, though they don't always succeed. Network topologies that employ redundancy are of much interest. Draw an example of a six-node network in which (i) The failure of a single link does not disconnect the entire network. (ii) The failure of any single link cannot disconnect the entire network, but the failure of some single node does disconnect it. (iii) The failure of any single node cannot disconnect the entire network, but the failure of some single link does disconnect it.	5
(b)	The figure shows an unrealistic example of a sliding window. The sender has sent bytes up to 202. We assume that the congestion window (cwnd) is 20 (in reality this value is thousands of bytes). The receiver has sent an acknowledgement number of 200 with a receiver window (rwnd) of 9 bytes (in reality this value is thousands of bytes). Bytes 200 to 202 are sent, but not acknowledged. Bytes 203 to 208 can be sent without worrying about acknowledgement. Bytes 209 and above cannot be sent.  (i) The server receives a packet with an acknowledgement value of 202 and an rwnd of 9. The host has already sent bytes 203, 204, and 205. The value of the cwnd is still 20. Show the new window.	5

	(ii) In new window, the sender receives a packet with an acknowledgement value of 206 and an rwnd of 12. The host has not sent any new bytes. The value of cwnd is still 10. Show the new window.	
4. (a)	A Pure ALOHA network transmits 200-bit frames on a shared channel of 200 kbps. What is the throughput if the system (all stations together) produces 1000 frames per seconds? Write the throughput for Slotted ALOHA network too.	5
(b)	Suppose a router has built up the following routing table: Subnet Number | Subnet Mask | Next Hop 128.96.170.0 | 255.255.254.0 | Interface 0 128.96.168.0 | 255.255.254.0 | Interface 1 128.96.166.0 | 255.255.254.0 | R2 128.96.164.0 | 255.255.252.0 | R3 Default | | R4 The router can deliver packets directly over interfaces 0 and 1, or it can forward packets to routers R2, R3, or R4. Assume the router does the longest prefix match first. Describe what the router does with a packet addressed to each of the following destinations: (i) 128.96.171.92 (ii) 128.96.167.151 (iii) 128.96.163.151	5
5. (a)	An organization is granted a block of addresses with the beginning address 14.24.74.0/24. The organization needs to have 2 subblocks of addresses to use in its two subnets: one subblock of 120 addresses, and other subblock of 60 addresses. Design the subblocks (i.e., indicates the first and last address of each block. Also shows the list of unused addresses.).	5
(b)	What is the purpose of DNS? Consider the resolution of the domain name www.iitism.ac.in by a DNS resolver. Assume that no resource records are cached anywhere across the DNS servers and that iterative query mechanism is used in the resolution. Calculate the number of DNS query-response pairs involved in completely resolving the domain name. Also show each interaction.	5

Section B (Marks: 30) – Attempt Any TWO

6. (a)	Sixteen stations, numbered 1 through 16, are contending for the use of a shared channel by using the adaptive tree walk protocol. If all the stations whose addresses are prime numbers suddenly become ready at once, how many bit slots are needed to resolve the contention?	5
(b)	Suppose we want to transmit the message (←)1011001001001011 and protect it from errors using the CRC8 polynomial $x^8 + x^2 + x^1 + 1$. (i) Determine the message that should be transmitted. (ii) Suppose the leftmost bit of the message is inverted due to noise on the transmission link. What is the result of the receiver's CRC calculation? How does the receiver know that an error has occurred? Note: A bit next to arrow (←) is the one which will be transmitted first.	6
(c)	Consider the network topology shown below. Assume that the processing delay at all the nodes is negligible. 	4

