RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. FOURTH SEMESTER EXAMINATION, MAY 2016

SECOND YEAR [BATCH 2014-17]

Date : 20/05/2016 **COMPUTER SCIENCE (Honours)**

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

[Use a separate Answer Book for each group]

Group – A

Answer any three questions from question nos. 1 to 5 : [3×10]

1. a) How protection is ensured during paging? 4

   b) Suppose that total 64 MB memory is available in a system. This memory space is partitioned into 8 fixed sized slots of 8 MB each. Assume 8 processes are currently requesting memory usage with sizes indicated as: 2 MB, 4 MB, 3 MB, 7 MB, 9 MB, 6 MB, 1 MB, 8 MB. Calculate the size of memory wasted due to external fragmentation. Derive the memory utilization ratio by dividing the total requested memory. 4

   c) Why is page size always a power of 2? 2

2. a) Explain Thrashing in brief. 4

   b) Consider the following page reference string: 1, 2, 3, 4, 2, 1, 5, 6, 2, 1, 2, 3, 7, 6, 3, 2, 1, 2, 3, 6. How many page faults would occur for LRU page replacement algorithm, assuming the page frame size of two, six and seven? 3

   c) What is Belady's Anamoly? Explain with example. 3

3. a) Use a multi resource Banker's algorithm in an OS containing 3 resource classes. The number of resource units available for allocation is 7, 7 and 10 respectively.

   The current resource state is given as below:

Process	Allocation			Maximum		
	R1	R2	R3	R1	R2	R3
P_1	2	2	3	3	6	8
P_2	2	0	3	4	3	3
P_3	1	2	4	3	4	4

   i) Is the current allocation state safe? 3

   ii) Would the following request be granted in current state? 3

   - P_1 requests (1, 1, 0)
   - P_2 requests (0, 1, 0)
   - P_3 requests (0, 1, 0)

   b) Can a system detect that some of its processes are starving? If your answer is yes, explain how it can? If your answer is no, explain how the system can deal with starvation problem? 4

4. a) Consider the following set of processes. CPU burst time is given in milliseconds:

Process	Arrival time	Burst time
P1	0.0	7
P2	2.0	4
P3	4.0	1
P4	5.0	4

Draw the Gnatt Chart for preemptive and non-preemptive SJF scheduling. Find average waiting time and turn around time for preemptive and non-preemptive SJF scheduling. 2+2+2

b) What is the difference between logical and physical address? 1

c) What is semaphore? Briefly explain the role of semaphore in critical section problem. 1+2

5. a) What is context switching? Why is it considered to be an overhead? 1½ X 2

b) What are the differences between process and thread? 2

c) Mention advantages and disadvantages of round robin scheduling. 2

d) What are the conditions for deadlock? 3

Group – B

Answer <u>any two</u> questions from question nos. <u>6 to 9</u> : [2×10]

6. a) Construct a DFA accepting the language, consisting the set of strings such that the number of 0 be one or more and the number of 1's is divisible by 2, defined over the alphabet {0,1}. 3

b) Design the equivalent DFA for the following NFA with necessary steps. 3+2

	0	1
→p	{p,q}	{p}
q	{r,s}	{t}
r	{p,r}	{t}
*s	ϕ	ϕ
*t	ϕ	ϕ

Informally describe the language it accepts.

c) What do you mean by ambiguous grammar? Give an example. 2

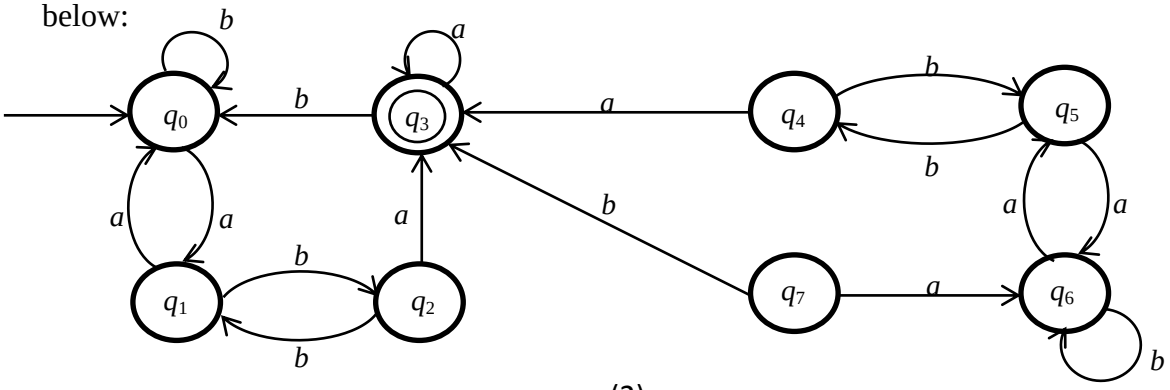
7. a) Find the regular expression for the following language:–
The set of all strings of 0's and 1's, when interpreted as a binary integer, is a multiple of 3. 4

b) Using pumping lemma for context free language, check whether the language $L = \{0^n 1^n 2^n \mid n \geq 1\}$ is context free language or not. 4

c) Construct a Mealy Machine which is equivalent to the Moore machine given by the following table. 2

