KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 4th Year 2nd Term Examination, 2022
Department of Computer Science and Engineering
CSE 4221
Natural Language Processing

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) Define corpus. What are the properties of a corpus? (05) [CO1]
   b) "Patterns are greedy" – why? Design a regular expression to answer the following statement: "Find a computer with at least 6 GHz and 512 GB RAM for less than BDT 4000". (10) [CO1]
   c) Define subword tokenization. Explain the BPE algorithm for subword tokenization. Use the following corpus to explain the algorithm.
   "low low low low low lowest lowest Newer Newer Newer Newer wider wider wider new new"
   Test Set: newer, lower. (15) [CO2]
   d) Define stop words. What are the applications of stop word detection in NLP tasks? (05) [CO1]

2. a) You have two strings "brief" and "drivers". Figure out whether "drive" is closer to "brief" or "drivers" using minimum edit distance algorithm. (14) [CO2]
   b) What is *n*-gram language model? Find the uni-gram, bi-gram, and tri-gram from the following corpus.
   "This is Big Data AI Book". (06) [CO3]
   c) Why do you need smoothing techniques for *N* gram model? Explain the following smoothing techniques: (15) [CO3]
      i) Add-1 smoothing.
      ii) Stupid back off.
      iii) Kenser-Ney smoothing.

3. a) Give a formal definition of supervised text classification. How can you differentiate generative and discriminative classifier? (05) [CO4]
   b) What is "Bag of words" model? What are the assumptions of Bag of words model? How does Bag of words applied for multinomial Naïve Bayes Classifier? Using the following training set find the class of the test set. (15) [CO4]

		Document	Class
Training	:	Just plain boring	–ve
		No surprise and few laughs	–ve
		Very powerful	+ve
		Most fun film of the summer	+ve
Test	:	Predictable with no fun	?

   c) When is "Accuracy" not a good metric? Explain with example. (07) [CO3]
   d) "The noisy channel is a kind of Bayesian inference" – explain the term. (08) [CO3]

4. a) What are the types of spelling errors? you wanted to type 'three' but mistakenly you typed 'there'. How can you detect such an error automatically? How to correct these types of errors? (12) [CO3]
   b) What are the common structural ambiguities of Natural Language Processing? Explain. (06) [CO3]
   c) What is partial parsing? What are the applications of partial parsing? (05) [CO3]
   d) Consider the following grammar G. Using the CYK algorithm, find whether "ababa" is L(G) or not. (12) [CO3]

$$S \rightarrow AB|BC$$
$$A \rightarrow BA|a$$
$$B \rightarrow CC|b$$
$$C \rightarrow AB|a$$

SECTION B

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

5. a) Explain the large language model (LLM) with an example. Discuss computational resources and energy consumption in LLM. (10) [CO1]
   b) "Parts-of-Speech (POS) tagging is a disambiguation task" – justify the statement with example. (10) [CO2]
   c) Discuss POS tagging and tagsets for English. (10) [CO3]
   d) How difficult is POS tagging in English? (05) [CO3]

6. a) Discuss Conditional Random Fields using Bayes' rule. (10) [CO2]
   b) We have a dataset (NewG). Some information about the dataset is given below. (25) [CO2]

No. of VB	:	17619	Starting probability VB	:	0.024
No. of MD	:	11338	Starting probability MD	:	0.11
No. of NN	:	16559	Starting probability NN	:	0.86
$t_{i-1} - t_i$			$t_i - w_i$		
VB – VB	:	8583	VB – race	:	5391
VB – MD	:	6988	VB – will	:	6308
VB – NN	:	5826	VB – begin	:	7488
MD – VB	:	7984	MD – race	:	6557
MD – MD	:	4204	MD – will	:	6635
MD – NN	:	4046	MD – begin	:	6905
NN – MD	:	5006	NN – race	:	4163
NN – NN	:	4568	NN – will	:	6103
			NN – begin	:	7863

Use the dataset to answer the following questions:

i) Calculate the transition probability (A).
ii) Calculate the emission probability (B) for sentence: "race will begin".
iii) Find the tag sequence for the sentence "race will begin" using hidden Markov model.

