KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 4th Year 2nd Term Examination, 2018
Department of Computer Science and Engineering
CSE 4207
Computer Graphics

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 computer graphics deal with? Mention some prominent applications of it. (06)
   b) Explain the geometry stage of graphics rendering pipeline with necessary illustration. (12)
   c) Find a transformation matrix that aligns line $L_1$, with line $L_2$ given by the following equations: (17)

$$L_1 = \begin{cases} \bar{v} = 2I - 3J + 4K \\ P_0 = (1, 1, 0) \end{cases}$$

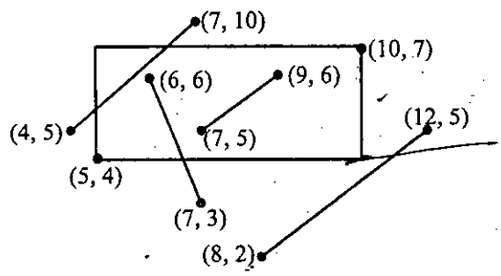
$$L_2 = \begin{cases} x = 1 + 3t \\ y = 4t \quad 0 \le t \le 1 \\ z = 2 - 5t \end{cases}$$

2. a) Derive a transformation matrix to convert an asymmetric view frustum to a Canonical View Volume (CVV). (15)
   b) What is projection? Find a parallel projection of the point (7, 8, 9) with DOP, $\bar{v} = I + 2J + K$ onto a projection plane parallel to $xy$ plane and cuts $z$-axis at a distance of 1. (10)
   c) What are the parameter needed to define a View-Coordinate System (VCS)? How can a world coordinate point be converted to VCS point? (10)

3. a) Let a VCS point $p(3, 2, 6)$, projection reference point is at VCS origin, and a symmetric view volume is defined by the following parameters: (14)

$$left = right = 1,\ bottom = top = 0.8,\ near = 1,\ far = 7$$

   Find the Normalized Device Coordinate System (NDCS) value of the point $p$.
   b) Clip the lines presented in the following figure using Cohen-Sutherland algorithm. Also mention how CVV helps 3D clipping. (12)




   c) Show that the path of a ray transmitted through a surface is $t = z - \left(\sqrt{1 - |z|^2}\right).n$, where (09)

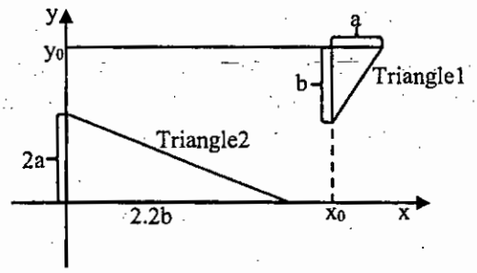
$z = \frac{\eta_1}{\eta_2}(u - (u.n))n$, $u$ is an incoming ray, $n$ is the surface normal, and $\eta_1, \eta_2$ are the refractive indices of the media.

4. a) "Phong shading is more realistic than Gouraud shading, but expensive"– Justify the statement. (12)
   b) Let a surface is illuminated by an RGB light source with light intensity (0.9, 1, 0.9), positioned at (5, 4, 2). A vertex (4, 1, 3), whose surface normal is (0, 2, –1), is viewed from (3, 2, 2). Find the intensity that the viewer will see at the vertex, if the surface diffuse and specular reflectively are (0.4, 0.3, 0.6) and (0.8, 0.8, 0.8) with shininess = 10. Consider there is no ambient light, and no attenuation of light. (15)
   c) Explain a method to find the intersection of an incoming ray with a sphere. (08)

## SECTION B

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

5. a) What are the raster and vector graphics? Write the differences between vector and raster graphics. (07)
   b) Convert these homogeneous points to Cartesian: (0, 1, 3, 2) and (2, 1, 3, 4). (07)
   c) Transform Triangle1 to Triange2 in the following figure by a sequence of basic transformations. Write the transformation matrices in 2D Homogeneous Coordinates. Compute the final transformation matrix. Note that the size of the triangle has also been changed; see the following figure for the dimensions. (14)




   d) Explain the difference between "Object Coordinates", "World Coordinates", and "Camera Coordinates". (07)

