KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 4th Year 2nd Term Examination, 2021
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 right margin indicate full marks.

SECTION A

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

1. a) What are the differences between Natural Language Processing (NLP) and Text Mining? Explain. (06)
   b) What is Lemmatization and Stemming? Discuss one popular Lemmatization and Stemming algorithm with example. (10)
   c) Develop the regular expression to find all the instances of the word "there" in a text. (07)
   d) You have two strings X of length n and Y of length m. Develop an algorithm to edit the string X to Y. How many operations you need? Explain your algorithm for X = "KITTEN" and Y = "SITTIN". (12)

2. a) Define N-gram language model. How can you compute the probability of a sentence of n words P(w), $w = w_1 w_2 \ldots w_n$. How can you calculate maximum likelihood by bigram probabilities? (10)
   b) Consider the following corpus. (15)

<S> I Like Henry </S>
<S> I Like College </S>
<S> Do Henry Like College </S>
<S> Henry I am </S>
<S> Do I Like Henry </S>
<S> Do I Like College</S>

What is the most probable next word
   i) "<S> Do —" applying bigram probability model?
   ii) "<S> Do I Like —" applying bigram probability model?
   iii) "<S> Do I Like —" applying trigram probability model?

   c) Define smoothing. How can you smooth the language model by interpolation? How to choose the value of 'λ' to maximize the probability? (10)

3. a) What is Bag of words representation? How do you apply Bag of words assumption and conditional independence for naïve bayes classifier? Explain. (12)
   b) Consider the following Training dataset. (08)

item	class
Just plains boring	–
Entirely Predictable and lacks energy	–
No surprises and very few laughs	–
Very powerful	+
The most fun film of the summer	+

Find the class of the following sentence "Predictable with no fun", using naïve bayes classifier.
   c) How can you apply noisy channel for real world spelling correction? (10)
   d) "Accuracy is not a good metric when the goal is to discover something rare" –justify the statement. (05)

4. a) What are the common structural ambiguities for any NLP task? Give example(s). (08)
   b) Consider the following grammar G (13)

$S \rightarrow NP\ VP$
$NP \rightarrow Det\ N$
$VP \rightarrow V\ NP$
$V \rightarrow includes$
Det → the | a
$N \rightarrow meal \mid flight$

Is the string "The flight includes a meal." in L(G)? Answer it using CYK algorithm.

c) Define PCFG. What is the condition to be maintained by a PCFG? How can you disambiguate the parsing using PCFG? (09)

d) What are the applications of shallow parsing? (05)

SECTION B

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

5. a) What is closed class and open class of parts of speech? Explain with example. (08)

   b) Give a short description of Viterbi algorithm. What are the applications of the algorithm? (07)

   c) Use the following table to answer the following questions. (20)

We have a dataset (NextD). Some information about the dataset is given below.	
No. of VB: 10756	Starting probability VB: 0.44417
No. of MD: 19375	Starting probability MD: 0.7836
No. of NN: 14479	Starting probability NN: 0.25762
$(t_{i-1} - t_i)$	
VB–MD: 9544	VB–race: 6272
VB–NN: 9385	VB–will: 8977
MD–VB: 9918	VB–begin: 5569
MD–NN: 9590	MD–race: 6891
NN–VB: 9065	MD–will: 6301
NN–MD: 9754	MD–begin: 4857
VB–VB: 0	NN–race: 4910
NN–NN: 0	NN–will: 4012
MD–MD: 0	NN–begin: 4617

   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 Viterbi algorithm.

6. a) Define Named Entity Recognition. Why recognizing name entity is difficult? (07)

   b) Discuss conditional random fields (CRF). Write down the features in a CRF PoS tagger. (08)

   c) Discuss the IR-based Factoid Question Answering system with proper diagram(s). (10)

   d) Define knowledge-based question answering. Discuss four broad stages of Watson QA with block diagram(s). (10)

7. a) Write down classes of algorithms for relation extraction. Describe Relation Extraction via Supervised Learning and Feature-based supervised relation classifiers. (10)

   b) Write down three ways to extract Times and temporal Expression. Explain with examples. (08)

   c) Discuss the encoder-decoder model for machine translation with proper figures. (10)

   d) Define entity linking. Discuss neural graph-based linking with proper diagram(s). (07)

8. a) Discuss the information Retrieval question-answering system. Explain with examples. (08)

   b) Consider the following data: (12)

Query	:	Sweet love
Doc 1	:	Sweet sweet nurse! Love?
Doc 2	:	Sweet sorrow
Doc 3	:	How sweet is love?
Doc 4	:	Nurse!

