Maximum Marks: 60
Credits: 04
Duration: Two Hours

Answer all the questions. Assume suitable data if missing. Notations used have their usual meaning.

Q.No.          Question                                                    M.M.
1(a)           Find a minimal DFA for the language \( L = \{ w_1 a w_2 \mid w_1, w_2 \in \{a, b\}^*, |w_1|=2, |w_2|\geq3\} \). [05]
1(b)           Find the extended transition function \( \delta(q_3,aba) \) for \( \lambda \)-NFA and discuss why the concept of nondeterminism is important. [05]

\[ \begin{array}{c|c|c|c}
   \delta & \lambda & a & b \\
   \hline
   q_0 & \{q_2\} & \{q_1\} & \{q_0\} \\
   q_1 & \{q_2\} & \{q_2\} & \{q_3\} \\
   q_2 & \{q_0\} & \emptyset & \emptyset \\
   q_3 & \emptyset & \emptyset & \{q_2\} \\
\end{array} \]

1(c)           Find a regular expression for the language \( L = \{ w \in \{0, 1\}^* : w \) has no pair of consecutive zeros\}. [05]

1(c')          Prove that given a right-linear grammar \( G = (V,T,S,P) \), the language generated \( L(G) \) is a regular language. [05]

OR

2(a)           Define context-free grammar in term of production rules. Discuss how the complexity of exhaustive search parsing is exponential for context-free grammar. [05]

OR

2(a')          Discuss Chomsky normal form and Greibach normal form for context-free grammar. [05]

2(b)           Remove all the unit productions from the grammar given below. [05]

\[ S \to Aa | B, \]
\[ B \to A | bb, \]
\[ A \to a | bc | B. \]

cont'd...
2(b') Show using pumping lemma that the language \( L = \{ww : w \in \{a, b\}^*\} \) is not context-free.

2(e) Find a nondeterministic pushdown automaton NPDA for accepting the language \( L = \{ww^R : w \in \{a, b\}^+\} \).

3(a) Construct a PDA that accepts the language generated by the following grammar.

\[
S \rightarrow aA,
A \rightarrow aABC \mid bB \mid a,
B \rightarrow b,
C \rightarrow c.
\]

3(b) Design a Turing machine that computes the function

\[
f(x, y) = \begin{cases} 
  x + y & \text{if } x \geq y, \\
  0 & \text{if } x < y.
\end{cases}
\]

OR

3(b') What is meant by undecidability? Define the Turing machine halting problem.

4(a) Define unrestricted grammar and context sensitive grammar in terms of production rules. Draw the Chomsky hierarchy.

4(b) Define complexity classes P, NP and NP complete with the help of examples.
Q.No.  Question  M.M.
1(a)  Consider the ER diagram shown in figure below for part of a BANK database. Each bank can have multiple branches, and each branch can have multiple accounts and loans.  [2.5*3]

![ER Diagram]

i. List the strong (nonweak) entity types in the ER diagram.

ii. Is there a weak entity type? If so, give its name, partial key, and identifying relationship.

iii. What constraints do the partial key and the identifying relationship of the weak entity type specify in this diagram?

1(b) How can hashing be used to construct an index? Explain with suitable example.  [7.5]

cont...
2(a) Consider the following schema:

*Actor* (*actorID*, *name*, *nationality*, *age*), *Film* (*filmID*, *title*, *year*, *directorID*),

*Performance* (*actorID*, *filmID*, *character*), *Director* (*directorID*, *name*, *nationality*).

The primary keys are indicated as underlined and foreign keys are also recognizable. For each of the following parts, formulate the specified queries in a relational algebra and tuple-relational calculus.

i. Retrieve details of all actors that are not in their thirties.

ii. Find out the names of all actors that have performed in a film directed by Christopher Nolan.

iii. Retrieve the titles of all films in which Leonardo Di Caprio and Kate Winslet have co-acted.

2(b) List and describe the Codd's twelve rules for RDBMS.

3(a) i. Consider the relation schema Membership for a library database as follows:

*Membership* (*MID*, *Name*, *Address*, *PhoneNum*, *ParentMID*, *ISBN*,

*Title*, *Authors*, *BorrowDate*, *ReturnedDate*, *FineDue*, *FinePaid*).

