

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
 B.Sc. Engineering 2nd Year 2nd Term Examination, 2024
 Department of Computer Science and Engineering
 CSE 2201

Algorithm Analysis and Design

TIME: 3 hours

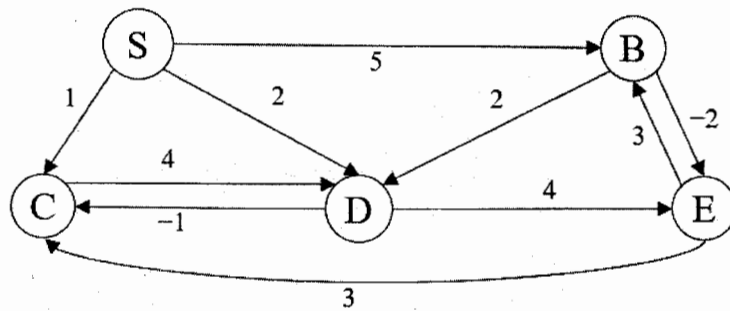
FULL MARKS: 210

- N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
 ii) Figures in the immediate right column of the questions indicate full marks.
 iii) The rightmost column indicates course outcomes.

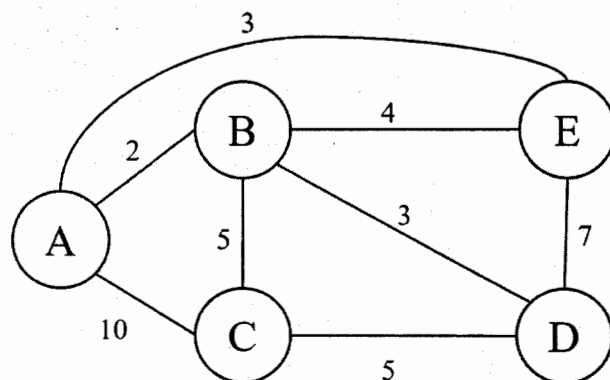
SECTION A

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

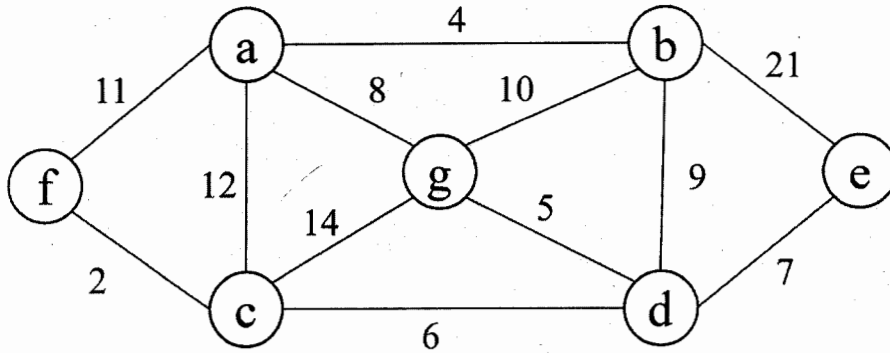
1. a) What are the basic criteria that an algorithm must satisfy? Two sorting algorithms are used on two different computers to sort a large dataset. Bubble sort is executed on a computer C1 which can perform 10^{10} instructions/second and Quick sort is executed on computer C2 which can perform 10^7 instructions/second. Assume, time complexities of the algorithms are- $T_{Bubble}(n) = 4n^2$, $T_{Quick}(n) = 30n \log_2 n$ and number of elements $n = 2 \times 10^7$. Which algorithm finishes first? Justify your answer based on algorithm efficiency and hardware improvement. (10) [CO1]
- b) A city traffic management authority wants to design a navigation system to compute the shortest travel time between intersections. The road network is represented as a weighted directed graph, where some roads may have negative weights due to traffic incentives, but no negative cycle exists. Apply the appropriate algorithm on the given graph to compute the shortest path from S vertex as the source. (13) [CO4]



- c) Write down the best Big-oh(O) characterization for each of the running time estimates of different algorithms: (12) [CO1]
 (i) $\log(n!)$, (ii) $6 \cdot 2^n + n^2$, (iii) $1000n^2 + 100n - 6$, (iv) $6n^3 / (\log n + 1)$
2. a) Explain the relation among P, NP, NP-hard and NP-complete. Also explain why Boolean Satisfiability Problem is consider fundamental in the study of NP-complete problems. (10) [CO1]
- b) Given an undirected graph G and an integer K , explain why the Clique problem belongs to the NP-complete problem class by examining its verification process and its relationship with other known NP-complete problems. (14) [CO3]
- c) Consider the following undirected graph as a water line network connecting five neighborhoods: A, B, C, D, E . The city wants to design a backup plane in case the cheapest pipeline link is unavailable. Design the second-best network, explain your choice of edges and compute the total cost. (11) [CO4]



