Sardar Patel Institute of Technology

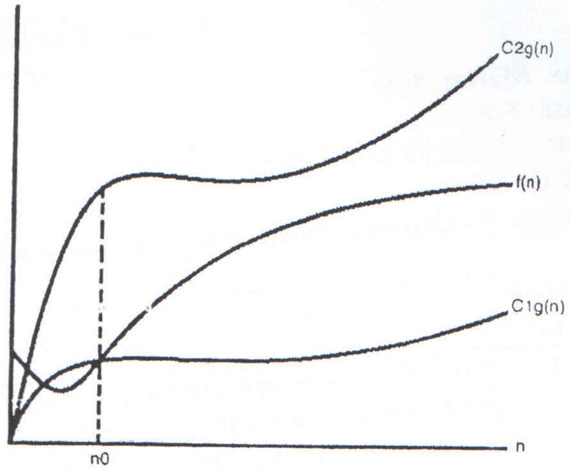
Bhavan's Campus, Munshi Nagar, Andheri (West), Mumbai-400058-India
(Autonomous College Affiliated to University of Mumbai)

Synoptic End Semester Examination
April 2018

Max. Marks: 100
Class: S.E.
Course Code: IT41 / CE41
IT/COMP
Name of the Course: Design And Analysis of Algorithm

Duration: 3 Hrs
Semester: IV
Branch:

Question No.	Question
Q. 1 a)	One of the important criteria is to evaluate time which algorithm takes to complete its single task. This is done to get meaningful Comparison between the algorithms , to get the computational time independent from the programming language , compiler, application software , operating system,and computer hardware. **Asymptotic Notation:** The notation use to define the asymptotic running time of an algorithms are describe in terms of functions whose domains are set of the natural numbers. Types of Asymptotic Notation used to compare the efficiency and performance of algorithm as follows: 1. O-notation(Big O notation). 2. Θ-notation(Theta notation). 3. Ω -notation(Big Omega notation). **Theta Notation(Θ-notation):** $\Theta(g(n)) = \{ f(n)$: There exist three positive constant C1 ,C2 and n_0 such that $0 \le C1g(n) \le f(n) \le C2g(n)$ for all $n \ge n_0 \}$. or $\Theta(g(n)) = O(g(n)) \cap \Omega(g(n))$. or $\Theta(g(n)) = \{f(n) \mid \exists C1 > 0, \exists C2 > 0, \forall n > n_0 : 0 \le C1g(n) \le f(n) \le C2g(n) \}$ The graph of Θ-notation is as follows:



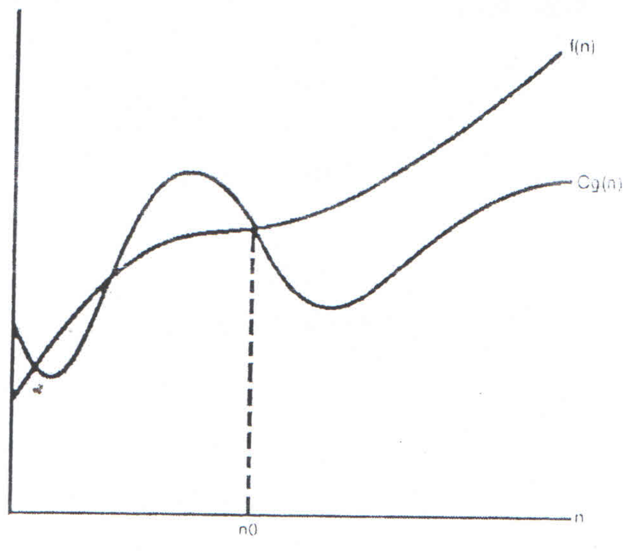
Big O- notation(O-notation):

$O(g(n)) = \{ f(n)$: exists positive constant C and n_0 such that $0 \leq f(n) \leq Cg(n)$ for all $n \geq n_0 \}$

or

$O(g(n)) = \{ f(n) : \exists C>0 , \exists n_0>0 , \forall n \geq n_0 : 0 \leq f(n) \leq Cg(n) \}$

The graph of BigO-notation:



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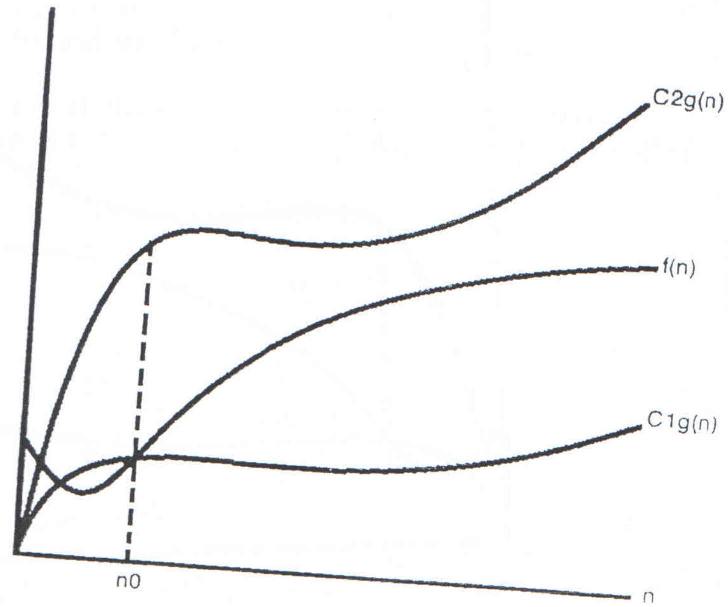
	Theta Notation(Θ-notation): $\Theta(g(n)) = \{ f(n)$: There exist three positive constant C1 ,C2 and n_0 such that $0 \le C1g(n) \le f(n) \le C2g(n)$ for all $n \ge n_0\}$. or $\Theta(g(n)) = O(g(n)) \cap \Omega(g(n))$. or $\Theta(g(n)) = \{f(n) \mid \exists C1 > 0, \exists C2 > 0, \forall n > n_0 : 0 \le C1g(n) \le f(n) \le C2g(n)\}$ The graph of Θ-notation is as follows:  **Marks Distribution:** Explained all three notation with diagram ---------- 05mks Explained all three notation without diagram-------- 03mks
Q. 1 b)	i) $T(n) = 3T(n/2) + n^2 \Rightarrow T(n) = \Theta(n^2)$ (Case 3) ii) $T(n) = T(n/2) + 2^n \Rightarrow \Theta(2^n)$ (Case 3) Marks Distribution: Solved correctly and also stated the cases applicable ---- 2.5 mks (each)