7. a) Discuss the sequence to sequence model with attention mechanism (AM). Demonstrate the limitations without AM. (10) [CO2]
   b) Can hidden Markov models incorporate features? (05) [CO2]
   c) What is bootstrapping in information extraction? Explain the architecture for bootstrapping. (10) [CO4]
   d) How do we detect events? Write down features commonly used in both rule-based and statistical approaches to event detection. (10) [CO4]

8. a) Explain term weighting and document scoring. (05) [CO5]
   b) (12) [CO5]

Query	:	Hello dear
doc1	:	Hello my friends
doc2	:	Hello Karim, hello Rahim
doc3	:	My dear friend, Hello
doc4	:	Hello, Dear, dear

Using term weighting and document scoring, rank the document for Query.

   c) Discuss language models (LMs) to do question answering (QA). Write down the comparative analysis between LM QA models and classic QA models. (10) [CO5]
   d) What is homograph disambiguation? What problems does CMU face in this regard, and how does UNISYN address these issues? (08) [CO4]

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 4th Year 2nd Term Examination, 2022
Department of Computer Science and Engineering
CSE 4223
Digital System Design

TIME: 3 hours FULL MARKS: 210

N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
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iii) The rightmost column indicates course outcomes.

SECTION A

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

1. a) Define register and counter. Draw a 4-bit asynchronous counter with JK flip-flops. (08) [CO1]
   b) "Ripple counter is called a divide-by-2 circuit." Do you agree with this statement? Justify your answer. (12) [CO2]
   c) Describe the working principle of a controlled left shift register with parallel loading. Is there any forbidden condition? If any, then discuss the condition. (15) [CO2]

2. a) How does a ring counter work? Explain it. Also mention it's applications. (10) [CO1]
   b) Is it possible to design a mod-12 counter? If possible, then design it with proper explanation. Otherwise, explain why it is not possible to design. (15) [CO2]
   c) Define ROM and RAM. Classify the types of ROM and RAM. (10) [CO1]

3. a) Describe the working principle of a three-state switch with the necessary figure. (08) [CO1]
   b) Design a three-state ROM with on-chip decoding for the following table. (12) [CO1]

Register	Address	Value
R0	0	0001
R1	1	0101
R2	2	1010
R3	3	1011
R4	4	1011
R5	5	0100
R6	6	1100
R7	7	1110

   c) Draw the architectural diagram of the SAP-1 computer by showing its registers. Describe each register in brief. You can use any SAP-1 program for each of the description. (15) [CO2]

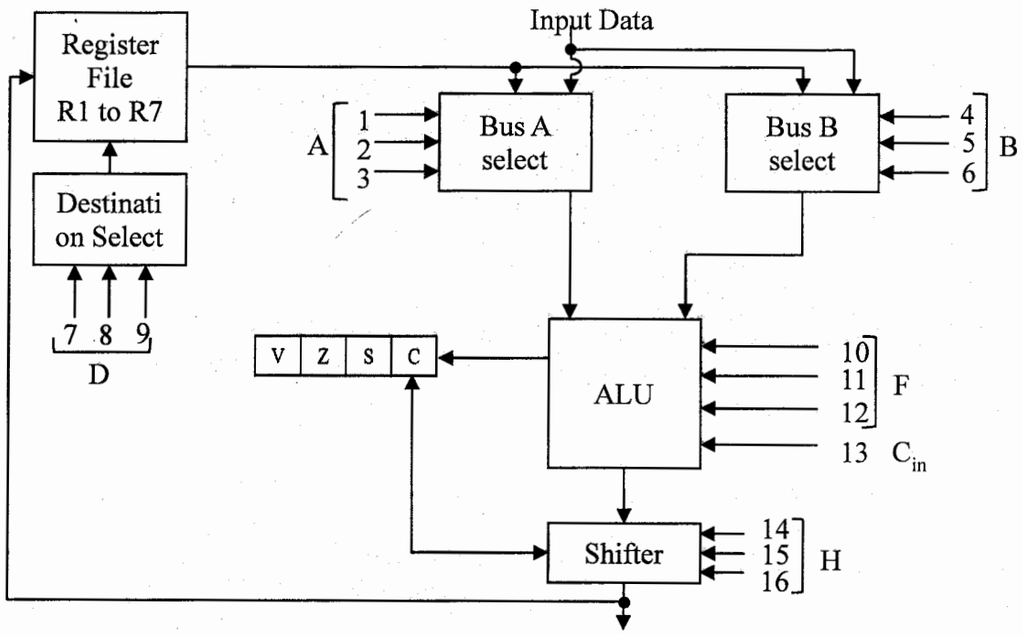
4. a) Consider the expression: $10 - 8 + 6 - 7 + 3$ and answer the following questions: (10) [CO1]
      i) Write an SAP-1 program to evaluate the expression,
      ii) Write a machine language code for the above SAP-1 program (as you have written in (i)),
      iii) Rewrite the machine language code in a chunk format.
   b) "While fetching and executing two different types of SAP-1 instructions (LDA, ADD), they generate the same control word values for half of the T-states"—justify the statement with example(s). (10) [CO2]
   c) Consider that you have two numbers +8 and +9. Each number is represented in 5 bits, where the MSB is the sign bit. Now, if you add these two numbers, will there be any overflow? If overflow occurs, then how you can detect it with hardware. Otherwise, explain why overflow will not occur. (15) [CO1]

