KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 2nd Year 2nd Term Examination, 2015
Department of Computer Science and Engineering
CSE 2201
Algorithm Analysis and Design

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) What is an algorithm? Explain the criterion that an algorithm must have, using example(s). (11)
   b) Draw the recursion tree for $T(n) = 4T(n/2) + cn$, where c is a constant. Provide a good asymptotic upper bound on its solution, and verify you bound by substitution method. (13)
   c) Write the Dijkstra's algorithm to find the shortest path from a source node to all other nodes in a weighted graph. (11)

2. a) Define and explain different asymptotic notations used to analyze the algorithms. (12)
   b) Write down the best Big-oh (O) characterization for each of the following running time estimates of different algorithms. (10)
      i) $\log(n) + 10000$, ii) $n\log(n) + 15n + 0.002n^2$, iii) $1000n^2 + 16n + 2^n$, and iv) $2^{10} + 3^5$
   c) What is flow network? Explain the properties of a flow network using example(s). (13)

3. a) What are the different phases of divide-and-conquer paradigm? Develop its general form of algorithm. (08)
   b) Write down an algorithm for finding maximum and minimum values from set of values using divide-and-conquer method. (12)
   c) What is stable matching problem? Explain the Gale-Shapley algorithm to solve the stable matching problem using an example. (15)

4. a) What is dynamic programming method? Differentiate between greedy and dynamic programming methods. (07)
   b) How can you estimate the efficiency of dynamic programming approach? Explain. (13)
   c) State differences between Prim's and Kruskal's algorithm. Which one is better? (08)
   d) Explain how the solution space is reduced from N^N to $N!$ in N-Queen problem. (07)

SECTION B

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

5. a) What do you mean by greedy choice property? What are the characteristics of the optimization problem, in the context of greedy algorithm? (09)
   b) Consider a 0/1 Knapsack Problem, explain the application of Dynamic Programming, and Greedy algorithm to find an optimal solution. Give the two separate repetition of problem space and compare the time complexity of the algorithm under the said paradigm. (11)
   c) "Is the minimum spanning tree generated using both Kruskal's and Prim's Unique"? Explain your answer of you say 'yes' or give a counter example if you say 'no'. (08)
   d) Write the control abstraction for greedy method. (07)

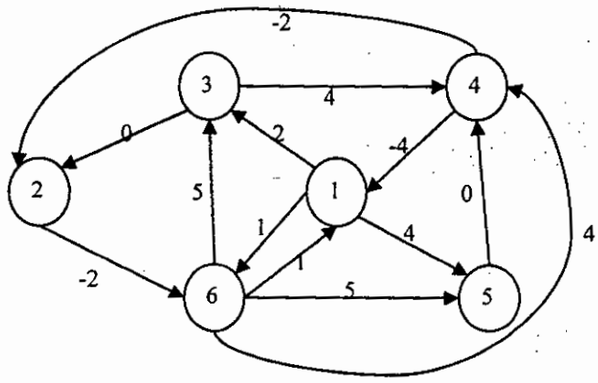
6. a) Define the Least-Cost (LC) search. How can you convert LC search into BFS and DFS search? Explain. (07)
   b) The Knapsack problem takes 2 inputs: the capacity of the knapsack and a list of items. Each item has a value and weight. The goal is to put items into the knapsack such that the value is maximized (optimal) but we cannot go over the weight capacity of the knapsack (valid). As an example, consider a knapsack with capacity 15 and items (25, 5), (45,11), (12,3), (7,2), (6,2), (10,7), and (5,4), where the first number in each pair indicates the value and second number the weight. Valid solutions are: <>, <1, 3, 4>, <2, 3, 4, 5>, and an optimal solution is <2,7>. (12)
      i) Describe a possible way of creating a state space tree for this problem.
      ii) Design a heuristic for a branch-and-bound algorithm.
         A) Will the branch-and-bound algorithm return a valid solution?
         B) Will the branch-and-bound algorithm return an optimal solution?
   c) Define Implicit and Explicit constraints? Write Implicit and Explicit constraints for n-queen (08)

and Sum of Sub Set problems.

d) Describe the steps in applying dynamic programming strategy when developing an algorithm. (08)

7. a) What is Negative Weight Cycle? How is Bellman-Ford solving the Negative Cycle problem? (06)

b) Consider the instance of the shortest path problem shown below. The number labeling an arc indicates the length of the arc. The table below lists the $y_v^{(i)}$ values obtained by running the first one iteration of the Bellman-Ford algorithm with s = 1. Continue the algorithm from this point to compute y(3), y(4), y(5), and y(6). Does the final vector y(6) give the feasible potentials? (11)



