RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. FOURTH SEMESTER EXAMINATION, MAY 2017

SECOND YEAR [BATCH 2015-18]

Date : 18 /05/2017 **COMPUTER SCIENCE (Honours)**

Time : 11 am – 3 pm **Paper :** IV Full Marks : 75

[Use a separate Answer Book for <u>each group</u>]

Group – A

Answer **<u>any three</u>** questions from **<u>Question Nos. 1 to 5</u>** : [3×10]

1. a) What is virtual memory? Explain its mole in page replacement techniques. 2+2
   b) What are the two basic implementation techniques of LRU page replacement algorithms? 3
   c) With a proper diagram show how does internal fragmentation occur in paging? 3

2. a) A system that uses Banker's Algorithm, has five processes and uses resources of four different types (A, B, C and D).

<u>Total Resources</u>:

A	B	C	D
13	13	9	13

<u>Process:</u>	<u>Allocation</u>				<u>Need</u>			
	A	B	C	D	A	B	C	D
P_0	1	0	2	0	3	2	4	2
P_1	0	3	1	2	3	5	1	2
P_2	2	4	5	1	2	7	7	5
P_3	3	0	0	6	5	5	0	8
P_4	4	2	1	3	6	2	1	4

Is the state of the system safe? 5

   b) Write the classical definitions of wait() and signal() in context with semaphore. Explain their demerits. 2+2
   c) What is Mutex? 1

3. a) What are the two models of IPC? Explain their strengths are weaknesses. 4
   b) Calculate average turn around time and average waiting time using SRTF for the following scenario: 3

<u>Process</u>	<u>Arrival Time</u>	<u>Burst Time</u>
P_1	0	10
P_2	1	9
P_3	2	12
P_4	4	4

   c) Explain Thrashing. 3

4. a) Explain blocking and non-blocking IO. 4
   b) What is file system mounting? 3
   c) What is copy-on-write? 3

5. a) Compare address binding in compile time with address binding in load time. 4
   b) What do you mean by front end and backend of a complier? 3
   c) Briefly state the functions of a relocatable loader. 3

Group – B

Answer **any two** questions from **Question Nos. 6 to 9** : [2×10]

6. a) Construct a Mealy machine which takes a binary number and replaces the first '1' with a '0' from every substring starting with 1. For example, 0000100110 becomes 0000000010. 3
   b) State and prove Arden's theorem. 4
   c) Represent the following sets by regular expressions: 1+1+1
      i) $\{0,1,2\}$
      ii) $\{1^{2n+1} \mid n>0\}$
      iii) $\{a^2, a^5, a^8, \cdots\}$

7. a) Show that $L\{ww \mid w \in \{a,b\}^*\}$ is not regular. 3
   b) Construct a finite automaton *M* which can recognize DFA in a given string over the alphabet $\{A, B, \cdots, Z\}$. For example, *M* has to recognize DFA in the string ATXDFAMN. 3
   c) Construct a deterministic finite automaton equivalent to the grammar: 2
      $S \to aS \mid bS \mid aA$
      $A \to bB$
      $B \to aC$
      $C \to \wedge$
   d) What do you mean by equivalence of deterministic and non-deterministic finite automaton? 2

8. a) Consider the following grammar: (S is the starting symbol and other symbols have their usual meanings): 2+1
      $S \to AB$
      $A \to A1 \mid 0$
      $B \to 2B \mid 3$
      i) Identify the type of grammar according to Chomsky classification. Justify your answer.
      ii) Find the language generated by the grammar. Justify your answer.
   b) And a grammar generating $L = \{a^n b^n c^i \mid n >= 1, i >= 0\}$. 3
   c) Construct a grammar which generates all even integers up to 998. 2
   d) Define the role of pumping lamma for context-free languages. 2

9. a) Construct a PDA P accepting the set of all strings over {*a*, *b*} with equal number of *a*'s and *b*'s. 3
   b) What are the basic components of a push-down automation? 2
   c) Design a Turing machine M to recognize the language $\{1^n 2^n 3^n \mid n >= 1\}$. 4
   d) The intersection of a context-free language and a regular language is _____. 1

Group – C

10. Answer **any one** question: [1×5]

a) i) Find the tightest upper bound for the following piece of code: 2½

```
fun(int n)
    {
        for(i=1;i<=n;i=i*2)
        {
            for(j=1;j<=i;j=j*2)
            printf("GATE 2017");
        }
    }
```

ii) What is an optimal Huffman code for the following set of frequencies, based on the first of Fibonacci numbers? 2½

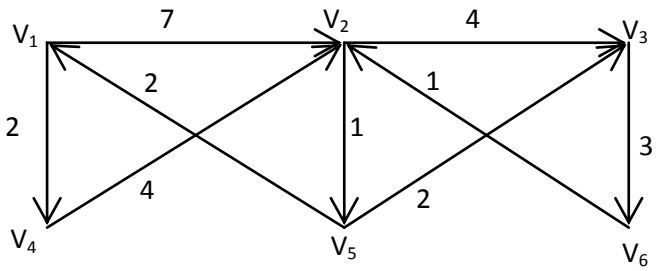
a:1 b:1 c:2 d:3 e:5 f:8 g:13 h:21

b) i) How can we store a graph using a sequential data structure that contains $O(|V|+|E|)$ amount of space? How does it differ from traditional graph storing data structure? 2½

ii) Suppose that we represent the graph $G(V,E)$ as an adjacency matrix. Give a simple implementation of Prim's algorithm for this case that runs in $O(V^2)$ time.

Answer **any two** questions from **Question Nos. 11 to 13**: [2×10]

11. a) Execute the Dijsktra algorithm for the following graph span V_1: 5



b) Find an optimal parenthesization of a matrix-chain product whose sequence of dimensions is $(5,10,3,12,5,50,6)$. 5

12. a) Define Big-Theta notation in asymptotic time complexity computation.
Prove that the worst case time complexity of the quick sort algorithm is $O(n^2)$, where 'n' is the input size. 1+4

b) Find the solution to the following Knapsack problem using dynamic programming: 5

$n = 6, (p_1, p_2, p_3, p_4, p_5, p_6) = (6,5,4,3,2,1)$ and $(w_1, w_2, w_3, w_4, w_5, w_6) = (100,50,20,10,7,3)$ and $m = 165$.

13. a) Consider the following two codes:

```
if(x<z) then
    ℓ=m+1
else if(x>z) then
    h=m–1
else
    i=m
    return true
```

```
if(x=z) then
    i=m
    return true
else if(x>z) then
    h=m–1
else
    ℓ=m+1
```

The results for the above two codes are same. Will both the algorithms take same amount of time during execution? If no, then what will be the difference in running cost if the probabilities of '>' and '<' is approximately ½? 3

b) Suppose we define a different kind of graph where we have weights on the vertices and not on the edges. Does the shortest-paths problem make sense for this kind of graph? If so, give a precise and formal description of the problem. If not, explain the reason. 2

c) What is Boolean satisfiability problem? State Cook's theorem in the context. 2½+2½

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