Bangabandhu Sheikh Mujibur Rahman Science and Technology University
Department of Computer Science & Engineering
2nd Year 2nd Semester B.Sc. Engineering Examination-2017

Course Title: ~~Theory of Computing~~ Automata Theory **Course Code: CSE 260**
Full Marks: 60 **Time: 3(Three) Hours**

N.B.: i) Answer SIX questions, taking any THREE from each section, ii) All questions are of equal values, iii) Use separate answer script for each section.

SECTION-A

Q.1 (a) What is the principal objective of the studying of Automata Theory? 2

(b) Define alphabet and power of an alphabet. Differentiate between $\sum$ *and* $\sum^1$ 3

(c) Design a DFA to accept the language L= {w|w ends in 0011} and prove that $(q_0, 0110011) = q_3$ for this DFA, where q_0 and q_3 are the start and final states respectively. 5

Q.2 (a) Write down the physical significance of a transition function. 2

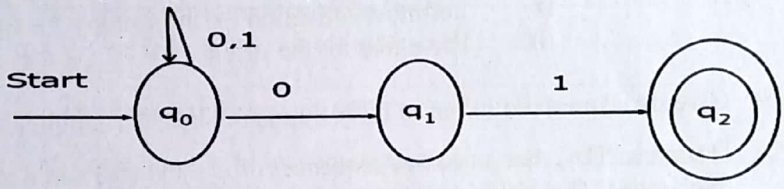
(b) Prove that for each NFA, there is an equivalent DFA. 3

(c) Design a DFA where L = { w ∈ {0, 1}*| every other character of w, starting with the first character, is 0 } 5

Q.3 (a) Is it true that the language accepted by any NFA is different from the regular language? Justify your answer. 2

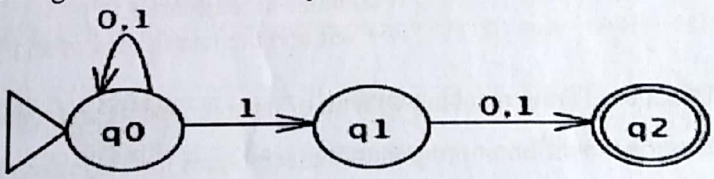
(b) Design an NFA accepting the following language L={w | w Ɛ {1,0}* and second last position is 1} so that you can test this string x=01010. 4

(c) Define the extended transition function for an NFA and use the extended transition function to describe the processing of input 00101 by the following NFA. 4

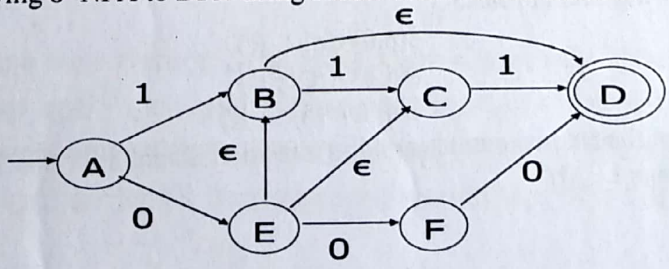


Q.4 (a) Using pumping lemma for regular sets. Prove that the language L = {anbn/n>1} is not regular. 4

(b) Consider the following NFA. Does *M*3 accept *s* = 011101? What about *s* = 011111? 2



(c) Convert the following ε- NFA to DFA using subset construction method. 4



SECTION-B

Q.5 (a) What is Chomsky Normal form? 2

(b) Convert the following grammar G in GNF form, 4
$S \rightarrow ABb \mid a$, $A \rightarrow aaA \mid B$, $B \rightarrow bAb$.

