



Department of Information and Communication Engineering  
Pabna University of Science and Technology  
Faculty of Engineering and Technology  
B.Sc. (Engineering) 2<sup>nd</sup> Year 2<sup>nd</sup> Semester Examination-2017  
Session: 2015-2016 & 2014-2015

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Course Code: ICE-2201

Course Title: Data Structure and Algorithm

- NB: 1. Answer any SIX (THREE from each PART) questions.  
2. Figures in the right margin indicate marks.  
3. Parts of the same question should be answered together and in the same sequence.  
4. Separate answer script must be used for answering the question of PART-A and PART-B.

Time: 3 Hours

Total Marks: 70

PART-A

1. a) Consider the pattern  $P = a^2ba$ . Construct the table and the corresponding labeled directed graph used in the "fast" pattern matching algorithm.  
b) Suppose A is a sorted array with 400 hundred elements, and suppose a given element x appears with the same probability in any place in A. Find the worst case running time  $f(n)$  and the average case running time  $g(n)$  to find x in A using the binary search algorithm.
2. a) Let n denote a positive integer. Suppose a function L is defined recursively as follows  
$$L(n) = \begin{cases} 0, & \text{if } n = 1 \\ L(\lfloor n/2 \rfloor + 1), & \text{if } n > 1 \end{cases}$$
  
i) Find  $L(25)$ . ii) What does this function do?  
b) Consider the following stacks of city names:  
STACK: London, Berlin, Rome, Paris, \_\_\_\_\_  
i) Describe the stack as the following operations take place:  
A) PUSH(STACK, Athens)  
B) POP(STACK, ITEM)  
C) POP(STACK, ITEM)  
D) PUSH(STACK, Dhaka)  
E) PUSH(STACK, Tokyo)  
F) POP(STACK, ITEM)  
ii) Describe the stack if the operation POP(STACK, ITEM) deletes London.
3. a) What is transitive closure? Write a procedure that finds the shortest path from a given node NA to a given node NB.  
b) Discuss the standard ways of traversing a binary tree T with root R with examples.  
c) Describe merge sort algorithm.
4. a) Construct a 3-way search tree for the list of keys in the order shown below. What are your observations?  
List A: 10, 15, 20, 25, 30, 35, 40, 45  
List B: 20, 35, 40, 10, 15, 25, 30, 45  
b) Consider the following 4-digit employee numbers  
9614, 5882, 6713, 4409, 7148  
Find the 2-digit hash address of each number using  
i) the division method with  $m = 97$ ;  
ii) the mid-square method  
iii) the folding method without reversing; and  
iv) the folding method with reversing.

PART-B

5. a) What do you mean by feasible solution? Give the general method of Greedy algorithm.  
b) Give an algorithm for Greedy Knapsack. Consider  $n = 7$ ,  $m = 20$ ,  
 $(p_1, p_2, p_3, p_4, p_5, p_6, p_7) = (10, 5, 15, 7, 6, 18, 2)$  and  $(w_1, w_2, w_3, w_4, w_5, w_6, w_7) = (2, 3, 5, 7, 1, 4, 2)$ . Obtain the optimal solution for this Knapsack instance.
6. a) Write algorithm for travelling salesperson problem using dynamic programming.  
b) Schedule two jobs on 4 machine using flow shop scheduling technique. The time required by each operation of these jobs is given by following matrix.  
$$J = \begin{bmatrix} 3 & 0 \\ 0 & 3 \\ 4 & 2 \\ 5 & 2 \end{bmatrix}$$
7. a) Differentiate between dynamic programming and divide and conquer paradigm.  
b) Explain the concept of backtracking with the help of suitable example.  
c) Solve 8-queen's problem for a feasible sequence (8, 2, 5, 3).
8. a) State the problem of graph coloring with example.  
b) Prove that the size of the set of all subsets of n elements is  $2^n$ .  
c) Write down the general iterative backtracking method. On what factors does the mental backtracking algorithm depend?



