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R. V. COLLEGE OF ENGINEERING

Autonomous Institution affiliated to VTU

IV Semester B. E. Fast Track Examinations July-16

Common to CSE / ISE

DESIGN AND ANALYSIS OF ALGORITHMS

Time: 03 Hours ***Maximum Marks: 100***

Instructions to candidates:

1. Answer all questions from Part A. Part A questions should be answered in the first three pages of the answer book only.
2. Answer FIVE full questions from Part B.

PART-A

1	1.1	State the basic operation in the recursive function to find factorial of a number.	01
	1.2	What is the efficiency class of the algorithm if the scatterplot has a concave shape?	01
	1.3	What is the worst case efficiency of Brute Force string matching algorithm?	01
	1.4	State max-flow min-cut theorem.	01
	1.5	Order the following functions according to their order of growth (from the lowest to the highest): $(n-2)!$, $5log(n+100)^{10}$, 2^{2n}, $0.001n^4 + 3n^3 + 1$, ln^2n, $\sqrt[3]{n}$, 3^n.	02
	1.6	Apply Master theorem to find the efficiency of $T(n) = 16\,T({}^{n}/_{4}) + n$.	02
	1.7	List the different variants of decrease and conquer.	02
	1.8	Compute $C\,(4, 2)$ by applying dynamic programming.	02
	1.9	What is the minimum number of nodes an AVL tree of height 3 will have?	02
	1.10	Compare DFS and BFS.	02
	1.11	What is the time complexity of finding the duplicate element in an array by presorting-based algorithm?	02
	1.12	How many character comparisons will be made by Horspool's algorithm in searching for each of the following patterns in the binary text of 1000 zeros? a) 00001; b) 01010.	02

PART-B

2	a	With a neat diagram, explain algorithm design and analysis process.	06
	b	Prove that if $t_1(n) \in O(g_1(n))$ and $t_2(n) \in O(g_2(n))$, then $t_1(n) + t_2(n) \in O\{max\,(g_1(n),\, g_2(n))\}$	05

c Consider the following code:

```
for(i = 1; i <= n; i ++)
{
  pos = i;
  smallest = Array[pos];
  for(j = j + 1; j <= n; j ++)
    if(Array[j] < smallest)
    {
      pos = j;
      smallest = Array[pos];
    }
    Array[pos] = Array[i];
    Array[i] = smallest;
}
```

What does the algorithm compute? Determine the efficiency class of the algorithm. 05

OR

3 a Discuss the general plan for analyzing time efficiency of non-recursive algorithm. Apply the same for finding the number of binary digits in the binary representation of a positive decimal integer. 06

b Write the steps to perform empirical analysis. 05

c Consider the following recursive algorithm:

```
ALGORITHM Q(n)
//Input: A positive integer n
if n = 1
  return 1
else
  return Q(n − 1) + 2 ∗ n − 1
```

i) Set up a recurrence relation for this function's values and solve it to determine what this algorithm computes;

ii) Set up a recurrence relation for the number of multiplications made by this algorithm;

iii) Setup a recurrence relation for the number of additions/subtractions made by this algorithm. 05

4 a Write and explain the algorithm for merging two sorted arrays and derive the worst case efficiency of merge sort. 08

b Define an AVL tree. Construct an AVL tree by inserting the elements $9, 12, 10, 5, 3, 8, 13$ successively, starting with an empty tree and explain each step. 08

OR

5 a Design an algorithm to traverse a given graph using DFS. Apply DFS method to obtain the topological ordering of the graph given in Fig. 5a.

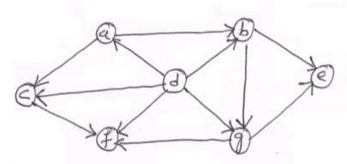


Fig. 5a 06

	b c	Find the median of the following nine numbers: 4 1 10 9 7 12 8 2 15 Construct a $2-3$ tree for the list C, O, M, P, U, T, E, R by inserting elements successively starting with the empty tree.	05 05
6	a b	Define Heap. Using heap-sort, sort the elements $3, 6, 5, 1, 2, 4$ in non-decreasing order. Find Pattern AT_THAT in the text $WHICH\_FINALLY\_HALTS.\_\_AT\_THAT$ using Horspool's and Boyer-Moore's algorithms.	06 10
		OR	
7	a b	Give the recurrence to solve $0/1$ knapsack using dynamic programming. Using the same, solve the problem instance given below in the order: (Item, weight, value) – $(1, 5, 2), (2, 1, 6), (3, 4, 5), (4, 3, 7)$ and $w = 5$. Design an algorithm to find the All-pairs shortest paths. Comment on the efficiency of the algorithm.	08 08
8	a	Construct a Huffman tree for the following data:	