(c) Find a grammar in Chomsky normal form equivalent to 4
$S \rightarrow aAbB$, $A \rightarrow aA \mid a$, $B \rightarrow bB \mid b$

Q.6 (a) What are the important components of a CFG? What are the importance's of CFG's in computer science studies? 3

(b) What is palindrome? Write a CFG for palindromes. 3

(c) Assume that a CFG, G=(V,T, P, S), where V, T, S and P are as follows: 4

Variable v={E}
Terminal T={+, -, *, x, y}
Start symbol, S ⟶ E
Production P={
E ⟶ +EE,
E ⟶ *EE,
E ⟶ -EE,
E ⟶ x,
E ⟶ y}

This grammar generate prefix expressions with operands x and y and operators +,- and * .Find

i) Leftmost derivation for the string + * - x y x y

ii) Parse tree for the string - * + - y x y x y

Q.7 (a) Give the formal definition of PDA by specifying each component. 3

(b) Design a PDA, that processes sequences of if's and else's in a c program. Convert a PDA, P_2 Such that $L(P_2)=N(P)$ i.e, P_2 accepts by final state what p accepts by empty stack. 3

(c) Construct pushdown automata for the following languages. 4

I. $L = \{ w \in \{0, 1\}^* \mid w \text{ contains at least three 1s} \}$

II. $B = \{ w \in \{0, 1\}^* \mid w = wR \text{ and the length of w is odd} \}$

Q.8 (a) Describe a Turing machine with all of its components and then explain how it works. 3

(b) Describe the different programming techniques for Turing machine. 3

(c) Consider the TM: $M=(\{p, q, r, s\},\{0, 1\},\{0,1, B\}, \delta, p, B, \{S\})$ where δ consists of the following sets of rules: 4

$\delta(p,0)=(q, 1, R)$
$\delta(q,1)=(p, 0, R)$
$\delta(q, B)=(S, B, R)$

Design the transition table and the transition diagram for this TM and informally describe the language L (M).

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Course Title: Digital Logic Design **Course No: CSE 252**
Full Marks: 60 **Time: 3 hours**

N.B.
i) Answer **SIX** questions, taking any **THREE** from each section.
ii) All questions are of equal values.
iii) Use separate answer script for each section.

SECTION-A

Q.1 (a) Simplify the functions F_1 and F_2 from the following truth table to a minimum number of literals: 3

x	y	z	F_1	F_2
0	0	0	0	1
0	0	1	1	0
0	1	0	1	0
0	1	1	0	0
1	0	0	1	1
1	0	1	1	1
1	1	0	1	0
1	1	1	0	1

(b) Implement the following function with NAND gates: 3

$$F(x, y, z) = \sum(3, 6, 7)$$

(c) Obtain the simplified expression by using Tabulation method for the following Boolean expression: 4

$$F = ab'c'd' + a'b'c'd' + a'b'c'd + a'b'cd' + ab'cd' + ab'cd + abcd' + abcd$$

Q.2 (a) What is Karnaugh map? Give an example of two and three variables map. 3

(b) Simplify the Boolean function F using the don't care conditions d, in product of sums and implement the simplified expression : 5

$$F = w'(x'y + x'y' + xyz) + wx'z$$
$$d = w'x(y'z + yz') + wyz$$

(c) What is the acceptable input voltage range of logic 0 for TTL? What is for a logic 1? 2

Q.3 (a) Draw the logic diagram of full adder with two half adder circuits. 2

(b) Design a 2-bit comparator circuit. 4

(c) A combinational circuit has four inputs and one output. The output is equal to 1 when (i) all the inputs are equal to 1 or, (ii) none of the inputs are equal to 1 or, (iii) an odd number of inputs are equal to 1. 4

I. Obtain the truth table.
II. Find the simplified output function in sum of products.
III. Draw the logic diagram.

Q.4 (a) Draw the 4-bit register with parallel load by using clocked S-R flip-flop. 2

(b) Show the serial input transfer from shift register A to shift registers B with appropriate block and timing diagram for the following initial content:
A:1101
B:1001 6

(c) What is a combinational logic circuit? Draw its block diagram. 2

SECTION-B

Q.5 (a) Draw the block diagram of 4×16 decoder with 3×8 decoder. 2

(b) Show the read and write operations in memory unit by drawing appropriate figure and following initial contents: 4
i. 0000111010 in memory address register (MAR)
ii. 10010111 in memory buffer register (MBR)
iii. 01101110 in memory register addressed by MAR