   Using Term Weighting and document scoring, Rank the document for query.

   c) What is Homograph disambiguation? What are the problems of CMU? How does UNISYN overcome the problems of CMU? (07)

   d) Speech synthesis performs text-to-waveform mapping in two steps. Name and discuss the steps using Hourglass metaphor. (08)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 4th Year 2nd Term Examination, 2021
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.
ii) Figures in the right margin indicate full marks.

SECTION A

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

1. a) "A counter is a special purpose register" – justify the statement with proofs. (10)
   b) Demonstrate the basic principle of static and dynamic semiconductor RAMs. (12)
   c) Design a Mod-6 counter with necessary figures. How it can be converted into a simple Buffer register? Explain with logic. (13)

2. a) Explain SAP-I architecture with block diagram and state the specific operations of each block. (15)
   b) Write an SAP-I program to solve the following arithmetic problem. (20)

   $$16 + 20 + 24 - 32$$

   The numbers are in decimal form. Now state the Fetch and Execute cycle for each instruction.

3. a) Classify the micro-operations in digital system. (08)
   b) Solve the following binary arithmetic operations: (12)

   $$\begin{array}{rrr} & \underline{1} & 011101 \\ (+) & \underline{1} & 011000 \end{array}$$

   Here, underlined bits are signed bit and the maximum length of the registers are 7 bit. Do you think there can arise any problem? If so, how the problem can be solved? Please explain.
   c) Show the memory representation of the following instructions: (09)
   (i) $A \leftarrow R$, (ii) $A \leftarrow Operand$, (iii) $A \leftarrow M[Address]$
   d) Design the hardware implementation for the following statements. Assume that registers are 8 bit in length. (06)

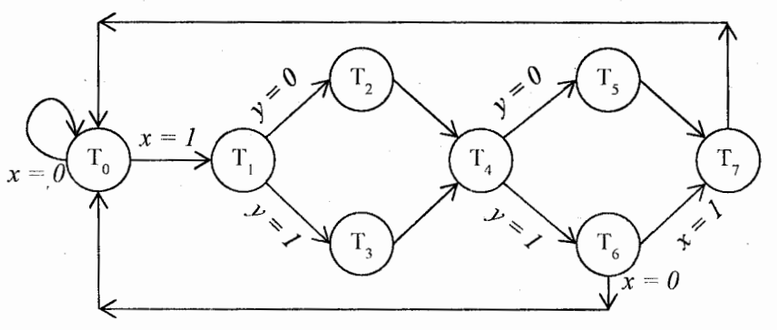
   $T_1: C \leftarrow A$
   $T_2: C \leftarrow B$

4. a) How can you improve the performance of a processor unit that employs a strachpad memory? Explain with figures. (12)
   b) Explain the working principle of register transfers using bus organization. (15)
   c) What is an FPGA? Briefly explain some features of it for digital system design. (08)

SECTION B

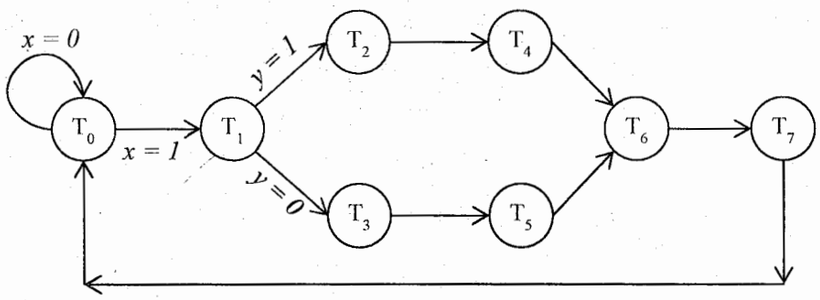
(Answer **ANY THREE** questions from this section in Script B)

5. a) Write down the purposes of control logic in any digital system. What are the significant properties of a control logic circuit? (07)
   b) A control unit has two inputs x and y, and eight states shown in the following figure. (14)