Theta Notation(Θ-notation):

$\Theta(g(n)) = \{ f(n)$: There exist three positive constant C1 ,C2 and n_0 such that $0 \le C1g(n) \le f(n) \le C2g(n)$ for all

$n \ge n_0\}$.

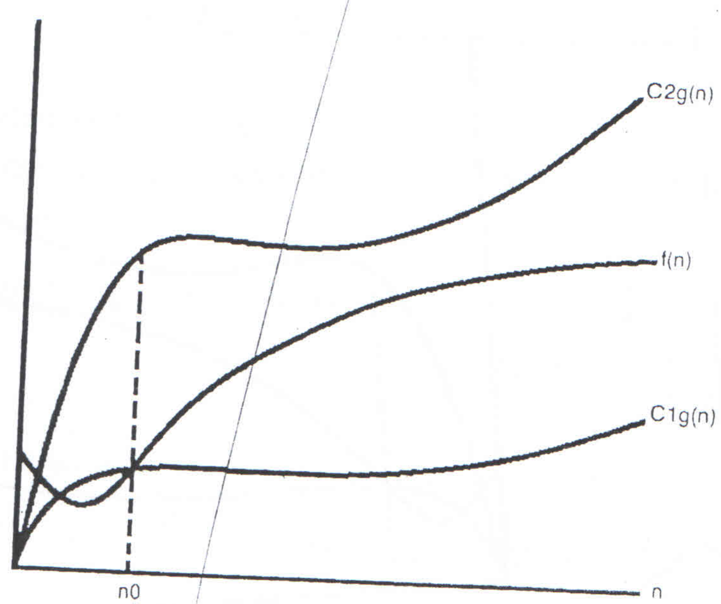
or

$\Theta(g(n)) = O(g(n)) \cap \Omega(g(n))$.

or

$\Theta(g(n)) = \{f(n) \mid \exists C1 > 0, \exists C2 > 0, \forall n > n_0 : 0 \le C1g(n) \le f(n) \le C2g(n)\}$

The graph of Θ-notation is as follows:



Marks Distribution:
Explained all three notation with diagram --------- 05mks
Explained all three notation without diagram-------- 03mks

Q. 1 b)

i) $T(n) = 3T(n/2) + n^2 \Rightarrow T(n) = \Theta(n^2)$ (Case 3)
ii) $T(n) = T(n/2) + 2^n \Rightarrow \Theta(2^n)$ (Case 3)

Marks Distribution:
Solved correctly and also stated the cases applicable ---- 2.5 mks (each)

Answer Synotpic

Question No.	Question	Max. Marks	(
Q. 1 c)	Write an algorithm using Divide and conquer approach for finding minimum and maximum number form a given set. Analyze it's time complexity by stating its recurrence relation. Simulate the above algorithm to find Min and Max on the following elements. Show the tree of recursive calls 22 13 -5 -8 15 60 17 31 47 Algorithm-----05 marks Time complexity analysis-----------02 marks Simulation with correct tree drawn----03 marks	*10*	CC

```
Algorithm MaxMin(i, j, max, min)
// a[1 : n] is a global array. Parameters i and j are integers,
// 1 ≤ i ≤ j ≤ n. The effect is to set max and min to the
// largest and smallest values in a[i : j], respectively.
{
    if (i = j) then max := min := a[i]; // Small(P)
    else if (i = j - 1) then // Another case of Small(P)
        {
            if (a[i] < a[j]) then
            {
                max := a[j]; min := a[i];
            }
            else
            {
                max := a[i]; min := a[j];
            }
        }
        else
        {   // If P is not small, divide P into subproblems.
            // Find where to split the set.
                mid := ⌊(i + j)/2⌋;
            // Solve the subproblems.
                MaxMin(i, mid, max, min);
                MaxMin(mid + 1, j, max1, min1);
            // Combine the solutions.
                if (max < max1) then max := max1;
                if (min > min1) then min := min1;
        }
}
```