(c) What is parity bit? Draw the Odd-parity generation table and its figure. 4

Q.6 (a) Define master-slave flip-flop with logic diagram. 3

(b) How J-K flip-flop is different from T flip-flop? 2

(c) Draw the logic diagram of R-S flip-flop and graphic symbol. Also obtain the truth table and simplified expression by using map method. 5

Q.7 (a) Design a sequential circuits whose state table is given below using register and combinational gates : 3

Present State		Input	Next State		Output
A_1	A_2	x	A_1	A_2	y
0	0	0	0	0	0
0	0	1	0	1	0
0	1	0	0	1	0
0	1	1	0	0	1
1	0	0	1	0	0
1	0	1	0	1	0
1	1	0	1	1	0
1	1	1	0	0	1

(b) What is Multiplexer? Explain a 4-to-1 line multiplexer.

(c) What is the function of actuator? Draw the block diagram of 4-bit DAC with voltage output.

Q.8 (a) In what purposes, PLDs are used? Write the differences between standard logic circuits and programmable logic circuits.

(b) What is ROM? Design a 32×4 ROM.

(c) Draw the structure of CPLD and FPGA PLDs.

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2nd Year 2nd Semester B.Sc. Engineering Final Examination-2017

Course Title: Design and Analysis of Algorithms **Course Code: CSE250**
Full Marks: 60 **Time: 3(Three) hours**

N.B.
i) Answer **SIX** questions, taking any **THREE** from each section.
ii) All questions are of equal values.
iii) Use separate answer script for each section.

SECTION-A

Q.1 (a) Describe space complexity and time complexity briefly. 2

(b) What do you mean by O(1)? 3
Which of the following equalities are correct and why:
i. $33n^2+4n^2= O(n^2)$
ii. $10n^2+9=O(n)$
iii. $10n^2+4n+2=O(n^2)$
iv. $5n^2-6n=O(n^2)$

(c) Explain time and space analysis are both the important factor for measuring the complexity of algorithms. In what ways best case, worst case and average case complexity are defined? 5

Q.2 (a) What is meant by selection sort? Sort the lists of numbers of an array A by using selection sort. A: 84, 23, 12, 56, 43, 18, 33, 87, 97, 99 5

(b) Depict the operation of BUILD-MAX-HEAP on the following array 5
B: 12, 34, 56, 32, 58, 90, 64, 99
If we delete the root node what would be the array B?

Q.3 (a) Mr. Shakil is a successful business figure in Bangladesh. For business purposes he travels several countries. The airline that he chooses sometimes did not have direct route to the destination country via some countries. And there may have several paths to reach his destination country. Shakil always choose the route that gives him minimum time. Your job is to help shakil by providing an algorithm so that he can know the minimum time to reach his desired country. 4

(b) Write the difference between Greedy method and Dynamic programming. 2

(c) Suppose a student wants to go from home to school in the shortest possible way. He knows some roads are heavily congested and difficult to use. Find the shortest path from home to school in the following graph Fig: 3(c): 4

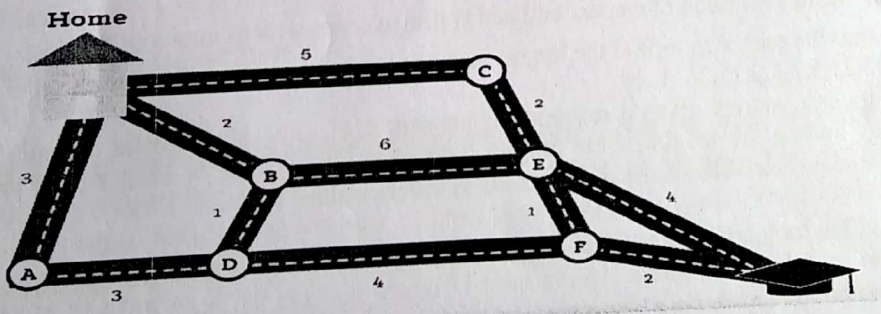

Fig: 3(c)