SECTION B

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

5. a) State which method of control logic design is the best. Justify your reasonings. (12) [CO1]

b) You are given an ALU and its function table as shown in the following figure. (23) [CO



(i) Computation unit

1 2 3	4 5 6	7 8 9	10 11 12	13	14 15 16
A	B	D	F	C_{in}	H

(ii) Control Word

Binary Code	Function of selection variables					
	A	B	D	F with $C_{in} = 0$	F with $C_{in} = 1$	H
0 0 0	Input data	Input data	None	A, C ← 0	A + 1	No Shift
0 0 1	R1	R1	R1	$A + B$	$A + B + 1$	Shift -right
0 1 0	R2	R2	R2	$A - B - 1$	$A - B$	Shift -left
0 1 1	R3	R3	R3	$A - 1$	A, C ← 1	0's to output
1 0 0	R4	R4	R4	$A \vee B$	–	–
1 0 1	R5	R5	R5	$A \oplus B$	–	CRC
1 1 0	R6	R6	R6	$A \wedge B$	–	CLC
1 1 1	R7	R7	R7	$\bar{A}$	–	–

(iii) Function table of ALU

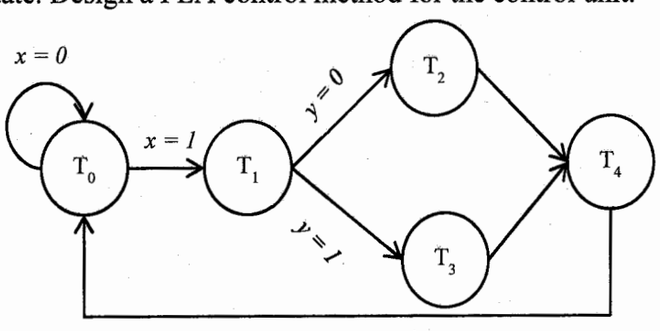
Design a control unit using one flip-flop per state method that conveys the following operation:

"The computation unit will wait for an external input q_s to become 1. When q_s becomes 1, the ALU will take an input data and store it in the R1 register. Then it will count the number of 1's in the R1 register. Finally, the count value will be stored in the R1 register."

6. a) Suppose, you want to build a microprogram control unit. However, you don't have a multiplexer available. Discuss about the issues you will face to build the control unit. (10) [CO1]

b) Let, you have implemented a PLA control unit. Total number of control bit output is 13. Among the 13 bits, 3 bits are connected to the sequence register. There are four external variables that determine or manipulate the workflow of the control unit. Now, you want to replace the PLA control unit with a microprogram control unit. Determine the size of the ROM you will need for this job. Justify your choice. (10) [CO1]

c) Consider the following control state diagram and the control words generated in each state. Design a PLA control method for the control unit. (15) [CO2]



