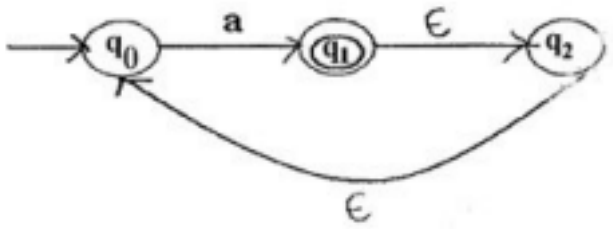
Exam : CIA -1

Sub: Automata Theory Class: Int MSc, Sem VI Time: 12:00 – 1:30 pm Marks: 20

Q -1. Find the complement of the language accepted by the NFA shown below. Assume alphabet $\Sigma = \{a\}$ and ϵ is the empty string. **[3]**



Q-2. Definition of a language L with alphabet {a} is given as following. $\{ a^{n^k} | k > 0$, and n is a positive integer constant$\}$

Draw DFA to recognize L with minimum number of states. **[2]** Q -3. Design Mealy Machine to convert each occurrence of substring 1000 by 1001. **[4]**

Q -4. Define a regular expression. Write a regular expression for the following languages, over alphabet $\Sigma = \{a, b\}$. **[2 + 1 x 3 = 5]**

1. Seventh symbol from right must be a.

2. Every second character is b.

3. Exactly one ab.

Q – 5. Differentiate between NFA and DFA. **[2]** Q – 6. Construct DFA for following over alphabet $\Sigma = \{a, b\}$. **[2 x 2 = 4]**

(a) All strings not containing more than 3 a's.
(b) All strings containing either aa or bb.

Consider the graph M with 3 vertices. Its adjacency matrix is shown below. Which of the following is true?

2 points

$$M = \begin{bmatrix} 0 & 1 & 1 \\ 1 & 0 & 1 \\ 1 & 1 & 0 \end{bmatrix}$$

Graph M has 3 distinct minimum spanning trees, each of cost 2

Graph M has no minimum spanning tree

Graph M has 3 spanning trees of different costs

Graph M has a unique minimum spanning trees of cost 2

What is the worst case run-time complexity of binary search algorithm?

2 points

O(n)

None

O(n3)

O(nlog n)

O(n2)

Given items as {value,weight} pairs {{50,20},{50,25},{20,5}}. The capacity of knapsack=40. Find the maximum value output assuming items to be divisible and non-divisible respectively.

2 points

110, 70

110, 80

130, 110

100, 70

In a Graph, we have more no. of edges. Which algorithm is suitable(less running cost) to find MST?

2 points

Prims

Both

Kruskal

None

Given items as {value,weight} pairs {{40,20},{20,10},{20,5}}. The capacity of knapsack=20. Find the maximum value output assuming items to be divisible.

2 points

60

50

80

40

Consider the following definition in c programming language. Which of the following c code is used to create new node?

2 points

```
struct node
{
   int data;
   struct node * next;
}
typedef struct node NODE;
NODE *ptr;
```

ptr = (NODE*)malloc(sizeof(NODE*));

ptr = (NODE*)malloc(sizeof(NODE));

ptr = (NODE)malloc(sizeof(NODE));

ptr = (NODE*)malloc(NODE);

After each iteration in Bubble sort

2 points

at least one element is at its sorted position

Both

one less comparison is made in the next iteration.

None

Following code is example of .....Sorting

2 points

```
function sort(n) {
  for (let outer = 0; outer < n.length; outer++) {
    let outerElement = n[outer];

    for (let inner = outer + 1; inner < n.length; inner++) {
      let innerElement = n[inner];

      if(outerElement > innerElement) {
        // swap
        n[outer] = innerElement;
        n[inner] = outerElement;
        // update references
        outerElement = n[outer];
        innerElement = n[inner];
      }
    }
  }
  return n;
}
```

Quick

Merge

Bubble Sort

Selection

Selection sort algorithm is an example of

2 points

Divide and Conqure

Greedy Method

Dynamic Programming

None

Consider the matrices P, Q, R and S which are 20 x 15, 15 x 30, 30 x 5 and 5 x 40 matrices respectively. What is the minimum number of multiplications required to multiply the four matrices?

2 points

- 6050
- 7500
- 7750
- 12000

Which of the following sorting algorithms does not have a worst case running time of O(n^2) ?