gorithm 3.6 Recursively finding the maximum and minimum

Answer Synotpic

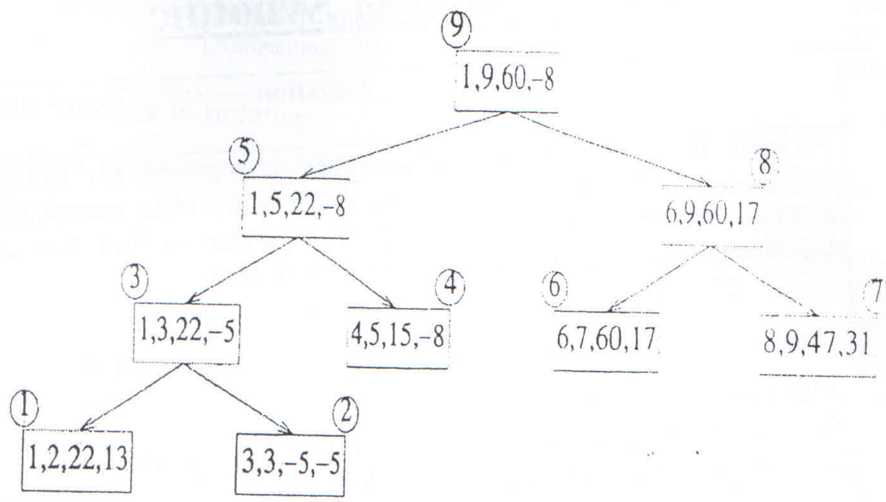


Figure 3.2 Trees of recursive calls of MaxMin

$T(n)$ represents this number, then the resulting recurrence relation is

$$T(n) = \begin{cases} T(\lceil n/2 \rceil) + T(\lceil n/2 \rceil) + 2 & n > 2 \\ 1 & n = 2 \\ 0 & n = 1 \end{cases}$$

When n is a power of two, $n = 2^k$ for some positive integer k, then

$$\begin{aligned} T(n) &= 2T(n/2) + 2 \\ &= 2(2T(n/4) + 2) + 2 \\ &= 4T(n/4) + 4 + 2 \\ &\vdots \\ &= 2^{k-1}T(2) + \textstyle\sum_{1 \le i \le k-1} 2^i \\ &= 2^{k-1} + 2^k - 2 = 3n/2 - 2 \end{aligned} \qquad (3.3)$$

Note that $3n/2 - 2$ is the best-, average-, and worst-case number of comparisons when n is a power of two.

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Q.2a)

0	2	9	10
1	0	6	4
15	7	0	8
6	3	12	0

$g(2,\emptyset) = c_{21} = 1$
$g(3,\emptyset) = c_{31} = 15$
$g(4,\emptyset) = c_{41} = 6$

$k = 1$, consider sets of 1 element:

Set {2}: $g(3,\{2\}) = c_{32} + g(2,\emptyset) = c_{32} + c_{21} = 7 + 1 = 8$ $\quad p(3,\{2\}) = 2$
$g(4,\{2\}) = c_{42} + g(2,\emptyset) = c_{42} + c_{21} = 3 + 1 = 4$ $\quad p(4,\{2\}) = 2$

Set {3}: $g(2,\{3\}) = c_{23} + g(3,\emptyset) = c_{23} + c_{31} = 6 + 15 = 21$ $\quad p(2,\{3\}) = 3$
$g(4,\{3\}) = c_{43} + g(3,\emptyset) = c_{43} + c_{31} = 12 + 15 = 27$ $\quad p(4,\{3\}) = 3$

Set {4}: $g(2,\{4\}) = c_{24} + g(4,\emptyset) = c_{24} + c_{41} = 4 + 6 = 10$ $\quad p(2,\{4\}) = 4$
$g(3,\{4\}) = c_{34} + g(4,\emptyset) = c_{34} + c_{41} = 8 + 6 = 14$ $\quad p(3,\{4\}) = 4$

$k = 2$, consider sets of 2 elements:

Set {2,3}: $g(4,\{2,3\}) = \min\{c_{42} + g(2,\{3\}), c_{43} + g(3,\{2\})\} = \min\{3+21, 12+8\} = \min\{24, 20\} = 20$
$p(4,\{2,3\}) = 3$

Set {2,4}: $g(3,\{2,4\}) = \min\{c_{32} + g(2,\{4\}), c_{34} + g(4,\{2\})\} = \min\{7+10, 8+4\} = \min\{17, 12\} = 12$
$p(3,\{2,4\}) = 4$

Set {3,4}: $g(2,\{3,4\}) = \min\{c_{23} + g(3,\{4\}), c_{24} + g(4,\{3\})\} = \min\{6+14, 4+27\} = \min\{20, 31\} = 20$
$p(2,\{3,4\}) = 3$

Length of an optimal tour:

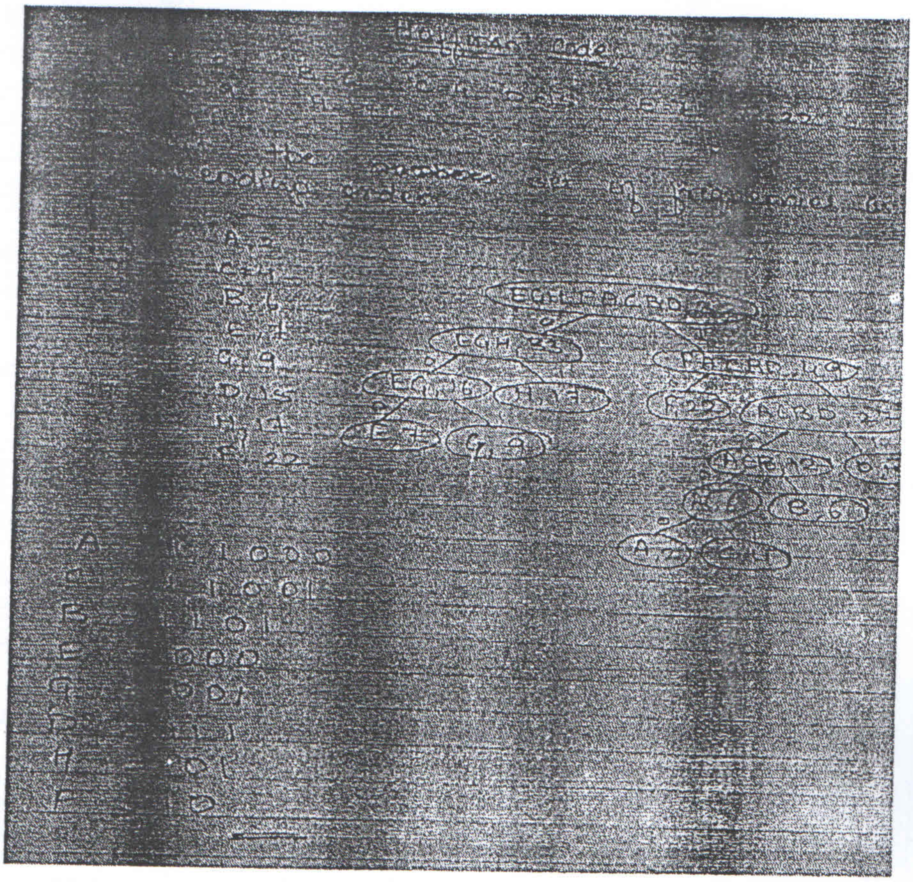
$$f = g(1,\{2,3,4\}) = \min\{c_{12} + g(2,\{3,4\}), c_{13} + g(3,\{2,4\}), c_{14} + g(4,\{2,3\})\}$$
$$= \min\{2 + 20, 9 + 12, 10 + 20\} = \min\{22, 21, 30\} = 21$$

Successor of node 1: $p(1,\{2,3,4\}) = 3$
Successor of node 3: $p(3,\{2,4\}) = 4$
Successor of node 4: $p(4,\{2\}) = 2$

Optimal TSP tour: $1 \rightarrow 3 \rightarrow 4 \rightarrow 2 \rightarrow 1$

Marks Distribution:
Stated the general formula for solving the problem --------------------- 01mks
Solved correctly with all steps shown --------------------------------------08mks
Mentioned the optimal TSP Tour/Path--------------------------------------01mks

Q2. b)



Marks Distribution:

Solved correctly with all steps shown and huffman code written ---------- 10 mks
Solved correctly with all steps shown and NO huffman code written- ------------ 07 mks
Solved correctly with only final tree shown and huffman code written------------ 05mks
Solved correctly with only final tree shown and No huffman code written --------- 02 mks
Solved correctly but Huffman code wrong ------------------------------- 07mks

CLASS TEST

Name of the Student ______________________ Roll No. __________

Class : __________ Semester : ______________ Date __________

Subject : ______________________ Stamp of the Department with Date

Question No.	1	2	3	4	5	6	7	8	TOTAL	Signature of the Examiner
Marks awared										

~~Q.2.b~~ Q.2.b

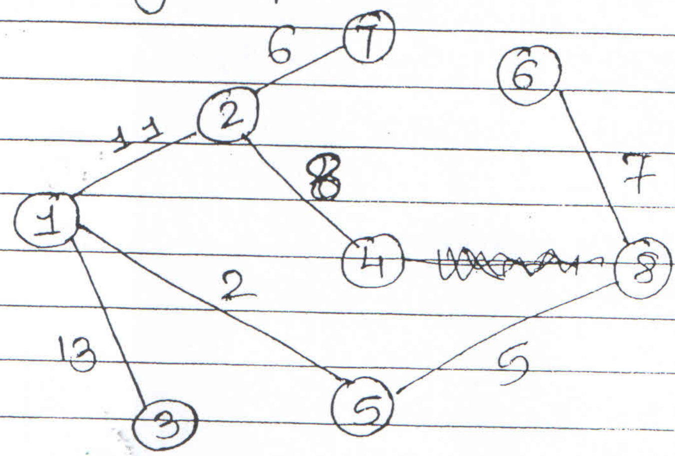
START WRITING HERE
(Begin answer for each question on a new page)

	Q =>	1*	2	3	4	5	6	7
(1)	Key	∞	∞	∞	∞	∞	∞	∞
	π	–	–	–	–	–	–	–
(2)		0*	11	13	∞	2	∞	∞
		1	1	1		1		
(3)		1*	2	3	4	5*	6	7
		0	11	13	~~16~~	2	∞	∞
		1	1	1	5	1	–	–
(4)		1*	2	3	4	5*	6	7
		0	11	13	14	2	7	11
		1	1	1	5	1	8	8
(5)	Vertices →	1*	2	3	4	5*	6*	7
	key →	0	11	13	14	2	7	11
	parent →	1	1	1	5	1	8	8
(6)		1*	2*	3	4	5*	6*	7
		0	11	13	8	2	7	6
		1	1	1	2 ?	1	8	2
(7)		1*	2*	3	4	5*	6*	7*
		0	11	13	8	2	7	6
		1	1	1	2	1	8	2

8

1*	2*	3*	4*	5*	6*	7*	8*
0	11	13	8	2	7	6	5
1	1	1	2	1	8	2	5

9 Final graph



10 Final Cost of MST

$11 + 13 + 8 + 2 + 7 + 6 + 5 = 52$

Total 10 steps each step 1 mark

Answer Synotpic

Q.3 a)

The steps of sequence we should follow to develop a dynamic programming approach-------------02 marks
the steps are applicable to solve Longest common subsequence problem efficiently using Dynamic programming approach------------- 08 marks(4*2 each)

When developing a dynamic-programming algorithm, we follow a sequence of four steps:

1. Characterize the structure of an optimal solution.
2. Recursively define the value of an optimal solution.
3. Compute the value of an optimal solution, typically in a bottom-up fashion.
4. Construct an optimal solution from computed information.