(i) Control state diagram

T_0	:	0	0	1	0	0
T_1	:	0	0	0	1	0
T_2	:	0	1	1	1	0
T_3	:	0	0	0	0	1
T_4	:	0	0	1	1	1

(ii) Control words in each state

7. a) Let, you have to design a small computer. You have a ROM of 8192 words of 16 bit. Determine how many simple instructions we can fit in the instruction set of the computer. Draw the block diagram of your computer mentioning the size of each necessary register. (15) [CO1]

b) Consider the situation that we removed the MBR (Memory Buffer Register) from a computer and design it in a way so that the accumulator register can directly read from and write to memory. Will the small computer work properly? Justify your answer. (10) [CO1]

c) Describe the reasoning of instruction register being optional in a microprogram control unit of a small computer. (10) [CO2]

8. a) Describe how the data and instructions resides in memory. Demonstrate how a computer distinguish between these two. (10) [CO1]

b) Explain a way for a small computer to synchronize its own action with an external I/O device (i.e., read write operations). (05) [CO2]

c) A small computer has the following instruction set. (20) [CO1]

Symbol	Hexa-decimal code	Description
CLA	6800	Clear A
CLE	6400	Clear E
CMA	6200	Complement A
CME	6100	Complement E
SHR	6080	Shift-right A and E
SHL	6040	Shift-left A and E
INC	6020	Increment A
SPA	6010	Skip on Positive A
SNA	6008	Skip on Negative A
SZA	6004	Skip on Zero A
SZE	6002	Skip on Zero E
HLT	6001	Halt computer
SKI	7800	Skip on input flag
INP	7400	Input to A
SKO	7200	Skip on output flag
OUT	7100	Output from A

(i) Instruction set for Register and I/O reference instructions.

Symbol	Hexa-decimal code	Description
AND	0 *m*	AND to A
ADD	1 *m*	ADD to A
STO	2 *m*	Store in memory from A
ISZ	3 *m*	Increment and skip if zero
BSB	4 *m*	Branch to subroutine
BUN	5 *m*	Branch unconditionally

(ii) Instruction set for Memory reference instructions (here *m* denotes a 12-bit address).

The RAM

Address	Value	Comments
01	0012	Value of *a*
02	000A	Value of *b*
03	0000	Value of *res*
⋮	⋮	⋮
		Start of your code

(iii) The RAM

Now, a program to multiply two numbers *a* and *b*, stored in the memory. Put the result in the memory in the convenient position (i.e., *res* = *a*b*). The RAM is drawn in the given figure with some information. It is a 32×16 bit RAM. Show the state of the RAM after loading your written program in it. For simplicity, assume that the multiplication result will not exceed 16 bits. Note that all values in the RAM are in hexadecimal format. You may take necessary assumptions.

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 4th Year 2nd Term Examination, 2022
Department of Computer Science and Engineering
CSE 4225
Embedded 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.
iii) Graph papers will be supplied (if required).

SECTION A

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

1. a) What are embedded systems? What are the differences between embedded systems and general-purpose computers? (09)
   b) Write short notes on (i) ASSP, (ii) Embedded Systems' Memory. (08)
   c) Why are embedded systems called application and domain specific? How do these systems help human being by working in harsh environment? (08)
   d) If the lifetime of an embedded system is 52 weeks then calculate the revenue loss for the following two cases and remark on the results. (10)
      (i) Delay is 4 weeks,
      (ii) Delay is 10 weeks.

2. a) What are the metrics of embedded systems design? Explain them in brief. (08)
   b) Justify the statement – "The choice of hardware versus software for a particular function is simply a trade-off among various design metrics". (09)
   c) What is design productivity gap? Explain in brief. (06)
   d) Assume a designer's productivity, when working alone on a project, is 5,000 transistors per month, and each additional designer reduces productivity by 5%. (12)
      (i) plot teams' monthly productivity versus team size for team sizes ranging from 1 to 40 designers,
      (ii) plot (on the same graph) the project completion time versus team size for projects of sizes 100,000 and 1,000,000 transistors,
      (iii) provide the optimal number of designers for each of the two projects, indicating the number of months required in each case.