6. a) What are the three major efficiency ingredients in Bresenham's line drawing algorithm? (07)
   b) Consider the line from (0, 0) to (–8, –4), use general Bresenham's line algorithm to rasterize this line. Evaluate and tabulate all the steps involved. (12)
   c) Write down the difference between DDA line drawing algorithm and Bresenham's line drawing algorithm. (06)
   d) Explain the steps in Bresenham's circle drawing algorithm. (10)

7. a) How many real values are necessary to describe the shape of a cubic rational Beizer curve in three dimensional space? Provide a short justification for you answer. (06)
   b) Prove that $R(\theta_1).R(\theta_2) = R(\theta_1 + \theta_2)$, where $R()$ is a rotation function and $\theta_1, \theta_2$ are angle of rotation. (08)
   c) Define Hermite Surface. Find the geometry vector $G_{Hx}$ for Hermite Surface. Also find the first of the vecrtor. (10)
   d) Construct the Beizer curve of order 3 with 4 polygon vertices A(0, 1), B(3, 3), C (4, 5) and D (7, 5) (11)

8. a) What is fractals? What are the types of self-similarity? Explain with example(s). (08)
   b) Explain $z$-Buffer algorithm in details for visible surface detection. What are the advantages and disadvantages of $z$-Buffer algorithm? (13)
   c) What is continuity? Compare between $G^1$ and $C^1$ continuity. (06)
   d) What is Koch Curves? How is Koch curve generated? Explain with suitable example(s)? (08)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 4th Year 2nd Term Examination, 2018
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 is Disjunction, Grouping and Precedence for pattern matching in regular expressions? Explain with example. (10)
   b) "Pattern matching by regular expressions are greedy." – Justify the statement. (09)
   c) Design a regular expression to find all instances of the word "the" in a text. (10)
   d) Define types and tokens. How many types and tokens are there in the following sentence: (06)
   "They picnicked by the pool, then lay back on the grass and looked at the stars."

2. a) What is Lemmatization and Stemming? How is Lemmatization done? (08)
   b) What are the operations for editing one string to another? Explain. (06)
   c) Explain the algorithm to edit one string $X$ of length $n$ to a string $Y$ of length $m$. Show the steps of your algorithm for $X$ = INTENTION and $Y$ = EXECUTION. (12)
   d) Discuss about the problem with Maximum Likelihood. How does the Laplace (add-1) Smoothing solve the problem? (09)

3. a) "Accuracy is not a good metric when the goal is to discover something that is rare." – Justify the statement with example. Propose a metric to solve the drawbacks of accuracy. (10)
   b) Given the following short movie reviews, each labeled with a genere, either comedy or action: (10)
      i) fun, couple, love, love ⇒ comedy
      ii) fast, furious, shoot ⇒ action
      iii) couple, fly, fast, fun, fun ⇒ comedy
      iv) furious, shoot, shoot, fun ⇒ action
      v) fly, fast, shoot, love ⇒ action

   Consider a new document D: fast, couple, shoot, fly. Compute the most likely class for D.
   c) Find the context free rules and hence the Context Free Grammar (CFG) for the following English sentences: (15)
      i) I want a morning flight.
      ii) I want a flight from Ontario to Chicago.
      iii) Show me the cheapest fare that has lunch.
      iv) Do any of these flights have stops?
      v) Which flights serves breakfast?

4. a) Consider the following grammar in CNF. (10)

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

   Is '*baaba*' in L(G)? Explain your answer using CYK algorithm.
   b) Define shallow parsing. What are the applications of shallow parsing? (05)
   c) Define Probabilistic Context Free Grammar (PCFG). Consider the following PCFG. (12)

$$S \rightarrow NPVP \mid AuxNPVP \mid VP \; [0.8 \mid 0.1 \mid 0.1]$$
$$NP \rightarrow Pronoun \mid Proper\text{-}noun \mid DetNominal \; [0.2 \mid 0.2 \mid 0.6]$$
$$Nominal \rightarrow Noun \mid NominalNoun \mid NominalPP \; [0.3 \mid 0.2 \mid 0.5]$$
$$VP \rightarrow verb \mid verbNP \mid VPPP \; [0.2 \mid 0.5 \mid 0.3]$$
$$PP \rightarrow PrepNP \; [1.0]$$
$$Det \rightarrow the \mid a \mid that \mid this \; [0.6 \mid 0.2 \mid 0.1 \mid 0.1]$$
$$Noun \rightarrow book \mid flight \mid meal \mid money \; [0.1 \mid 0.5 \mid 0.2 \mid 0.2]$$
$$verb \rightarrow book \mid include \mid prefer \; [0.5 \mid 0.2 \mid 0.3]$$
$$Pronoun \rightarrow I \mid he \mid she \mid me \; [0.5 \mid 0.1 \mid 0.1 \mid 0.3]$$
$$Proper\text{-}noun \rightarrow Houston \mid NWA \; [0.8 \mid 0.2]$$
$$Prep \rightarrow from \mid to \mid on \mid near \mid through \; [0.25 \mid 0.25 \mid 0.1 \mid 0.2 \mid 0.2]$$