A subsequence of a given sequence is just the given sequence with zero or more elements left out. Formally, given a sequence $X = \langle x_1, x_2, \ldots, x_m \rangle$, another sequence $Z = \langle z_1, z_2, \ldots, z_k \rangle$ is a ***subsequence*** of X if there exists a strictly increasing $\langle i_1, i_2, \ldots, i_k \rangle$ of indices of X such that for all j $j = 1, 2, \ldots, k$, we have $x_{i_j} = z_j$.

Step 1: Characterizing a longest common subsequence------------02 marks

Theorem 15.1 (Optimal substructure of an LCS)
Let $X = \langle x_1, x_2, \ldots, x_m \rangle$ and $Y = \langle y_1, y_2, \ldots, y_n \rangle$ be sequences, and let $Z = \langle z_1, z_2, \ldots, z_k \rangle$ be any LCS of X and Y.

1. If $x_m = y_n$, then $z_k = x_m = y_n$ and Z_{k-1} is an LCS of X_{m-1} and Y_{n-1}.
2. If $x_m \neq y_n$, then $z_k \neq x_m$ implies that Z is an LCS of X_{m-1} and Y.
3. If $x_m \neq y_n$, then $z_k \neq y_n$ implies that Z is an LCS of X and Y_{n-1}.

Step 2: A recursive solution -----------------------------------02 marks

$$c[i,j] = \begin{cases} 0 & \text{if } i = 0 \text{ or } j = 0, \\ c[i-1, j-1] + 1 & \text{if } i, j > 0 \text{ and } x_i = y_j, \\ \max(c[i, j-1], c[i-1, j]) & \text{if } i, j > 0 \text{ and } x_i \neq y_j. \end{cases}$$

Step 3: Computing the length of an LCS--------------------------02 marks

Procedure LCS-LENGTH takes two sequences $X = \langle x_1, x_2, \ldots, x_m \rangle$ and $Y = \langle y_1, y_2, \ldots, y_n \rangle$ as inputs. It stores the c(I, j) values in a table c(0….m; 0 …. n), and it computes the entries in ***row-major*** order. The procedure also maintains the table b(1…m; 1… n) to help us construct an optimal solution. Intuitively(I, j) points to the table entry corresponding to the optimal sub problem solution chosen when computing c(I, j)

Step 4: Constructing an LCS----------------------------------02 marks

We simply begin at b[m, n] and
trace through the table by following the arrows. Whenever we encounter a "↖" in entry $b[i,j]$, it implies that $x_i = y_j$ is an element of the LCS that LCS-LENGTH

10 CO

Answer Synotpic

Q.3 b)	Consider the Traveling Salesperson instance defined by the cost matrix $\begin{array}{|c|c|c|c|} \hline \infty & 11 & 10 & 9 \\ \hline 8 & \infty & 7 & 3 \\ \hline 8 & 4 & \infty & 4 \\ \hline 11 & 10 & 5 & \infty \\ \hline \end{array}$ i) Obtain the reduced cost matrix------------ 02 marks ii) Draw the portion of state space tree that will be generated by LCBB. Label each node by its ĉ value. --------------------02 marks iii) Write out the reduced matrices corresponding to each of these nodes. ----06 **Marks** **Solution is attached**	*10*	C
Q.4 a)	**Write a backtracking algorithm for sum of subset problem---------05 marks** **Correctly drawn state space tree**-----------05 marks **Solution is attached**	*10*	C

