

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
 B.Sc. Engineering 3rd Year 1st Term Examination, 2022
 Department of Computer Science and Engineering
 CSE 3101
 Theory of Computation

TIME: 3 hours

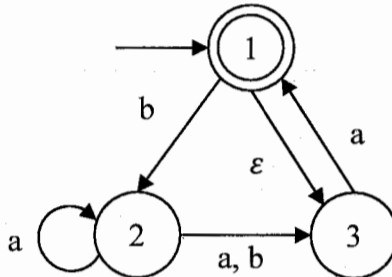
FULL MARKS: 210

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

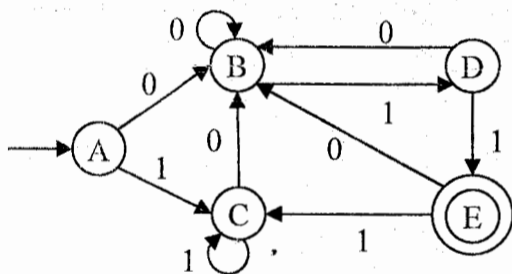
SECTION A

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

1. a) Define the terms with example(s): (i) Alphabet, (ii) Power of alphabet, and (iii) Language. (08)
 b) Construct the equivalent DFA for the following NFA. (15)



- c) Proof that for any NFA, there is a DFA D such that $L(N) = L(D)$. (12)
2. a) “If N is an NFA that recognizes language L, then swapping the final and non-final states in M does not necessarily yield a new NFA that recognizes L”—justify this statement. (08)
 b) Write the significances of using extended transition function. (05)
 c) Consider the following machine D. Apply the Myhill-Nerode theorem using the Table to minimize D and then convert it to a regular expression. (The following Table represents the marking of all pairs of state (P, Q) where $P \in \text{final states}(F)$ and $Q \notin F$ for the given D). (22)

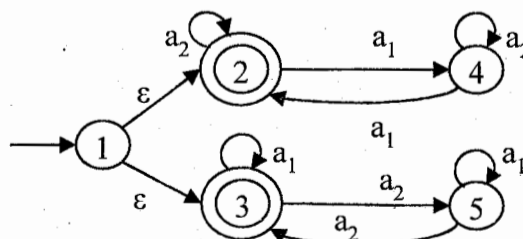


	A	B	C	D
B	0			
C	0	0		
D	0	0	0	
E	1	1	1	1

Machine D

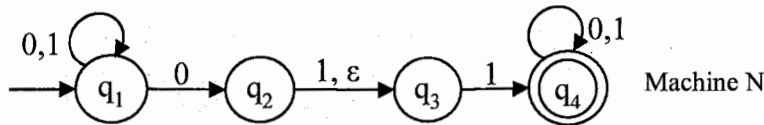
Table

3. a) Suppose, R be a regular expression that has length n (the length of a regular expression is the number of symbols it contains, including members of Σ , operation symbols, and parenthesis. For example, the regular expression $(01^*)0$ has length 6). If R is converted to an equivalent NFA N, then determine how many states would N have? Answer this question by giving an approximate bound on the number of states in N. (10)
 b) Let $\Sigma_m = \{a_1, \dots, a_m\}$ be an alphabet containing m elements for some integer $m \geq 1$. Let L_m be the following language: (14)
 “Accepts all strings which at least one a_i occurs an even number of times (not necessarily consecutively), where $1 \leq i \leq m$.” The following figure shows an NFA for the language L_2 . Construct an NFA for the language L_3 that has at most 7 states.



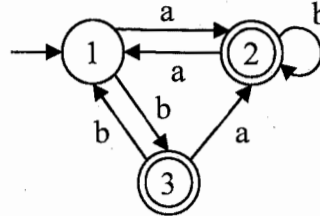
- c) You want to establish an account with an on-line service, for which you need to choose a password. They require that your password contain at least eight symbols, including at least two different letters, at least two digits, and at least one special symbol. Generate a regular expression that accepts exactly the string that satisfy these requirements, which you can use to test your password choice for validity. For simplicity, assume that the set of possible symbols is $\{a, b, c, d, 0, 1, \#, \$\}$, of which a, b, c and d are letters, 0 and 1 are digits, and $\#$ and $\$$ are special symbols. (11)

4. a) Consider the following machine N. (08)



Construct the tree for input 1001101.

b) Convert the following finite automata to an equivalent regular expression with ripping states order 3, 2, 1. (15)



c) Using Pumping lemma, show that the following languages are not regular. (12)
 i) $\{1^p \mid p \text{ is a prime number}\}$,
 ii) $\{0^n \mid n \text{ is a perfect square}\}$.

