

RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College under University of Calcutta)

B.A./B.SC. FOURTH SEMESTER EXAMINATION, MAY 2015

SECOND YEAR

COMPUTER SCIENCE (Honours)

Date : 22/05/2015

Time : 11 am – 2 pm

Paper : IV

Full Marks : 75

[Use a separate Answer book for each group]

Group - A

[Answer any three questions]

1. a) What is the major problem with contiguous memory allocation? How is it resolved? [4]
b) Why page size is always a power of 2? [3]
c) For a paged system, TLB hit ratio is 0.8. RAM access time t be 30nS and TLB access time T be 100 nS. Find out memory access time with TLB? [3]
2. a) What is the use of Linker? [2]
b) Write a short note on Assembler. [5]
c) Explain the working of File Server. [3]
3. a) Give the difference between Interpreter & Compiler. [4]
b) What is Interrupt handler? [2]
c) Explain two basic methods of IPC? [4]
4. a) Show that if the Wait () and Signal () are not executed automatically, then mutual exclusion may be violated. [3]
b) An OS contains 3 resource types. The current resource state is given below :

Process	Allocated			Maximum			Available		
	R ₁	R ₂	R ₃	R ₁	R ₂	R ₃	R ₁	R ₂	R ₃
P ₁	2	2	3	3	6	8	7	7	10
P ₂	2	0	3	4	3	3			
P ₃	1	2	4	3	4	4			

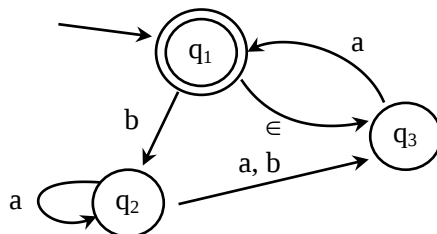
- i) Is the current allocation safe state?
- ii) Would the following request be granted in the current state?
 - P₁ requests (1,1,0)
 - P₂ requests (0,1,0)
 - P₃ requests (0,1,0)[6]
- c) What is spinlock? [1]
5. a) What are the basic properties of a Distributed OS? [3]
b) Explain process control block. [4]
c) Explain various types of kernels. [3]

Group - B

[Answer any two questions]

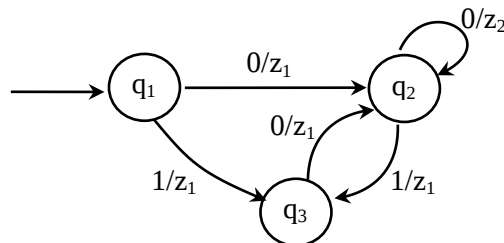
6. a) Draw a deterministic finite automata recognizing the language over alphabet {a,b} : the set of all strings containing same symbol at beginning and ending that is first and last symbol must be same. [3]
b) State and proof Arden's Theorem. [4]
c) Show that the language consisting of all strings with an equal number of 0's and 1's, is not a regular language. [3]

7. a) Show the steps to convert the following NFA to its equivalent DFA. [4]

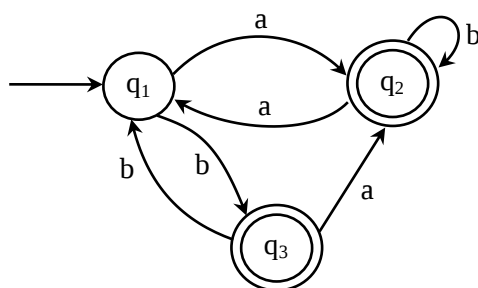


b) Define Mealy Machine. [2]

c) Construct a Moore machine equivalent to the following Mealy machine. [4]



8. a) Construct a regular expression corresponding to the following finite automata. [4]



b) Convert the following Context Free Grammar to Chomsky Normal Form with illustration of necessary steps. [4]

$S \rightarrow A S A \mid aB$

$A \rightarrow B \mid S$

$B \rightarrow b \mid \epsilon$

c) Give the difference between Context Free Grammar and Regular Grammar with example. [2]

