M.Sc 4th Semester Examination, 2011

APPLIED MATHEMATICS WITH OCEANOLOGY AND COMPUTER PROGRAMMING

PAPER—MA-2201

Full Marks : 50

Time : 2 hours

The figures in the right-hand margin indicate marks

GROUP — A

(*Topology*)

[*Marks* : 25]

1. Answer any *two* questions :   1 × 2

    (*a*) State the second axiom of countability.

    (*b*) Define a disconnected subset of a topological space.

    (*c*) Define a Lindelof space.

2. Answer any *three* questions : 4×3

   (a) Let R be the set of all real numbers and
       let S consists of subsets of R defined as
       follows :

       (i) $\varphi \in S$

       (ii) a non-empty subset G of R belongs to S
            iff to each $x \in G$, there exists a right half
            open interval $[a, b[$ such that

            $x \in [a, b[\subset G.$

       Prove that S is a topology for R.

   (b) Prove that on the set of all real numbers R
       the lower limit topology is finer than the usual
       topology.

   (c) Define boundary of a subset A of a topological
       space (X, Y). Prove that a space (X, Y) is
       connected if and only if every non-empty
       proper subset of X has a non-empty boundary.

(d) Let $X = \{a, b, c\}$ and topology on X be

$$\mathcal{T} = \{\varphi, X, \{a\}, \{a, b\}, \{a, c\}\}.$$

Determine the limit points of the set $\{b, c\}$.

(e) Let f be a mapping of R into R as

$$f(x) = \begin{cases} -5, & x < 0 \\ 3, & x \geq 0. \end{cases}$$

Find whether f is $\mathcal{T}$- u continuous and $\mathcal{D}$- u continuous where $\mathcal{I}$ and $\mathcal{D}$ are respectively the indiscrete and discrete topologies.

3. Answer any *one* question : 6 × 1

(a) Prove that a topological space is disconnected iff there exists a proper subset which is both open and closed.

(b) Prove that every convergent sequence in a Hausdroff space has a unique limit. Is the converge true ? Justify your answer.

[*Internal Assessment* : 5 Marks]

GROUP – B

*(Data Structure and Design and
Analysis of Algorithms)*

[*Marks* : 25]

Answer **Q. No. 4** and any *two* from the rest

4.   Answer any *two* questions :   2 × 2

   (a) Define the data structure "stack". How stack
         is better than array ?

   (b) Define time and space complexities of an
         algorithm.

   (c) Define "ω" and "Ω" notations for asymptotic
         growth rate of a function.

   (d) Find the prefix and postfix expressions of the
         following infix expression

$$A * (B + C) - (D * E - F * G).$$

5. Write quickshort algorithm to arrange a set of real numbers in ascending order. What is the time complexities of this algorithm? Why this short is referred as 'quick'? $6 + 1 + 1$

6. Explain how a polynomial can be represented as a circular linked list. Suppose P and Q are two polynomial stored in two circular linked list. Write an algorithm to find the sum of P and Q and the result will be stored in the polynomial P. $2 + 6$

7. Explain the main steps of Dijkstra algorithm to find the shortest distance between two vertices. Find the shortest distance between the vertices b and e from the following graph. $4 + 4$
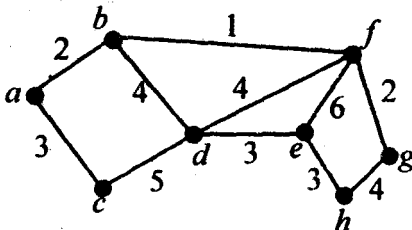
8. Write recursive algorithm for BFS. Find the BFS tree for the following graph starting from the vertex *a*.
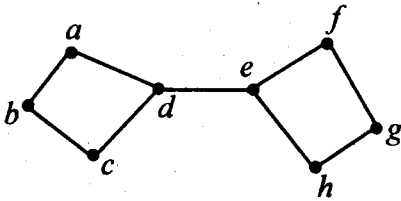
Is the tree unique ?   3 + 4 +1

[*Internal Assessment* : 5 Marks]

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