SECTION B

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

5. a) Consider the grammar: (20)

$$\begin{aligned} S &\rightarrow AaA \mid CA \mid BaB \\ A &\rightarrow aaBa \mid CDA \mid aa \mid DC \\ C &\rightarrow Ca \mid bC \mid D \\ D &\rightarrow bD \mid \epsilon \end{aligned}$$

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.
 b) Interpret the characteristics of a Context-free grammar (CFG) must hold to generate a regular language. Demonstrate them by generating CFG for regular expression: (15)
 $"(0 + 1)^* 12 (2 + 3)^*"$

6. a) Consider the problem of checking a string whether belong to the language (15)
 $L = \{0^n 1^n 2^n \mid n \geq 0\}$ using Turing machine. State if the problem is decidable.
 b) State Boolean satisfiability problem is NP complete problem. (10)
 c) Define ambiguity in Context-free Grammar. For the grammar: (10)

$$S \rightarrow SaS \mid b$$

Mention the techniques to resolve the ambiguity.

7. a) Generate Context-free Grammar that supports: (12)
 i) Following markup text in below figure,
 ii) A language containing all binary strings with even number of '0's.

```
<html>
<div id = "container" class = "main" >
This is some text.
<div id = "inner" >
This is inner text.
</div>
</div>
</html>
```

b) Compare how recursive and recursively enumerable language acts differently on Turing machine. (08)
 c) 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 first spot and your friend from last spot to first spot. Determine using Turing machine with storage if both of you have chosen balls of same color in same sequence when you meet at the middle spot. (15)

8. a) Use the languages $A = \{a^m b^n c^n \mid m, n \geq 0\}$ and $B = \{a^n b^n c^m \mid m, n \geq 0\}$ to show whether Context-free language is closed under intersection and union. (08)
 b) Define Pumping lemma for CFG. Show $L = \{0^i 1^j \mid j = i^2\}$ is not context-free grammar using Pumping lemma. (07)
 c) Create Pushdown automata (PDA) for $L = \{a^i b^j c^k \mid i \neq j + k\}$. (20)
 Convert your PDA to CFG.

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
 B.Sc. Engineering 3rd Year 1st Term Examination, 2022
 Department of Computer Science and Engineering
 CSE 3103
 Peripherals and Interfacing

TIME: 3 hours

FULL MARKS: 210

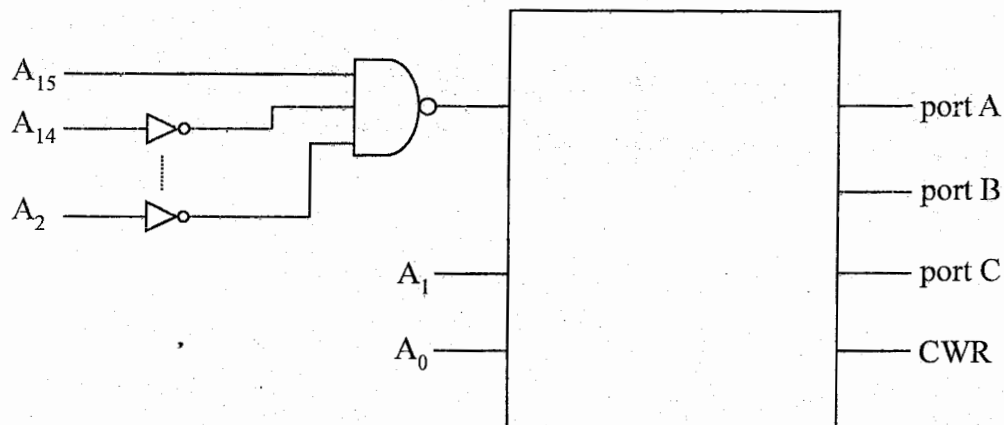
- N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
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SECTION A

