KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 2nd Year 1st Term Examination, 2015
Department of Computer Science and Engineering
CSE 2101
Data Structures and Algorithms

TIME: 3 hours   FULL MARKS: 210

N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
     ii) Figures in the right margin indicate full marks.

SECTION A

(Answer **ANY THREE** questions from this section in Script A)

1. a) Define Data Structure. Distinguish between data type and abstract data type.   (08)
    b) Suppose A is a two dimensional Array declared in C language. The location of A[0][0] is   (10)
        ∞ and the declaration is A[5][6].
        (i) Where is the location of A[1][2] if the row-major representation is used?
        (ii) Where is the location of A[4][5] if the column-major representation is used?
    c) Give two sorted arrays, A with n elements and B with m elements. Write a method   (09)
        merging the elements of B into A in sorted order without using extra space. Assume A has
        a large enough buffer at the end to hold all of B's elements.
    d) How do you access and store the elements of array?   (08)

2. a) Define data structure for a two way Linked List. Discuss the advantages of searching an (12)
        unsorted list for a given element ITEM with respect to the two-way list over one-way list.
    b) Write a method to reverse a linked list.   (08)
    c) Consider the following C++ function: (10)
        void SomeFunction(NodeType *n)
        {
           if(Head= = NULL)
              Head=n;
           else
              Tail→Next=n;
              n→Next=NULL;
              Tail=n;
        }
        (i)   What does the function do?
        (ii) Is the list linear or circular?
        (iii) Which of "Head", "Tail" and "n" are pointers?
        (iv) What is another valid syntax for "n→Next"?
    d) "Binary search tree is also called sorted binary tree"-why?   (05)

3. a) What do you mean by heap and heap property?   (06)
    b) Construct a Max-heap H from the following list of numbers: (13)
        34, 30, 40, 22, 50, 2, 55, 77, 55
        and (i) Insert another item 70 into constructed heap. (ii) Then delete the number 22 for re-
        heaping it. What the correct steps in both cases. Explain.
    c) What is Multi-way Linked list. How sparse matrix is implemented by Multiway linked   (11)
        list. Explain with proper example(s).
    d) You have learned that singly linked list are trees. Are circularly linked lists also trees? (05)
        Why or why no?

4. a) How a node deletion occurs in a binary search tree? Explain each case with example. (10)
   b) Define Multiway-tree with example(s). In the BST shown in the following figure (Fig. (10)
   4(b)), the value I inside in the node marked 1 is to be removed. This may involve the
   swapping of values among nodes, and will involve the removal of one node. There are
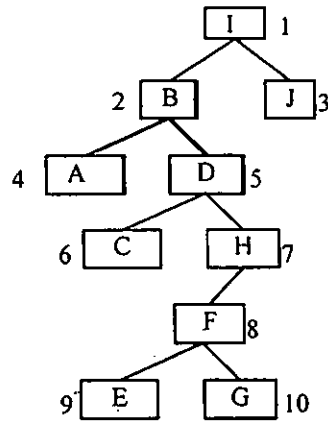   two possible solutions to this problem-Identify the changes in order for both.

Fig. 4 (b)

   c) Using radix sort method, sort the data elements 9, 159, 59, 113 and 26 in decreasing order. (10)
   Then calculate the total number of comparisons needed to sort the data.
   d) Compare Bucket Sort and Radix Sort with respect to advantages and disadvantages. (05)

SECTION B
(Answer **ANY THREE** questions from this section in Script B)

5. a) What is Hash function? Write down the desirable properties of Hash function. (06)
   b) Given a hash table of size 13, show the contents of your hash table after inserting the (10)
   values {8, 2, 7, 18, 15, 19, 23, 15, 20, 16} using open addressing with quadratic probing
   $(f(i)=i^2)$ for collision resolution.
   c) "Stacks are used in processing of data when certain steps of processing must be postponed (09)
   until other conditions are fulfilled"-Explain with an example.
   d) Using your own data, explain how binary search algorithm works. Also discuss the (10)
   limitations of this algorithm.

6. a) How 'overflow in stacks' can be minimized? Explain with an example. (06)
   b) Show the steps of QUICKSORT algorithm when you apply it on your own data where the (13)
   number of data is 10. Also discuss the complexity of it in this case.
   c) Define and discuss the criteria of Recursion. Solve Fibonacci sequence recursively. (10)
   d) Write down the procedure of garbage collection. (06)

7. a) Define Priority Queue. How do you write Priority Queue in a linear array and one-way (09)
   list?
   b) Consider a circular queue having five memory cells. Now depict at least four examples to (08)
   show how regular insertion and deletion occurs in it.
   c) Consider the following dequeue of characters where DEQUE is a circular array which is (10)
   allocated six memory cells: LEFT:2, RIGHT=4, DEQUE:_, A, C, D, _, _. Describe the
   dequeue while the following operations take place.
       (i) F is added to the right of the dequeue
       (ii) Two letters on the right are deleted.
       (iii)K, L, and M are added to the left.
       (iv)One letter on the left is deleted.
   d) Define graph. Why linked representation of a graph is better than array representation. (08)

8. a) Define the terms: Labeled graph, directed graph and complete graph. Consider the graph (16)
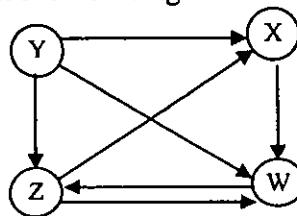   G in Fig. 8(a). Find the path matrix P of G using warshall's algorithm.