3. a) Depict the ideal top-down design process of embedded systems with a neat sketch. (08)
   b) What are the functions of sensors and actuators in embedded systems? (06)
   c) Why is partitioning done in hardware-software co-design? Explain the Double-Root Model of co-design. (11)
   d) What are the three key embedded system technologies? Compare the advantages and disadvantages of them. (10)

4. a) What is Internet of Underwater Things? How does IoT work? Explain in brief. (07)
   b) Compare the advantages of Arduino board and Raspberry PI board. (06)
   c) Show the hardware design of a microcontroller-based washing machine. (12)
   d) Prove that low level redundancy yields higher reliability than high level redundancy. (10)

SECTION B

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

5. a) What is Real-Time operating system (RTOS)? How does it differ from traditional Operating System (OS)? Also, discuss some applications where RTOS is needed. (10)
   b) Discuss the RTOS kernel architecture and the modes of operation. Include necessary figure(s). (12)
   c) What is the main difference between cooperative scheduling and preemptive scheduling? How does Earliest Deadline First (EDF) algorithm work? Show the feasibility of scheduling for the following tasks by using EDF algorithm. (13)

Task	Release Time	Compute Time (C_i)	Deadline	Period (T_i)
T1	0	2	8	8
T2	0	4	12	12
T3	0	6	16	16

6. a) How can data be shared between processes in RTOS? What is shared data problem and how can you solve this problem? (12)
   b) Suppose, you have to develop an embedded system for an Automated Chocolate Vending Machine (ACVM). (15)
      (i) Draw the basic system diagram of it,
      (ii) Specify the design metrics,
      (iii) Discuss the hardware requirement for it.
   c) Explain the factors for choosing a right platform to develop an embedded system. (08)

7. a) What are the security issues of OS in embedded systems? (08)
   b) Show the hardware architecture and software design for developing a smart card system. (13)
   c) How can you consider white box testing and black box testing in your system? Discuss simulation as a verification method and compare its speed at various level with a pyramid. (14)

8. a) How do multiple microcontrollers and peripherals communicate using I^2C BUS? Discuss briefly about MODBUS. (11)
   b) Differentiate between VHDL and Verilog. (10)
   c) List the IEEE 802 standards. Discuss a wireless device that uses 802.11 b/g/n standards with its pin diagram. Also write a program to connect this device with a WiFi network. (14)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 4th Year 2nd Term Examination, 2022
Department of Computer Science and Engineering
CSE 4233
Robotics

TIME: 3 hours FULL MARKS: 210

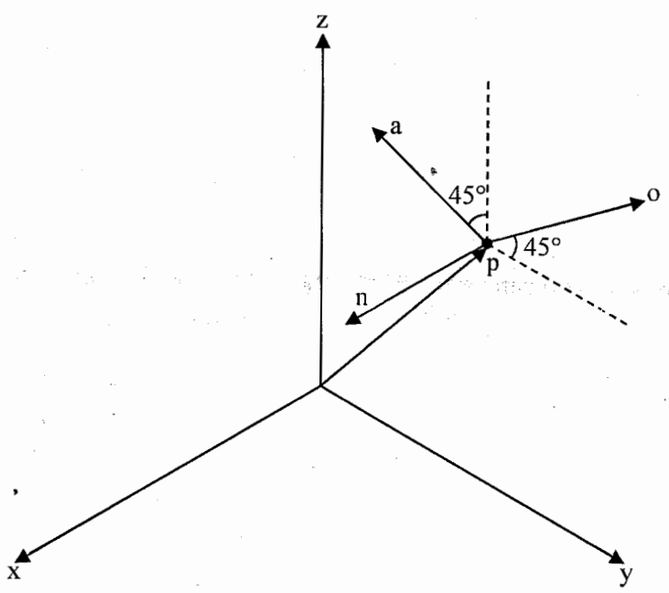
N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.