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

1. a) Define microprocessor and multiprocessor from the view of components they contain. (06)
 - b) Suppose you have a memory chip where each word has 32 bits and the total number of rows are equal to the number of rows of a N MB memory. Now draw the complete memory chip by showing the size of address lines and data lines. Here,

$$N = (\text{last digit of your roll number \% } 2) + 1.$$
 - c) Discuss the advantages and disadvantages of system memories and standard memories. (12)
 - d) What is bus contention? Discuss the outcomes of bus contention. (05)
2. a) Classify the types of memory. Explain each type with corresponding examples. (06)
 - b) Suppose you have a PC that is equipped with an 8085 microprocessor and you have connected an I/O device to your PC. Now discuss the ways of parallel interfaces that will be performed between your pc and the I/O device with necessary figures. (12)
 - c) Write a program to read the DIP switch and display the reading from port B at port A and port C_U at port C_L, respectively. Use the following figure as a reference. (12)



- d) Define the serial mode of data transfer and classify it with appropriate figures. (05)
3. a) What is fully decoded addressing scheme? Design a fully decoded address decoder circuit for interfacing 4k bytes of RAM using 6116 and 4k bytes of EPROM using 2716. (13)
 - b) Design an interface circuit using 8255A where chip is selected when A₁₅ is high. In this design: (12)
 - i) Identify the port address.
 - ii) Identify the mode 0 control word to configure port A and port C_U input ports and port B and port C_L output ports.
 - iii) Write a program to read DIP switches and display the reading from port A at port B from port C_U and C_L.
 - c) Design a traffic controlling system of a typical busy cross road and write a program to switch ON and OFF the traffic lights in a proper sequence. (10)
4. a) Suppose you have two different scenarios for 8254 as follows: (10)

Scenario1: A programmer wants to check the count value and the status of a selected counter.

Scenario2: A programmer wants to latch the count of a selected counter.

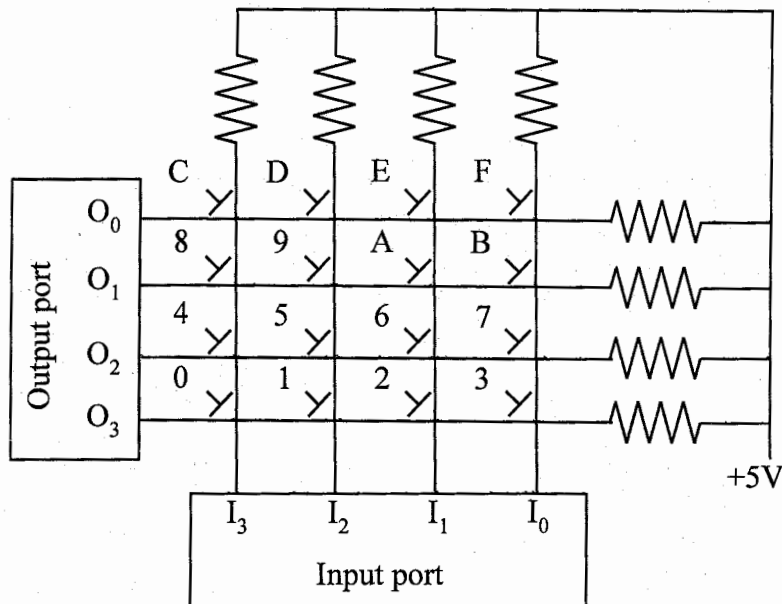
Now you as a programmer, in which scenario will you use which command mode? Justify your answer.
 - b) Briefly explain the following operating modes of 8254: (09)
 - (i) Rate generator, (ii) Square wave generator, (iii) Interrupt on terminal count.
 - c) Describe the process of developing a Cyclic Redundancy Check (CRC) algorithm for the message = 29 and key = 1010. Now detect the error assuming that an error has occurred at position, $p = 2$. (10)