Design the control unit using sequence register and decoder method. Use *T*, *JK*, and *RS* Flip-Flops for *G*3, *G*2, and *G*1 registers, respectively.

c) When PLA is suitable to consider for control logic design? Design the control unit using a PLA and other required elements for the following state diagram. (14)



6. a) Draw block diagram of a typical micro-programmed control and briefly explain purpose of its parts. (07)

b) Register-transfer operations with a 2-bit sequence register G are: (14)

$$x'T_0: G \leftarrow 00;\ xT_0: G \leftarrow 01;\ y(T_1 + T_2): G \leftarrow G + 1;$$
$$y'(T_2 + T_3): G \leftarrow G - 1;\ yT_3: G \leftarrow 00$$

Draw the state diagram and design the control system with T Flip-Flop and decoder. Draw the logic diagram again replacing T Flip-Flops with JK Flip-Flops with necessary additional connections.

c) Design the control unit using micro-program for the following operations where n varies from 0 to 3 and values in G register indicate the states. (14)

$$x'T_n: G \leftarrow G - 1;\ xT_n: G \leftarrow G + 1;\ yT_n: G \leftarrow 00$$

7. a) What do you mean by reengineering and reverse engineering? Briefly mention different aspects of both. (07)

b) Consider a control logic with two D Flip-Flops and 2×4 decoder. The inputs of the D Flip-Flops are (14)

$$TD_1 = xT_0 + yT_1 + xyT_2 + xy'T_3$$
$$TD_2 = T_1 + xT_2 + xT_3$$

Here x and y are inputs of the system; and T_0, T_1, T_2 and T_3 are the states of system. Draw the state diagram of the system. Resign the system with T Flip-Flops.

c) Mention purposes of different registers in studied small-scale digital computer. (07)

d) Explain uses of timing variables in the studied digital computer to perform AND operation between a value in memory and value in accumulator register. Mention operations in each timing step of Fetch and Execute cycles. (07)

8. a) What are the different types of instruction in a digital computer? Briefly describe significances of each type of instruction. (07)

b) Draw pictorial view of the microprogram control unit of studied computer for the microoperation in the following general form. (14)

$$CAR \leftarrow 2^2B(OP) + 3$$

Here, CAR is Control Address Register and $B(OP)$ is the operation code from B register. Also explain how the formula defines location of different operations in the ROM of the microprogram.

c) An instruction in address $(0AB)_{16}$ in the computer has the operation-code of ADD instruction and an address Port $(0CD)_{16}$. The memory word of address $(0CD)_{16}$ contains $(ABCD)_{16}$. Register A contains $(0101)_{16}$. Tabulate the contents of register PC, MAR, B, A, and I after the instruction is executed. Repeat the problem two more times for operations AND and STO. (07)

d) Why several ROM addresses are unusual in micro-program control in the studied system? What will happen if program reach such a location due to malfunction? (07)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 4th Year 2nd Term Examination, 2021
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.

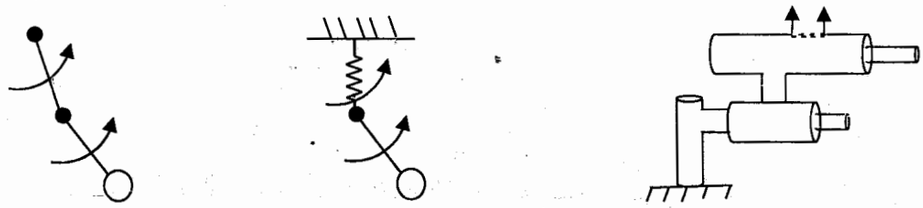
SECTION A

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

1. a) Define robot. Briefly describe the historical evolution of robots and its market share based on countries. (12)
   b) Write short notes on: (i) Manipulator, and (ii) Mobile Robot. (09)
   c) As a CSE engineer, which kinds of robots you will expect to bring in market? Explain its features and components and justify your decision. (14)