Q.4 (a) Now-a-days the transmission wire over the road creates a very dangerous situation for passerby. This wire creates spider net like situation over most of the road. The main reason of this situation is redundant wire and unplanned connections between electric poles. So, write an algorithm which will take position of poles and length of the wire connected them. Your correct algorithm will provide an efficient connection among the poles which will provide an efficient connection among the poles which will reduce the hazard with lower amount of wire. 5

(b) consider the knapsack instance n=3,(w1,w2,w3)=(2,4,3),(p1,p2,p3)=(1,2,5)and m=6. Use 0/1 knapsack to find an optimal solution. 5

SECTION-B

Q.5 (a) Any comparison based sorting can be thought of as defining a decision tree of possible executions. Justify this. 2

(b) Rocky is a novice programmer. He wants to make a program that takes a set of points as input and selects those points by which he can make the largest polygon. Your job is to help rocky by providing an algorithm so that he can follow it to make his polygon. 4

(c) Imagine that you have 5 friends: Billy, Jenna, Cassie, Alyssa, and Harry. You know a few roads that connect some of their houses, and you know the length of those roads. But, Floyd-Warshall can take what you know and give you the optimal route given that information. For example, look at the graph below, it shows paths from one friend to another with corresponding distances. 4

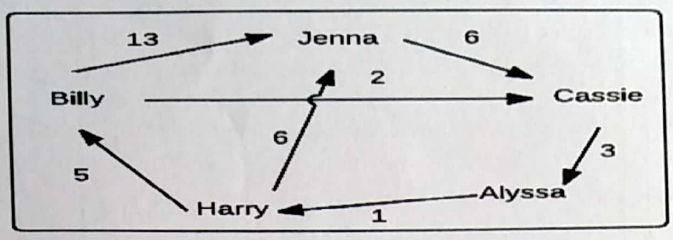

Fig: 5(c)

Q.6 (a) Prove the following theorem: 4

i. A spanning tree T in a connected graph G= (V, E) is a maximal subgraph of G that is a tree.

ii. Let T = (V(T), E(T)) be a minimum spanning tree of G. Let S= (V(S), E(S)) be a subgraph of T. Let e be an edge of a minimum weight among all edges that do not close a cycle with edges in E(S), then E(S)U{e}is a subgraph of minimum spanning tree.

(b) Why greedy algorithm is used? Write down the Bellman Ford algorithm. 4

(c) What are the differences exist between directed and ordered trees? 2

Q.7 (a) Write the definition of convex hull and Huffman codes with example. 2

(b) Describe each step to find the largest increasing subsequence from the given set of numbers: 21,25,5,7,3,9,15,2, 11, 18. 4

(c) Suppose you are given a sequence of integers A[1],…….,A[n]. Give a dynamic algorithm for finding the length of the longest increasing subsequence of integers and printing the subsequence. What is the running time of the algorithm? 4

Q.8 (a) Let the hash table be an 11 element array and k is the key of a data record. H(k) represents the hash function where H(k)=k mod 11.insert the keys 83,14,29,70,10,55,72,36,65,48 for resolving collision use linear probing. 5

(b) Given an array of jobs where every job has a deadline and associated profit if the job is finished before the deadline. It is also given that every job takes single unit of time, so the minimum possible deadline for any job is 1. How to maximize total profit if only one job can be scheduled at a time.

Input: Five Jobs with following deadlines and profits

JobID	Deadline	Profit
a	2	100
b	1	19
c	2	27
d	1	25
e	3	15

Fig: 8(b)

e/o

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2nd Year 2nd Semester B.Sc. Engineering Final Examination-2017

Course Title: Numerical Methods for Engineers **Course Code: CSE262**
Total Marks: 60 **Time: 3 (three) Hours**

N.B.
i) Answer **SIX** questions, taking any **THREE** from each section.
ii) All questions are of equal values.
iii) Use separate answer script for each section.