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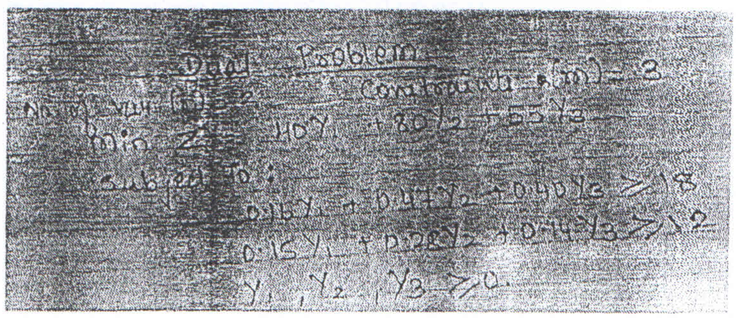
Q4 b)	**Marks Distribution;** • Properly explained any two String Matching Algorithms with solved Example ---- **10mks** • Properly explained any two String Matching Algorithms without solved Example ---- -- **06mks** OR **Marks Distribution:** Correct Algorithm of String matching with Finite Automata --- ---- 06mks Correct Solved Example------------------------------- 04mks
Q.5a)	(i)**Defining the Decision Variables:** Let Z = Profit Let X_1= number of deluxe jackets to produce Let X_2= number of regular jackets to produce **Complete LP Model would be written as:** Max $Z = \$18X_1 + \$12 X_2$ -- Equation 1 Subject To: $0.16X_1 + 0.15X_2 \leq 40$ hrs -------------- Equation 2 $0.47X_1 + 0.28X_2 \leq 80$ hrs-------------- Equation 3 $0.40X_1 + 0.14X_2 \leq 55$ hrs-------------- Equation 4 $X_1, X_2 \geq 0$ (ii) <u>**Slack Form**</u> Max $Z = 18X_1 + 12 X_2 + 0S_1 + 0S_2 + 0S_3$ Subject To: $0.16X_1 + 0.15X_2 + S_1 = 40$ hrs $0.47X_1 + 0.28X_2 + S_2 = 80$ hrs $0.40X_1 + 0.14X_2 + S_3 = 55$ hrs $X_1, X_2, S_1, S_2, S_3 \geq 0$ iii) **Dual Problem**  Dual Problem Constraints (m) = 3 No. of var (n) = 2 Min $Z = 40Y_1 + 80Y_2 + 55Y_3$ Subject To : $0.16Y_1 + 0.47Y_2 + 0.40Y_3 \geq 18$ $0.15Y_1 + 0.28Y_2 + 0.14Y_3 \geq 12$ $Y_1, Y_2, Y_3 \geq 0$. <u>Marks distribution:</u> i) **01mk** ------Decision Variable Defined **04mks** ------ All four equation written correctly ii) **02mks** ------ For correct slack form. iii) **03mks**------- For correct Dual Form

Q.5. b)

[illegible] $= 12x_1 + 16x_2 + 0s_1 + 0s_2$

$10x_1 + 20x_2 + s_1 = 120$

$8x_1 + 8x_2 + s_2 = 80$

x_1, x_2, s_1 and $s_2 \geq 0$

Initial Simplex Table

CB	C_j / Basic var	12 / x_1	16 / x_2	0 / s_1	0 / s_2	Soln	Ratio
0	s_1	10	20	1	0	120	120/20 = 6
0	s_2	8	8	0	1	80	80/8 = 10
	Z_j	0	0	0	0	0	
	$C_j - Z_j$	12	16	0	0		

$Z_j = \sum (CB_i)(a_{ij})$ if $C_j - Z_j \leq 0$ for max
if $C_j - Z_j \geq 0$ for min

Iteration 1

CB	C_j / BV	12 / x_1	16 / x_2	0 / s_1	0 / s_2	Soln	Ratio
16	x_2	1/2	1	1/20	0	6	6/(1/2) = 12
0	s_2	4	0	-2/5	1	32	32/4 = 8
	Z_j	8	16	4/5	0		
	$C_j - Z_j$	4	0	-4/5	0		

$\Rightarrow$ New value = Old value $-$ $\dfrac{\text{Corr. Key Col. Val} \times \text{Corr. Key Row Value}}{\text{Key Element}}$

$8 - \dfrac{8 \times 1}{20} = 8 - \dfrac{8}{20} = 8.4 = [illegible]$

$8 - \dfrac{8 \times 20}{20} = 8 - \dfrac{160}{20} = 8 - 8 = 0$

$1 - \dfrac{8 \times 0}{20} = 1 - 0 = 1$

$80 - \dfrac{8 \times 120}{20} = 80 - 960/20 = 80 - 48 = \underline{32}$

Iteration II

C_{Bi}	C_j / B.V.	12 / x_1	16 / x_2	0 / S_1	0 / S_2	Soln	Ratio
16	x_2	0	1	1/10	-1/8	2	
12	x_1	1	0	-1/10	1/4	8	
	Z_j	12	16	2/5	1	128	
	$C_j - Z_j$	0	0	-2/5	-1		

$1/2 - \left(\dfrac{1/2 \times 4}{4}\right) = 0$ $\quad$ $0 - \left(\dfrac{1/2 \times 1}{4}\right) = -1/8$

$1 - \left(\dfrac{1/2 \times 0}{4}\right) = 1$ $\quad$ $6 - \left(\dfrac{1/2 \times 32}{4}\right) = 2$

$1/20 - \left(\dfrac{1/2 \times -1/5}{4}\right) = 1/10$

$\therefore \quad x_1 = 12 \qquad x_2 = 16$

$Z(\text{optimum}) = 128$

CLASS TEST

lame of the Student ______________________ Roll No. __________

lass : __________ Semester : __________ Date __________

ubject : ______________________ Stamp of the Department with Date

uestion No.	1	2	3	4	5	6	7	8	TOTAL	Signature of the Examiner
Marks warded										

START WRITING HERE
(Begin answer for each question on a new page)

8. b.

1)
$$\begin{bmatrix} \infty & 11 & 10 & 9 \\ 8 & \infty & 7 & 3 \\ 8 & 4 & \infty & 4 \\ 11 & 10 & 5 & \infty \end{bmatrix} \begin{matrix} 9 \\ 3 \\ 4 \\ 5 \end{matrix} \xrightarrow{\text{Row Reduc}} \begin{bmatrix} \infty & 2 & 1 & 0 \\ 5 & \infty & 4 & 0 \\ 4 & 0 & \infty & 0 \\ 6 & 5 & 0 & \infty \end{bmatrix}$$

$$25 = 21 + 4 = 4 \quad 0 \quad 0 \quad 0$$

Column Red.

