Khulna University
CSE Discipline
CSE 4103: Computer Graphics
Class Test # 1, Date: 22 February 2018

		Marks
1.	Using proper figure derive the transformation that rotates translate an object θ^0 about the origin	10
2.	Suppose you want to scale an object by one-half in the vertical direction and then rotate it by 45 degree. What will be the transformation matrix?	10
3.	Magnify the triangle with vertices A (0, 0), B (1, 1) and C (5, 2) to twice its size while keeping C (5, 2) fixed.	10

Khulna University, CSE Discipline
CSE 4103: Computer Graphics
Class Test # 2, Date: 28 March 2018

		Marks
1.	For the rectangular window boundaries given as $x_{min}=2$, $y_{min}=2$, $x_{max}=8$, $y_{max}=8$, check the visibility of the following segments using the Cohen-Sutherland algorithm and, if necessary, clip them against the appropriate window boundaries. Line AB: A(3,10) B(6,12), Line CD: C(4,1), D(10,6)	15
2.	A window is defined by the coordinates of its lower left corner (2, 2) and upper right border (8, 6). A line segment from A(4,3) to B(10,5) is to be clipped against this window. Find the endpoint codes of the line and their AND logical intersection. If needed, calculate the points of intersection of the line against the window boundaries by the midpoint subdivision method.	15

Date: 26. 04. 2018

KHULNA UNIVERSITY, KHULNA
Computer Science and Engineering Discipline
4th Year, Term I
Session: 2017-2018
Course No: CSE 4103
Full Title of Course: Computer Graphics
Full Marks: 60 Time: 03 Hours

- The figures in the margin indicate full marks. The questions are of equal value.
- Use separate sheet for each section.

Section A

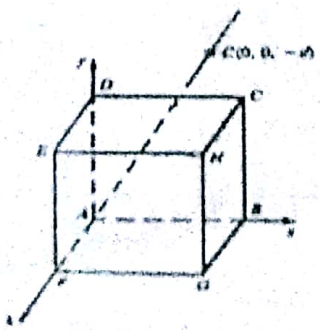
There are **FOUR** questions in this section. Answer any **THREE** questions

1(a)	What is computer graphics? Describe some of its application.	03
(b)	Briefly describe the steps required for analogue to digital (A/D) conversion.	04
(c)	Write down the steps that are required to plot a line whose slope is between 0^0 and 45^0 using the slope-intercept equation.	03
2(a)	Explain digital differential analyzer (DDA) algorithm for scan converting a line.	04
(b)	Compare boundary and flood fill algorithm.	02
(c)	Explain scan line polygon area algorithm.	04
3(a)	Reflect the diamond shaped polygon whose vertices are *A(-1, 0), B(0, -2), C(1, 0),* and *D(0, 2)* about the line $y = x+2$.	05
(b)	Generate the intermediate points for the line whose starting point is at (1,1) and ending point is at (8,5) using 12 Bresenham's line drawing algorithm.	05
4(a)	Magnify the triangle with vertices *A(0,0), B(1,1),* and *C(5,2)* to twice its size while keeping *C(5,2)* fixed.	05
(b)	Show that $R_\alpha . R_\beta = R_\beta . R_\alpha = R_{\alpha+\beta}$.	03
(c)	Define vanishing point and principal vanishing point.	02

Section B

There are **FOUR** questions in this section. Answer any **THREE** questions

5(a)	Explain the Cohen- Sutherland line clipping algorithm.	05
(b)	Perform a 45^0 rotation of triangle A(0,0), B(1,1) C(5,2) about P(-1,-1).	03
(c)	What do you mean by a composite transformation?	02
6(a)	What steps are required to scan convert a circle using Bresenham's algorithm.	03
(b)	For the rectangular window boundaries given as $x_{min}=2$, $y_{min}=2$, $x_{max}=8$, $y_{max}=8$, check the visibility of the following segments using the Cohen-Sutherland algorithm and, if necessary, clip them against the appropriate window boundaries. Line AB: A(3,10) B(6,12), Line CD: C(4,1), D(10,6)	05
(c)	Classify orthogonal projection.	02
7(a)	Find the matrix for mirror reflection with respect to the plane passing through the origin and having a normal vector whose direction is $N = I + J + K$.	05
(b)	Define projection. Explain the perspective anomalies.	05
8(a)	Find a transformation A_V which aligns a given vector $V = aI + bJ + cK$ with the vector **K** along the positive z-axis.	06
(b)	The unit cube in the following figure is projected onto the xy plane. Note the position of the x, y, and z axes. Draw the projected image using the standard perspective transformation with d = 10.	04