2 points

- Bubble sort
- Quick sort
- Merge sort
- Insertion sort

Which of the following is false in the case of a spanning tree of a graph G?

2 points

- It is tree that spans G
- none of above
- It includes every vertex of the G
- It is a subgraph of the G

Find time complexity of following code. for (int i = 1; i <= n^2; i++) { // some O(1) expressions }

2 points

n

None

1

logn

n^2

Other:

The running time of quick sort depends on the selection of. Select one:

2 points

Number of passes

Number of input

None

All Options

Selection of pivot elements Correct

Arrangements of the elements

Following are the example of Greedy approach

2 points

Optimal Merge Pattern

0/1 Knapsack

LCS

MST

Which of the following is not the longest common subsequence between the strings “hbcfgmnapq” and “cbhgrsfnmq” ?

2 points

None

bfmq

fgmna

hgmq

cfnq

Find out of the sequence of multiply matrices(A1,A2,A3,A4,A5) with dimensions[10,20,30,5,2,6].

2 points

(A1(A2A3))(A4A5)

(A1(A2A3(A4A5)))

(A1(A2(A3A4A5)))

None

All Options

In insertion sort, the worst case input is an array that is already

2 points

Un-sorted

Sorted in reverser Order

none

All

Sorted

1.Which of the given options provides the decreasing order of asymptotic complexity of functions f1, f2, f3 and f4?

2 points

f3, f2, f4, f1

f2, f3, f1, f4

f3, f2, f1, f4

f1, f4, f2, f3

2 points

What would be the asymptotic time complexity to add a node at the end of singly linked list, if the pointer is initially pointing to the head of the list?

θ(n)

θ(1)

O(1)

O(n)

Intg. M.Sc. VIth Semester, May 2021
End of Semester Examination
Computer System Architecture
Paper Code: CSC-306

Time: 3 Hour **Maximum marks: 60**

Section A

Note: **This section contains short answer questions (about 30 words).Each question carries equal marks. (1.5*10=15)**

Q.1 Attempt any four

a) What do you mean by the additive method of division? Divide **$(66)_{10}$ by $(12)_{10}$** using the additive method.
b) What rules are applied to perform Subtraction using Complementary Method? Using binary division, divide **$(65)_{10}$ by $(29)_{10}$**.
c) What is BCD code? Show the binary digits used to record the word "**your first name**" in BCD.
d) Differentiate between the register addressing and register indirect addressing modes with example.
e) Represent the integer **+ (age) and - (age)** in sign-magnitude using signed 1's and 2's complement. Where age represents your age.
f) Implement the following expression using the switches-

$$L(W,X,Y,Z) = W.X.Y' + W.Z$$

g) Show $A + B + A'.B' = 1$ using the various Boolean algebra rules.
h) Simplify the following SOP function- $F(A,B,C) = \Sigma m(1,4,5,6,7)$ and implement it using AND/OR Two-level Implementation.
i) Implement a D flip-flop using an SR flip-flop.
j) What are the Edge-Triggered Flip-Flops? Give suitable examples.

Section B

Note: **This section contains long answer questions (150 words). Attempt any three. Each question carries equal marks. (15*3=45)**

Q2. a) Implement the **1x16 De-Multiplexer** using the lower order De-Multiplexers. Discuss the various applications of Multiplexers. (5)

b) Draw the logic circuit diagram of full adder using K-map and its corresponding truth table. (5)

c) What do you mean by principal of duality? Find the dual of the following with their corresponding minterms -

i) XY+X'Y

ii) (X+Y) (X+Y') (2+3)

Q3. a) Write programs in assembly language to evaluate the value of $y = x^2 + 2x + 3$ for a given x using-

(i) 3-address instructions

(ii) 2-address instructions

(iii) 1-address instructions (7.5)

b) Find the prime implicants and essential prime implicants using the k-map in the following Boolean function $F = \Sigma(0, 2, 3, 5, 7, 8, 9, 10, 11, 13, 15)$. Also, find out the corresponding optimized Boolean function (5+2.5)

Q4. a) Derive the Boolean function for O_1, O_0, **and** O from the following truth table- (7.5)

Inputs				Outputs		
X_3	X_2	X_1	X_0	O_1	O_0	O
0	0	0	0	0	0	0
0	0	0	1	0	0	1
0	0	1	x	0	1	1
0	1	x	x	1	0	1
1	x	x	x	1	1	1

b) Design the 4-bit Synchronous Binary Up Counter. Show all the intermediate steps for the same. (7.5)