2 marks $\Rightarrow$ Reduced cost matrix =
$$\begin{bmatrix} \infty & 2 & 1 & 0 \\ 1 & \infty & 4 & 0 \\ 0 & 0 & \infty & 0 \\ 2 & 5 & 0 & \infty \end{bmatrix}$$

(a) – (f) – each 1 mark

) path (1, 2); node 2

$$\hat{C}(2) = \hat{C}(1) + A(1,2) + r$$

$$\hat{C}(2) = 25 + 2 + 0 = 27$$

$$\begin{bmatrix} \infty & \infty & \infty & \infty \\ \infty & \infty & 4 & 0 \\ 0 & \infty & \infty & 0 \\ 2 & \infty & 0 & \infty \end{bmatrix}$$

) Path (1, 3); node 3 $\hat{C}(3) = \hat{C}(1) + A(1,3) + r$

$$= 25 + 1 + 2 = 28$$

$$\begin{bmatrix} \infty & \infty & \infty & \infty \\ 1 & \infty & \infty & 0 \\ \infty & 0 & \infty & 0 \end{bmatrix} \begin{matrix} - \\ 0 \\ 0 \end{matrix} \Rightarrow \begin{bmatrix} \infty & \infty & \infty & \\ 1 & \infty & \infty & 0 \end{bmatrix}$$

Column red = 0

2(c) path (1,4); node 4

$$\hat{c}(4) = \hat{c}(1) + A(1,4) + r$$

$$= 25 + 0 + 1 = 26$$

$$\begin{array}{cc} & \text{Row min} \\ \begin{bmatrix} \infty & \infty & \infty & \infty \\ 1 & \infty & 4 & \infty \\ 0 & 0 & \infty & \infty \\ \infty & 5 & 0 & \infty \end{bmatrix} & \begin{array}{c} - \\ 1 \\ 0 \\ 0 \\ \hline 1 \end{array} \end{array}$$

$$\downarrow$$

$$\begin{bmatrix} \infty & \infty & \infty & \infty \\ 0 & \infty & 3 & \infty \\ 0 & 0 & \infty & \infty \\ \infty & 5 & 0 & \infty \end{bmatrix} \qquad r = 1 + 0 = 1$$

Col. min $\quad 0 \quad 0 \quad 0 \quad - \quad = 0$

min)

min. in level one is node 4

(d) path(1, 4, 2) ; node 5

$$\begin{array}{c} \\ \begin{bmatrix} \infty & \infty & \infty & \infty \\ \infty & \infty & 3 & \infty \\ 0 & \infty & \infty & \infty \\ \infty & \infty & \infty & \infty \end{bmatrix} \end{array} \quad \begin{array}{c} \text{Row min} \\ - \\ 3 \\ 0 \\ - \\ \hline 3 \end{array}$$

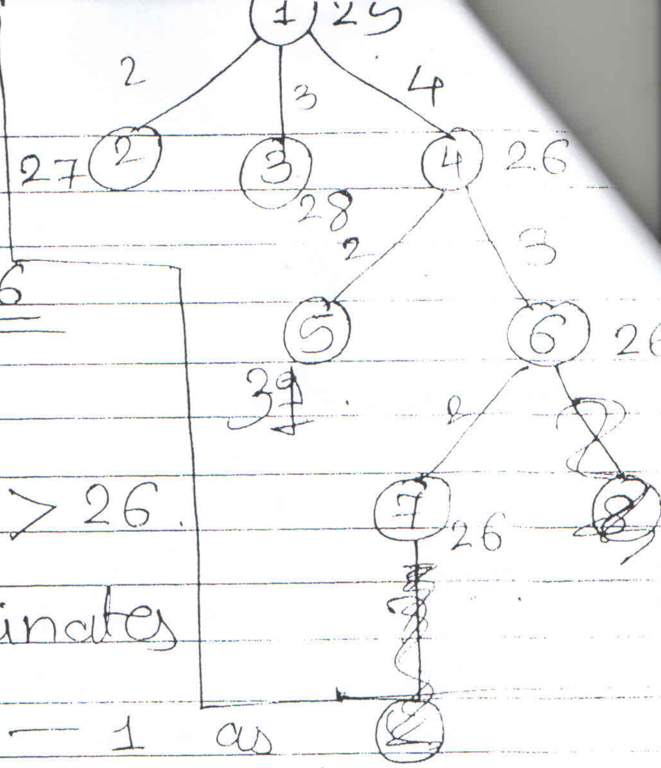
$$\begin{bmatrix} \infty & \infty & \infty & \infty \\ \infty & \infty & 0 & \infty \\ 0 & \infty & \infty & \infty \\ \infty & \infty & \infty & \infty \end{bmatrix} \quad r = 3 + 0 =$$

Col. min $\quad 0 \quad - \quad 0 \quad -$

$$\hat{c}(5) = \hat{c}(\cancel{2}4) + A(4, 2) + r$$

$$= 26 + 0 + \cancel{5}3 = 29$$

2 marks $\Rightarrow$ 2



Upper updated to $\underline{\underline{26}}$

For next E node

$\hat{c}(2), \hat{c}(3), \hat{c}(5)$ all > 26.