2. a) Why frame to frame transformation is important in Robotics? Derive the transformation matrix for mapping involving general frames. (13)
   b) Assume, frame {M} is the universal coordinate frame. Frame {N} is translated 25 unit in $\hat{X}_M$ and 32 unit in $\hat{Y}_M$ directions. Additionally, frame {N} is rotated relative to frame {M} about $\hat{Z}_M$ by 60^0. Draw the frames and find M_P, where $N_P = [12 \quad 18 \quad 0]^T$. (10)
   c) A surgical robot should have good accuracy and precision in its smooth motion. Which actuator should be used to ensure those features with a good feedback? Explain its working principle. (12)

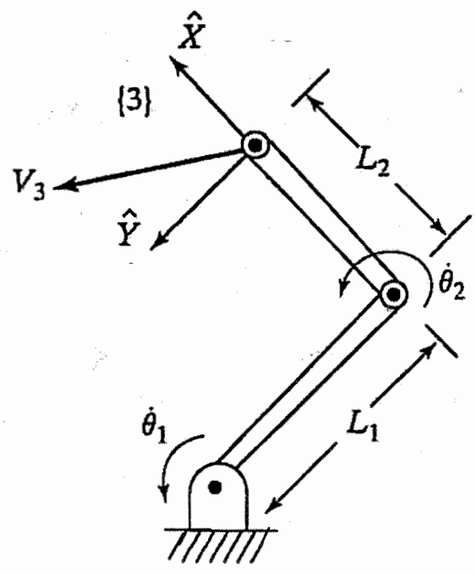
3. a) Define Degree of Freedom (DoF). Write the DoF of the following figures. (05)



(i) (ii) (iii)

   b) Explain Denavit-Hartenberg notation. (05)
   c) Draw a link-frame arrangement and denote the D-H parameters. Briefly explain the physical meaning of the matrices generated from the D-H parameters. (12)
   d) Find the two joint angles of a 2DoF planner manipulator by using given end effector position and orientation. (13)

4. a) Write short notes on 'Jacobians' and 'Singularities' in robotics, and mention their relationship. (10)
   b) A two-link manipulator with revolute joints is shown in following figure. Calculate the velocity of the tip of the arm as a function of joint rates. Find the velocity in terms of frame {3} and frame {0}. (15)



   c) Derive the Jacobian matrix of the manipulator in question 4(b), and compute the points of singularity. (10)

SECTION B

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

5. a) Analyze the application of sensors in industrial robots and medical robots with the explanation of sensor characteristics. (15)
   b) Find the epipoles e and e' when two image planes are parallel in a binocular stereo system. (05)
   c) Develop the working steps of an autonomous system. In which steps do sensor fusion happen? How does sensor fusion help the system? (15)

6. a) What are the purpose of control system in robots? Explain feed-forward and feedback control for robotic system. (10)
   b) Let you design a fuzzy-controlled line follower robot. Design a Mamdani-style fuzzy logic controller for the robot. (15)
   c) Design a trajectory following robot control system with block diagram. (10)

7. a) Derive equation of robot trajectory by using cubic polynomial method. A revolute joint of a robot manipulator is motionless at $\theta = 25^0$. It is desired to move the joint in a smooth manner to $\theta = 95^0$ in 5 sec. Find the equation of position, velocity and acceleration of the joint as a function of time. (15)
   b) Describe and differentiate the trajectory planning approaches in the cartesian and joint space. (10)
   c) What is the hierarchy of motion planning of a robot? Why trajectory planning is important for robot manipulator? (10)

8. a) Write short notes on: (i) Work space, (ii) Task space, and (iii) C-space. (06)
   b) How to construct ROADMAP for a non-point robot? (07)
   c) Develop the position equation of a differential-drive robot. (10)
   d) Differentiate between an obstacle and a c-obstacle. (04)
   e) "C-obstacle of A and robot B equals $A \oplus (-B)$" –justify the statement. (08)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 4th Year 2nd Term Examination, 2021
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 right margin indicate full marks.
iii) Necessary table/graphs/charts (if any): χ^2-table.