Here, *ParentMID* may have the values *Null*, *Father_Name*,

*Mother_Name* or both. The following is the set *F* of functional dependencies that hold in Membership table;

\[F = \{ \text{MID} \rightarrow \text{Name, Address, PhoneNum, ParentMID}; \]

\((\text{MID, ISBN, BorrowDate}) \rightarrow \text{ReturnedDate, FinePaid, FineDue};\]

\(\text{ISBN} \rightarrow \text{Title, Authors}\)}

Normalize the Membership schema to 3NF and show the steps.

ii. Consider a relation R(*A*, *B*, *C*) with Functional Dependencies (FD)

\(AB \rightarrow C, AC \rightarrow B, BC \rightarrow A.\)

Determine all the keys of relation R. Is the relation R in BCNF?

3(b) Write pseudo code for locking unlocking operations for shared-exclusive locks.

OR

3'(a) Discuss Two-Phase Locking protocol. Discuss the number of variations of two

phase locking protocols with their merits and demerits.

3'(b) What is view serializability? Consider the following statement:
"Any schedule that is conflict-serializable is also view-serializable, but the reverse is not true."

Is this statement true? Justify your answer with proper example.

4(a) Briefly describe Query Optimization. Discuss five typical instances of situations promoting query tuning with examples.

4(b) Define Distributed Databases (DDB). What are the additional types of transparencies possible in DDB? Draw properly labelled block diagram of Truly Distributed Database Architecture.

OR

4'(a) Discuss in detail, update polices for databases in the presence of a VIEW.

4'(b) What is a data warehouse? List any eight differences between a Data Warehouse and an OLTP Database.
2017-18
B.TECH. (WINTER SEMESTER) EXAMINATION
COMPUTER ENGINEERING
COMPUTER NETWORKS
CO-313
Credits: 04
Duration: Two Hours

Maximum Marks: 60

Q.No  Question  MM

1(a)  What is meant by a protocol? Describe functions of different layers of Internet protocol stack. How does a message flow between a sender and a receiver?  [8]

(b) Consider sending real-time voice from Host A to Host B over a packet switched network (Voice over IP). Host A converts analog voice to a digital 64 kbps bit stream on the fly. Host A then groups the bits into 56-byte packets. There is one link between Host A and B; its transmission rate is 2 Mbps and its propagation delay is 10 msec. As soon as Host A gathers a packet, it sends it to Host B. As soon as Host B receives an entire packet, it converts the packet’s bits to an analog signal. How much time elapses from the time a bit is created (from the original analog signal at Host A) until the bit is decoded (as part of the analog signal at Host B)? Disregard the times of analog-to-digital and digital-to-analog conversions.  [7]

OR

(b') Suppose users share a 1 Mbps link. Also, suppose each user requires 100 kbps when transmitting, but each user transmits only 10 percent of the time.

(i) When circuit switching is used, how many users can be supported?

(ii) For the remainder of this problem, suppose packet switching is used. Find the probability that a given user is transmitting.

(iii) Suppose there are 40 users. Find the probability that at any given time, exactly \( n \) users are transmitting simultaneously. Find the probability that there are 11 or more users are transmitting simultaneously.  [7]

2(a) How do the meanings of Name and Value fields depend on Type field of a resource record in Domain Name System (DNS)? With the help of a suitable diagram, describe the format of a DNS message.  [7]

Contd... 2.
OR

(a') With the help of suitable diagrams, describe different components of email application.

(b) Let there be an institutional network that consists of 10 Mbps Local Area Network (LAN) and is connected to the public Internet via an access link of 1.5 Mbps (Figure 1). Let the average request rate from institution's browsers to origin servers be 15 per second with the average object size 100000 bits. Let the average Internet delay be 2 seconds. What is the total delay? To reduce the total delay, one may either upgrade the bandwidth of the access link to 10 Mbps or install a web cache with a hit ratio of 0.4. What is the total delay for each of these cases? Which solution should one prefer?

3(a) With the help of suitable diagram(s), describe the fairness of TCP.

OR

(a') Consider the TCP procedure for estimating RTT. Suppose that $\alpha = 0.25$. Let $\text{SampleRTT}_1$ be the most recent sample RTT, let $\text{SampleRTT}_2$ be the next most recent sample RTT, and so on.

(i) For a given TCP connection, suppose four acknowledgements have been returned with corresponding sample RTTs $\text{SampleRTT}_1$, $\text{SampleRTT}_2$, $\text{SampleRTT}_3$, and $\text{SampleRTT}_4$. Express $\text{EstimatedRTT}$ in terms of the four sample RTTs.