3. a) What is spanning tree? Use Prim's algorithm to determine the Minimum Cost Spanning Tree of the graph below. (12) [CO2]

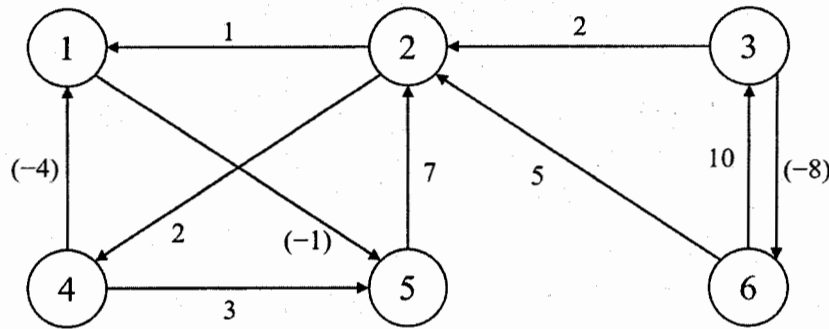


- b) A distributed system generates timestamps that must satisfy the following modular constraints: (10) [CO4]

$$x \equiv 2 \pmod{5}, x \equiv 3 \pmod{7}, x \equiv 4 \pmod{9}$$

Determine the smallest non-negative integer x that satisfies all the above congruences by applying the Chinese Remainder Theorem. Use Extended Euclidean Algorithm wherever necessary.

- c) Apply the Floyd-Warshall algorithm on the weighted directed graph shown in the following figure. Show the matrix (all pair) D^k that results for each iteration of the outer loop. (13) [CO3]

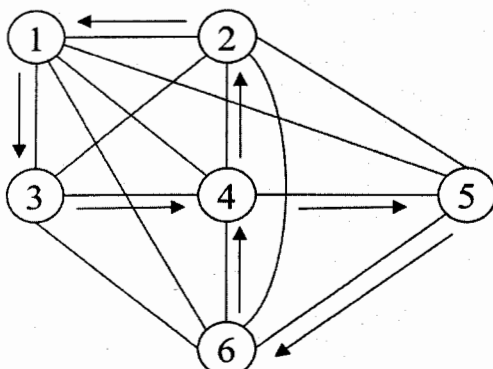


4. a) Solve the following recurrence relation using an appropriate method: (10) [CO1]
- $T(n) = 4T\left(\frac{n}{2}\right) + n \log n$
 - $T(n) = T\left(\frac{n}{4}\right) + T\left(\frac{n}{2}\right) + n$
- b) Let $C(x) = A(x) \times B(x)$, where $A(x) = 3x^2 + 4x + 1$ and $B(x) = x^2 + 2x + 5$. (10) [CO2]
Now, find the resultant polynomial $C(x)$ using algebraic transformation and evaluation.
- c) Compare the efficiency of Straightforward Method and Horner's method in evaluating the polynomial: $f(x) = 5x^4 - 3x^3 + 4x^2 - 9x + 1$, evaluated at $x = 2$. (10) [CO3]
- d) "Any algorithm that computes the largest and smallest elements of a set of n ordered elements require $(\lceil 3n/2 \rceil - 2)$ comparison". Prove the statement. (05) [CO4]

SECTION B

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

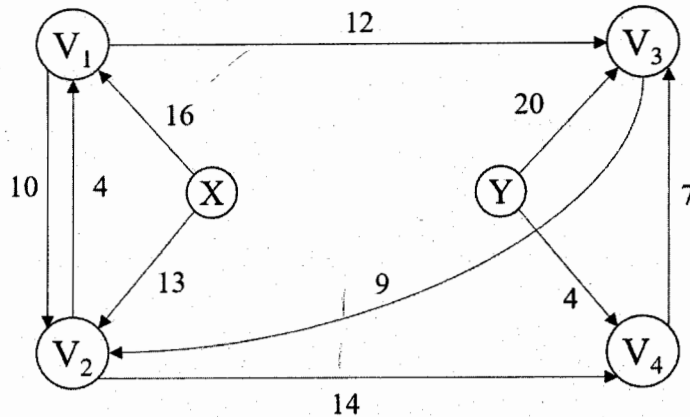
5. a) Given the sentence "Set a task and ask a team to act". Represent it using Huffman encoding. Show the complete process of construction of Huffman tree step by step. (14) [CO2]
- b) An undirected graph and its adjacency matrix are given. A cycle is indicated by a sequence of arrows in the graph. Determine whether the cycle satisfies Dantzig-Fulkerson-Johnson constraints. (15) [CO3]