Fig. 8(a)

   b) Consider a directed graph G having 9 nodes. Apply BFS to find the minimum path P from (09)
   a source node to a destination node with G.
   c) Write down the steps needed to follow to delete a node from a graph. Explain with (10)
   example.

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    iii) Assume any necessary data if needed.

SECTION A
(Answer **ANY THREE** questions from this section in Script A)

1. a) Define and explain the following terms-(i) Figure of merit (ii) Fan out (iii) Noise margin   (10)
      (iv) power dissipation (v) storage time.
   b) Draw the circuit diagram of Dual-slope A/D converter and describe its operation in short.   (10)
   c) How 3-terminal AND and OR gate are made using diode? Explain with proper circuit   (15)
      diagram.

2. a) What is meant by PLA, PLD, ROM , RAM and EPROM?   (10)
   b) Sketch the circuit diagram of Tri-state TTL(TSL) Logic circuit and explain its operation.   (12)
      Why ECL is faster than TTL?
   c) Design a BCD to Excess-3 code converter using PLA with its Program table.   (13)

3. a) How transistor can be used as a switch? Describe the operation of diode-transistor NAND   (10)
      gate.
   b) What is CMOS? How CMOS can be used as inverter? Draw the basic circuitry of a TTL-   (15)
      3 input NAND gate.
   c) How op-amp can be used as a summing integrator and differentiator?   (10)

4. a) Define operational register. Explain the operation of information transfer, during read and   (07)
      write operations in a memory unit.
   b) What are the significances of the name of Integrated Injection Logic (I^2L)? Describe the   (14)
      operation of different types of I^2L inverters.
   c) Draw the circuit diagram of 16 bit ROM array. What LCD?   (10)
   d) Define the terms: resolution and setting time.   (04)

SECTION B
(Answer **ANY THREE** questions from this section in Script B)

5. a) Describe pulse waveform. Classify the pulse generating circuit. Mention some   (12)
      applications of pulse waveforms.
   b) Explain linear wave shaping technique. Derive the response of the RC High Pass filter to   (12)
      a pulse input with necessary sketches.
   c) Differentiate between clipping circuit and clamping circuit. Draw the output waveform of   (11)
      the following circuits (Fig.5(c)-(i),(ii),(iii)) for their respective given input.
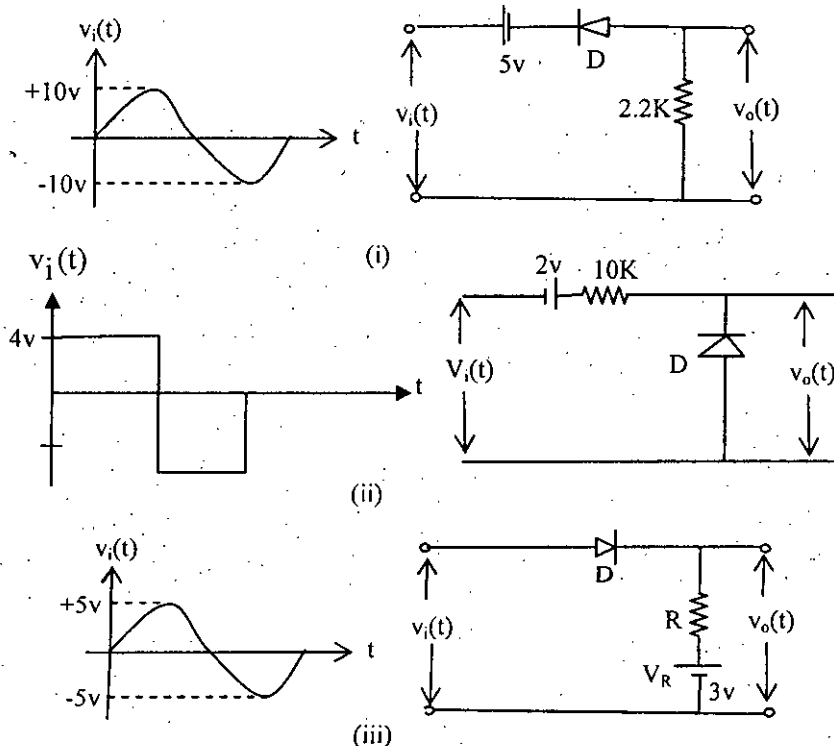

Fig. 5(c)

6. a) Define blocking oscillator. Mention some applications of it. (10)
   b) What is pulse transformer? Write down the function and types according to size with application of pulse transformer. (12)
   c) What do you mean by timing circuit. Draw the functional block diagram of Monostable multivibrator with a 555 IC timer and explain its operation principle. (13)

7. a) Describe the operation of astable circuit. Why it is called free running multi-vibrator? (10)
   b) For a monostable multivibrator show that t=0.69RC, where the symbols have their usual meanings. (13)
   c) Design a collector coupled bi-stable Multivibrator to operate from a $\pm 5V$ supply, using transistor 2N3904, $h_{FE(min)}$=70 and $I_{C(sat)}$=2mA. (12)

8. a) What do you mean by UTP and LTP? Draw the input/output characteristics of schimitt trigger circuit. (10)
   b) Describe the operation of Bootstrap and op-amp function generator. (10)
   c) Explain the exponential charging approach of generating voltage sweep waveforms. (08)
   d) Draw and explain the principle of a constant current ramp generator. (07)