      i) Find the probability of the sentence "book the flight through Houston".
      ii) Using the disambiguation algorithm select the proper parse tree.
   d) What are the stages of IR based question answering? Explain. (08)

## SECTION B

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

5. a) Define Natural Language Processing (NLP). What are the major areas of research and development of NLP? (10)
   b) What does *n*-gram mean? Drive the equation of calculating the probability for *n*-grams model. (10)
   c) Consider the following corpus. (08)

<s> I am Sam </s>
<s> Sam I am </s>
<s> I am Sam </s>
<s> I do not like green eggs and Sam </s>

Using a Bigram Language model with add-one smoothing, what is $P(sam \mid am)$? Include <s> and </s> in your counts just like any other token.

   d) What is absolute discounting? What is its advantages? (07)

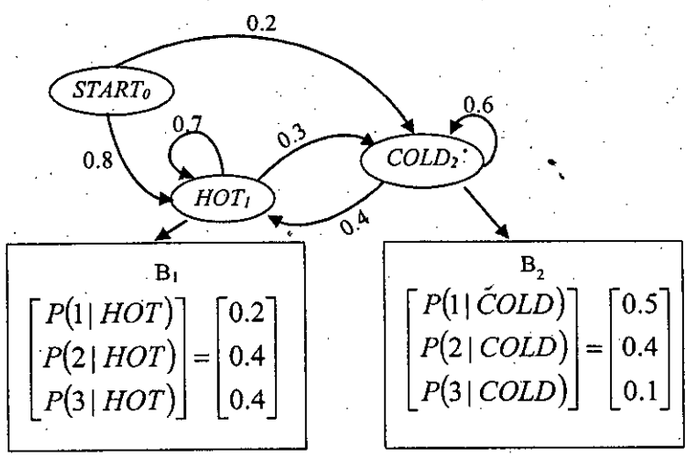
6. a) What is closed class and open class of Part-of-Speech (POS)? Explain with example. (08)
   b) Discuss about Rule-Based POS tagging. Write the ADVERBIAL-THAT RULE. (12)
   c) For Hidden Markov Model (HMM) POS Tagging, using the following formula, find the equation of calculating tag transition probabilities. (08)

$$\hat{t}_1^n = \arg\max_{t_1^n} P(t_1^n \mid w_1^n)$$

   d) Consider the sentence: "Secretariat/NNP is/BEZ expected/VBN to/TO race/? Tomorrow/NR". The word "race" is often used as VB or NN. Given the probabilities below, find the right POS tag for the word "race". (07)

$P(NN \mid TO) = 0.00047, P(VB \mid TO) = 0.83, P(race \mid NN) = 0.00057, P(race \mid VB) = 0.00012,$
$P(NN \mid VB) = 0.0027, P(NR \mid NN) = 0.0012.$

7. a) HMM characterized by three fundamental problems. Name and discuss about the problems. (09)
   b) Given a sequence of ice-cream observations 313 and an HMM $\lambda = (A, B)$ in the following figure, find the best hidden weather sequence $Q(like\ H\ H\ H)$. (12)




   c) Define the term odds for logistic regression. Show that the observation should be labeled true if $\sum_{i=0}^{N} w_i f_i > 0$. (09)
   d) Write the three-steps of Forward Algorithm. (05)

8. a) Name and discuss about the types of TTS. (06)
   b) Speech Synthesis perform text to waveform mapping in two-steps. Name and discuss about the steps. Using Hourglass Metaphor. (12)
   c) What is Homograph disambiguation? What are the problems of CMU? How does UNISYN overcome the problems of CMU? (10)
   d) Define text normalization. Why does text normalization important for Speech Synthesis? (07)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 4th Year 2nd Term Examination, 2018
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) "Flip-flops are the basic building blocks of register and counter." – Is it true? If yes, arrange flip-flops to develop register and counter. Write down the functional differences between register and counter. (12)
   b) Differentiate between serial loading and parallel loading. Why is ripple counter too slow for application? Explain. (12)
   c) What are the significant differences between ripple counters and synchronous counters? Design a BCD ripple counter with JK flip-flops. (11)