1. Three dice are thrown. What is the probability that the same number appears on exactly two of the three dice. (5)

2. Suppose that 5 percent of men and 0.25 percent of women are color-blind. A color blind person is chosen at random. What is the probability that the person is male? Assume that there are equal number of males and females. (5)

3. A gambler has two coins in his pocket. One coin is a fair coin and the other is a two-headed coin. He selects one of the coins at random, flips it, and gets head. What is the probability that he selected the fair coin? (5)

4. An urn contains b black balls and r red balls. One of the balls is drawn at random, but when it is put back in the urn, c additional balls of the same color are put in with it. Now suppose that we draw another ball. What is the probability that the first ball drawn was black given that the second ball is red? (5)

1. We roll a die 10000 times. X is a random variable that denotes the number of times '2' appeared. Determine P {X = 450}. (2)

2. We roll a die 5 times. X is a random variable that denotes the number of times '4' did not appear. Determine F(3). (8)

3. A random variable generator generates 1, 2, 3, or 4 each time we run it. We run this generator 3 times. X is a random variable that denotes the number of times '1' appears. Determine E[X]. (8)

4. A continuous random variable X is uniformly distributed over the interval 5 to 10. Determine $E[(x-1)^2]$. (2)

Date: 03. 05. 2018

KHULNA UNIVERSITY, KHULNA
Computer Science and Engineering Discipline
4th Year, Term I
Session: 2017-2018
Course No: CSE 4121
Full Title of Course: **Applied Probability and Queuing Theory**
Full Marks: 60 Time: 03 Hours

- The figures in the margin indicate full marks. The questions are of equal value.
- Use separate sheet for each section.

SECTION A

There are **FOUR** questions in this section. Answer any **THREE** questions.

1. a) Explain sample space, event, and probability with examples. **03**

b) Five dice are thrown. What is the probability that the same number appears on exactly four of these? **03**

c) Two dice are rolled. What is the probability that the summation of the two face values is at least 6? **02**

d) A coin is to be tossed until a head appears twice in a row. If the coin is fair, what is the probability that it will be tossed exactly four times? **02**

2. a) What is conditional probability? **01**

b) Consider two urns. The first contains two white and seven black balls, and the second contains five white and six black balls. We flip a fair coin and then draw a ball from the first urn or the second urn depending on whether the outcome was heads or tails. What is the conditional probability that the outcome of the toss was heads given that a white ball was selected? **04**

c) Assume that each child who is born is equally likely to be a boy or a girl. If a family has two children, what is the probability that both are girls given that the eldest is a girl? **03**

d) Describe Bayes' formula. **02**

3. a) What is cdf? What are the properties of it? **02**

b) Calculate E[X] if X is a Binomial random variable. **04**

c) An experiment consists of rolling 50 dice. What is the probability that 20 of these dice will not show 4? **02**

d) From the definition of a geometric random variable, show that it's probability mass function is, $p(n) = (1-p)^{n-1}p$. **02**

4. a) An experiment consists of rolling a die 5 times. X is a random variable that denotes the number of times 2 appears. Determine the value of cumulative distribution function F(3). **03**

b) Show that the expectation of a random variable uniformly distributed over the range (α, β) is $\frac{\beta+\alpha}{2}$. **04**

c) A random variable X is uniformly distributed over the interval (0, 1). Determine $E[(x-1)^3]$. **03**

SECTION B

There are **FOUR** questions in this section. Answer any **THREE** questions.