SECTION A

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

1. a) "Robotics is the basic building block of 4IR" – Justify this statement with necessary example. (10)
   b) Briefly explain the application of machine learning and AI in robotics. (08)
   c) What are the differences between robots and industrial automation? Why robot is becoming preferable than human worker day by day? (10)
   d) Write short note on the uses of robots in different country. (07)

2. a) How do you represent a frame relative to a fixed universal frame? Let, a frame in the following figure is located at 3, 5, 7 units with its n-axis parallel to x, its o-axis at 45° relative to the y-axis and its a-axis at 45° relative to the z-axis. Describe the frame. (12)



   b) Draw a 5 DOF robot manipulator. Denote its major components and briefly explain the singularity with Jacobian. (12)
   c) Draw a link-frame arrangement and denote D-H parameters. Briefly explain the physical meaning of the matrices generated from the D-H parameters. (11)

3. a) Draw a wrist joint to mimic human wrist. Draw the link-frame arrangements on it and find the D-H parameters. Find the position and orientation of end-effector with respect to base. (17)
   b) Why is inverse kinematics more important in robotics? Find the joint angles of RR manipulator from the given end-effector position. (18)

4. a) Derive the linear and angular velocity propagation equations from link $\{i\}$ to link $\{i+1\}$ with necessary sketch. (12)
   b) Calculate the velocity of the end-effector of a RR manipulator as a function of joint rates. Compute the Jacobian matrix and find the point of singularities. (17)
   c) Draw the following robot manipulators: (06)
      (i) SCARA Robot.
      (ii) Cartesian Robot.

SECTION B

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

5. a) Describe with proper illustration how a binocular stereo system calculates the depth of an object. (10)
   b) "Blending time can be bigger than half of the total trajectory time" – do you agree? Why or why not? (10)
   c) Let a point-robot intends to go from START-point to END-point within an environment containing obstacles. How ROADMAP can help in this regard? Also, find the path in the ROADMAP. Illustrate with proper example. (10)
   d) What are the differences between work space and task space? (05)

6. a) Suppose a robot (6-axis) go from an initial angle of 30° to a final angle of 75° in 5 seconds with its first joint. Assume maximum acceleration and deceleration are $5°/sec^2$. Using fifth-order polynomial calculate the joint angle at 1, 2, 3, and 4 seconds along with their corresponding velocity. Is it feasible to follow the path? Why or why not? (15)
   b) Describe the robot navigation problem. (06)
   c) Differentiate between open-loop controller and close-loop controller. (06)
   d) What are the problems of on-off controller? How those problems can be resolved? (08)

7. a) What are the design challenges of a wheeled mobile robot and a humanoid robot? Explain their special features and components. (15)
   b) A farmer robot with vision system is used for tomato pickup. Write the steps to execute the job. (13)
   c) How can you construct ROADMAP for a non-print robot? (07)

8. a) A semi-autonomous wheelchair for use by a blind user is to be designed where a force-feedback joystick helps the user in navigating the wheelchair. Sensors measure the distance and velocity. The controller provides resistive force feedback to the joystick. Design the fuzzy control system for the wheelchair. (Input: Distance, Velocity; Output: Resistance). N.B. For illustration purpose, you can assume any imaginary values/ functions/ methods/ rules. (17)
   b) "If a trajectory consists of more than two points, by applying the third-order polynomial, the positions and velocities are continuous but accelerations are not" – do you agree with the statement? Provide necessary justification. (12)
   c) Figure out the problems regarding cartesian space trajectory. (06)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 4th Year 2nd Term Examination, 2022
Department of Computer Science and Engineering
CSE 4239
Data Mining

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) Construct a decision tree for the data shown in the following table using ID3 algorithm. Also, explain how overfitting can be avoided in a decision tree. (20) [CO3]

Outlook	Temperature	Humidity	Windy	Play Golf
Rainy	Hot	High	False	No
Rainy	Hot	High	True	No
Overcast	Hot	High	False	Yes
Sunny	Mild	High	False	Yes
Sunny	Cool	Normal	False	Yes
Sunny	Cool	Normal	True	No
Overcast	Cool	Normal	True	Yes
Rainy	Mild	High	False	No
Rainy	Cool	Normal	False	Yes
Sunny	Mild	Normal	False	Yes
Rainy	Mild	Normal	True	Yes
Overcast	Mild	High	True	Yes
Overcast	Hot	Normal	False	Yes
Sunny	Mild	High	True	No

b) Why Naïve Bayes Classifier is called naïve? Based on the data shown in the above table decide, whether to Play Golf or not if Outlook = Sunny, Temperature = Cool, Humidity = High, and Windy = True. Use Naïve Bayes for decision making. (15) [CO3]