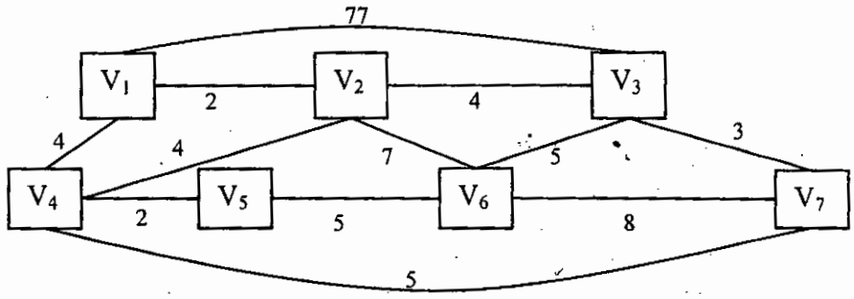
	$y_v^{(i)}$					
i	1	2	3	4	5	6
0	0	∝	∝	∝	∝	∝
1	0	∝	2	∝	4	1

c) Consider the following table where p is the probability and k is the key value. Construct optimal binary search tree (OBST). (12)

k	1	2	3	4	5
p(k)	0.25	0.20	0.05	0.20	0.30

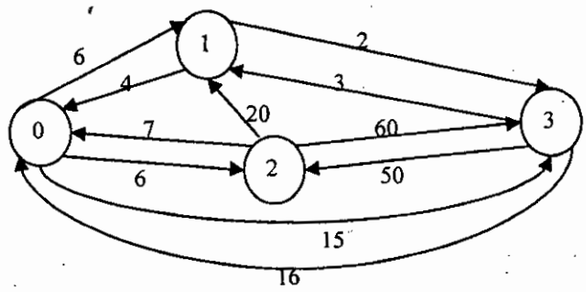
d) Define parallel algorithms. Explain speedup and efficiency of parallel algorithms. (06)

8. a) Consider the following undirected graph where the value of each edge represents the length of that edge: (10)



Apply Prim's algorithm, (i) What is the total length of the shortest path between V_1 and V_7? (ii) What is the total length of the edges in a minimum spanning tree?

b) Consider the following Traveling Salesman Problem (TSP): (12)



i) Convert multi-stage graph.

ii) Find the minimum cost path in the multi-stage graph (From (i)). Do this using the forward reasoning approach?

c) Apply backtracking technique to solve the following instance of sum of subset problem: S = {1, 3, 4, 5, 8} and d = 16. (09)

d) What are the differences between branch-and-bound and backtracking paradigm. (04)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 2nd Year 2nd Term Examination, 2015
Department of Computer Science and Engineering
CSE 2207
Numerical Methods

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) What is numerical computing? Describe different types of errors that occur in numerical computing. (10)
   b) Write underlying theory of bisection method. Using this method, find a root of the equation $x^2 - x - 3 = 0$. (10)
   c) Write the advantages of false position method over bisection method. Derive Newton-Raphson method from Taylor series expansion. (10)
   d) Prove that, "Newton-Raphson method said to have quadratic convergence". (05)

2. a) How does secant method overcome the limitation of Newton-Raphson method? Explain with example. (09)
   b) Define interpolation. Derive Lagrange interpolation polynomial and hence find linear interpolation polynomial. (12)
   c) For the following table of data, estimate *cos1.15* using Newton interpolation polynomial. (14)

x	1.0	1.1	1.2
$cosx$	0.5403	0.4536	0.3024

3. a) What is meant by divided difference table? Find $f[x_0, x_1]$, $f[x_1, x_2]$, and $f[x_0, x_1, x_2]$ for the following data points. (09)

i	0	1	2
x_i	1.0	1.5	2.5
$f(x_i)$	3.2	3.5	4.5

   b) Derive Newton-Gregory formula for forward interpolation. (13)
   c) What is regression and least square regression? Fit a straight line from the following data. (13)

x	1	3	4	6	8	9	11
y	1	2	4	4	5	7	8

Draw the regression line with the linear equation.

4. a) Define boundary value problem and eigen value problem. What is characteristics matrix, characteristics polynomial, coefficient matrix, eigen value, and eigen vector. (08)
   b) For the following system, find eigen values and eigen vectors using Fadeev-Leverrier method. (14)

$$2x_1 + 8x_2 + 10x_3 = \lambda x_1$$
$$8x_1 + 3x_2 + 4x_3 = \lambda x_2$$
$$10x_1 + 4x_2 + 7x_3 = \lambda x_3$$

   c) Derive the equations of Bisection method to find out the initial approximate value of the root of an algebraic equation. (13)

SECTION B

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

5. a) What do you mean by numerical integration? (07)
   b) Calculate the value of the integral (14)

$$\int_4^{5.2} \tan x dx$$

by Simpson's 1/3 rule. After finding the true value of the integral, compare the error in the four cases.

   c) *Derive five-point formula for Laplace's equations.* (14)

6. a) Explain partial differential equation with an example. (10)
   b) Suppose a matrix A will be factorized into L and U as follows: (13)
   A = LU. Then find the equation for L and U.
   c) Solve the Poisson equation $\nabla^2 f = 2x^2y^2$ over the square domain $0 \le x \le 3$ and $0 \le y \le 3$ (12)
   with $f = 0$ on the boundary and $h = 1$.