5. a) Describe and prove Markov's inequality. **04**

b) If X is a random variable with mean μ and variance σ^2, then for any value $k > 0$, show that $P\{|X-\mu| \geq k\} \leq \frac{\sigma^2}{k^2}$. **03**

c) The number of items produced in a factory during a week is a random variable with mean 500. If the variance of a week's production is 150, then what can be said about the probability that this week's production will be between 350 and 650. **03**

6. a) Define queue. Write the balance question for M/M/1 queue and show that $P_n = \left(\frac{\lambda}{\mu}\right)^n \left(1 - \frac{\lambda}{\mu}\right), n \geq 1$ where λ and μ represent arrival and service rates. **06**

b) Show that the average number of customers in an M/M/1 queuing system is $L = \frac{\lambda}{\mu - \lambda}$. **02**
The terms have their usual meanings.

c) Suppose that the customers arrive at an M/M/1 queuing system with a Poisson rate of one per every 20 minutes, and the service rate is exponential at a rate of one service per 10 minutes. Determine L and W. **02**

7. a) Define Markov chain. **01**

b) A man has two fair coins on a table. Each coin shows HEAD. The man randomly selects a coin, flips it, and puts it back on the table. He performs this activity two times. Determine the probability that each coin will now show TAIL. **04**

c) Balls are successively distributed among 4 urns with each ball being equally likely to be put in any one of the urns. What will be the probability that there will be exactly 2 non-empty urns after three balls have been distributed? **05**

8. a) Define transient and recurrent states in a Markov chain. What is an irreducible Markov chain? **03**

b) Consider that a Markov chain consisting of four states 0, 1, 2, and 3 have the following transition probability matrix. Determine the classes of states. Find out which states are transient and which states are recurrent. (4) **04**

$$P = \begin{Vmatrix} 0.5 & 0.5 & 0 & 0 \\ 0.5 & 0.5 & 0 & 0 \\ 0.25 & 0.25 & 0.25 & 0.25 \\ 0 & 0 & 0 & 1 \end{Vmatrix}$$

c) A particular day can be rainy or sunny. There is 80% possibility that tomorrow's weather will be like today's weather. If it is raining today, what is the probability that the day after tomorrow will be sunny? **03**

Computer Science and Engineering Discipline

Course: **CSE 4111,** Course Title: **Computer Networks**

Class Test: **1,** Time: **45 minutes,** Marks: **30**

1.	(a) Differentiate Internet and Intranet. (b) Draw a computer network of Internet that consists all of LAN, MAN and WAN types of networks.	2 8
2.	(a) FM radio spectrum is 88MHz to 108MHz and each radio station can be assigned 200KHz. What is the maximum number of radio stations possible in your FM band? Assume a guard band 50KHz between two radio stations. If $SNR_{dB} = 12$, what is the capacity (bps) of each radio station? (b) Human audio spectrum is 20Hz to 20KHz. If the signal is modulated using M = 256 signaling levels, what is the capacity (bps) of human audio? (c) Discuss whether the audio of (b) can be transmitted through the channel of (a)? If not how the parameters of (b) can be modified to allow the transmission? Show in detail.	7 6 7

Course: **CSE 4111,** Course Title: **Computer Networks**
Class Test: **2,** Time: **50 minutes,** Marks: **30**

1.	Draw the digital encoded signals of the following bit stream using **Differential Manchester**, and **HDB3** encoding schemes. **1 1 0 0 0 0 1 1 0 0 0 0 1 1 0 0 0 1**	**8**
2.	Design a new modulation technique, where you combine **BFSK**, **BASK**, and **BPSK** and encode the above given digital bit stream.	**10**
3.	Consider a setup, where a sender has 12 frames in the queue to be sent to the receiver while it can send up to 7 frames at a time. Draw the steps when sender-receiver are following **Go Back N error control** protocol for the scenarios, **a) a frame is received in out of order** in the receiver end**, b) an acknowledgement is lost** from receiver to the transmitter end.	**12**

Course: **CSE 4111,** Course Title: **Computer Networks**
Class Test: **3,** Time: **45 minutes,** Marks: **30**

1.	Your software company has assigned you to design an Intranet for them but they have limited budget. Authority has decided to buy networking devices such as HUB, BRIDGE and LEVEL-2 SWITCH if required. Their network has following requirements. • Connect eight offices which are in four different cities. Their internal network topologies are 2 offices use BUS, 2 offices use RING, 3 offices use STAR and the other one-use MESH. • You can only use above mentioned networking devices if required. Consider, each office has minimum 2 passive networking nodes. Draw the complete network diagram for your Intranet. Explicitly identify your networking device types.	**15**
2.	Replace your networking devices from the above designed diagram with ROUTERs. Create direct links between routers so that every router is directly connected with at least two other routers. If the organization has bought a Class C address 201.200.199.0, help the company to identify the sub-networks available in your designed network, by identifying the subnet mask, assigning addresses to each of the sub-networks, assigning needed IP addresses to the networking devices, respective interfaces and computers or printers. Assume that there is at least one computer and one networked printer on each of the offices.	**15**