- d) Define MDS and draw the block diagram of MDS. (06)

SECTION B

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

5. a) What is interfacing? What are the main functions of interfacing? (06)
 b) What is optocoupler? Briefly describe slotted and reflected optocoupler. (06)
 c) How host processor and independent processor communicate in closely coupled configuration? (13)
 d) XYZ, a tech firm, has chosen a centralized arbitration method to connect 256 servers in their data center in a loosely coupled manner. Although they do not intend to relocate these components over next 5 years, priorities among the servers may shift. Now, find a reliable but cost-effective solution for their data center architecture. (10)
6. a) Define transducer. What are the properties of a transducer? (07)
 b) Consider building a deep-sea submersible with a pressure and an ultrasonic sensor onboard. The vessel transmits pulses of ultrasound with a speed of 1480 m/s to the source above the water. The submersible's motor automatically shuts down if water pressure rises above 70 atm, preventing it from delving further into the ocean. Now design a control system with appropriate sensors and switches for your underwater explorer. Note that, water pressure at depth d , $P = 10.05d$ (Pa), $101325 \text{ Pa} = 1 \text{ atm}$. (10)
 c) Describe keyboard scanning technique when the key '2' is pressed on the 4×4 keyboard shown in following figure. (13)



4×4 keyboard

- d) Describe the working procedure of a laser-jet printer. (05)
7. a) Describe the machine code formats of ESC instruction. (05)
 b) Briefly discuss the coprocessor configuration. Then describe the procedure to establish communication between processor and coprocessor. (12)
 c) What is a USB cable? Draw the flow diagram to implement the USB interface. (12)
 d) Write short note on sensitivity property of a transducer. (06)
8. a) Describe the problems of the large screen memory. Compute the dot clock frequency for refreshing graphics screen in 640×480 resolution with 256 colors at a refresh rate of 60 Hz. (10)
 b) Suppose you are using a PS/2 mouse. A single left-button click occurred when you moved it 20 mm to the left and 16 mm up from the calibrated point. If mouse resolution is set to 4 counts/mm, what will be the bit definitions of data packet sent by the mouse? (11)
 c) What are the advantages successive approximation counter have over counter type ADC? (14)
 Illustrate the process of converting 12 V analog input into digital output in a 4-bit successive approximation ADC with $V_{ref} = 16 \text{ V}$. Given output of R-2R ADC,

$$V_{out} = b_3 \frac{V_{ref}}{2} + b_2 \frac{V_{ref}}{4} + b_1 \frac{V_{ref}}{8} + b_0 \frac{V_{ref}}{16}$$
 where b_3 corresponds to bit 3, b_2 to bit 2 etc.

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
 B.Sc. Engineering 3rd Year 1st Term Examination, 2022
 Department of Computer Science and Engineering
 CSE 3109
 Database Systems