	1	2	3	4	5	6
1	∞	1	1	10	10	10
2	10	∞	10	1	10	10
3	10	10	∞	1	10	10
4	10	10	10	∞	1	1
5	10	10	10	10	∞	1
6	10	10	10	10	10	∞

- c) Though Approximation algorithms and Monte Carlo algorithms produce near optimal results, their working principles are different- Explain. (06) [CO2]

6. a) At node X , there is a text file containing all the dates (01012026...31122026) of the year 2026, written sequentially with no spaces or any other symbols within dates or between the dates. Is it possible to encode the information in the text file in such a way that the information can be transmitted through the network to node Y within 5 minutes? (23) [CO3]



- b) Write the implicit and explicit constraints of the N-Queen Problem. Write a pseudocode to determine the no. of ways to place $(n - 3)$ queen on an $n \times n$ chessboard such that no two queens attack each other. (12) [CO2]
7. a) Given two courses, their prerequisite courses and students grade sheet of all previous semester. Design an algorithm to assign students to the courses in a justified manner such that CSE 4444 is assigned to 60 students and CSE 5555 is assigned to 61 students. (16) [CO4]

Courses	Prerequisite Courses
CSE 4444: Compiler Design	CSE 1111: Theory of Computation
CSE 5555: Algorithm Analysis and Design	CSE 2222: Object Oriented Programming CSE 3333: Data Structure and Algorithm

- b) Prove that LPT based algorithm for Scheduling Independent Tasks problem is an ϵ -approximation problem. (12) [CO1]
- c) Explain the two fundamental properties of dynamic programming with respect to the LCS problem. (07) [CO2]
8. a) Given $W = \{10, 20, 30, 40, 50\}$, $V = \{100, 200, 300, 400, 500\}$, $M_1 = 30$, $M_2 = 60$. Find an assignment $X = \{x_1, \dots, x_5\}$ to maximize $\sum_{i=1}^5 x_i \times v_i$ where $\sum_{i=1}^5 x_i \times w_i \leq M_1 + M_2$ and $x_i \in [0,1]$. (14) [CO2]
- b) What are the differences between branch-and-bound and backtracking paradigm? (12) [CO2]
- c) A problem has optimal substructure and disjoint subproblems. Which algorithm technique would you use to solve the problem? (09) [CO3]

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 2nd Year 2nd Term Examination, 2024
Department of Computer Science and Engineering
HUM 2207

Economics and Accounting

TIME: 3 hours

FULL MARKS: 210

- N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
ii) Figures in the immediate right column of the questions indicate full marks.
iii) The rightmost column indicates course outcomes.

SECTION A

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

1. a) Explain the concept of Economics, Microeconomics and Macroeconomics. (10) [CO1]
b) Graphically present the demand function $D = 20 - 2P$ and supply function $S = -4 + 2P$ and determine equilibrium price and equilibrium quantity. (25) [CO1]

2. a)

Quantity of production (Q)	1	2	3	4	5	6
Total cost	30	40	45	48	60	84

 (25) [CO2]

- i) Find average cost (AC) and marginal cost (MC).
ii) Draw the 'AC' curve and 'MC' curve.
iii) Explain the relationship between 'AC' and 'MC'.

- b) What do you mean by fixed cost and variable cost? (10) [CO2]

3. a) The schedule is given below: (25) [CO2]

Goods 'X'	Goods 'Y'
0	150
50	140
100	100
140	50
150	0

- i) Draw a production possibility curve from the given schedule.
ii) Explain the logic of production when $X = 60, Y = 80$ and $X = 80, Y = 160$.

- b) What is inflation? Explain the main causes of inflation. (10) [CO3]

4. a) Explain the idea of factors of production. (15) [CO3]
b) What is short-run and long-run production function? (05) [CO3]
c) Define Saving, Investment, GNP, NNP, and Per Capita income. (15) [CO4]

SECTION B

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

5. a) Define Accounting. Discuss the functions of Accounting. (10) [CO1]
b) What do you mean by transaction? Describe the characteristics of transactions. (10) [CO1]
c) Describe the steps in the accounting process. (15) [CO1]

6. a) What is ledger? Why is ledger called the king of all accounts? (10) [CO2]
b) From the following transactions, you are required to prepare necessary ledger accounts: (25) [CO3]

2025

- July-01 Mr. Rafin invested cash TK 200,000.
" 02 Cash deposited into bank TK 50,000.
" 03 Advertisement expense paid by cheque TK 5,000.
" 04 Furniture purchase in cash TK 25,000.
" 06 Service provided and receive cash TK 40,000.
" 07 Utility bill received but not yet paid TK 1,000.
" 10 Utility bill paid in cash TK 1,000 transaction July 07.