$Character$	A	B	C	D	E
$Probability$	0.4	0.1	0.2	0.15	0.15

		Encode the text $ABACABAD$ and decode 100010111001010.	06
	b	Apply Kruskal's algorithm to the graph given in Fig. 8b	

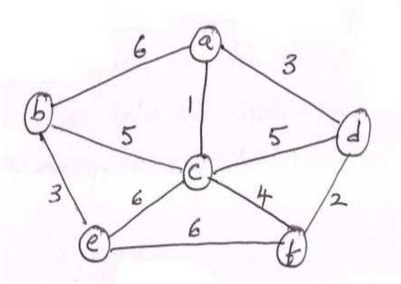


Fig. 8b

			05
	c	Design an algorithm to find the single source shortest path.	05
		OR	
9	a b	What is decision tree? Write a decision tree considering three-element insertion sort. Define source and sink. Find out the maximum flow of the following transport network Fig. 9b (where s = source and t = sink)	05

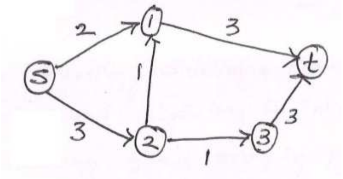
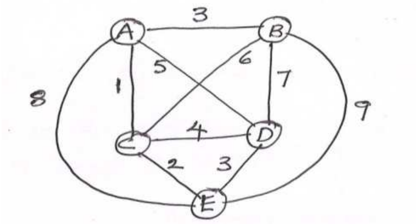


Fig. 9b

			05
	c	Design an algorithm to find a maximum matching in a bipartite graph.	06
10	a	Write the recursive backing algorithm for sum of subsets problem. Also draw the state space tree generated for the following problem instance: $s = \{5, 10, 12, 13, 15, 18\}$ and $d = 30$.	08

	b	Write an algorithm to check whether queen can be placed successfully on chess board. Give the state space tree for solving 4-Queens problem for atleast one solution.	08
		OR	
11	a	State the Assignment problem. Find the optimal solution for the given assignment problem which is represented as a matrix as shown below using branch and bound: $\begin{array}{cc} & \begin{array}{cccc} J1 & J2 & J3 & J4 \end{array} \\ \begin{array}{c} P1 \\ P2 \\ P3 \\ P4 \end{array} & \begin{bmatrix} 9 & 2 & 7 & 8 \\ 6 & 4 & 3 & 7 \\ 5 & 8 & 1 & 8 \\ 7 & 6 & 9 & 4 \end{bmatrix} \end{array}$	08
	b	State the travelling salesman problem. Apply the branch and bound algorithm to solve the *TSP* for the following graph given in Fig. 11b.  A B C D E 3 5 6 8 1 7 9 4 2 3 Fig. 11b	08

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IV Semester B. E. Fast Track Examinations July-16

Computer Science and Engineering

OPERATING SYSTEMS

Time: 03 Hours ***Maximum Marks: 100***

Instructions to candidates:

3. Answer all questions from Part A. Part A questions should be answered in the first three pages of the answer book only.
4. Answer FIVE full questions from Part B.