TIME: 3 hours

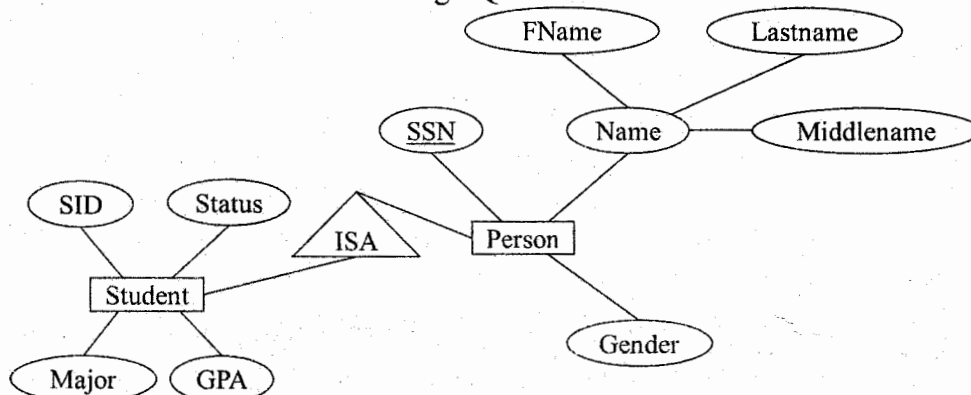
FULL MARKS: 210

- 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) Make a classification of data models for database design. (08)
- b) Suppose you are given the following requirements for a simple database for the Bangladesh Premier League (BPL). (10)
 The BPL has many teams; each team has a name, a city, a coach, a captain, and a set of players; each player belongs to only one team; each player has a name, ID, a position (such as bowler, batsman, all-rounder), a skill level, and a set of injury records; a team captain is also a player; a game is played between two teams (host and guest team) that has a date and status (win, loss, drawn, postponed).
 Construct a clear and concise ER diagram for the BPL database. Show the relationships with cardinalities.
- c) Explain the concept of generalization and specialization. Transform the following ERD into relational schema. Create the schema using SQL code. (12)



- d) What are the contents of a data dictionary? (05)
2. a) Consider two tuples t_1 and t_2 in a relation r . If $t_1 \neq t_2$ and $t_1.k \neq t_2.k$ then what decision(s) you can take about k , where k is an attribute of r . Explain with example. (08)
- b) what are the forms of join operation? Explain with example. (12)
- c) Consider the employee database as follows: (15)
employee (name, street, city)
works (name, company_name, salary)
company (company_name, city)
 - i) Draw the schema diagram of the database.
 - ii) What are the appropriate primary keys?
 - iii) Give an expression in relational algebra to express the following queries:
 - Find the name of each employee who lives in city Miami,
 - Find the name of each employee whose salary is greater than \$10,000.

3. a) What is role of disk page size to design a good index? (06)
- b) When do you apply bitmap indexing in a database? Consider the following table: (10)

ID	S_1	S_2	S_3	S_4	S_5
Gender	m	f	f	m	f
Income level	L_1	L_2	L_1	L_4	L_3

Find the bitmaps for income level and gender attributes. Hence formulate following queries using bitmap operations:

- (i) the females with income level L_1 , (ii) the males with income level L_4 .
- c) Construct a B⁺ tree with following key values when $n = 3$. (12)
 10, 12, 1, 2, 3, 30, 32, 20, 25, 40, 45.
- d) In a B⁺ tree, a node is same size with block size (4 kilobytes) and $n = 100$. If 1 million key values are entered in the tree then how many nodes are accessed to lookup a single key? (07)

4. a) A relation R is decomposed into two relations R_1 and R_2 . How do you say this decomposition is lossless? Explain for $R(A, B, C)$, $R_1(A, B)$ and $R_2(B, C)$. (08)
- b) "Functional dependency is the generalization of the notion of a super key"—justify the statement. (10)
- c) What are the goals of database normalization? Make a comparison of BCNF and 3NF with respect to database normalization. (10)
- d) Consider the relation $R(A, B, C, G, H, I)$ with $F = \{A \rightarrow B, A \rightarrow C, CG \rightarrow H, CG \rightarrow I, B \rightarrow H\}$. Do you think (AG) and (BG) are the keys of R ? (07)

SECTION B

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

5. a) Write examples of potential problems caused by concurrency and explain these problems with examples. (13)
- b) Write the aggregate functions and explain with example. (10)
- c) Explain RDF and Knowledge Graphs with appropriate figures. (12)
6. a) Define these terms: data definition language, data manipulation language, primary key, foreign key. (10)
- b) Consider the following insurance database, where the primary keys are underlined. (15)

person (driver_id, name, address)

car (license_plate, model, year)

accident (report_number, year, location)

owns (driver_id, license_plate)

participated (report_number, license_plate, driver_id, damage_amount)

Construct the following SQL queries for this relational database: (i) Find the total number of people who owned cars that were involved in accidents in 2017, (ii) Delete all year-2010 cars belonging to the person whose ID is '13456'.

- c) Consider the following SQL query that seeks to find a list of titles of all courses taught in Spring 2017 along with the name of the instructor. (10)

"Select name, title from instructor natural join teaches natural join section natural join course where semester = 'Spring' and year = 2017"

What is wrong with this query and explain with example.