(ii) Generalize your formula for $n$ sample RTTs.

(iii) For the formula in part (ii) let $n$ approaches infinity. Comment on why this averaging procedure is called an exponential moving average.

(b) Consider the idealized model for the steady-state dynamics of TCP. In the period of time from when the connection's window size varies from $W/(2\text{RTT})$ to $W/\text{RTT}$, only one packet is lost (at the very end of the period).

(i) Show that the loss rate, $L$, is given by

$$L = \text{loss rate} = \frac{1}{\frac{3}{8}W^2 + \frac{3}{4}W}$$

(ii) Use the result above to show that if a connection has loss rate $L$, then its average throughput is approximately given by

\[\text{cont...} 3.\]
\[ \approx \frac{MSS}{\text{RTT}} \frac{3}{\sqrt{2L}} \]

where MSS is Maximum Segment Size.

4(a) Consider a network with six routers named from u to z (as shown in Figure 2). Router u intends to find least-cost paths from itself to all other routers in the network. Describe the computation of least-cost paths using a link state routing algorithm. What is the complexity of such a link state algorithm? With the help of suitable diagrams, describe the problem with the link state routing algorithm.

OR

(a') With the help of suitable diagrams, describe the architecture of a router and its components in detail.

(b) With the help of suitable diagrams, describe the operation of Dynamic Host Configuration Protocol (DHCP).

Figure 1: Institutional network connected to the Internet (figure for Q2(b)).

\[\text{Contd...}4.\]
Figure 2: A network with six routers named from u to z (figure for Q4(a)).
2017-18  
B.TECH. (WINTER SEMESTER) EXAMINATION  
COMPUTER ENGINEERING  
DESIGN AND ANALYSIS OF ALGORITHMS  
CO-314  

Maximum Marks: 60  
Credits: 04  
Duration: Two Hours  

Answer all the questions.  
Assume suitable data if missing.  
Notations used have their usual meaning.  

<table>
<thead>
<tr>
<th>Q.No</th>
<th>Question</th>
<th>M.M.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(a)</td>
<td>Explain in brief the concept of O-notation(Big O), o-notation(small o) and ( \Theta ) (theta) notation.</td>
<td>[6]</td>
</tr>
</tbody>
</table>
| 1(b) | Tower of Hanoi is a mathematical puzzle where we have three rods and \( n \) disks of varying sizes stacked upon in an ascending order, i.e. the smaller ones sit over the larger ones. The objective of the puzzle is to move the entire stack to another rod, obeying the following simple rules:  
1. Only one disk can be moved at a time.  
2. Each move consists of taking the upper disk from one of the stacks and placing it on top of another stack i.e. a disk can only be moved if it is the uppermost disk on a stack.  
3. No disk may be placed on top of a smaller disk.  
   Design an algorithm to solve the above puzzle and analyse the algorithm. | [9]  |

OR  

<table>
<thead>
<tr>
<th>Q.No</th>
<th>Question</th>
<th>M.M.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(b')</td>
<td>Give the proof for Master theorem.</td>
<td>[9]</td>
</tr>
</tbody>
</table>
| 2(a) | Given two sequences, design an algorithm to find the longest subsequence that is common in both of them (LCS).  
A subsequence is a sequence that appears in the same relative order, but not necessarily contiguous. For example, “abc”, “abg”, “bdf”, “aeg”, “acefg”, .. etc are subsequences of “abcdefg”.  
Examples:  
LCS for input Sequences “ABCDGH” and “AEDFHR” is “ADH” of length 3.  
LCS for input Sequences “AGGTAB” and “GXTXAYB” is “GTAB” of length 4. | [9]  |
| 2(b) | Given an array of integers where each element represents the max number of steps that can be made forward from that element. Design an algorithm to return the minimum number of jumps to reach the end of the array (starting from the first element). If an element is 0, then you cannot move through that element.  
Example:  
Input: \{1,3,5,8,9,2,6,7,8,9\}  
Output : 3 \(1 \rightarrow 3 \rightarrow 8 \rightarrow 9\). | [6]  |
2(b') Mansoor is going to an island. He is allowed to carry one bag with him and the bag holds no more than 5 Kg, so he can't bring all what he wants. So, he weighs and values each item he wants to bring. What should he be putting in the bag? The values and weights of different items are as given below. Provide an optimal solution.