2. a) What is three state switch? Explain the operation of three state register with proper diagram. (12)
   b) Explain the operation of ROM with on-chip decoding. (08)
   c) Explain the operation of SAP–1 architecture with proper block diagram. (15)

3. a) Generate control word and draw timing diagram for LDA, ADD, SUB and OUT instructions in case of SAP–1 computer. (18)
   b) Write a SAP–1 program for the expression 20 + 25 – 30 + 5. (10)
   c) What is register transfer logic? "In register transfer logic '+' symbol has two meanings."– Explain. (07)

4. a) Show the H/W implementation for the following statements. Assume that registers are 4-bit in length. (12)

$$T_0 : A \leftarrow R_0;\ T_1 : A \leftarrow R_1;\ T_2 : A \leftarrow R_2;\ T_3 : A \leftarrow R_3$$

   b) Define overflow with example. Design an overflow detector circuit. (12)
   c) What are the significances of Bus Transfer in digital system? Describe bus system for four registers with appropriate block diagram (11)

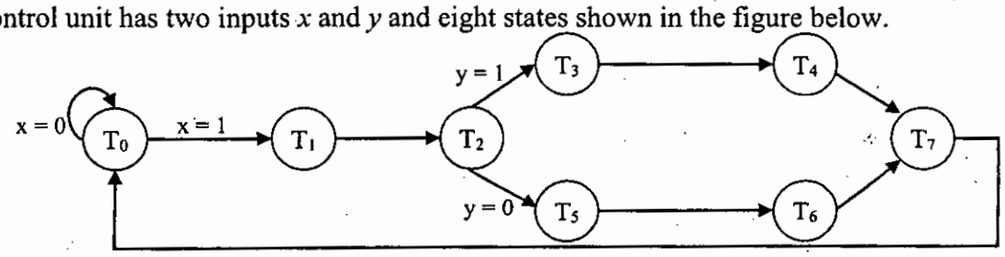
## SECTION B

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

5. a) Explain the relationship between control logic and data processor in a digital system using a block diagram. (09)
   b) Draw flowchart, state diagram and finally design control system to multiply two fixed-point binary numbers in sign-magnitude representation. Is it preferable to use T flip-flops in control circuit? (13)
   c) Draw state diagram and design the control unit with JK flip-flops for the following operations where $n$ varies from 0 to 3 and G is a two bit sequence register. (13)

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

6. a) A control unit has two inputs $x$ and $y$ and eight states shown in the figure below. (11)




Design the control using a PLA and other required elements such as a register and a decoder.
   b) What are the advantages of micro-programmed control unit over hardwired control unit? Explain basic operations of Control Address Register (CAR) in micro-program control. (06)

c) Design a micro-programmed control unit for a system that is able to display 0 to 9 through seven segment display. The control unit takes two inputs $q_{odd}$ and $q_{even}$ and functions of the system for the inputs are below. (12)

| $q_{odd}$ | $q_{even}$ | Action |
|---|---|---|
| 0 | 0 | Stay in the initial state; display nothing. |
| 0 | 1 | Display even numbers only and back to initial state. |
| 1 | 0 | Display odd numbers only and back to initial state. |
| 1 | 1 | Display all the numbers and back to initial state. |

d) What are the advantages and disadvantages of FPGA? Write down its applications. (06)

7. a) Draw the block diagram of a digital computer marking different counters and registers. What are the different phases of digital computer design? (08)
   b) Data and instrumentation both reside in memory as a binary format. How does a computer system distinguish between both? (07)
   c) Why different timing signals are required in a digital system. Explain with a particular example. (08)
   d) An instruction in address $(021)_{16}$ in the computer has the operation-code of the AND instruction and an address part $(088)_{16}$. The memory word of address $(088)_{16}$ contains the number $(B8F2)_{16}$. Register A contains $(A938)_{16}$. Tabulate the contents of register PC, MAR, B, A, and I, after the instruction is executed. Repeat the problem two more times, for memory reference operation code ADD and STO. (12)