7. a) Mr. Rahman started a business on June 01, 2024. The following transactions during June: (35) [CO2]

2024

- June-01 Invested cash for the business TK 3,50,000.
 " 02 Purchase a Delivery Van for the business in cash TK 40,000.
 " 03 Equipment purchase for office use in cash TK 20,000.
 " 04 A fee of TK 12,000 for the hauling goods is billed to a customer on account.
 " 05 Cash received from customer transaction June 04.
 " 06 Cash deposited into bank TK 45,000.
 " 07 Repair expense paid by cheque TK 10,000.
 " 08 Advertisement expense occurred in the Daily Bangladesh Pratidin on account TK 7,000.
 " 09 Supplies purchase for office use in cash TK 9,000.
 " 10 Advertisement bill paid by cheque transaction June 08.

Required:

- Prepare journal.
- Prepare a tabular summary and show the effect on accounting equation. Mr. Rahman arrange the assets and liabilities are: Cash + Delivery Van + Equipment + Supplies = Accounts Payable + Rahman's Capital.

8. a) The following Trial Balance for ABC Company at the end of December 2023: (35) [CO4]

ABC Company
Trial Balance as on December, 2023

Account Titles	Debit (TK)	Credit (TK)
Cash	400,000	
Accounts Receivable	220,000	
Supplies	120,000	
Prepaid insurance	180,000	
Salaries expense	480,000	
Equipment for office	400,000	
Accumulated depreciation-office equipment		40,000
Accounts payable		60,000
Capital		800,000
Withdrawn	160,000	
Service revenue		1,400,000
Advertisement expense	80,000	
Rent expense	180,000	
Miscellaneous expense	80,000	
	2,300,000	2,300,000

Additional information:

- Salaries payable TK 20,000.
- Depreciation of the office equipment TK 30,000 for the year.
- Supplies on hand at December 31, 2023 TK 18,000.

Required:

- Prepare a statement of comprehensive income for the year ended December 31, 2023.
- Prepare a statement of owner's Equity.
- Prepare a statement of Financial Position as on December 31, 2023.

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
 B.Sc. Engineering 2nd Year 2nd Term Examination, 2024
 Department of Computer Science and Engineering
 MATH 2207
 Complex Variable, Vector Analysis and Statistics

TIME: 3 hours

FULL MARKS: 210

- N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
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 iv) z-table will be provided if required.

SECTION A

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

1. a) First, find the three moments measured from the origin using the following observation (18) [CO3]
 data. Then, use these moments to calculate the mean, CoV, moment coefficient of
 skewness. Moreover, find and draw the relative frequency.

Class interval	2-5	6-9	10-13	14-17
Observation	2	5	7	9

- b) In a container there are 15 CPUs, 10 Laptops and 3 Workstations. If six devices are (08) [CO4]
 selected from the container for each single office room, find the probability that there
 is
 i) exactly one workstation
 ii) at least three CPU, and
 iii) at most three laptops.
- c) When three fair coins are flipped, let the random variable x be defined as 3 times the (09) [CO3]
 number of the upper face of the head minus 7. Now, express the probability distribution
 of the random variable x corresponding to these flipped coins. Subsequently, determine
 the mean. Additionally, calculate the probability $P(x < 1)$ and identify the actual
 number of heads for the values of $x < 1$.
2. a) A binary communication channel carries data as one of the two types of signals denoted (12) [CO3]
 by 0 and 1. Owing to noise, a transmitted 0 is sometimes received as 1 and a transmitted
 1 is sometimes received as a 0. For a given channel, assumed a probability of 0.95 that
 a transmitted 0 is correctly received as a 0 and a probability of 0.90 that a transmitted 1
 is correctly received as a 1. In that binary communication channel it is observed that
 out of 100 transmitted signals, type of signal 0 is 60. If a signal is transmitted then
 determine the probability of (i) 0 was transmitted given that 0 was received, (ii) total
 error.
- b) Find the first four moment of the following probability density function. Also, draw the (13) [CO4]
 function, where $f(x) = \begin{cases} \frac{1}{4}, & \text{if } 1 \leq x \leq 5 \\ 0, & \text{otherwise} \end{cases}$
- c) List the necessary assumptions of the Bernoulli distribution. An automatic traffic (10) [CO4]
 control system monitors video download speeds for under-speeding. Based on a
 previous analysis, the probability of a video being under-speeded is 0.15. In a specific
 time-frame, four videos are investigated. Calculate the probabilities for the following
 scenarios:
 i) Green light: No under-speeded video observed.
 ii) Red light: All videos are under-speeded.
 iii) Yellow light: At least one, but not all, videos are under-speeded.