<table>
<thead>
<tr>
<th>Item</th>
<th>weight (Kg)</th>
<th>value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Book</td>
<td>5</td>
<td>30</td>
</tr>
<tr>
<td>Game Pad</td>
<td>1</td>
<td>8</td>
</tr>
<tr>
<td>Harmonica</td>
<td>0.5</td>
<td>5</td>
</tr>
<tr>
<td>Roller Blades</td>
<td>2</td>
<td>6</td>
</tr>
</tbody>
</table>

3(a) Given a graph $G=(V,E)$, write an algorithm to compute its Strongly Connected Components. Also demonstrate the working of the algorithm using the graph below.

3(b) Briefly explain the deduction of Prim's algorithm from Generic Spanning Tree Algorithm.

3(b') Explain in brief how Edmonds Karp Algorithm reduces the complexity of Max flow problem in comparison to Ford Fulkerson Method.

4(a) Prove that the CIRCUIT-SATISFIABILITY problem is an NP-Hard problem.

4(b) If a known NP-complete problem is somehow proved to be solvable in polynomial time. Explain with reasons the impact it will have in the problem classes P and NP.

4(b') A problem P1 is such that 3-SAT problem is polynomial time reducible to P1. Also, P1 is polynomial time reducible to 3-SAT. Which of the following is true? Explain.

(i) P1 is NP-hard but not NP-complete
(ii) P1 is in NP, but is not NP-complete
(iii) P1 is NP-complete
(iv) P1 is neither NP-hard, nor in NP.
2017-18
B.TECH. (WINTER SEMESTER) EXAMINATION
COMPUTER ENGINEERING
INTERACTIVE COMPUTER GRAPHICS
CO-315

Maximum Marks: 60 Credits: 04 Duration: Two Hours

Answer all the questions.
Assume suitable data if missing.
Notations used have their usual meaning.

Q.No. Question M.M.

1 Write brief answers for any Five the following:
   i) What do you mean by resolution? What is 4K resolution?
   ii) What is AMOLED technology and how does it compare with LCD?
   iii) What is a GPU? List some advanced current age GPUs.
   iv) Distinguish between Direct and Multiplexed addressing in Graphics displays.
   v) What is Retina display? Explain PPD unit of resolution.
   vi) Operating principle of Liquid Crystal Displays with illustrations.
   vii) Working principle and advantages of Capacitive Touch Screens
   viii) Possible applications of 3D Printers.

2(a) What are the different characteristics of Bezier curves? Derive the blending functions for a quadratic Bezier curve.

2(b) Derive Bresenham's line drawing algorithm. Using this algorithm plot a 3 pixels wide line between (2,6) and (8,10) and show the intermediate values in tabular form. Propose a method to select different line styles through line drawing algorithms.

3(a) Apply the following transformations separately to a unit square with coordinates A(1,1), B(2,1), C(2,2), D(1,2). Determine all the transformations in homogeneous coordinate system.
   a) Shear with parameters $\text{sh}_y = 1/2$ and $x_{\text{ref}} = -1$.
   b) Reflection about the line $y = -x$
   c) Increase the length of diagonal by 2 units.

3(b) Why line clipping algorithms cannot be applied for clipping a Polygon? Mention the

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20/05/18
Time: 12:30/2:30
Evening

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drawbacks of Sutherland Hodgeman Polygon clipping algorithm and how these drawbacks are overcome by Weiler Atherton polygon clipping algorithm? In Figure 1, apply Sutherland Hodgeman Polygon clipping algorithm to clip the polygon \( V_1V_2V_3 \) with respect to the clipping window ABCD.

![Diagram](image)

Figure 1.

**OR**

3b' Classify and define different types of projections with suitable illustrations. Derive a transformation matrix for producing an oblique projection of a point \((x,y,z)\) onto the \(xy\) plane.

4(a) Explain depth buffer algorithm for visible surface detection. Derive the mathematical expressions for calculating the depth along horizontal and vertical scan lines.

**OR**

4(a') Explain Phong model for polygon surface rendering. Compare it with Gouraud surface rendering.

4(b) Differentiate between any four of the following:

(a) Interpolation spline and Approximate spline
(b) Knot point and Control Point
(c) Object space methods and image space methods
(d) Diffuse reflection and Specular reflection
(e) Cabinet and cavalier projection