SECTION-A

Q.1 (a) By the method of least squares, fit a parabola $y=a+bx+cx^2$ to the following data 04

x	2	4	6	8	10
y	3.07	12.85	31.47	57.38	91.29

(b) Fit a straight line of the form $y=a+bx$ to the data by the method of moments 04

x	1	2	3	4	5	6
y	4	8	10	12	16	20

(c) What is direct substitution method? Write down the condition of the existence and uniqueness of a root of an equation. 02

Q.2 (a) Use Regula Falsi method to obtain roots of the following equation to five decimal places: 05

$$x^3 + 7x^2 + 9 = 0.$$

(b) "The sum of the residuals is zero"- Justify the statement by using group of average method. 05

Q.3 (a) Find a root lies in [2,3] of the equation $x^3-2x-5=0$ by the method False position correct to three decimal place. 05

(b) Consider the equation $x^3+2x^2+10x-20=0$. Find a root to seven decimal places using Newton-Raphson method for initial value $x_0=(1.2)$. 04

(c) Define Secant Method. 01

Q.4 (a) Solve the following system of equations using Gauss elimination method, 05

$$x_1 + 2x_2 + 3x_3 = 8$$
$$2x_1 + 4x_2 + 9x_3 = 8$$
$$4x_1 + 3x_2 + 2x_3 = 2$$

(b) Perform third iteration of the following system using Gauss-Seidel iteration method, 05

$$28x + 4y - z = 32$$
$$x + 3y + 10z = 24$$
$$2x + 17y + 4z = 35$$

SECTION-B

Q.5 (a) The following tables gives the values of densities of saturated water for various temperature of saturated stream: 05

Temp(T)	100	150	200	250	300
Density(D)	958	917	865	799	712

Find by Interpolation the densities when the temperature is 275°C.

(b) Using Taylure series method, solve $\frac{dy}{dx} = x^2 - y, y(0) = 1 \; at \; x = 0.1,0.2$ 05

Q.6 (a) Construct a divided difference table for the following data. 02

x	4	5	7	10	11	13
f(x)	48	100	294	900	1210	2028

(b) Given $\log_{10} 654=2.8156$, $\log_{10} 658=2.8182$, $\log_{10} 659=2.8189$, $\log_{10} 661=2.8202$. Find by using Newton's divided difference formula the value of $\log_{10} 656$ 05

(c) By using of Lagrange's formula, prove that $y_1=y_3-0.3(y_5-y_{-3})+0.2(y_{-3}-y_{-5})$ 03

Q.7 (a) Write down the difference between Simpson's 1/3 rule and 3/8 rule. 01

(b) Evaluate $\int_0^{10} \frac{dx}{1+x^2}$ by using (i) Trapezoidal rule and (ii) Simpson's 1/3 rule. 06

(c) Explain the theorem of Romberg's method. 03

Q.8 (a) Solve $\frac{dy}{dx}$ =1-y and y(0)=0 in the range 0<x<0.3 using Euler's method. 04

(b) Using Runge-Kutta method of third order, solve for y(0.1) given that $y' = xy+y^2$, y(0)=1 04

(c) Find out intimate relation between sums and recurrences. 02

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2nd year 2nd Semester B. Sc. Engineering Final Examination-2017

Course Title: Linear Algebra **Course Code: MAT 256**

Time: 3 Hours **Total Marks: 60**

*(Answer any **SIX (06)** questions, taking any **THREE (03)** from each section. All parts of a question must be answered sequentially. The figures in the right margin indicate the marks for each question)*

Section A

1. **(a)** Define homogenous and non homogenous systems of linear equations with examples. Solve the following system of linear equations using Gaussian elimination: **6**

$$x_1 - x_2 + 2x_3 = 5$$
$$2x_1 + x_2 - x_3 = 2$$
$$2x_1 - x_2 - x_3 = 4$$
$$x_1 + 3x_2 + 2x_3 = 1$$