7. a) Solve $\frac{dy}{dx} = \frac{1}{x+y}$ for $x = 0.5$ to $x = 2$ $(h = 2)$ by using Runge-Kutta method, initial value (12)
   $x_0 = 0$, $y_0 = 1$.
   b) Solve the following system by iteration method of Gauss-Seidel. (13)

$$2x + 3y + z = 9$$
$$x + 2y + 3z = 6$$
$$3x + y + 2z = 8$$

   c) Find the inverse of $\begin{bmatrix} 0 & 1 & 2 \\ 1 & 2 & 3 \\ 3 & 1 & 1 \end{bmatrix}$. (10)

8. a) Describe about the ordinary differential equations with an example. (08)
   b) Derive the finite difference equations. (13)
   c) Give $\frac{dy}{dx} = x^2 + xy + y^2$ with $y = 1$ for $x = 0$. Find y approximately for $x = 0.1$ by Euler's (14)
   method.

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 2nd Year 2nd Term Examination, 2015
Department of Computer Science and Engineering
CSE 2213
Computer Architecture and Organization

TIME: 3 hours FULL MARKS: 210

N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
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SECTION A

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

1. a) Define computer architecture and computer organization with example. Why we need to study computer architecture and computer organization? Explain. (10)
   b) How the evolution of computer has been characterized? Explain the operation of IAS machine with proper diagram. (10)
   c) State the criterion and explain Von Neumann architecture with proper diagram. (08)
   d) Discuss data flow in fetch, indirect and interrupt cycle with proper diagram. (07)

2. a) What are the principles concerns for computer arithmetic? "2's complement representation is better than 1's complement and sign magnitude representation"-justify. (10)
   b) Define overflow. Design an overflow detector circuit by discussing underlying theory. (10)
   c) Write an algorithm to multiply binary integers. Using an example describe your algorithm. (07)
   d) Describe Booth's algorithm for two's complement multiplication. (08)

3. a) What is instruction? Explain instruction cycle state diagram with figure. (08)
   b) Compute $Z = \frac{(A-B)+C}{D(E/F)}$ using one, two, and three address instruction. (07)
   c) What do you mean by addressing modes? Describe different types of addressing modes with principles advantages and disadvantages. (12)
   d) What is control and status register? What is meant by supervisor mode? Explain. (08)

4. a) What do you mean by instruction level parallelism? How it is differ from machine level parallelism? Explain. (10)
   b) Explain the limitations of instruction level parallelism. (10)
   c) What are the advantages and disadvantages of variable length instruction format? (08)
   d) What is branch penalty in a pipeline? Explain with diagram. (07)

SECTION B

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

5. a) What is bus? Draw traditional and high performance bus architecture. List improvements in high performance bus architecture. (15)
   b) What is interrupt? How does it improve computer performance handling low speed devices? (10)
   c) Discuss multiple interrupts handling mechanism. (10)

6. a) What is locality of reference? Describe its classification. (06)
   b) Describe write-through and copy-back protocol. Also mention their merits and demerits. (06)
   c) An 8 bit data 00111001 is passed and written in memory. After that when reading we get 00111101 (bit position 3 is changed). How you detect and correct this one bit error using Hamming code? (10)
   d) Suppose the data cache has space for only eight blocks of data. Each block consist of only one 16-bit word and the memory is word addressable with 16-bit address. Consider a 4×10 array of numbers, each occupying one word. The task is to normalize the first row of that array and can be expressed as: $a_{0,j} \leftarrow \frac{a_{0,j}}{(\sum_{j=0}^{9} a_{0,j})/10}$ for $i, j = 0,1,\ldots,9$. (13)

7. a) What is DMA? Explain DMA data transfer procedure using appropriate figure. (12)
   b) Define: i) Seek time and ii) Rotational delay. (05)
   c) "RAID 4 involves a write penalty when an I/O write request of small size is performed"- justify the statement. (08)

d) Consider disks with an advertised average seek time of 4 ms, rotation speed 12000 rpm and 512 byte sectors with 500 sectors per track. We wish to read a file consisting of 2500 sectors for a total of 1.28 Mbytes. Find total average access time for: i) sequential access and ii) random access. (10)

8. a) What do you mean by memory hierarchy? What problems are solved using memory hierarchy? Explain. (10)

b) Define micro-operation. Write down the sequence of micro-operations for the execution of the following instructions: (10)

i) ISZ X and ii) BSA X

c) How the concept of microprogramming is used to implement a control unit? Explain with appropriate figure. (10)

d) How next address decision is made in micro-programmed control unit. (05)