8. a) Draw the micro-program control unit of the studied small-scale digital computer. Why I, G and F registers are not necessary in such control system? (10)
   b) Explain in detail the transfer of micro-program control to execute different instructions from different locations of ROM after FETCH operation. (07)
   c) Why several ROM address are unusual in micro-program control in the studied system? What will happen if program reach such a locations due to malfunction? (06)
   d) What is ISZ memory reference instruction? List the micro-operations to execute ISZ. What problem arises to execute it and how it solved? (06)
   e) What are basic input and output instructions considered in the studied small-scale digital computer? Briefly explain their operations. (06)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 4th Year 2nd Term Examination, 2018
Department of Computer Science and Engineering
CSE 4233
Robotics

TIME: 3 hours FULL MARKS: 210

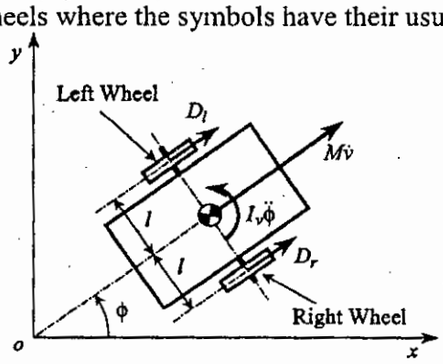
N.B. i) Answer **ANY THREE** questions from each section in separate scripts.
ii) Figures in the right margin indicate full marks.

## SECTION A

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

1. a) What do you mean by Autonomous Mobile Robots? Mention some vital usages of Autonomous Mobile Robots. (07)
   b) Explain the differences between manipulators and mobile robots. (05)
   c) What do you mean by "*kinematics*" and "*dynamics*" of a mobile robot? Elaborate. (08)
   d) Develop the forward kinematic and inverse kinematic models (equations) for a differential drive mobile robot. Use appropriate robot diagram. (15)

2. a) What is robot reference frame? What do you mean by ICR or ICC for a mobile robot? (08)
   b) Find out the state-space model (equations) for mobile robot shown in the following figure, with two independent driving wheels where the symbols have their usual meaning. (15)




   c) A robot is positioned at a 60° angle with respect to the global reference frame and has wheels with a radius of 1 cm. These wheels are 2 cm from the center of the chassis. If the speed of wheels 1 and 2 are 4 cm/s and 2 cm/s, respectively, find the robot velocity with respect to the global reference frame. (12)

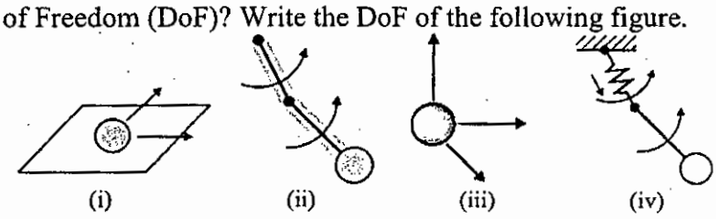
3. a) Explain "*degree of mobility*", "*degree of steerability*" and "*degree of maneuverability*" for mobile robots. (09)
   b) What is locomotion? Explain the key issues for locomotion of mobile robots. (10)
   c) "Perception is used for the robot to acquire knowledge from its environments." – Justify the statement using a real world example. (08)
   d) What is a sensor? Give a vivid classification of sensors used in mobile robotics applications. (08)

4. a) "Perception (sensors) and motion control (effectors) play an integral role in localization of robots." – Justify the statement. (07)
   b) What is PID control? Explain it using an example of mobile robots. (10)
   c) Explain the hybrid motion control mechanism using an example. (10)
   d) "In mobile robotics, the specific aspect of cognition directly linked to robust mobility is navigation competence." – Explain this statement. (08)

## SECTION B

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

5. a) What is Degree of Freedom (DoF)? Write the DoF of the following figure. (05)




   b) Suppose frame {B} is known relative to frame {A}. Give the description of frame {A} relative to frame {B}. Also write the transformation matrix. (10)

c) Frame {B} is rotated relative to frame {A} about $z$-axis by 30 degrees, translated 10 units in $x$-axis of frame {A}, translated 5 units in $y$-axis of frame {A}. Find position vector of point $p$ with respect to frame {A}, where position vector of point $p$ with respect to frame {B} is $[3.0\ 7.0\ 0.0]^T$. (10)