Q5. a) What do you mean by Bus and Memory Transfers? Design a bus system using the buffer gates with explanation. (5)

b) Discus the Hardware Implementation of Logic Microoperations. Also discuss the various applications of logic microoperations. (5)

c) Discuss the working of Serial In - Parallel Out (SIPO) Shift Register. Explain the working of 3-bit SIPO shift register by giving the binary information "**101**" from LSB to MSB serially at the input. (5)

Intg. M.Sc. VIth Semester, May 2021
Ist Internal Assessment
Computer System Architecture
Paper Code: CSC-306

Time: 1 Hour **Maximum marks: 20**

Section A

Note: **This section contains short answer questions (about 40 words). Attempt any four. Each question carries equal marks. (2*4=8)**

Q1. What do you mean by the additive approach of subtraction? Subtract **$(65)_{10}$ from $(95)_{10}$** using the complementary method.

Q2. What rules are applied to perform binary division? Using binary division, divide **$(43)_{10}$ by $(7)_{10}$**.

Q3. What is Gray code? Give suitable examples for generating the Gray code.

Q4. Generate the Excess-3 code for **71.65**. What codes are never used for Excess-3 code and why?

Q5. Represent the integer **+110 and -110** in sign-magnitude using signed 1's and 2's complement.

Note: **This section contains long answer questions (150 words). Attempt any two. Each question carries equal marks. (6*2=12)**

Q6. a) Discuss the switching theory of a normally-open switch with a suitable example. (3)

b) What are the logic gates? Implement the AND gate and OR gate using NOR gates. (3)

Q7. a) Prove the following theorems- (3)

i) XY+X'Y=X+Y

ii) (X+Y) (X+Y') =X

b) Simplify the following Boolean expression-(3)

i) XY'Z'+XY'Z'W+XZ'

ii) Z(Y+Z) (X+Y+Z)

Q8. Find the prime implicants and essential prime implicants using the k-map in the following Boolean function- F(A,B,C,D)=Σ(3,7,8,9,11,12,13,15). Also, find out the corresponding optimized Boolean function (3+2)

Central University of Rajasthan
End term Examination – June 2021
Desigen Analysis and Algorithm

Degree Program: Integrated MSc. Computer Science
Course Title: Desigen Analysis and Algorithm
Date of Examination: 7.7.2021
Teacher's name: Ravi Raj Choudhary
Course Code: CSC-304

Semester: VI
Time duration: 3 hours
Total Marks: 60
Roll No: _____

Instructions:

- Don't Copy Questions and Answer with your friends.
- Attempt any Five question from first Six
- Attempt all question (7-11)

Q.1) Five cities, $\{A, B, C, D, E\}$, are connected via roads, $\{(A, B), (A, C), (A, D), (B, C), (B, D), (B, E), (C, D), (D, E)\}$, in the following manner AS SHOWN IN THE IMAGE (Figure-1) BELOW.
There is a travel-cost to travel from one city to another (any direction) via the road connections. Let, all the travel-costs are unique and the travel-cost from City-X to City- Y is the same as the travel-cost from City-Y to City-X. Moreover, there is a tourist-cost (associated with every city) which one has to pay if (s)he touches any city while travelling.
Define all the travel-costs (as a positive number) to make the above example (wighted undirected graph) complete.

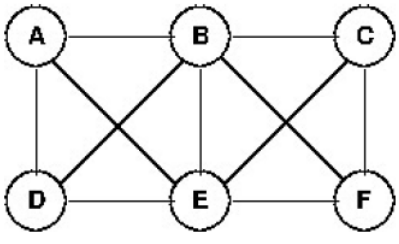


Figure 1: Dijkstra's

(i) You start from the City-A and want to estimate the minimum cost route to visit all the other destination cities, B, C, D, E. Write the Dijkstra's algorithm to solve this problem.

(ii) Show the step-wise running of a modified Dijkstra's algorithm over the example graph that you constructed.

4 marks

Q.2) Find number of spurious hit in following Text T and Pattern P.