3. a) An observer counts the number of correct signals for each 2-minute time interval. (12) [CO3]

Possible number of correct signals within 2 min	0	1	2	3	4	>4
Number of observations	3	4	5	0	1	0

- i) Find the probability that 15 correct signals observed within 5 minutes.
 ii) Find the probability that no correct signal observed within the duration
 10.00 – 01.10 a.m, it is observed that (given that) no correct signal observed
 10.00 – 01.05 a.m.
 iii) Find the probability that 15 correct signals observed within the duration
 11.00 – 11.10 a.m. or 5.00 – 5.10 p.m.
 iv) Find the probability that 15 correct signals observed within the duration
 11.00 – 11.10 a.m. or 11.05 – 11.15 a.m.

- b) What is the value of k for which the following table represent a probability distribution. (13) [CO3]

x	-1	0	2	3	4
$T(x)$	$2k$	$5k$	0.2	0	0.1

Then, find first four raw moments (measured from origin). Then find first four central moments. Also find mean and variance of the distribution.

- c) The grade on a quiz were $0, 1, 2, \dots, 10$ points, depending the number answered correctly out of 50 questions. The mean grade was 6.25 and the standard deviation was 1.25. Express with appropriate assumptions to determine the following probabilities. (10) [CO4]
- the percentage of student scoring 6.0 point.
 - the maximum grade of the lowest 20% of the class.
 - the minimum grade of the highest 15% of the class.
4. a) Given $A = \begin{bmatrix} 0 & -2 \\ 2 & 3 \end{bmatrix}$, reduce it as a product of elementary matrices. Identify the type of each elementary matrix obtained from A (scaling, shear, rotation, etc.), and then apply these transformations sequentially to the line joining the point $(1,1)$ and $(3,3)$ illustrating each step graphically. (17) [CO4]
- b) A moving particle is given by the parametric equations $x = \sin t$, $y = \cos t$ and $z = t$. Find unit tangent vector \underline{T} , Normal vector \underline{N} and radius of curvature at $t = \frac{\pi}{2}$. Then find the trihedral Normal plane containing \underline{B} and \underline{N} at the point where at $t = \frac{\pi}{2}$ and tangent line at $t = \frac{\pi}{2}$ along \underline{T} . (18) [CO4]

SECTION B

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

5. a) Find the modulus and principal argument of the complex number $\frac{1+2i}{1-(1-i)^2}$ (06) [CO2]
- b) Show that the roots of $(x-1)^5 = 32(x+1)^5$ are given by: (09) [CO2]
- $$x = \frac{-3 + 4i \sin \frac{2n\pi}{5}}{5 - 4 \cos \frac{2n\pi}{5}}, \quad n = 0, 1, 2, 3, 4.$$
- c) Define harmonic function and analytic function. (03) [CO3]
- d) Prove that $u = x^3 - 3xy^2 + 3x^2 - 3y^2 + 1$ is harmonic. Find v , such that $f(z) = u + iv$ is analytic, where v is harmonic conjugate. (11) [CO3]
- e) Prove that $\lim_{z \rightarrow 0} \frac{\bar{z}}{z}$ does not exist. (06) [CO3]
6. a) Evaluate $\oint_c \frac{z-1}{(z+1)^2(z-2)} dz$, where c is the circle $|z-i|=2$. (10) [CO3]
- b) Locate and name all the singularities of the following function $f(z) = \frac{1}{z^3(z+5)(z^2+9)}$, and is there any isolated singularity in $|z|=3$? (06) [CO1]
- c) Find the orthogonal trajectories of the families of curves $e^{-x} \cos y + xy = \alpha$, where α is an arbitrary constant. (10) [CO3]
- d) Let $f(z)$ be analytic in a region R bounded by two simple closed curves c_1 and c_2 . Then prove that $\oint_{c_1} f(z) dz = \oint_{c_2} f(z) dz$, where c_1 and c_2 are both traversed in the positive sense relative to their interiors. (09) [CO2]
7. a) Find the directional derivative of the divergence of $f(x, y, z) = xy\vec{i} + xy^2\vec{j} + z^2\vec{k}$ at the point $(2, 1, 2)$ in the direction of the outer normal to the sphere $x^2 + y^2 + z^2 = 9$. (10) [CO2]
- b) If $\vec{F} = 2z\vec{i} - x\vec{j} + y\vec{k}$, evaluate $\iiint_v \vec{F} \cdot d\vec{v}$, where v is the region bounded by the surfaces $x=0$, $y=0$, $x=2$, $y=4$, $z=x^2$, $z=2$. (14) [CO3]
- c) Find the work done of a moving particle once around a circle c in the xy -plane, if the circle has centre at the origin and radius 4 and if the force field is given by $\vec{F} = (3x - 2y + 9)\vec{i} + (5x + 3y - 10z^3)\vec{j} + (3x - 4y + 2z)\vec{k}$. (11) [CO2]
8. a) Evaluate $\iint_S \vec{A} \cdot \vec{n} ds$, where $\vec{A} = 18z\vec{i} - 12\vec{j} + 3y\vec{k}$ and S is that part of the plane $2x + 3y + 6z = 12$ which is located in the first octant. (14) [CO2]
- b) Find equations for the tangent plane and normal line to the surface $z = x^2 + y^2$ at the point $(2, -1, 5)$. (10) [CO2]
- c) Show that $\vec{F} = (2xy + z^3)\vec{i} + x^2\vec{j} + 3xz^2\vec{k}$ is a conservative force field. Find the scalar potential. (11) [CO2]