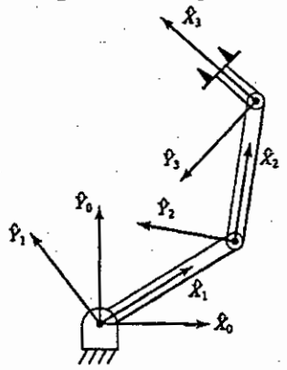
d) Describe the type of joints in robot manipulator. Also explain the link description of manipulator including first link and last link. (10)

6. a) What is inverse manipulator kinematics? When a manipulator is called solvable in case of inverse manipulator kinematics? (04)

b) State the Cyclic Co-ordinate Descent algorithm. Explain it with proper iteration. Write down the advantage and disadvantage of the Cyclic Co-ordinate Descent algorithm. (16)

c) Explain the Denavit-Hartenberg notation. (06)

d) Find the link parameters of the following three-link planar manipulator. (09)

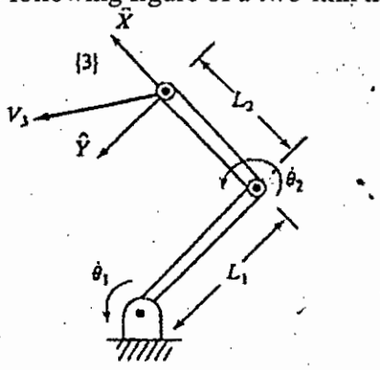


7. a) What is rotational inertia? Derive the moment of inertia matrix in case of rotation of an object relative to frame {A}. (15)

b) Explain the reduction to polynomial formula in case of inverse kinematics. (05)

c) What is manipulator kinematics? Describe the procedure of representing one joint with respect to another joint in case of manipulator kinematics. (15)

8. a) What is angular velocity? See the following figure of a two-link manipulator. (16)




Now calculate the followings:

i) Linear and angular velocity of each joint.

ii) Linear velocity of the end effector with respect to the base joint.

iii) Find out the Jacobian matrix with respect to the third-joint.

b) Derive the equation, $\tau = J^T F$, for representing Jacobian in force domain. (10)

c) Describe the outward iteration in case of the iterative Newton-Euler Dynamic Algorithm. (09)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 4th Year 2nd Term Examination, 2018
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.

## SECTION A

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

1. a) What is Data Mining? "Data Mining and Knowledge Discovery are often used interchangeably, yet part of a Knowledge Discovery process."–Justify the statement. (11)
   b) Define data cleaning. How can you detect data discrepancy? (10)
   c) Briefly explain a typical framework of a data warehouse. (14)

2. a) Discuss the motivation behind OLAP Mining (OLAM). (07)
   b) Suppose that a data warehouse for 'Big University' consists of the following four dimensions: *student*, *course*, *semester* and *instructor*; and two measures *count* and *avg_grade*. When at the lowest conceptual level (e.g., for a given *student*, *course*, *semester* and *instructor* combination), the *avg_grade* measure stores the actual course grade of the *student*. At higher conceptual levels, *avg_grade* stores the average grade for the given combination. (18)
      i) Draw the snowflake schema for the data warehouse.
      ii) Starting with the base cuboid [*student*, *course*, *semester*, *instructor*], what specific OLAP operations should one perform in order to list the average grade of CS courses for each 'Big University' student.
      iii) If each dimension has five levels, such as "*student* < *major* < *status* < *university* < *all*", how many cuboids will this cube contain?
   c) Why do we need OLAP indexing? Consider a cube [*date*, *spectator*, *location*, *game*] and the measures '*count*' and '*charge*', where *charge* is the fare that a *spectator* pays when watching a *game* on a given *date*. Briefly discuss the advantages and disadvantages of using Bitmap indexing on this cube. (10)

3. a) What is Data Mart? Explain the categories of a Data Mart. (07)
   b) Draw the FP-tree from the following table of five transactions, where minimum support (*min_sup*) count = 3. (13)

| TID | Item |
|---|---|
| T1 | C, D, G, I, M, P, F, A |
| T2 | F, L, M, O, A, B, C |
| T3 | B, F, H, J, O |
| T4 | B, C, K, S, P |
| T5 | E, L, P, N, M, A, F, C |

   c) Discuss different types of multidimensional association rules with example. (10)
   d) What are the advantages of FP growth method over Apriori method for mining frequent itemsets? (05)