T= 12k3567423k14, P=314 here q=13

Where k is the last two digit of your enrolment no. 4 marks

Q.3) Suppose we have a given set of positive numbers and a value sum W. Find out if there exist a subset in array whose sum is equal to given sum W in 2^n time 4 marks

Q.4) What is divide-and–conquer technique? Apply this method to find multiplication of integers 2101 and 113 4 marks

Q.5) Briefly explain the concepts of P, NP and NP complete problems. 4 marks

Q.6) Explain all step to sort $Your\_Name$ using quick sort. Here $Your\_Name = your\_full\_name$, please fill space by using @ character 4 marks

Q.7) Given a weighted directed graph $G = (V, E, W)$, where the vertices are $V = \{A, B, C, D, E, F\}$, the directed edges are $E = \{(A, B), (A, C), (B, C), (B, D), (C, D), (C, E), (D, E), (D, F), (E, B), (E, F), (F, A)\}(|E| = 11)$, the weights form the set W (specified partially – only negative edge-weights are given, that is, $W(A, C) = -5$, $W(C, D) = -8$ and $W(E, F) = -6$ and rest will be filled by you).
PLEASE REFER TO THE IMAGE (Figure-2) GIVEN BELOW.
Show the step-wise running (as asked below) of Floyd-Warshall's algorithm over the example graph that you constructed. 8 marks

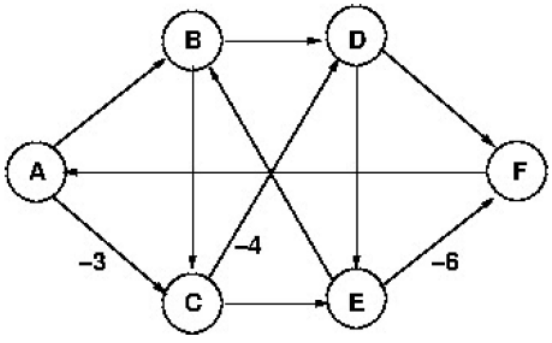


Figure 2: Floyd-Warshall's

Q.8) The knight is placed on the first block of an empty board and, moving according the rule of chess, must visit each square exactly once. Solve the problem using back-tracking. 8 marks

Q.9) Discuss in detail about Travelling Sales Person problem using following(Figure 3) example. 8 marks

Q.10) Write matrix chain multiplication algorithm and obtain optimal parenthesize for matrix(P Q R T S) having dimensions as follows [5, k, 15, k, 10, 4]. Here k is the last two digit of your enrolment number. 8 marks

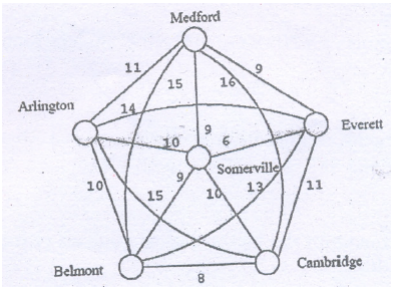


Figure 3: Travelling Sales Person

Q.11) We are given n tasks to perform in sequence. Suppose that task i needs t_i units of time. If the tasks are done in the order 1, 2, 3, ..., n, then task i completes at time $c_i = \sum_{j=1}^{i} t_j$. The average completion time (ACT) is $\frac{1}{n}\sum_{i=1}^{n} c_i$. 8 marks

(i) Calculate ACT by considering n tasks when the task order is 1, 2, 3, ..., n. ($n \geq 5$)

(ii) The following method constructs a task order that tries to minimize the ACT: *Construct the order in n stages; in each stage select from the remaining tasks one with least task time.* What is the ACT for this greedy order?

(iii) Suggest an algorithm that implements the greedy strategy of (ii). The complexity of your algorithm should be $O(n \log n)$.

(iv) Show that the greedy strategy of (ii) results in task orders that have minimum ACT

Exam : CIA - 2

Sub: Automata Theory Class: Int MSc, Sem VI

Time: 3:30 – 5:00 pm Marks: 20

Q -1. Do all parts. [1.5 x 4=6]

(a) Convert the following CFG to CNF.

$S \rightarrow aSa \mid SSa \mid a$

(b) Make CFG for the regular language that have strings ending with b and having even no of b's. Consider input alphabet $\Sigma = \{a, b\}$.

(c) Following CFG has a production using the symbol Λ and yet Λ is not a word in the language. Show that there is some other CFG for this language that does not use Λ.
$S \rightarrow aX \mid bS \mid a \mid b$
$X \rightarrow aX \mid a \mid \Lambda$

(d) Find the left most derivation for the word abba in the grammar
$S \rightarrow AA$
$A \rightarrow aB$
$B \rightarrow bB \mid \Lambda$

Q-2. Build a PDA to accept the language $a^n b^{n+1}$, where n = 1, 2, 3, …. [4]

Q -3. Consider the following CFG.