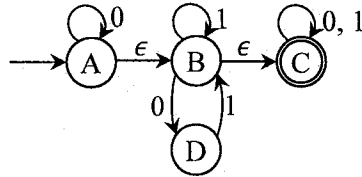
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SECTION A

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

1. a) Analyze how the transition functions of DFA, NFA and ϵ -NFA differs mathematically (10) [CO2] and illustrate the differences with suitable examples.
- b) Build a DFA over alphabet $\Sigma(a, b)$ where for any string, w : (13) [CO3]
 - i) $n_a(w) \bmod 2 = 0$ and $n_b(w) \bmod 3 = 0$,
 - ii) $n_a(w) \bmod 2 < 1$ and $n_b(w) \bmod 3 \geq 1$.
- c) Design NFA for the following Languages over alphabet $\Sigma(0, 1)$ where for any string, (12) [CO3] w :
 - i) number of '0's is even and ends with 1,
 - ii) contains '01' and ends with 10,
 - iii) w does not contain '101'.

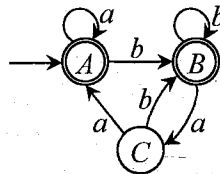
2. a) What does a DFA do on reading an input string? (05) [CO1]
- b) Design an ϵ -NFA for the regular expression $a(ab + ba)^*a^*b$. (08) [CO3]
- c) Eliminate ϵ -moves from the following ϵ -NFA: (10) [CO4]



- d) Convert the following NFA to DFA: (12) [CO4]

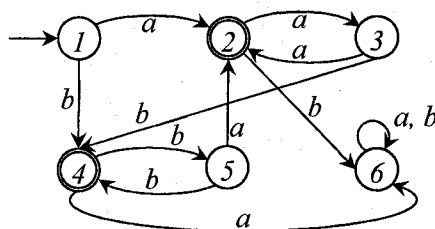
	0	1
$\rightarrow p$	{q, s}	{q}
* q	{r}	{q, r}
r	{s}	{p}
* s	\emptyset	{p}

3. a) Define decision problem and decision property. (05) [CO1]
- b) Explain how finiteness or infiniteness of a language can be determined. (08) [CO2]
- c) Find regular expression for the following DFA having alphabet $\Sigma(a, b)$ using Ardens method. (10) [CO3]



- d) Describe the algebraic laws for regular expression and use them to prove the following: (12) [CO4]
- i) $(AB)^*A = A(BA)^*$
 - ii) $(L + M)^* = (L^*M^*)^*$
 - iii) $(L^*)^*L = L^* - \epsilon$

4. a) Define *init* operation on a regular language. (05) [CO1]
- b) Write regular expression for the following languages: (12) [CO3]
 - i) After removing first and last symbol, the remaining string has an odd no. of 1's.
 - ii) Strings that begin with 1 and end with 0, and contain no two consecutive 0's.
 - iii) Strings that do not contain 'aba' as a substring.
- c) Use table filling algorithm to minimize the following DFA: (12) [CO2]



- d) Using Pumping Lemma, show that the even palindrome language is not regular. (06) [CO4]