PART-A

1	1.1	What is Symmetric Multi-Processing?	01
	1.2	Distinguish between hard real time system and soft real time systems.	02
	1.3	What is meant by context switch?	01
	1.4	List any four benefits of multithreaded programming.	02
	1.5	The _________ scheduling algorithm is designed especially for time-sharing systems.	01
	1.6	The situation where the high-priority process would be waiting for a lower-priority one to finish is known as _________.	01
	1.7	Write the organization of mutual-exclusion implementation with semaphores for each process.	02
	1.8	List any two methods to eliminate deadlocks by aborting a process.	02
	1.9	The collection of processes on the disk that is waiting to be brought into memory for execution forms the ______ queue.	01
	1.10	The user process is of size 1 MB and the backing store is a standard hard disk with a transfer rate of 5 MB/s. The actual transfer of the 1MB process to or from memory takes _________ milliseconds.	01
	1.11	What is meant by lazy swapper?	01
	1.12	Distinguish between global and local page-replacement algorithms.	02
	1.13	In disk management, some controllers can be instructed to replace a bad block by _________.	01
	1.14	Define capability list for domains.	01
	1.15	List any two file attributes.	01

PART-B

2	a	With memory layout, discuss simple batch system and multiprogramming system.	08
	b	With a neat process state diagram, explain the states of a process in detail.	08
		OR	

3 a Write four reasons for process cooperation. 04

b List and explain the major advantages of multiprocessor systems. 04

c Explain operating system services in detail. 08

4 a Discuss various threading issues considered with multithreaded programs. 10

b Consider the following processes, with the length of the CPU-burst time given in milliseconds:

$Process$	$Arrival\ Time$	$Burst\ Time$
$P1$	0	8
$P2$	1	4
$P3$	2	9
$P4$	3	5

If the processes arrive at the ready queue at the times shown and need the indicated burst times,

i) Draw a Gantt chart illustrating the execution of these processes using preemptive SJF schedule;

ii) Calculate the average waiting time for preemptive and nonpreemtive SJF scheduling. 06

OR

5 a With suitable example, explain multilevel queue scheduling algorithm. 08

b Discuss various multithreading models used in threading implementation. 08

6 a List and explain the requirements to the critical section problem. Discuss Bakery algorithm with code. 08

b Explain four necessary conditions used during deadlock preventions. 08

OR

7 a Consider a system with time processes ($P1$ to $P5$) and three resources (A, B, C). Suppose at time t_o, the following snapshot of the system has been taken:

	$Available$			Max			$Available$		
	A	B	C	A	B	C	A	B	C
$P1$	0	1	0	7	5	3	3	3	2
$P2$	2	0	0	3	2	2			
$P3$	3	0	2	9	0	2			
$P4$	2	1	1	2	2	2			
$P5$	0	0	2	4	3	3			

Answer the following questions using Banker's algorithm:

i) What is the content of matrix need?

ii) Is the system in a safe state? If yes, find its safe sequence.

iii) If $P2$ sends an additional request for (1 0 2), can it be granted immediately? 08

b Write a monitor solution code to the dining-philosopher problem. 08

8	a	With a neat diagram, explain paging hardware with TLB.	08
	b	With suitable example, explain $FIFO$ and optimal page replacement algorithms.	08
		OR	
9	a	With a neat sketch, explain the steps in handling a page fault.	08
	b	Write a short note on address binding and swapping.	08
10	a	With a neat sketch, explain Tree-structured and Acycilc-graph directories.	08
	b	Summarize the concepts used for effective implementation of the access matrix.	08
		OR	
11	a	With suitable example, discuss $SCAN$ scheduling and $C-SCAN$ scheduling algorithms.	08
	b	Differentiate between Boot block and Bad block.	04
	c	Discuss various file operations in detail.	04

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IV Semester B. E. Fast Track Examinations July-16

Computer Science and Engineering

OBJECT ORIENTED PROGRAMMING WITH C++

Time: 03 Hours ***Maximum Marks: 100***

Instructions to candidates:

5. Answer all questions from Part A. Part A questions should be answered in the first three pages of the answer book only.
6. Answer FIVE full questions from Part B.