4. a) Consider a transaction database for drag data set mentioned in the following table. Now apply Apriori algorithm on the drug data set given in the table with *min_sup* = 4. Show the candidate and frequent itemsets for each iteration. Enumerate all the final frequent itemsets. Also indicate the association rules that could be generated from these itemsets and highlight the strongest one. (15)

| CustomerID | TransactionID | BasketContent |
|---|---|---|
| 1 | 1234 | {Aspirin, Panadol} |
| 1 | 4234 | {Aspirin, Sudafed} |
| 2 | 9373 | {Tylenol, Cepacol} |
| 2 | 9843 | {Aspirin, VitC, Sudafed} |
| 3 | 2941 | {Tylenol, Cepacol} |
| 3 | 2753 | {Aspirin, Cepacol} |
| 4 | 9643 | {Aspirin, VitC} |
| 4 | 9691 | {Aspirin, Ibuprofen, Panadol} |
| 5 | 5313 | {Panadol, VitC} |
| 5 | 1003 | {Tylenol, Cepacol, Ibuprofen} |
| 6 | 5636 | {Tylenol, Panadol, Cepacol} |
| 6 | 3478 | {Panadol, Sudafed, Ibuprofen} |

   b) "Strong association rules are not necessarily interesting."– Justify the statement with example. (12)
   c) Differentiate between ROLAP, MOLAP and HOLAP servers. (08)

## SECTION B

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

5. a) What is five number summary? How can you visualize a distribution by Boxplots? (08)
   b) Consider the following data for the analysis of attribute *age*. (15)

      13, 15, 16, 16, 19, 20, 21, 22, 22, 25, 30, 30, 33, 35, 35, 40, 45, 46, 52, 70

      i) Using smoothing by bean means, smooth the above data using bean depth 3. How much effective is this technique for data?
      ii) Use min-max normalization to transform value 46 into range [0–1].
      iii) Use $z$ score normalization to transform value 40 (stdv = 12.9).
   c) Explain principal component analysis as measure of dimensionality reduction. (12)

6. a) "Support Vector Machine is a method of classification for both linear and nonlinear data"– explain the idea. (10)
   b) Consider the following table. (10)

| Refund | Marital Status | Tenable Income | Status |
|---|---|---|---|
| Yes | Single | 125k | No |
| No | Married | 100k | No |
| No | Single | 70k | No |
| Yes | Married | 120k | No |
| No | Divorced | 95k | Yes |
| No | Married | 60k | No |
| Yes | Divorced | 220k | No |
| No | Single | 85k | Yes |
| No | Married | 75k | No |
| No | Single | 90k | Yes |

   Now determine the '*Status*' of the tuple (*Refund* = No, *Marital Status* = Married, *Tenable Income* = 120k) using Naïve Bayesian Classification, where '*Status*' attribute represents the class level.
   c) What is class imbalance problem? How will you evaluate the performance of a classifier having class imbalance problem? (10)
   d) Discuss the trade-off between eager and lazy learners. (05)

7. a) Suppose a hospital tested the age and body fat data for 10 randomly selected adults with following result: (15)

| *age* | 23 | 23 | 27 | 27 | 39 | 41 | 47 | 49 | 50 | 52 |
|---|---|---|---|---|---|---|---|---|---|---|
| *%fat* | 9.5 | 26.5 | 7.8 | 17.8 | 31.4 | 25.9 | 27.4 | 27.2 | 31.2 | 34.6 |

      i) Draw the Boxplot for *age*.
      ii) Draw a scatter plot on these two variables.
      iii) Calculate the Correlation Coefficient (Pearson's product moment coefficient). Are these two variables positively or negatively correlated?
   b) How can you measure the proximity of symmetric and asymmetric binary attributes? (06)
   c) How can you explain the idea of clustering as a means of the following: (14)

      i) Classification, ii) Data reduction and iii) Finding $k$-nearest neighbor.