Department of Information and Communication Engineering  
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B.Sc. (Engineering) 2<sup>nd</sup> Year 2<sup>nd</sup> Semester Examination-2018  
Session: 2016-2017

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Course Title: Data Structure and Algorithm

- QB:
1. Answer any SIX (three from each part) questions.
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Time: 3 Hours

Total Marks: 70

PART-A

- a) What are the differences between a Stack, Queue and Array? 4
  - b) Mention the advantage of sparse matrix. Suppose an integer occupies 4 bytes of memory space. Then Calculate the memory space required to store a 2D-array int LA[30][50]. If the starting address (base address) of LA is 2000H, then calculate the address of LA[11][15]. 3 2 3
  - c) Explain the process of insertion an item into a linked list in the middle. 4
- a) Write down the properties of stack and queue data structures. Write an algorithm to insert an item into a stack. 4
  - b) Let  $a$  and  $b$  denote positive integers. Suppose a function  $Q$  is defined recursively as follows:  
$$Q(a, b) = \begin{cases} 0, & \text{if } a < b \\ Q(a - b, b) + 1, & \text{if } a \geq b \end{cases}$$
    - (i) Find the value of  $Q(2, 3)$  and  $Q(14, 3)$
    - (ii) What does this function do? Find  $Q(5861, 7)$
  - c) What are the most commonly used operations on a link list? Is it possible to apply binary search algorithm in a sorted linked list? Write a program segment to insert an item of a node in a linked list at any position. 3 2 3
- a) Given that following list of 12 numerical data :  
44, 33, 11, 55, 77, 90, 40, 60, 99, 22, 88, 66.  
Use the quicksort algorithm to find the final position of the first number 44. 5
  - b) Write an ADT to implement stack of size  $N$  using an array. The elements in the stack are to be integers. The operations to be supported are PUSH, POP and DISPLAY. Take into account the exceptions of stack overflow and stack underflow. 2 6 3
- a) Define "extended binary tree". Explain with an example, how to convert a binary tree to an extended binary tree. 3 2 3
  - b) Construct a 3-way search tree for the list of keys in the order shown below. What are your observations? 4
  - c) Apply selection sort algorithm to sort the following elements:  
List A: 10, 15, 20, 25, 30, 35, 40, 45  
List B: 20, 35, 40, 10, 15, 25, 30, 45  
77, 33, 44, 11, 88, 22, 66, 55, 99 4

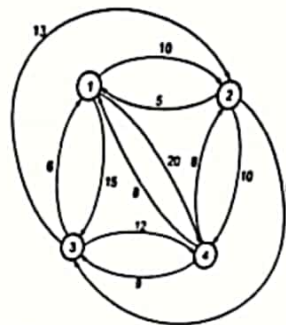




## PART-B

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5. a) What is a greedy algorithm? Write down its advantages and disadvantages.
- b) What is a recursive algorithm? Write an algorithm for tower of Hanoi puzzle to move  $n$  disk from tower  $x$  to tower  $y$ .
- c) Define minimum-cost spanning tree. Illustrate with an example the Prim's algorithm to obtain a minimum-cost spanning tree.
6. a) Describes Bellman-Ford algorithm with example.
- b) Explain Dijkstra's algorithm for finding the shortest path.
7. a) For the given diagram, obtain optimum cost tour for the travelling salesperson problem.



- b) Solve 0/1 Knapsack problem for the instance  $n=4$ ,  $m=21$ ,  $(p_1, p_2, p_3, p_4) = (2, 5, 8, 1)$  and  $(w_1, w_2, w_3, w_4) = (10, 15, 6, 9)$ .
8. a) State the principle of backtracking.
- b) Give a formal definition of the  $n$ -queen's problem. Find all possible solution to 4-queen's problem. Establish the relationship between the two solutions.
- c) What do you understand by graph coloring? Describe backtracking algorithm to find all Hamiltonian cycles in a graph.

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$5\frac{2}{3}$





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Course Code: ICE-2201 Course Title: Data Structure and Algorithm

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1. Answer any SIX (THREE from each PART) questions.
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Time: 3 Hours