Date: 10. 05. 2018

KHULNA UNIVERSITY, KHULNA
Computer Science and Engineering Discipline
4th Year, Term I
Session: **2017-2018**
Course No: **CSE 4111**
Full Title of Course: **Computer Networks**
Full Marks: **60** Time: **03** Hours

- The figures in the margin indicate full marks. The questions are of equal value.
- Use separate sheet for each section.

SECTION A

There are **FOUR** questions in this section. Answer any **THREE** questions.

Q1. a) Describe circuit switching and packet switching network. How does TCP and UDP relate to them. **03**

b) Differentiate OSI and TCP/IP protocol architecture reference models. **03**

c) Draw the frequency domain of the following time domain signal. Also, find out the spectrum, absolute bandwidth and possible data rate of the given signal. Make necessary assumptions if required. **03**

$$\left(\frac{1}{2}\right)[\sin(2\pi(f)t) + \left(\frac{2}{3}\right)\sin(2\pi(2f)t) + \left(\frac{3}{5}\right)\sin(2\pi(3f)t) + \left(\frac{5}{7}\right)\sin(2\pi(5f)t) + \left(\frac{7}{9}\right)\sin(2\pi(6f)t)]$$

d) How does socket program work? **01**

Q2. a) Suppose that a color TV picture is to be transmitted from a source that uses a matrix of 640x480 picture elements (pixels). If a Color TV uses 3 separate RGB pixels to represent one color pixel, where each RGB pixel can take one of 128 color values then find the source data rate (bps). **06**

I. Assume that the TV picture is to be transmitted over a channel with 4 MHz bandwidth and 10 dB signal-to-noise ratio. Find the capacity of the channel (bps).

II. Discuss whether the TV signal can be transmitted through the mentioned channel? If not, how the parameters can be modified to allow the transmission? Give details.

b) FM radio spectrum is 88MHz to 108MHz and each radio station can be assigned 100KHz. What is the maximum number of radio stations possible in FM band? If $SNR_{dB} = 10$ dB, what is the capacity (bps) of each radio station? **04**

Q3. a) Draw the digital encoded signals of the following bit stream using **Bipolar AMI**, **B8ZS**, and **HDB3** encoding schemes. **03**

1 0 0 0 0 0 0 0 0 0 1 1 0 0 0 0 1 1 0 1

b) Draw 8-QAM signal of the following bit stream. **04**

11101010000110101011000011100 0

c) For a parabolic reflective antenna with a diameter of 2 m, operating at 12 GHz, what is the effective area and the antenna gain? **03**

Q4. a) Briefly explain optical fiber data transmission approach. **02**

b) What are the four possible types of data and signal combinations? Explain briefly. **02**

c) For the **Sliding Window** based **flow control** protocol, a frame number is chosen using **K** bits. Theoretically, the window size can be maximum 2^K**-1**. Explain why? **02**

d) Consider a setup, where a sender has 13 frames in the queue to be sent to the receiver while it can send up to 7 frames at a time. Draw the steps when sender-receiver are following **Go Back N error control** protocol for the scenarios, **a) a frame is received in out of order** in the receiver end, **b) an acknowledgement is lost** from receiver to the transmitter end. **04**

SECTION B

There are **FOUR** questions in this section. Answer any **THREE** questions.

Q5. a) Consider there are 5 mobile operators that support mobile calls both inter and intra operators. Here, every BTS tower can accept 50 mobile calls at any time and each mobile **06**

call is allocated 4KHz full duplex voice channel. BTCL terminates inter operator mobile calls as well as the calls that are destined outside of the country.