	(i) The sender sends two 1000-byte data packets back-to-back with a negligible inter-packet delay. The queue has no other packets. What is the time delay between the arrival of the first bit of the second packet and the first bit of the first packet at the receiver? (ii) The receiver acknowledges each 1000-byte data packet to the sender, and each acknowledgment has a size A = 100 bytes. What is the minimum possible round trip time between the sender and receiver?	
7. (a)	A computer sends a timestamp request to another computer. It receives the corresponding timestamp reply at 3:46:07 AM. The values of the original timestamp, receive timestamp, and transmit timestamp are 13,560,000 msec, 13,562,000 msec, and 13,564,300 msec, respectively. (i) What is the sending trip time? (ii) What is the receiving trip time? (iii) What is the round-trip time? (iv) What is the difference between the sender clock and the receiver clock? Note: Time calculation always starts from 0:0:0 AM.	5
(b)	If 11,980 bytes data payload is inserted into an IP packet with no options, and is transmitted over a link with an MTU (Maximum Transfer Unit) of 3300 bytes. The packet arrived a network and it need to be transmitted again over a link with an MTU of 1300 bytes. Show the details of the fragmented packets along with its value for MF, offset field, total data and its range.	6
(c)	Let us consider a Statistical TDM of packets. The number of sources is 10. In a time unit, a source transmits a packet of 1000 bits. The number of sources sending data for the first 20 time units is 6, 9, 3, 7, 2, 2, 2, 3, 4, 6, 1, 10, 7, 5, 8, 3, 6, 2, 9, 5 respectively. The output capacity of multiplexer is 5000 bits per time unit. Calculate the average number of backlogged of packets per time unit during the given period. Note: Backlog is the count of packets not sent in a particular time unit.	4
8. (a)	Explain the concept of pushing data and urgent data of TCP. Show the position of its associated flags in the control bit/flags of TCP.	5
(b)	Consider the following figure:  Assuming TCP is the protocol experiencing the behavior shown in the above figure, answer the following questions. i) Identify the interval of time when TCP slow start is operating. ii) Identify the interval of time when TCP congestion avoidance is operation. iii) After the 16th transmission round, is segment loss detected by a triple duplicate ACK or by a timeout? Specify the value of new congestion window. iv) After the 22nd transmission round, is segment loss detected by a triple duplicate ACK or by a timeout? Specify the value of new congestion window. v) What is the value of ssthresh at the 24th transmission round? vi) During what transmission round is the 70th segment sent?	6

(c)	Explain, with a proper diagram, the architecture of SMTP. What is the difference between MAIL FROM: in SMTP and From: in the mail message itself?	4

Section C (Marks: 20) – All Questions are COMPULSARY

9. The cache table content of the ARP is: **10**

State	Queue	Attempt	Time-Out	Protocol Address	Hardware Address
R	5		900	180.3.6.1	ACAE32457342
P	2	2		129.34.4.8	
P	14	5		201.11.56.7	
R	8		450	114.5.7.89	457342ACAE32
P	12	1		220.55.5.7	
F					
R	9		60	19.1.7.82	4573E3242ACA
P	18	3		188.11.8.71	

Assume that the maximum permissible attempt made for ARP request is 5. Write the outcome of the following operations and also show the content of cache table after each operation (in order):

(i) The ARP output module receives an IP datagram (from the IP layer) with the destination address 114.5.7.89.
(ii) Twenty second later, the ARP output module receives an IP datagram (from the IP layer) with the destination address 116.1.7.22.
(iii) Fifteen seconds later, the ARP input module receives an ARP packet with target protocol (IP) address 188.11.8.71.
(iv) Twenty-five seconds later, the cache-control module updates every entry.

10. A host sends four segments and receives three acknowledgements after the establishment of connection. The time is shown as hour:minute:seconds. **10**

(i) Host sent SYN segment at 0:0:00.
(ii) Host received SYN+ACK segment at 0:0:02.
(iii) Host sent ACK segment at 0:0:04.
(iv) Segment 1 was sent at 0:0:06
(v) Segment 2 was sent at 0:0:08
(vi) ACK for segments 1 and 2 received at 0:0:10
(vii) Segment 3 was sent at 0:0:12 and was lost on transit
(viii) Segment 3 was re-sent on time-out.
(ix) ACK received for Segment 3 at 0:0:25.
(x) Segment 4 was sent at 0:0:27
(xi) ACK for segment 4 received at 0:0:31

Assume the initial value of RTO is 8 seconds. Calculate the values of Measured RTT (RTT_M), Smoothed RTT (RTT_S), RTT Deviation (RTT_D), and Retransmission Time-Out (RTO) at different point of time. Also mention the reason of calculating or not calculating new RTO at different stages.