(b) Define the rank of a matrix. Determine the rank of the matrix: **4**

$$\begin{pmatrix} 2 & 1 & 0 & -1 \\ 3 & 4 & 2 & 5 \\ -1 & 0 & 3 & -2 \\ 4 & 1 & 1 & 0 \end{pmatrix}$$

2. **(a)** Define vector space and subspace. **2**

(b) Prove that a non empty subset W of a vector space V over the field F is a subspace of V if and only if $\alpha, \beta \in F$ *and* $u, v \in W \Rightarrow \alpha u + \beta v \in W$. **4**

(c) Define linear transformation. Let $T: \mathbb{R}^2 \to \mathbb{R}^3$ be the function defined by $T(x, y) = (x + y, x - y, x)$. Then show that T is a linear transformation. **4**

3. **(a)** Define sum and direct sum. Prove that the vector space V is the direct sum of the its subspaces S and T if and only if (i) $V = S \oplus T$ (ii) $S \cap T = \{0\}$. **4**

(b) Define linear combination of a vector. Let the vectors $u_1 = (1, 3, -2)$, $u_2 = (2, 7, -1)$ and $u_3 = (1, 6, 7)$ in $\mathbb{R}^3$. Show that $v = (1, 5, 4)$ is a linear combination of the vectors u_1, u_2 and u_3. **4**

(c) Define linear dependence and independence. Is the set of vectors $\{(1, 2, 1, -2), (0, -2, -2, 0)$ and $(0, 2, 3, 1)\}$ linearly independent? **2**

4. (a) Define subspace of a vector space. Show that the set $T = \{(a, b, c, d) \in R^4 : 2a - 3b + 5c - d = 0\}$ is a subspace of R^4. **4**

(b) Let $V = R^3$. Show that W is not a subspace of V where, $W = \{(a, b, c) | a^2 + b^2 + c^2 \leq 1\}$. **2**

(c) Prove that the vector space V is the direct sum of its subspaces S and T if and only if (i) $V = S + T$ and (ii) $S \cap T = \{0\}$ **4**

Section B

5. **(a)** State and prove Cayley-Hamilton Theorem. 4

(b) Let $A=\begin{pmatrix}1 & 2 & 2\\ 1 & 2 & -1\\ -1 & 1 & 4\end{pmatrix}$ be a matrix. Find the all eigenvalues and associated eigenvectors of the matrix A. Also Find an invertible matrix P such that $P^{-1}AP$ is a diagonal matrix. 6

6. **(a)** Define inner products and norm. 2

(b) If $u=(u_1,u_2)$ and $v=(v_1,v_2)$ are vectors in $\mathbb{R}^2$, then show that $\langle u,v\rangle=3u_1v_1+2u_2v_2$ defines an inner product. 4

(c) Let u and v be vectors in an inner product space V. Then prove that $|\langle u,v\rangle|\le\|u\|\,\|v\|$ 4

7. (a) Define Linear functional. Let $B=\{(-1,3),(2,-5)\}$ be a basis of R^2. Then find the dual basis of B. 5

(b) Define annihilators. Let W_1 and W_2 be subspace of a finite dimensional vector space V. Then prove that, $(W_1+W_2)^\circ=W_1^\circ\cap W_2^\circ$ 5

8. **(a)** Find the LU factorization of the following matrix

$$A=\begin{pmatrix}-1 & 2 & -3\\ 2 & 1 & 0\\ 4 & -2 & 5\end{pmatrix}$$ 3

(b) Find the standard matrix for the linear transformation $T:\mathbb{R}^3\to\mathbb{R}^4$ defined by $T(x,y,z)=(x+y,x-y,z,x)$. $T(x,y,z)=(x+y,x-y,z,x)$ 3

(c) Prove that every vector $v\in V$ can be expressed uniquely in the form $v=\alpha_1v_1+\alpha_2v_2+\alpha_3v_3+\ldots\ldots\ldots+\alpha_nv_n$, If $\{v_1,v_2,v_3\ldots\ldots\ldots v_n\}$ is a basis of the vector space V. 4