I. Design an analog carrier system for the mobile operators along with all intermediate device bandwidth.

II. Show the call path between two mobiles, when a mobile call is initiated inside one operator.

III. Show the call path when a mobile call is initiated between two different operators.

b) In a CRC error-detecting scheme, the generator polynomial is $X^3 + X^2 + 1$. Encode the bits 10111100. **04**

Q6. a) Your software company has assigned you to design an Intranet for them but they have limited budget. Authority has decided to buy networking devices such as HUB, BRIDGE and LEVEL-2 SWITCH if required. Their network has following requirements. **05**

I. Connect eight offices which are in four different cities. Their internal network topologies are 2 offices use BUS, 2 offices use RING, 3 offices use STAR and the other one-use MESH.

II. You can only use above mentioned networking devices if required. Consider, each office has minimum 2 passive networking nodes.

III. Draw the complete network diagram for your Intranet. Explicitly identify your networking device types.

b) What is the difference of CSMA and CSMA/CD protocol? **02**

c) Differentiate SWITCH, BRIDGE and ROUTER. **03**

Q7. a) Explain fragmentation and re-assembly using an example network. **04**

b) Consider an organization has 7 subnets in its intranet. If it has bought a Class C address 197.198.199.0, help the company to identify the sub-networks available in your designed network, by identifying the subnet mask, assigning addresses to each of the sub-networks, assigning needed IP addresses to the networking devices and computers. Assume that there are two computers on each of the offices. **06**

Q8. a) What is distance vector routing? Explain Routing Information Protocol algorithm. **04**

b) Show the steps to find the shortest path from source router E to all other routers for the following network. Write down the link state based routing table of router E. **04**

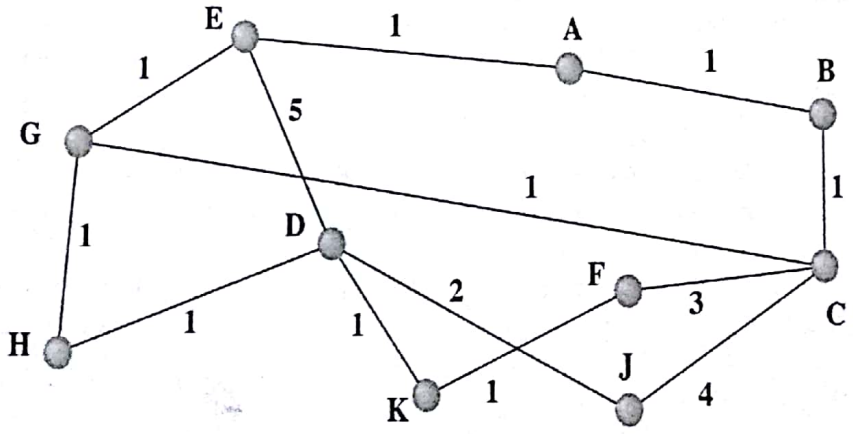


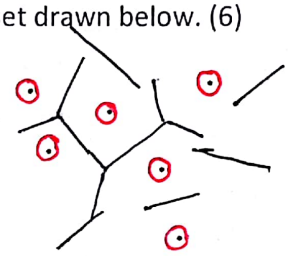
Figure 8.c

c) What is congestion? How can we control it? **02**

Q1. Define Art Gallery Problem. (20)

Q2. Let P be a set of n points in the plane in general position—that is, no three points in P are collinear. In pseudocode, write an algorithm that reorders P into a sequence S such that the path that visits the points of S in order (following straight edges from point to point) makes left turns only. In other words, any three consecutive points in S occur in counterclockwise order. (10)

1) (Mark True or False) (2 points each).
   a) The largest angle in a DT cannot exceed 90 degrees.
   b) Among all triangulations, the DT has the minimum total edge length.
   c) Among all triangulations, the DT maximizes the minimum angle.
   d) Among all triangulations, the DT minimizes the maximum angle.
2) Numerical Answer (3 points each).
   a) An arrangement of n lines in general position defines a planar subdivision with how many vertices, edges, and faces (in big-O notation)?
   b) What is the maximum degree of a vertex of a Delaunay Triangulation of n points in general position?
3) Draw the Delaunay Triangulation of the point set drawn below. (6)



4) You are given a set P of n points in general position on the plane. Give an efficient algorithm to find the largest empty circle whose center lies inside the convex hull of the point set P. (10)

Date: 17. 05. 2018

KHULNA UNIVERSITY, KHULNA
Computer Science and Engineering Discipline
4th Year, Term I
Session: **2017-2018**
Course No: **CSE 4125**
Full Title of Course: **Computational Geometry**
Full Marks: **60** Time: **03** Hours

- The figures in the margin indicate full marks. The questions are of equal value.
- Use separate sheet for each section.