7. a) Consider the following bank database. (15)

branch (branch_name, branch_city, assets)

customer (customer_name, customer_street, customer_city)

loan (loan_number, branch_name, amount)

borrower (customer_name, loan_number)

account (account_number, branch_name, balance)

depositor (customer_name, account_number)

Let us define a view *branch_cost* as follows:

"create view branch_cost as select branch_name, customer_name from depositor, account where depositor.account_number=account.account_number"

Suppose that the view is materialized; that is, the view is computed and stored. Write triggers to maintain the view, that is, to keep it up-to-date on insertions to depositor or account. It is not necessary to handle deletions on updates. Note that, for simplicity, the elimination of duplicates is not required.

- b) Write an SQL query to create a table called "employees" with columns: *id* (integer), *name* (varchar), and *salary* (decimal). (20)
 - i) Create an SQL function called "calculate_bonus" that takes an employee's salary as input and returns the bonus amount. If the salary is greater than 6000, the bonus should be 10% of the salary; else it should be 5% of the salary.
 - ii) Write an SQL procedure "update_salaries" that updates the salaries of all employees in the "employees" table. The procedure should use a loop and a cursor to iterate over the employees. Inside the loop, all the "calculate_bonus" function to calculate the bonus for each employee and update the salary with the bonus amount.

8. a) Explain state transition diagram of transaction with appropriate examples and figures. (10)
- b) Define JSON data format with example. What are the applications of JSON data format? (10)
- c) Make a comparison between views and tables. (07)
- d) When do you need referential integrity? You have two tables customer and branch. Create the two tables to explain the referential integrity. Assume the attributes of the tables you need. (08)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 3rd Year 1st Term Examination, 2022
Department of Computer Science and Engineering
ECE 3115
Data Communication

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) Give a block diagram representation of data communication system. Briefly explain the function of each block and typical process involved with it. (10)
- b) State and explain Nyquist channel capacity theorem. (05)
- c) Describe the key network performance parameters. (10)
- d) A band limited signal is expressed as $15 + 7\cos\pi 10 \times 10^6 t$. (10)
 - i) Sketch the spectrum of the signal.
 - ii) What will be the required channel bandwidth to transmit this signal?
 - iii) Estimate thermal noise level of this channel when operated at 35°C.

2. a) Classify transmission media. Briefly explain the common transmission impairments of digital communication system. (11)
- b) Describe the fundamental blocks of PCM. How does non-uniform quantization overcome the problems of uniform quantization? (14)
- c) What is the total delay for a frame of size 5 million bits that is sent on a link with 10 routers each having a queuing time of 2 μ s and a processing time of 1 μ s. The length of the link is 2000 km. The speed of light inside the link is 2×10^8 m/s. The link has a bandwidth of 5 Mbps. Which component of the total delay is dominant? Which one is negligible? (10)

3. a) With appropriate block diagram, discuss about the principle of DM. State the advantages of DM and then compare the performance of DM with PCM. (10)
- b) What is antenna? Explain the role of antenna for signal transmission and reception. (07)
- c) Compare different data transmission modes. (10)
- d) For an 8-PSK modulator with an input data rate (f_b) equal to 10 Mbps and a carrier frequency of 70 MHz, determine the double-sided Nyquist bandwidth (f_N) and baud. Also, compare the results with those achieved with the BPSK and QPSK modulators. (08)

4. a) Suppose the input bit sequence (QIC): 100110010, for an 8-QAM modulator. (12)
 - i) Determine the output phases.
 - ii) Draw the constellation diagram for obtained symbols.
- b) Explain AM, FM and PM using necessary diagrams. (08)
- c) What is line coding? Sketch the waveform for the binary sequence 10011011 using the following methods: (10)
 - i) Differential Manchester Code.
 - ii) Bipolar-AMI.
 - iii) NRZI.
 - iv) Pseudoternary.
- d) Write down the limitations of Bipolar-AMI. (05)