Present State	Next State		o/p
	$a = 0$	$a = 1$	
→q_0	q_3	q_1	0
q_1	q_1	q_2	1
q_2	q_2	q_3	0
q_3	q_3	q_0	0

8. a) Construct the minimum state automation equivalent to the transition diagram given below: 3



b) Let G = ({S,A_1}, {0, 1, 2}, P, S), where P consists of S→OS$A_1$2, S→012, 2A_1→$A_1$2, 1A_1→11. Show that

$$L(G) = \{0^n\, 1^n\, 2^n \mid n \geq 1\}.$$ 2

c) Let G=({S,A_1,A_2}, {*a*,*b*}, P, S), where P consists of S→*a*$A_1$$A_2$ *a*, A_1→*b a* A_1 A_2 *b*, A_2→A_1 *ab*, *a*A_1→*b a a*, *b*A_2*b*→*a b a b*. Test whether *w* = *baabbabaabbaba* is in L(G). 3

d) What do you mean by halting problem of a Turing machine? 2

9. a) Define the different type of grammars, classified by Chomsky and mention also the respective automata, by which each type of grammar can be recognized distinctly. 3+2

b) Give the definition of deterministic pushdown automata. 1

c) Design a Turing machine accepting the language L={ww^R|w is any string of 0's and 1's}. 4

Group – C

Answer <u>any one</u> question from question nos. <u>10 to 11</u>: [1×5]

10. a) Write down the three steps of divide and conquer algorithm design technique. 3

b) Solve the following recurrence relation using Master Theorem: $T(n) = 9T\left(\frac{n}{3}\right) + n$. 2

11. What do you mean by dynamic programming? What is the difference between dynamic programming and greedy method? 2+3

Answer <u>any two</u> questions from question nos. <u>12 to 15</u> : [2×10]

12. a) Discuss the procedure for Stassen's matrix multiplication to evaluate the product of *n* matrices. Find the recurrence relation for the same and what is its time complexity? 3+1+1

b) Derive the time complexity of the following algorithm. 5

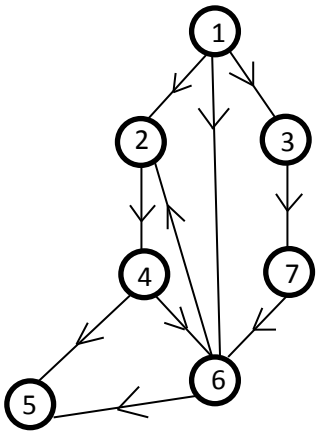
COUNT(*n*)
Input: $n = 2^K$, for some positive integer *K*.
Output: count = number of times step 4 is executed
1. count ←0
2. while *n*≥1
3. for *j*←1 to *n*
4. count ←count+1
5. end for
6. *n* ← *n*/2
7. end while
8. return count

13. a) Draw the decision tree for insertion sort algorithm operating on three elements. 3

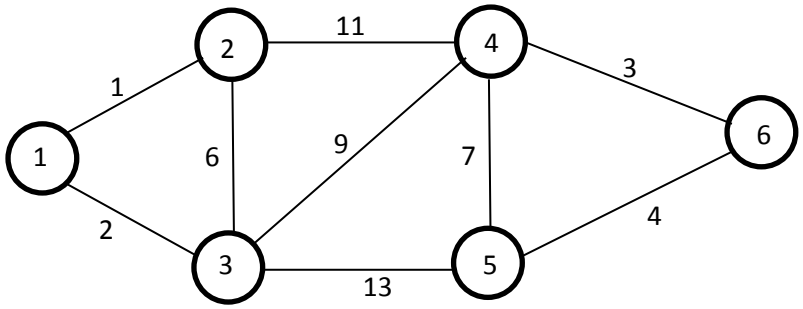
b) Prove that any comparison based sorting algorithm requires Ω (*n* log *n*) comparisons in the worst case. 5

c) Give an example where both greedy and dynamic programming techniques fail to produce the optimal solution. 2

14. a) For the following graph find i) BFS ii) DFS traversal. 2½ X 2



b) Write a greedy algorithm to find a minimum spanning tree for connected, weighted undirected graphs.
Find the minimum spanning tree step by step using your algorithm for the following graph. 2+3



15. a) Let G=(V,E) be connected unweighted graph. Write an O(|V|+|E|) time algorithm to find the shortest paths from a specified vertex to all other vertices in the graph. 5

b) Define incidence matrix for directed graph with example. What is adjacency matrix representation of a graph? 3+2

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