So LCBB terminates

with 1 - 4 - 3 - 2 — 1 as shortest length tour with cost $\underline{\underline{26}}$

(e) path (1, 4, 3) ; node 6

$$\hat{c}(6) = \hat{c}(4) + A(4,3) + r$$

$$= 26 + 0 + 0 = 26$$

$$\begin{array}{cc} & \text{Row} \\ \left[\begin{array}{cccc} \infty & \infty & \infty & \infty \\ 0 & \infty & \infty & \infty \\ \infty & \cancel{\infty} & \infty & \infty \\ \infty & \infty & \infty & \infty \end{array}\right] & \begin{array}{c} - \\ 0 \\ 0 \\ - \end{array} \\ \begin{array}{cccc} 0 & 0 & - & - \end{array} & \end{array} \qquad r = 0$$

minim...

node

minimum in level 2 is node

8 path (1, 4, 3, 2)

$$\begin{bmatrix} \infty & \infty & \infty & \infty \\ \infty & \infty & \infty & \infty \\ \infty & \infty & \infty & \infty \\ \infty & \infty & \infty & \infty \end{bmatrix} \quad r = 0$$

$\hat{C}(7) = \hat{C}(6) + A(3,2) + r$

$= 26 + 0 + 0 = 26$

Upper is $= 26$

1, 4, 6

~~X~~ Total 8 steps in sollution

1) Step no. 1 & 2 each have
   – 2 marks.

2) partially correct step 2 – 1 Mark

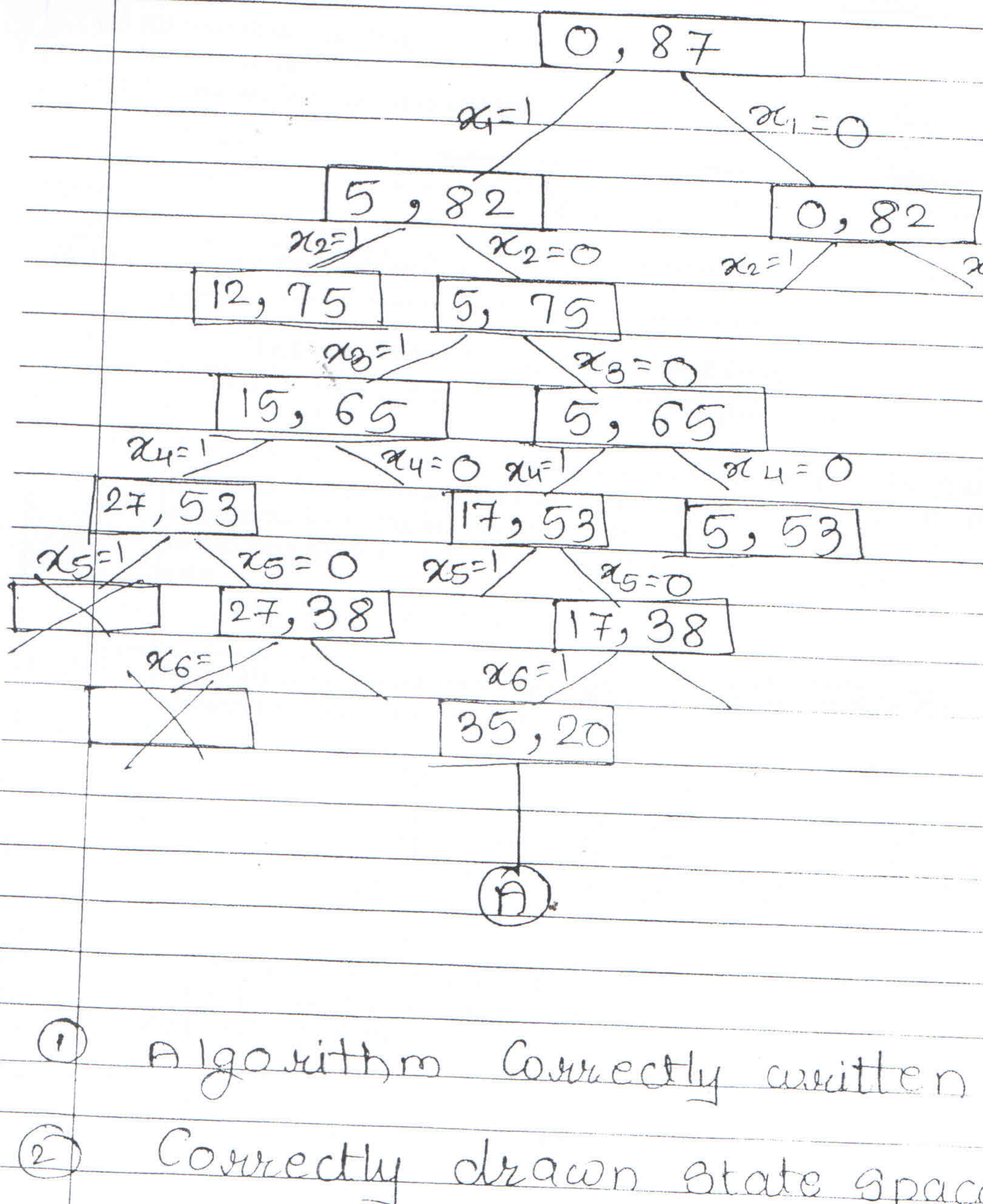
3) Step no. a to f each have – 1 Ma

Q.2 a

$$\begin{array}{cccccccc} & 1 & 2 & 3 & 4 & 5 & 6 & 7 \\ w = \{ & 5, & 7, & 10, & 12, & 15, & 18, & 20 \} \end{array}$$

$$m = 35$$

$$s = \sum_{i=1}^{n=7} w_i = 87$$



1. Algorithm Correctly written – 05 marks
2. Correctly drawn state space tree – 05 marks