2. a) Consider some points: (1, 2), (2, 1), (3, 5), (4, 4), (5, 2), (5, 5), and (6, 3). Construct a K-D tree using these points and also find three nearest neighbours to the query point (4.5, 2.5). (13) [CO2]
b) Explain how Ball tree construction works with a suitable example. Also, do a comparative analysis between K-D tree and Ball tree. (10) [CO1]
c) Estimate a regression line for the data shown in following table: (12) [CO3]

Hours Studied	2	9	5	5	3	7	1	8	6	2
Grade on Exam	69	98	82	77	71	84	55	94	84	64

3. a) Suppose, your computer is full of duplicate images with different names. Explain how Convolutional Neural Networks can be utilized to find duplicate/ near duplicate images. (05) [CO3]
b) Perform a comparative analysis of the following: (i) Batch gradient descent, (ii) Stochastic gradient descent, (iii) Momentum, (iv) Nesterov accelerated gradient, and (v) Adam. (13) [CO2]
c) Apply agglomerative hierarchical clustering to the data shown in following table to segment the students into different groups based on obtained marks. (09) [CO3]

Student_ID	1	2	3	4	5
Marks	10	7	35	20	28

d) Why dimensionality reduction is important for clustering? How can a neural network be utilized to perform dimensionality reduction? (08) [CO1]

4. a) Calculate the first and second principal components as a measure of dimensionality reduction for the data shown in following table. (16) [CO2]

Attribute_1	126	128	128	130	130	132
Attribute_2	78	80	82	82	84	86

b) Why Mahalanobis distance is preferred over Euclidian distance for multivariate data? (13) [CO3]
Calculate Mahalanobis distance of the point (4, 5) from the following dataset.

X	2	4	6
Y	3	5	7

c) Explain how neural networks can be utilized for anomaly detection. (06) [CO1]

SECTION B

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

5. a) Describe data mining. Differentiate between database processing and data mining processing. (10) [CO2]
   b) Give an example of what is not data mining. Find out the IQR and outliers and plot histogram from the dataset: 2, 7, 4, 5, 2, 4, 2, 9, 7, 7, 9, 7. (15) [CO3]
   c) "Histogram often tell more than boxplots" – explain it with example. (10) [CO1]

6. a) Why is data visualization important? (05) [CO1]
   b) Why FP-tree is complete and compacted in relevance to frequent pattern mining? (08) [CO2]
   c) Consider the following example from a supermarket transactions database: (15) [CO3]

	Rice	**Not Rice**	**Total**
Lentils	700	120	820
Not Lentils	50	330	380
Total	750	450	1200

Find out the support, confidence value for the association rule Rice → Lentils and discuss the correlation relationship between Rice and Lentils whether they are substitute or complementary to one another.

   d) Explain frequent itemsets using Vertical Data Format with example. (07) [CO1]

7. a) "Data mining works with warehouse data" – explain it with example. (10) [CO2]
   b) What do you mean by Minkowski distance? Explain its properties. Calculate a dissimilarity matrix from the given data matrix using Manhattan distance calculation. (10) [CO3]

Data Matrix

Point	**Attribute1**	**Attribute2**
x_1	5	3
x_2	2	4
x_3	6	0
x_4	2	5

   c) Explain the drawbacks of Apriori algorithm. Consider the transaction database shown in following table and generate C_2 using Hashing based technique. Let, min_sup = 2. (15) [CO3]

TID	**Items**
10	Tea, Coffee, Juice, Sugar
20	Tea, Coffee, Sugar
30	Tea, Milk, Salt
40	Tea, Sugar, Milk
50	Coffee, Sugar, Milk

8. a) Build conditional pattern bases for 'p' and 'm' from the given database. (13) [CO3]

TID	**Items Bought**
1	{f, c, a, d, g, i, m, p}
2	{a, b, c, f, l, m, o}
3	{b, c, k, s, p}
4	{a, f, c, e, l, p, m, n}
5	{b, f, h, j, o}

   b) Describe a multi-tiered architecture of data warehouse. Draw a snowflake schema diagram using the given dimensions: Time, Item, Location, Branch, Supplier. (10) [CO2]
   c) "Strong associative rules are not necessarily interesting" – why? What is the cure? (12) [CO1]

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 4th Year 2nd Term Examination, 2022
Department of Computer Science and Engineering
CSE 4241
Biomedical Engineering

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.
iii) The rightmost column indicates course outcomes.