SECTION A

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

1. a) "Data mining is also known as knowledge discovery from data." –justify the statement. (10)
   b) Show some examples of data origin that are highly complex. (10)
   c) Why do you need data normalization? Consider the following dataset, which attribute you will normalize and why? Then, do it (using the *z*-score normalization). (15)

Person name	Salary	Year of experience	Expected position level
Abdullah	100000	10	2
Abu bakar	78000	7	4
Siam	32000	5	8
Bijoy	55000	6	7
Aman	92000	8	3

2. a) Discuss the strength and weakness of *k*-means algorithm. (10)
   b) What are the differences between noisy data and outlier? (07)
   c) There are 100 people who attended a training course were asked to rate their satisfaction with the economy as very dissatisfied, dissatisfied, neutral, satisfied and very satisfied. Determine whether their level of satisfaction is independent of their political party (A, B) based on the contingency table shown in following. [Use degree of freedom 0.001] (18)

	very dissatisfied	dissatisfied	neutral	satisfied	very satisfied
A	6	9	10	15	7
B	4	6	15	25	3

3. a) Write down five real life examples of clustering. What are the challenges and requirements have to follow during cluster analyses? (10)
   b) Define classification accuracy. How does *k*-fold cross validation estimate classification accuracy? Explain. (09)
   c) Apply the BIRCH algorithm on the following dataset to form cluster. (16)
   Dataset: (3, 4), (2, 6), (4, 7), (3, 8), (4, 5), (6, 2), (8, 4), (7, 4), (7, 2), and (7, 9).
   Describe the weakness of this algorithm.

4. a) How does a bank detect a transaction of outlier? (05)
   b) Explain the limitations of histogram-based outlier detection with an example. (10)
   c) Check the data object (66, 570, 33) is an outlier or not in the following multivariate dataset. (20)
   [Use Mahalanobis distance]

Height	Score	Age
64	580	29
66	570	33
68	590	37
69	660	46
73	600	55

SECTION B

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

5. a) How does a data warehouse differ from a database? How are they similar? (11)
   b) What do you mean by outliers? Given, Data = 8, 5, 2, 4, 8, 9, 5. Find out IQR, outliers of the dataset and draw the boxplot for the dataset. (15)
   c) Explain symmetric and skewed data using necessary figures. (09)

6. a) Consider the following table containing attributes of binary type and show the similarity between them. (11)

Name	Cough	Fever	Test-1	Test-2	Test-3	Test-4	Test-5
Marry	N	Y	P	N	N	P	N
Jerin	N	Y	P	N	P	P	N
John	P	Y	N	N	N	N	P

b) Discuss each of the following with examples: (12)
(i) Drill up, (ii) Pivot, (iii) Closed patterns, and (iv) Dice.

c) Explain how Hashing Based Technique improves Apriori algorithm by considering the transaction database in the following table. Let, min-sup = 2. (12)

Transaction ID	Items
10	Aspirin, Cepacol, Sudafed, Vitc
15	Aspirin, Cepacol, Sudafed
20	Aspirin, Panadol, Tylenol
25	Aspirin, Sudafed, Tylenol
30	Cepacol, Sudafed, Tylenol

7. a) "Support Vector Machine is a method of classification for both linear and nonlinear data" –explain with example(s). (08)

b) What do you mean by closed frequent pattern? (03)

c) A database has six transactions described in the following table. Let, min-sup = 60% and min-conf = 80%. (17)

TID	Item Bought
T_{1000}	M, O, N, K, E, Y
T_{2000}	D, N, K, E, Y
T_{3000}	M, O, N, K, E, Y, L
T_{4000}	M, U, C, K, O
T_{5000}	C, O, O, K, E, S
T_{6000}	M, A, K, E

Now, perform the followings:
i) Find the frequent itemset using the apriori principle.
ii) List all the strong association rules.

d) Discuss the bottlenecks of Apriori algorithm. Differentiate between parallel projection and partition projection techniques. (07)

8. a) Explain multi-tiered architecture of data warehouse. (10)

b) Suppose that a data warehouse consists of the four dimensions: year, spectator, address, game and two measures: count and charge; where charge is the fare that a spectator pays when watching a game. Now, perform the followings: (10)
i) Draw a star schema diagram for the data warehouse.
ii) Starting with the base cuboid [year, spectator, address, game], what specific OLAP operations should you perform to list the total charge paid by spectators at GM-place in 2021?

c) Consider the following table and determine the 'Eat' of the tuple (Test = Spicy, Temperature = Cold, Texture = Soft) using Naïve Bayesian classification, where 'Eat' attribute represents the class level. (10)