SECTION B

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

5. a) Consider the grammar: (20) [CO3]
- $$\begin{aligned} S &\rightarrow AaA \mid CA \mid BaB \\ A &\rightarrow aaBa \mid CDA \mid aa \mid DC \\ C &\rightarrow Ca \mid bC \mid D \\ D &\rightarrow bD \mid \epsilon \end{aligned}$$
- i) eliminate ϵ -productions,
ii) eliminate unit productions from the resulting grammar from (i),
iii) eliminate useless productions from the resulting grammar from (ii),
iv) convert the grammar from (iii) into Chomsky Normal Form (CNF).
- b) Is Context Free Language (CFL) closed under Union and Intersection? Verify your answer. (07) [CO1]
- c) Show that the language $L = \{a^n b^j c^k \mid k = j^n\}$ on $\Sigma = \{a, b, c\}$ is not context free. (08) [CO4]
6. a) Given the following ambiguous Context Free Grammar (CFG): (13) [CO3]
- $$\begin{aligned} S &\rightarrow 0A \mid 1B \\ A &\rightarrow 0AA \mid 1S \mid 1 \\ B &\rightarrow 1BB \mid 0S \mid 0 \end{aligned}$$
- v) Find the string S generated by the grammar that has two leftmost derivations. Also show the derivations.
vi) Find an equivalent unambiguous CFG.
- b) Evaluate the problem of checking if a language $L(G)$ generated by a CFG G is empty or not – is decidable. (10) [CO2]
- c) Generate CFG that supports: (12) [CO3]
- i) Following markup text in below figure.
- ```
<html>
<div id = "container" class = "main" >
This is some text.
<div id = "inner">
This is inner text.
</div>
</div>
</html>
```
- ii) A language containing all binary strings with even number of 0's.
7. a) In province  $B$ , messages are sent using sequences of red ('0') and green ('1') Flags which can't be void. The rule says any message must feature at least one green on its second half. And importantly, the first half of the message must be at least as long as the second half. Now, (20) [CO4]
- i) Design a Push Down Automata (PDA) that ensures messages are generated following the rules.  
ii) Convert the PDA into its equivalent CFG.
- b) A software company is building an automated code verification system where the first requirement is to check whether program constructs (such as parentheses and block delimiters) are properly nested, and the second requirement is to ensure that every declared function is invoked exactly once and that the total number of variable declarations equals the total number of variable usages across the entire program. Now, (15) [CO2]
- i) Analyze whether a pushdown automaton is sufficient to handle both verification tasks.  
ii) Explain how Turing Machine (TM) can overcome the limitations of a PDA in this scenario and justify why a TM is strictly more powerful.
8. a) Analyze why the Halting problem of TM is undecidable. (12) [CO2]
- b) Suppose, you and your friend are playing a game where there are ' $k$ ' spots. Each spot has balls of same color. Each of you simultaneously picks a (single) ball from each spot and approach forward. You start from the first spot and your friend from the last spot to the first spot. Determine using TM with storage if both of you have chosen balls of same color in same sequence when you meet at the middle spot. (15) [CO2]
- c) Is it true that the language accepted by a PDA by empty stack or by that of final state are different languages? Explain. (08) [CO1]

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY  
B.Sc. Engineering 2<sup>nd</sup> Year 2<sup>nd</sup> Term Examination, 2024  
Department of Computer Science and Engineering  
ECE 2213  
Digital Electronics

TIME: 3 hours

FULL MARKS: 210

- N.B. i) Answer **ANY THREE** questions from each section in separate scripts.  
ii) Figures in the immediate right column of the questions indicate full marks.  
iii) The rightmost column indicates course outcomes.

**SECTION A**

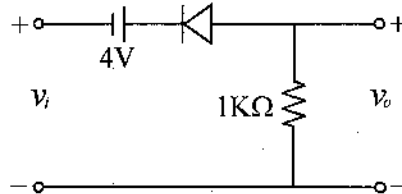
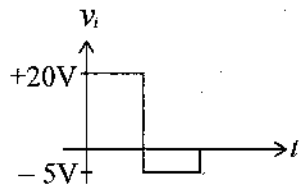
(Answer **ANY THREE** questions from this section in Script A)