PART-A

1	1.1	A structure is same as class except that it cannot be used in ________.	01
	1.2	Differentiate between const and mutable keywords with an example.	02

	1.3	Write the output for the following code:
		#include < iostream >
		using namespace std;
		int main()
		{
		  int x = 10;
		  int& ref = x;
		  ref = 20;
		  cout << "x = " << x << endl;
		  x = 30;
		  cout << "ref = " << ref << endl;
		  return 0;
		}
			02

	1.4	Give the syntax to overload the binary operator ‘ + ’ with friend and without friend keyword.	02
	1.5	Mention the two uses of ‘this’ pointer.	01
	1.6	Give the general syntax for copy constructor.	01
	1.7	Mention the difference between function overloading and function overriding.	02
	1.8	We can output text to an object of class ostream using the insertion operator << because ________ operator is overloaded in ________.	01
	1.9	Under what circumstances the default copy constructor and the default assignment do not work.	02
	1.10	An exception is caused by ________ type of error.	01
	1.11	Runtime polymorphism is achieved by ________ function.	01
	1.12	Mention functions to perform text input and output in $C++$.	01
	1.13	A pointer to the base class can hold address of ________ class object as well as ________ object.	01
	1.14	Write the code for finding the max of two elements using template function.	01

1.15	If there is a pointer p to the object of a base class and it contains the address of an object of a derived class and both classes contain a virtual member function abc(), then the statement $p\text{−>}\,abc()$; will cause the version of abc() in the ________ class to be executed.	01

PART-B

2 a	Write a $C++$ program to swap two numbers using pointer variables. Rewrite the same program using reference variables.	06
b	Write a program in $C++$ to calculate the area of circle, rectangle and triangle using function overloading.	10
	OR	
3 a	Write a program in $C++$ to read and print student details using constructor and destructor. The program should input student details such as name, roll number, height and weight. The program should invoke display() function and print the student details.	08
b	Write a program in $C++$ to implement arithmetic operations ‘+’ and ‘−‘ on complex numbers using constructor over loading.	05
c	When is default constructor required to be explicitly mentioned in the code? Explain with an example.	03
4 a	Write a program in $C++$ to demonstrate the use of new and delete operators. Add two integer numbers by allocating memory to pointer variables of integer type. Display the sum of the two numbers and deallocate the memory allocated for the two integer variables.	04
b	Write a note on visibility of member functions based on private and protected derivations.	04
c	Write a $C++$ program to create a class to calculate the area and perimeter of a rectangle using the concept of single inheritance.	08
	OR	
5 a	Write a $C++$ program to illustrate multiple inheritances with the class rectangle being derived from base classes Area and Circle.	06
b	What is the difference between malloc()/free() and new/delete?	04
c	Draw an inheritance hierarchy for students at a university. Use student as the base class of the hierarchy, then include classes UndergraduateStudent and GraduateStudent that derive from Student. Freshman, Sophomore, Junior, senior derive from UndergraguateStudent, and DoctoralStudent and MastersStudent derive from GraduateStudent. Define the class definition only for the inheritance structure.	06
6 a	Write a $C++$ program to overload binary ‘+’ operator to concatenate two strings.	10
b	What is operator overloading? Explain, with examples, the general structure, rules and advantages.	06
	OR	

7	a	Create a class Distance with metres and centimeters as data members and include suitable member functions. Write a program in $C++$ to overload the relational operator ‘$>$’ to compare two objects of distance class.	06
	b	List advantages of operator overloading feature of object oriented programming.	04
	c	Write the operator function to overload the insertion, extraction operators, increment and decrement operators (both prefix and postfix notations).	06
8	a	Explain the importance of pure virtual functions with an example.	04
	b	What is the Standard Template Library? Name any four of the template classes that are available in STL.	04
	c	Write a $C++$ program to create template for bubble sort function to sort array of integers and real numbers.	08
		OR	
9	a	Write a function template for finding the second maximum value from list of numbers.	06
	b	Declare the base class Base. Declare and define the virtual function show(). Declare and define the function display(). Create the derived class from the base class. Declare and define the functions display() and show(). Create the base class object and pointer variable. Call the functions display() and show() using the base class object and pointer. Create the derived class object and call the functions display() and show() using the derived class object and pointer. Display suitable messages.	08
	c	Discuss the importance of virtual base class.	02
10	a	Write a $C++$ program to illustrate error handling for divide by zero using Exception Handling concept of $C++$.	10
	b	With pictorial representation, discuss the complete taxonomy of library classes and their hierarchy that handle streams.	06
		OR	
11	a	Discuss the C style of error handling and $C++$ way of handling exceptions with suitable examples.	06
	b	Write a $C++$ program to perform the following file operations: i) Copy the contents of one file to another; ii) Append the file to another and search for number of occurrences of a specific word.	10