



Date: 28th June 2007

Time: 10.00 a.m. – 12.30 p.m.

Answer **FOUR** Questions **ONLY**.

Q1.

(a) State whether the following statements are **True** or **False**, and give reasons for your decision.

- (i) Usually the most difficult part of the *Problem Solving Process* is identifying the problem.
- (ii) The most suitable sorting algorithm for sorting more than 200 employee records is the *bubble sort* algorithm.
- (iii) *Quick sort* is an *Internal sorting* algorithm.
- (iv) Insertion can be done more efficiently in a *Queue* data structure than in a *Tree* data structure.
- (v) A *string* is an infinite sequence of characters.

(b) Perform a Big-O analysis for each of the following functions.

(i) $2n^2 + n - 6$

(ii) $\frac{10(n-1)(n+1)}{5(n-1)}$

(c) State which data structure is more appropriate for each of the following situations by giving reasons.

- (i) To store information of flights coming to an airport, that has to be given permission to land.
- (ii) A data structure used to keep track of the return addresses for nested functions while a program is running.
- (iii) To store student's data that are enrolled into a class.
- (iv) To check whether the parentheses are properly placed in a given arithmetic operation

Q2.

- (a) (i) What are the characteristics of an ADT?
(ii) Briefly explain each of them.
- (b) Create an ADT to store the radius and the height of a cylinder.

Radius - r
Height - h

- (c) Write a procedure to assign values for the ADT created in part (b).
- (d) Write a procedure to calculate the volume of the cylinder.
Volume of the cylinder - $\pi r^2 h$
- (e) The above cylinder is combined with another cylinder on the top. The radius of the second cylinder is a and the height is b . Write a procedure to calculate the volume of the combined object.

Volume of the combined object is $\pi r^2 h + \pi a^2 b$

Q3.

- (a) (i) Briefly explain the term "Algorithm".
(ii) "Recursion is an important concept in programming". Do you agree with this statement?. Justify your answer.
- (b) Consider the following function.

```
function fact (i:integer): integer;  
begin  
    fact := 0;  
    if i <= 0 then  
        fact := 1  
    else  
        fact := i * fact (i-1);  
end;
```

- (i) What are the differences between 'Recursive' and 'Non Recursive' algorithms?
- (ii) Write a non recursive algorithm for the function given above.
- (iii) Calculate the running time of the non recursive algorithm in part (ii).

Q4.

- (a) (i) What are the differences between *internal* and *external* sorting methods.
(ii) Name three criteria that can be used to classify *searching methods*.
- (b) With the aid of an example briefly explain what is *merging*.
- (c) Write a procedure to find the highest mark of a subject that is stored in an array without using a sorting algorithm. (Hint: use a searching algorithm).
- (d) Write a procedure using *Binary Search* algorithm to find the number of students who have scored exactly 70 marks for the above subject.

Q5.

- (a) Write down the *Linear insertion sort* algorithm to sort a set of integers into the descending order.
- (b) Compare and contrast the *Linear Insertion sort* algorithm with the *Straight Selection sort* algorithm.
- (c) Comparisons and swaps are expensive operations. Which algorithm has implemented to use the least number of swaps out of the above two algorithms in part (b)?
Briefly explain the strategy that has used for the task ?
- (c) Explain how *Straight Selection sort* works on the following set of characters when sorting into the alphabetical order.
U,N,I,V,E,R,S,I,T,Y

Q6. (a) What are the factors you should consider when selecting a sorting algorithm ?

- (b) Compare and contrast the *Bubble sort* algorithm with the *Quick sort* algorithm.
- (c) Write a complete program to insert 25 integers into an array and sort it into the descending order using the *Bubble sort* algorithm.
- (d) Explain how the *Bubble sort* algorithm works on the following set of integers into the descending order.
1, 5, 3, 2, 4.

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