9. a) Construct a pushdown automata accepting the language $L = \{W C W^R \mid w \in \{a, b\}^*\}$ by final state, where W^R implies the reverse string of w . [4]

b) Design a Turing machine to recognize the language $\{0^n 1^n 0^n \mid n \geq 1\}$. And also testify it for the input string 000111000. [4+2]

Group - C

Answer **any one** question :

10. a) Consider a weighted complete graph G on the vertex set $\{v_1, v_2, \dots, v_n\}$ such that the weight of the edge (v_i, v_j) is $2|i - j|$. What will be the weight of a minimum spanning tree of G ? Express the weight in terms of n where n is the number of vertices. [3]

b) Define Theta- θ notation with example. [2]

11. a) What is the time complexity of the following recursive function :

```

int Dosomething (int n)
{
    if (n <= 2)
        return;
    else
        {

```

```

    for (int j = 1; j <= n; j++)
        printf ("*");
    return (Dosomething (floor (sqrt (n))));
}
}

```

First derive the recursive formula and then solve it.

b) Prove that $n \neq \theta(\log n)$

Answer **any two** questions :

12. a) Sort the following sequence of numbers in step-by-step using Merge Sort algorithm.

2, 13, 24, 15, 31, 57, 5, 14, 73, 27

b) Given a sequence of n numbers $A(1 \dots n)$, Give a divide and conquer algorithm for finding a contiguous subsequence $A(i \dots j)$ for which the sum of elements in the sub-sequence is maximum.

c) Give the difference between DFS & BFS.

13. a) What is the difference between Dynamic programming and Divide-and-conquer approach.

b) Use Huffman's algorithm to construct an optimal prefix code for the letters in the following table

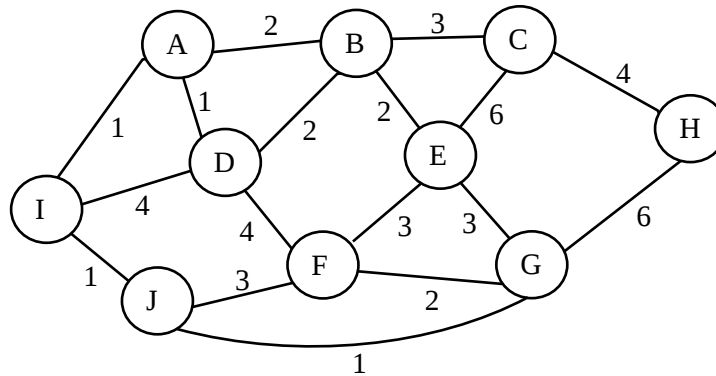
Letter	A	B	I	M	S	X	Z
Frequency	12	7	18	10	9	5	2

c) Given an input array of size unknown with all 1's in the beginning and 0's in the end. Write an $O(\log n)$ algorithm to find the index in the array from where 0's start. Consider there are millions of 1's and 0's in the array.

11111 ... 111000 ... 000

14. a) Explain the Strassen's Matrix Multiplication Method with an example.

b) Find the Minimum Spanning tree of the following graph using Prim's Algorithm.



c) Write an iterative dynamic programming algorithm to compute binomial coefficient.

$$\binom{n}{k} = \frac{n!}{k!(n-k)!} \text{ for } 0 \leq k \leq n$$

15. a) Write the Floyd-Warshall shortest path Algorithm.

b) You are given a connected undirected graph $G = (V, E)$ in which the weight of each edge is either 1 or 2. Present an $O(V+E)$ time algorithm to compute a minimum spanning tree for G .

c) You are given n objects and a knapsack by which you can carry a weight not exceeding W . For $i = 1, 2, \dots, n$ object i has a positive weight w_i and a positive value (say price) v_i . Write an algorithm which maximizes $\sum_{i=1}^n x_i v_i$ subject to $\sum_{i=1}^n x_i w_i \leq W$, where $v_i > 0$, $w_i > 0$ and $0 \leq x_i \leq 1$ for $1 \leq i \leq n$. You are allow to break objects.

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