SECTION A

There are **FOUR** questions in this section. Answer any **THREE** questions.

1(a) Discuss the applications of Computational Geometry in the field of GIS and Motion Planning. **04**
(b) Let P be a set of n points in the plane in general position that is, no three points in P are collinear. In pseudo code, write an algorithm that reorders P into a sequence S such that the path that visits the points of S in order (following straight edges from point to point) makes left turns only. In other words, any three consecutive points in S occur in counter clockwise order. **06**

2(a) Develop two different algorithms for computing convex hull of a given set of points P in the plane. **08**
(b) Compare the complexity of the algorithms of 2.a. **02**

3(a) Write some common features of sweep line algorithms? **03**
(b) Let a point r lies left or right of the directed line through two points p and q. Also let

$p = (p_x, p_y)$, $q = (q_x, q_y)$, and $r = (r_x, r_y)$.

i) Show that the sign of the following determinant determines whether r lies left or right of the line. **04**

$$D = \begin{vmatrix} 1 & p_x & p_y \\ 1 & q_x & q_y \\ 1 & r_x & r_y \end{vmatrix}$$

ii. Also show that |D| in fact is twice the surface of the triangle determined by p, q, and r. **03**

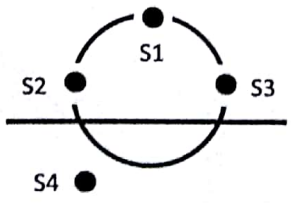
4(a) Prove that a triangulated polygon is 3-colorable. **03**
(b) Prove that a simple polygon with n vertices can always be triangulated and always with n-2 triangles. **03**
(c) Describe how a y-monotone polygon can be triangulated with O(n) time complexity. **04**

SECTION B

There are **FOUR** questions in this section. Answer any **THREE** questions.

5(a) What is a K-d tree? How is it useful for range search query? **04**
(b) Give algorithms for building and searching K-d trees. Analyze the efficiency of those algorithms. **06**

6(a) Explain how the data structure is changed when Fortunes Algorithm processes the events of following s3 event. **05**



(b) Describe Cell Decomposition and Sampling method for finding path for a robot. **05**

7(a) What is an approximation algorithm? **02**
(b) Develop a 2-approximation algorithm for solving Euclidian Travelling Salesman Problem. **08**

8(a) Prove that a simple polygon with n vertices can be triangulated in $O(n \log n)$ time with an algorithm that uses $O(n)$ storage. **05**
(b) Show the way of triangulating a Monotone Polygon. **03**
(c) What is polygon clipping? Give example. **02**

Continuous Assessment 02 (Compiler Design) **[Time: Not More Than 25 Minutes]**

Construct DFA from the following regular expression: $$(a\|b)^*abc;$$	
i. Construct Syntax tree.	02
ii. Compute First, Last and Follow Positions	06
iii. Construct DFA	05
iv. Justify that the language *aababaabc;* is either valid or not using the DFA.	02

Date: 24.05.2018

KHULNA UNIVERSITY, KHULNA

Computer Science and Engineering Discipline

4th Year, Term I

Session: **2017-2018**

Course No: **CSE 4105**

Full Title of Course: **Compiler Design**

Full Marks: **60** Time: **03** Hours

- The figures in the margin indicate full marks. The questions are of equal value.
- Use separate sheet for each section.

SECTION A

There are **FOUR** questions in this section. Answer any **THREE** questions.

1(a) What is compiler? Why has hybrid compilation system been introduced in some programming language? **03**

(b) What are the phases of a compiler? Consider the following source program- **05**

$r = a + (b - c) * 50$ // an arithmetic expression

Here, a, b and c contain floating values. Write the output of each phase of a compiler considering the above input program.