	Taste	Temperature	Texture	Eat
0	Salty	Hot	Soft	No
1	Spicy	Hot	Soft	No
2	Spicy	Hot	Hard	Yes
3	Spicy	Cold	Hard	No
4	Spicy	Hot	Hard	Yes
5	Sweet	Cold	Soft	Yes
6	Salty	Cold	Soft	No
7	Sweet	Hot	Soft	Yes
8	Spicy	Cold	Soft	Yes
9	Salty	Hot	Hard	Yes

d) "Any subset of a frequent itemset must be frequent." –explain with example. (05)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 4th Year 2nd Term Examination, 2021
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.

SECTION A

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

1. a) What is healthcare informatics? Make a relationship between bio-informatics and healthcare informatics. (09)
   b) Classify different types of databases that are used in biomedical Engineering? Explain with example(s). (09)
   c) What are the differences between molecular and system biology? (08)
   d) Write short notes on: (i) Genomes, (ii) Proteomics, and (iii) Amino Acid. (09)

2. a) Define sequence alignment and variation. Describe substitution, insertions and deletions with example(s). (08)
   b) Consider the following two sequences: (12)

      ACTAAGGTATGCT
      ACGCTATGGT

      Apply BLAST to compute the alignment.
   c) Write the working principle of FASTA. Make a relationship between FASTA and BLAST. (09)
   d) What is dot plot and what is it useful for? (06)

3. a) What is protein? "Protein act as messenger" –Justify the statement with example. (08)
   b) What is sequence motif and PROSITE? Write down the steps to find the motif on PROSITE. (11)
   c) Define multiple sequence alignment and phylogenetic tree. How to generate phylogenetic tree? (09)
   d) Explain Electron Microscopy (EM) and Nuclear Magnetic Resonance (NMR). (07)

4. a) Define the term propensity value. What are the steps of Chou Fasman method to predict protein secondary structure? (12)
   b) Define the term homolog. What are the differences between ortholog and paralog? (08)
   c) Consider the following two sequences: (10)

      GAATTCAGTTA
      GGATCGA

      Apply global sequence alignment for aligning two sequences.
   d) What are the differences between global and local sequence alignment? (05)

SECTION B

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

5. a) "Biomedical engineering is an interdisciplinary field" –Justify the statement explaining the scopes from engineering side. (07)
   b) What factors are needed to be considered in designing medical instruments? Briefly describe the design process of typical medical instruments. (09)
   c) Distinguish between action and resting biopotentials. Explain the propagation process of action potential through unmyelinated and myelinated nerve fiber using necessary diagrams. (11)
   d) Illustrate how the action potentials are varied among motorneuron, muscle, and cardiac cells. Calculate the resting potential at body temperature (37^0C) considering the following data: (08)

Ions	Permeability (cm/s)	Intracellular concentration (milimoles/litre)	Extracellular concentrations (milimoles/litre)
Na^+	2×10^{-8}	20	160
K^+	2×10^{-6}	180	10
Cl^-	2×10^{-6}	10	120

6. a) Compare different biosignals interms of their originating location, voltage, and frequency ranges. (06)
   b) Mention the electrophysiological happenings in a cardiac cycle drawing the ECG waveform. Briefly explain the block diagram of a modern electrocardiograph system. (12)
   c) Discuss on the noises and artifacts available in biomedical signals. (09)
   d) What is the necessity of defibrillation? Explain the working of capacitive discharge type defibrillator using necessary diagrams. (08)

7. a) Define biosensor. What are the different components of biosensor? Explain in brief. (10)
   b) What types of services are demanded from integrated clinical work stations? What should be the characteristics of medical records of evolving clinical work stations. (10)
   c) What are meant by PACS and DICOM? Why are they needed? (05)
   d) Describe the importance of using computers in patient monitoring system of ICU. Draw the block diagram of a computer based patient monitoring system. (10)

8. a) Briefly explain the basics of X-ray production and X-ray imaging. (10)
   b) Write short notes on: (i) e-Health, and (ii) Brain Computer Interface (BCI). (12)
   c) Draw the procedural flow chart of a computer aided diagnosis system from mammogram images. (07)
   d) What is IoMT? Write down the challenges of IOT in healthcare. (06)