1. a) What is digital logic family? Give the classification of logic family. Also mention the classification of digital ICs. (08) [CO1]
- b) Define the following parameters related to logic gates: (08) [CO1]  
Fan-out, Propagation delay, Noise margin, Figure of merit.
- c) Draw the circuit diagram of DTL NAND gate for three-inputs. Explain its working. (09) [CO1]
- d) Determine the high-level output voltage of RTL NOR gate for a fan-out of 6. Also determine the noise margin of this gate when input is high. Consider  $V_{CC} = 3.6V$ ,  $R_B = 450\Omega$  and  $R_C = 640\Omega$ . (10) [CO1]
2. a) Discuss three-input diode OR gate with necessary diagram. Why is such configuration not suitable for IC implementation? (06) [CO1]
- b) Explain the operation of TTL NAND gate with necessary diagrams. (10) [CO1]
- c) Draw and explain the two-input CMOS NOR gate. Also compare TTL, CMOS and ECL logic families in terms of speed, power dissipation and noise immunity. (09) [CO1]
- d) Draw a typical two-input basic gate using emitter coupled logic (ECL). Estimate the voltages across its gate outputs when all inputs are LOW. Choose the typical values for circuit components and voltages. (10) [CO1]
3. a) What is a memory unit? Discuss static bipolar RAM cell for linear selection. (07) [CO2]
- b) Briefly explain the basic operation of writing a 1 into and reading a 1 from a DRAM cell. (10) [CO2]
- c) Describe Programmable Read only memory (PROM) using MOS ROM cells. Compare it with the flash memories. (08) [CO2]
- d) Describe the operating principle of successive approximation A/D converter. (10) [CO2]
4. a) Distinguish between a programmable logic array (PLA) device and a programmable array logic (PAL) device in terms of architecture and capability to implement Boolean functions. (10) [CO2]
- b) Show the logic arrangement of both a PROM and a PLA required to implement a binary full adder. (11) [CO2]
- c) Draw the schematic diagram of a binary ladder D/A converter. Explain its operation. Also mention its merits and demerits. (08) [CO2]
- d) What is the necessity of sample and hold circuit in A/D conversion process? Explain its working. (06) [CO2]

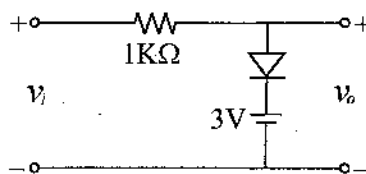
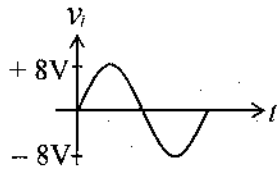
**SECTION B**

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

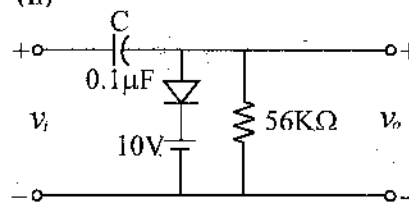
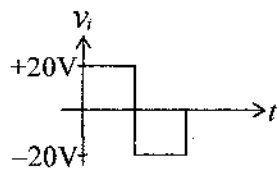
5. a) Briefly explain the working principle of a linear current sweep with a neat block diagram. (07) [CO3]  
 b) Draw the output waveforms of the following circuits. (20) [CO3]



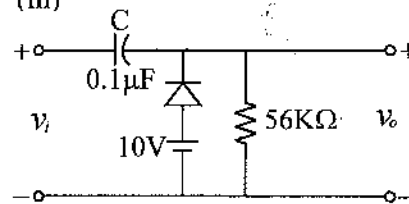
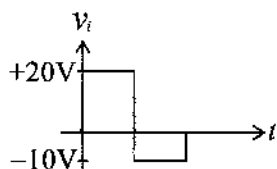
(i)



(ii)



(iii)



(iv)

- c) Design an inverting comparator that will compare its input with 4V and gives desired output. (08) [CO3]
6. a) Explain the difference between various types of multivibrator. (10) [CO3]  
 b) How 50% duty cycle can be attained using astable multivibrator. Draw the circuit and explain with necessary equations. (13) [CO3]  
 c) What is pulse transformer? Write down the difference between pulse transformer and power transformer. (12) [CO3]
7. a) What is blocking oscillator. Describe the operating principle of a transistor triggered monostable blocking oscillator with necessary diagrams. (11) [CO3]  
 b) Calculate (i) upper threshold voltage (ii) lower threshold voltage and (iii) Hysteresis voltage of a Schmitt trigger circuit, given that  $R_1 = R_2 = 5K\Omega$ . (12) [CO3]  
 c) Show with necessary diagram, how UJT relaxation oscillator can be used as a voltage sweep. (12) [CO3]
8. a) Write down the application of Digital Multimeter. Also, describe the parts of a digital multimeter. (07) [CO4]  
 b) Prove that  $E_C = QE$  for a Q meter where the symbols have their usual meanings. (10) [CO4]  
 c) Briefly explain the operating principle of VTVM. (08) [CO4]  
 d) A Q meter has a series coil of inductance (L) valued  $20\mu H$ , resistance (R) of the coil is  $20\Omega$  and resonant frequency of the circuit is 1MHz. Calculate the Q factor of the circuit. (10) [CO4]