Total Marks: 70

PART-A

1. a) Define data structure. Name different types of data structure. List operations that can be performed on these data structures.  $3 \frac{2}{3}$   
b) Using the bubble sort algorithm, find the number of comparisons (C) and the number of interchanges (D) which alphabetize the  $n = 7$  letters in RAJAPUR. 3  
c) Write down the algorithm for binary search. Validate the algorithm with a suitable data set. 3  
d) Calculate the total number of moves for the Tower of Hanoi for  $n=15$  disks. 2
2. a) Let  $a$  and  $b$  denote positive integers. Suppose a function  $Q$  is defined recursively as follows 5  
$$Q(a, b) = \begin{cases} 0, & \text{if } a < b \\ Q(a - b, b) + 1 & \text{if } b \leq a \end{cases}$$
  
i) Find the value of  $Q(2, 3)$  and  $Q(14, 3)$ . 29  
ii) What does this function do? Find  $Q(5861, 7)$   
b) Define binary tree and complete binary tree with example.  $6 \frac{4}{3}$   
A binary tree  $T$  has 9 nodes. The inorder and preorder traversals of  $T$  yield the following sequences of nodes. Draw the tree  $T$ .  
Inorder: E A C K F H D B G  
Preorder: F A E K C D H G B
3. a) Define B tree. Construct a B tree of order 3 by inserting the following keys in the order shown into an empty B tree: M Q A N P W X T G E J 5  
b) Suppose the 7 data items are assigned the following weights:  $2 \frac{2}{3}$   
(A, 13), (B, 2), (C, 19), (D, 23), (E, 29), (F, 5), (G, 9).  
Find a 2-tree with a minimum weighted path length  $P$ . What is the Huffman coding for the 7 letters?
4. a) Write the insertion sort algorithm. Apply this insertion sort algorithm to sort the following numbers: 99, 77, 33, 44, 11, 88, 22, 66, 55 5  
b) Consider the following 4-digit employee numbers 6  
9614, 5882, 6713, 4409, 7148  
Find the 2-digit hash address of each number using  
i) the division method with  $m=97$ ;





4. a) Write the insertion sort algorithm. Apply this insertion sort algorithm to sort the following numbers: 99, 77, 33, 44, 11, 88, 22, 66, 55
- b) Consider the following 4-digit employee numbers  
9614, 5882, 6713, 4409, 7148  
Find the 2-digit hash address of each number using
- the division method with  $m=97$ ;

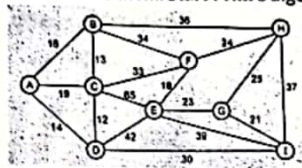
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- the midsquare method
- the folding method without reversing; and
- the folding method with reversing.

#### PART-B

5. a) Define an algorithm. Explain the features of an efficient algorithm. 4
- b) Elaborate on asymptotic notations with examples.  $3\frac{2}{3}$
- c) Calculate the time complexity of  $1 + 3 + 5 + 7 + \dots + 999$ . 4
6. a) State the general principle of the greedy algorithm. What is the drawback of the Greedy algorithm?  $3\frac{2}{3}$
- b) Consider the following weighted graph. Give the list of edges in the MST in the order that Prim's algorithm inserts them. Start Prim's algorithm from vertex A. 4



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- c) Explain how job sequencing with deadline problems can be solved using the Greedy approach. 4
7. a) Write the general procedure of dynamic programming. State the principle of optimality.  $3\frac{2}{3}$
- b) Solve the all pairs shortest path problem for the digraph with the following weight matrix. 6
- $$\begin{bmatrix} 0 & 2 & \infty & 1 & 8 \\ 6 & 0 & 3 & 2 & \infty \\ \infty & \infty & 0 & 4 & \infty \\ \infty & \infty & 2 & 0 & 3 \\ 3 & \infty & \infty & \infty & 0 \end{bmatrix}$$
- c) State the 0/1 knapsack problem. 2
8. a) What is backtracking? Write general recursive algorithm for backtracking.  $5\frac{2}{3}$
- b) Differentiate between backtracking and branch and bound. Draw state space tree for the given sum of subset problem: 6
- Set of elements = {3, 5, 6, 7} and  $d = 15$ .