SECTION B

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

5. a) What is data link control protocol? Briefly explain the requirements for effective data communication between transmitting and receiving stations. (12)
- b) Write down the advantages of vertical time sequence diagram. (05)
- c) Why is break up of large block of data into smaller blocks necessary in stop and wait flow control? (08)
- d) For error detection using cyclic redundancy check, prove that $T/p = Q$, where symbols have their usual meanings. (10)

6. a) What is HDLC? Write down the significance of address field of HDLC in operation. (10)
- b) Briefly explain different types of stations, link configurations and data transfer modes used in HDLC. (10)
- c) What is bit stuffing? A transmitter needs to transmit the following information bit: 110111111011111011111001 using HDLC. Write down the actual bit pattern that will be sent. (10)
- d) Draw the HDLC frame format. (05)
7. a) What is multiplexing? Draw the block diagram of FDM system and TDM system. (11)
- b) A communication system uses synchronous TDM to multiplex digital and analog sources. The system has 17 sources to multiplex on a single line as follows: (10)
- Source 1: Analog, 2 kHz bandwidth,
 Source 2: Analog, 4 kHz bandwidth,
 Source 3: Analog, 2 kHz bandwidth,
 Source 4: Analog, 2 kHz bandwidth,
 Source 5: Analog, 2 kHz bandwidth,
 Source 6 – 17: Digital, 7200 bps synchronous.
- Design a system to multiplex all the sources for a single link.
- c) Why synchronous TDM is called synchronous? (06)
- d) Why flow control and error control are not necessary in statistical TDM? (08)
8. a) Write down the advantages and disadvantages of frame relay. (07)
- b) Describe the elements and key features of X.25. (08)
- c) Draw the datagram approach and virtual circuit approach for packet switching. (10)
- d) Compare circuit switching and packet switching method. (10)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
 B.Sc. Engineering 3rd Year 1st Term Examination, 2022
 Department of Computer Science and Engineering
 CSE 3119

Software Engineering and Information Systems

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 do you mean by system concept? Describe the main components of the system concept. (11)
 b) Suppose you have been sent to update a system of a factory where various types of useful commodities are made. What steps should you take at first there? Describe that steps. (12)
 c) We know to run a company, there various types of employee are needed. Is there any system analyst needed? Explain why? (12)
2. a) Mr. Y is a head of an agriculture company. He collects some information from his company. Now, suppose you are asked to classify it, then how many categories of information do you classify it? Explain. (12)
 b) What do you mean by input design? Describe the purpose of it. (10)
 c) Identify the classification of form design. Why is the classification needed? Explain. (13)
3. a) What do you mean by prototyping? Explain it with a diagram. (10)
 b) What are the criteria used for system testing? And write the types of it. (12)
 c) Suppose, Mr. X drives a productive factory. Now, what will be your suggestion for him to maintain the quality of the product of his factory? (13)
4. a) What do mean by post implementation? Explain. (10)
 b) What are the steps taken to validate and prepare a system for final implementation? (12)
 c) Why a project is terminated? Explain it with an example. (13)

SECTION B

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

5. a) Define Software Engineering with examples. (10)
 b) What is overriding? How can you solve it using dynamic binding? Explain with example. (10)
 c) Develop a client-server architecture along with interfaces for a “Simple Messaging Application”. (15)
6. a) Apply the following design patterns on the concept of “Part-time and Full-Time M.Sc. students”. (20)
 i) Player Role Pattern
 ii) General Hierarchy Pattern.
 b) State some usability principles to build a complete software. (10)
 c) Write down the ethics of a system analyst. (05)
7. a) Explain the concept of following class diagram using (i) Sequence diagram, (ii) State diagram. (15)

Sports	1	*	TeamManger	1	*	Matches	*	1	Player
getfitness()			request-toplay() addtoTeam()			Manofthematch()			hassfitness() personalscore()
- b) “Increasing data coupling decreases stamp coupling”—explain the statement with example. (10)
 c) How “Anticipate Obsolence” keeps software to be updated? Explain. (10)
8. a) Design a test-driven development technique for “Online course registration” system. (08)
 b) What is critical race? Write down the two way to solve this problem. (13)
 c) What is project management? Apply software process models: (i) Waterfall model, (ii) Spiral model on the context of “Online clearance system”. (14)