8. a) Consider the table mentioned below taken from 'Playing Tennis' data. Now construct a decision tree using information gain. (18)

| Outlook | Temperature | Humidity | Wind | Play |
|---|---|---|---|---|
| Sunny | Hot | High | Weak | No |
| Sunny | Hot | High | Strong | No |
| Overcast | Hot | High | Weak | Yes |
| Rain | Mild | High | Weak | Yes |
| Rain | Cool | Normal | Weak | Yes |
| Rain | Cool | Normal | Strong | No |
| Overcast | Cool | Normal | Strong | Yes |
| Sunny | Mild | High | Weak | No |
| Sunny | Cool | Normal | Weak | Yes |
| Rain | Mild | Normal | Weak | Yes |
| Sunny | Mild | Normal | Strong | Yes |
| Overcast | Mild | High | Strong | Yes |
| Overcast | Hot | Normal | Weak | Yes |
| Rain | Mild | High | Strong | No |

   b) Explain Semi-Supervised classification, Active learning and transfer learning. (12)
   c) Discuss the advantage of fuzzy set classifier over rule based classifier. (05)

KHULNA UNIVERSITY OF ENGINEERING & TECHNOLOGY
B.Sc. Engineering 4th Year 2nd Term Examination, 2018
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) Define Biomedical Engineering. How can you contribute in the Biomedical Engineering and healthcare sector as a student/graduate of Computer Science and Engineering? (09)
   b) What factors are needed to consider in designing medical instruments? Describe the design process of typical medical instruments. (10)
   c) What are the basic differences between resting and action potential? Briefly explain the mechanism behind the generation of testing potential in a living cell. (11)
   d) Calculate the equilibrium resting potential of muscle tissue at 37°C for the following $k^+$ ion concentrations: (05)
   Intracellular concentration, $[k^+]_i = 150$ milimoles/Litre
   Extracellular concentration, $[k^+]_o = 4$ milimoles/Litre.

2. a) Draw and explain the block diagram of a modern electrocardiograph system. (14)
   b) What is EEG? Explain different components of EEG in terms of signal characteristics, electrode position and mental states. (11)
   c) What are the basic requirements of bio-potential amplifiers? Design an ECG amplifier circuit. (10)

3. a) Explain the role of Electronic Medical Records (EMR) in supporting clinical trials using necessary diagrams. (11)
   b) Describe typical networking infrastructure among various workstations inside as well as outside of a healthcare organization. (15)
   c) Define Bioinformatics. Write short note on HL–7 standard. (09)

4. a) Explain the importance of Artificial Intelligence (AI) in the advancement of healthcare service monitoring various applications. (12)
   b) Define Biosensor. Describe the working principle of Biosensor using suitable diagram. (10)
   c) What is the frequency range of X-ray? Describe the X-ray imaging principle and radiation phenomena behind the production of X-ray using suitable diagrams. (13)

## SECTION B

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

5. a) What are the major fields of Biomedical Engineering? Briefly write about each of the major branch of Biomedical Engineering. (09)
   b) Draw the block diagram of a basic bio-signal acquisition system. Briefly explain each part of the system. (07)
   c) Define bio-potential electrode and explain the process of current flow at the Electrode-Electrolyte interface. Also, draw and briefly explain the equivalent circuit of an electrode placed on the skin surface. (10)
   d) What are the commonly used bio-potential electrodes? What factors are needed to be considered to practically use bio-potential electrodes? (09)

6. a) Describe the principle of operation of a Linear Variable Differential Transformer (LVDT ) with proper diagram. How the LVDT can be used as a displacement and pressure transducer? (08)
   b) What are the problems of temperature measurement using mercury-in-glass thermometer? Explain different methods of electronic body temperature measurement systems. (07)
   c) Draw the block diagram of a Cardioscope using digital memory. Explain the quick recovery circuit and leads off detector circuit in brief. (10)
   d) Write an essay on prosthetics. (10)

7. a) Draw the block diagram of a clinical defibrillator and explain its working principle. (10)
   b) What is the normal average heart rate of people of different age? How to calculate the heart rate from an ECG strip? (06)
   c) Define Systolic, Diastolic, and Mean Arterial blood pressure. Discuss the blood pressure measurement techniques using Auscultatory and Oscillometric methods. (09)
   d) Describe the principle of Positive Pressure and Negative Pressure Ventilators. With proper diagram briefly explain the Positive Pressure Ventilator. (10)

8. a) What is meant by diathermy? Explain the operation and application of diathermy machine. (10)
   b) Describe different types of electric current concerned with patient safety mentioning their range and effect of them. (14)
   c) What are the needs for a cardiac pacemaker? What are the basic requirements of implantable cardiac pacemakers? Draw the block diagram of a typical modern pacemaker. (11)