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B.Sc. (Engineering) 2<sup>nd</sup> Year 2<sup>nd</sup> Semester Examination-2020

Course Code: ICE-2201

Session: 2018-2019

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Time: 3 Hours

Total Marks: 70

PART-A

1. a) Consider the pattern  $P = aaabb$ . Construct the table and the corresponding labeled directed graph used in the "fast" pattern matching algorithm. 6  
b) Suppose A is a sorted array with 300 hundred elements, and suppose a given element x appears with the same probability in any place in A. Find the worst case running time  $f(n)$  and the average case running time  $g(n)$  to find x in A using the binary search algorithm. 5.67
2. a) Let Q be an empty queue and S an empty stack. If elements A1, A2, A3 are placed in the queue and elements A4 and A5 are pushed onto the stack, and if all the elements from the queue are then dequeued and placed onto the stack, which element is on the top of the stack? Finally, depict the contents of S and Q. 2.5  
b) Consider the following arithmetic expression in postfix notation: 4  
 $7\ 5\ 2\ +\ * \ 4\ 1\ 5\ -\ / \ -$ 
  - i) Find the equivalent prefix form of the above by showing the state of the stack and other variables as they change.
  - ii) Obtain the computed value of the expression from its postfix notation.
- c) What is recursion? Let J and K be integers and suppose  $Q(J, K)$  is recursively defined by 2.5  
$$Q(J, K) = \begin{cases} 5 & \text{if } J < K \\ Q(J - K, K + 2) + J & \text{if } J \geq K \end{cases}$$

Find  $Q(2, 7)$ ,  $Q(5, 3)$ .
- d) Explain queue underflow and overflow with suitable illustration. 39
3. a) Draw all the possible dissimilar trees T where: 6
  - i) T is a binary tree with 3 nodes
  - ii) T is a 2-tree with 4 external nodes
- b) Explain the process of polyphase merge sort. 5.67
4. a) Define binary tree and complete binary tree with example. 3.67  
b) Construct a 3-way search tree for the list of keys in the order shown below. 4  
What are your observations?  
List A: 10, 15, 20, 25, 30, 35, 40, 45  
List B: 20, 35, 40, 10, 15, 25, 30, 45
- c) Apply selection sort algorithm to sort the following elements: 4  
77, 33, 44, 11, 88, 22, 66, 55, 99



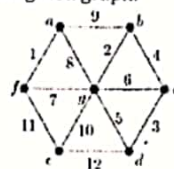


4. a) Define binary tree and complete binary tree with example. 3.67  
b) Construct a 3-way search tree for the list of keys in the order shown below. 4  
What are your observations?  
List A: 10, 15, 20, 25, 30, 35, 40, 45  
List B: 20, 35, 40, 10, 15, 25, 30, 45  
c) Apply selection sort algorithm to sort the following elements: 4  
77, 33, 44, 11, 88, 22, 66, 55, 99

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### PART-B

5. a) From a computational viewpoint, is it easy or hard to find the chromatic polynomial of an arbitrary graph? Explain. 3  
b) Consider the following edge-weighted graph. 4.67



- i) Use the greedy algorithm to find a minimum-weight spanning tree of this graph. What is the weight of such a spanning tree? Show your working.  
ii) How would you modify the greedy algorithm to find a maximum-weight spanning tree? No justification is necessary, but the modification needs to be clearly explained.
- c) Consider following instance for simple knapsack problem. Find the solution using greedy method. 4  
 $N=8$ ;  
 $P=\{11, 21, 31, 33, 43, 53, 55, 65\}$   
 $W=\{1, 11, 21, 23, 33, 43, 45, 55\}$   
 $M=110$
6. a) Apply Greedy method to solve the optimal storage on tapes problem if  $n = 3$  and  $(I_1, I_2, I_3) = (5, 10, 3)$ . 5  
b) What are differences between Prim's algorithm and Kruskal's algorithm? 40  
c) Explain how job sequencing with deadline problems can be solved using the Greedy approach.
7. a) Write the general procedure of dynamic programming. State the principle of optimality. 3.67  
b) Solve the all pairs shortest path problem for the digraph with the following weight matrix. 6
- $$\begin{bmatrix} 0 & 2 & \infty & 1 & 8 \\ 6 & 0 & 3 & 2 & \infty \\ \infty & \infty & 0 & 4 & \infty \\ \infty & \infty & 2 & 0 & 3 \\ 3 & \infty & \infty & \infty & 0 \end{bmatrix}$$
- c) State the 0/1 knapsack problem. 2
8. a) State and explain Graph coloring problem? How backtracking approach is useful for assigning different colors to adjacent vertices? 5  
b) Briefly Explain the concept of backtracking. 2  
c) Solve 8-queen's problem for a feasible sequence (8, 2, 5, 3). 67