$S \rightarrow XaaX$

$X \rightarrow aX \mid bX \mid \Lambda$

(a) Construct the PDA that accepts the language generated by following CFG. [3]
(b) Construct the PDA in conversion form. [3]

Q -4. Build a Turing Machine that accepts the language $a^n b^{n+1}$, where n = 1, 2, 3, ….. [4]

OR

Build a Turing Machine that accepts the language of odd palindrome, over alphabet $\Sigma = \{a, b\}$.

Central University of Rajasthan

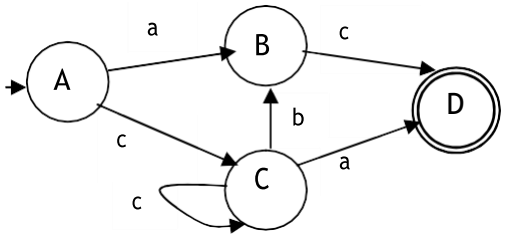
M.Sc., Computer Science, Session 2020 – 21

Sub: Theory of Computation **Marks:**60 **Time:** 3 hours

Q – 1. Do all parts. [3 x 5 = 15]

(a) Differentiate between the transition function in DFA, NFA and ϵ-NFA.

(b) What is the regular expression for the FA.



(c) Design a Moore machine to determine the residue of mod 2 of the input treated as a binary string.

(d) Give a regular expression for the set of all strings not containing 101 as a substring.

(e) How does a deterministic PDA differ from a non-deterministic PDA?

(f) Draw a PDA for the regular expression (0+1)(0+1)*.

Q – 2. Do all parts. [4 x 5 = 20]

(a) Convert the following ϵ-NFA to NFA.

	ϵ	1	2	3
q0	ø	{q0}	{q1}	{q2}
q1	{q0}	{q1}	{q2}	ø
q2	{q1}	{q2}	ø	{q0}

(b) Convert the following grammar into Chomsky normal form.

$S \rightarrow ASB \mid \wedge$

$A \rightarrow aAS \mid a$

$B \rightarrow SbS \mid A \mid bb$

(c) Let G be the grammar

$S \rightarrow aB \mid bA$

$A \rightarrow a \mid aS \mid bAA$

$B \rightarrow b \mid bS \mid aBB$

For the string aabbaabbba find

(i) leftmost derivation

(ii) parse tree, and

(iii) Is the grammar ambiguous?

(d) Construct the CFG for the union of the languages 0^n1^n and a^nb^n for n>0.

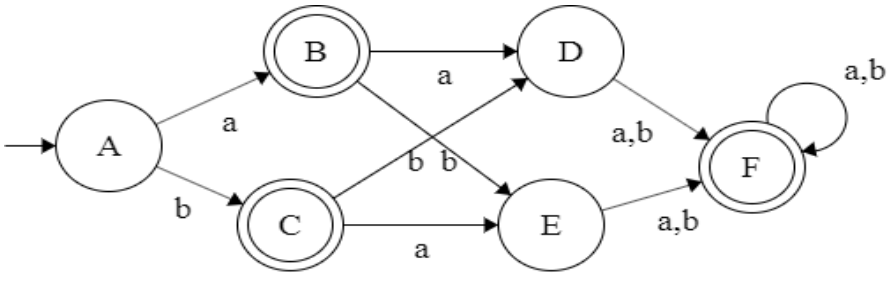
(e) Construct the PDA for the language 0^n1^n.

Q – 3. Do all parts. [5 x 5 = 25]

(a) Convert the following NFA to DFA and describe the language it accepts. Set of states = {P, Q, R, S, T}, Σ = {0, 1}. Transition table is following.

	0	1
P	{P, Q}	{P}
Q	{R, S}	{T}
R	{P, R}	{T}
S	-	-
T	-	-

(b) State Myhill – Nerode theorem. Minimize the following DFA.



(c) Design a Turing Machine to compute the 2's complement of a binary string.

(d) Design a Turing Machine to accept equal numbers of a's and equal number of b's.

(e) Design a Turing machine that accepts a^nb^m where n>0 and m>n.