SECTION A

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

1. a) What is bioinformatics? What kind of biological problems are dealt with bioinformatics? (08) [CO1]
   b) What is sequence Motifs and PROSITE? Write down the steps to find the motif on the PROSITE. (12) [CO1]
   c) Calculate the BLOSUM Scoring Matrix using the following sequence block. (15) [CO2]
   Seq 1: ATAC
   Seq 2: ATAG
   Seq 3: ATTC
   Seq 4: TGAT
   Seq 5: ATAA

2. a) What is homolog? What are the differences between ortholog and paralog? (06) [CO1]
   b) What is the dot plot method and where is it useful? (06) [CO2]
   c) Explain the dynamic programming algorithm. Write down the differences between global dynamic programming algorithm (Needleman-Wunsch algorithm) and local dynamic programming algorithm (Smith-Waterman algorithm). (13) [CO1]
   d) What is multiple sequence alignment? How many pairwise alignments would be performed to get a multiple sequence alignment of 4 sequences? Justify your answer with example. (10) [CO2]

3. a) Apply Neighbor Joining method to create phylogenetic tree using following distance matrix. (20) [CO2]

	A	B	C
B	.17		
C	.59	.60	
D	.59	.59	.13

   b) Classify different types of databases that are used in bioinformatics. What are the pitfalls of biological database? (08) [CO1]
   c) Write the working principle of FASTA. Make a relationship between FASTA and BLAST. (07) [CO1]

4. a) What is protein-protein interaction? (05) [CO2]
   b) Explain the Chou-Fasman method of protein secondary structure prediction. (10) [CO1]
   c) Explain physiological effect of electricity on human body. (10) [CO4]
   d) "Proper Grounding system can protect patient from both micro and macro shocks."— justify the statement. (10) [CO4]

SECTION B

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

5. a) Define Biomedical Engineering. Explain the working principle of a generalized medical instrumentation system using suitable block diagram. (10) [CO2]
   b) What are the main differences between resting and action potential? Briefly explain the mechanism behind the generation of resting potential in a living cell. (11) [CO1]
   c) Draw and explain the electrical equivalent circuit of a small length unmyelinated nerve fiber. (07) [CO2]
   d) What should be the preferable features of bipotential amplifier? —Justify your answer. (07) [CO2]

6. a) Explain the significance of Alpha rhythm of EEG in brief. (06) [CO1]
   b) What is ERG? Show the effects of varying light stimulus on ERG. (06) [CO1]
   c) Design a microcontroller based myoelectric hand prosthesis to write English alphabets related to $+90^o$, 0^o, -90^o rotations. Explain your design strategy using suitable block diagrams. (Details circuit diagrams are not necessary) (12) [CO4]
   d) Describe the working principle of biosensor in brief. Also, mention the typical sensing techniques for biosensors. (11) [CO3]

7. a) Describe the importance of using computers in patient monitoring system of ICU. Draw the block diagram of a computer based patient monitoring system. (10) [CO4]
   b) Explain the basic physics and image acquisition principle of magnetic resonance imaging (MRI). (12) [CO4]
   c) Define PACS and DICOM. Why are they needed? (05) [CO1]
   d) Write short notes on the standards HL-7 and Medical Information Bus – IEEE 1073. (08) [CO1]

8. a) What do you mean by eHealth? Write down the scopes, trends, and challenges of eHealth systems. (14) [CO1]
   b) What is meant by BCI? Explain a general BCI model using suitable diagram. (10) [CO4]
   c) Write down the benefits of smart hospitals. Draw and explain a typical IoT architecture targeting healthcare applications. (11) [CO1]