(c) Syntax and semantic analyzers should be combined into a single phase. Do you agree or not? Explain logically. [Not more than 60 words] **02**

2(a) How can you define a programing language? What are the functionalities of a preprocessor? **03**

(b) Describe the analysis-synthesis model of compilation. **03**

(c) What are the components of a context-free grammar? Consider the following context-free grammar- **04**

$$G \rightarrow GG + |GG * |c|b|a$$

i. Show how the string $cb * c +$ can be generated by the grammar.
ii. Construct a parse tree for this string

3(a) Define Token, Pattern and Lexeme with example. Describe the languages denoted by the following regular expressions: **05**

i. a(a|b)*a
ii. (a|b)*a(a|b)(a|b)
iii. a*ba*ba*ba*

(b) What are the advantages of input buffering technique with sentinels over buffer pairs? Outline the algorithm for input buffering technique with sentinels. **04**

(c) What do you mean by strings and languages? **01**

4(a) Define regular expression. Write the regular definitions for the following languages: **03**

i. All strings of 0's and 1's starting with 1010
ii. All strings of letters and digits having length 0 to infinity.

(b) What do you mean by Finite Automata? "Deterministic Finite Automata is a special case of Nondeterministic Finite Automata"-Explain rationally. **03**

(c) Construct NFA for the following regular expression using Thompson's construction: **04**

$$((a|b)^*(a|b))|c$$

SECTION B

There are **FOUR** questions in this section. Answer any **THREE** questions.

5(a) Define transition diagram. Consider the following regular definitions: **03**

$$D \rightarrow 0|1|2| \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots |9$$

$$L \rightarrow A|B|C| \ldots\ldots\ldots |Z|a|b|c| \ldots\ldots\ldots\ldots\ldots\ldots\ldots |z$$

$$ID \rightarrow (L \mid \_)(L \cup D)^*$$

Draw the transition diagram for ID.

(b) Construct DFA from the regular expression $(c|s)^*cse$ **07**

i. Construct Syntax tree.
ii. Compute First, Last and Follow Positions
iii. Construct DFA
iv. Justify that the language csecsecse is either valid or not using the DFA.

6(a) Define ambiguity. Consider the following grammar: **03**

$$stmt \rightarrow \textbf{if } expr \textbf{ then } stmt$$
$$| \textbf{ if } expr \textbf{ then } stmt \textbf{ else } stmt$$
$$| \ other$$

Here, **other** stands for any other statement.
Show that the following conditional statement is ambiguous with respect to the above grammar.

$$\textbf{if } E_1 \textbf{ then if } E_2 \textbf{ then } S_1 \textbf{ else } S_2$$

(b) Is the following grammar left recursive? Consider the following grammar. **03**

$A \rightarrow A + BC|C$
$E \rightarrow E + T|T$
$T \rightarrow E + F|F$
$F \rightarrow F(E) * |b$

Eliminate left recursion from the above grammar.

(c) Show that the following grammar is LL (1). **04**

$S \rightarrow iEtSS'|a$
$S' \rightarrow eS| \in$
$E \rightarrow b$

7(a) What is left recursion? Eliminate left recursion from the following grammar: **04**

E →E+T|T
T → T*F|F
F →(E)|id

(b) Show that the following grammar **05**

$$S \rightarrow CC$$
$$C \rightarrow aC|d$$

is LR(1).

(c) State the disadvantages of LR parsers. **01**

8(a) What is the difference between static and dynamic type checking? **03**

8(b) Define annotated parse tree. The syntax directed definition in Fig. 8(a) is for a desk calculator program. **04**

Fig. 8(a)

L	$\rightarrow$	E **n**	{ print($E.val$); }
E	$\rightarrow$	$E_1 + T$	{ $E.val = E_1.val + T.val$; }
E	$\rightarrow$	T	{ $E.val = T.val$; }
T	$\rightarrow$	$T_1 * F$	{ $T.val = T_1.val \times F.val$; }
T	$\rightarrow$	F	{ $T.val = F.val$; }
F	$\rightarrow$	(E)	{ $F.val = E.val$; }
F	$\rightarrow$	**digit**	{ $F.val =$ **digit**.$lexval$; }

Construct an annotated parse tree for the input $1 * 4 + 3n$ using the syntax directed definition in Fig. 8(a).

(c) What do you mean by directed acyclic graph? Draw directed acyclic graph for the expression $C + C * (B - D) + (B - D) * (A + E)$ **03**