SECTION – A

There are FOUR questions in this section. Answer any THREE.

1. (a) Prove that a minimum spanning tree of a set of points is a subset of the Delauny triangulation. How can you improve Kruskal’s algorithm for finding a minimum spanning tree using Delauny triangulation? (10)
(b) Outline an $O(n \log n)$ time randomized incremental algorithm to compute Delauny triangulation with necessary figures. (10)
(c) Prove that in the incremental algorithm for Delauny triangulation, if the points A, B, C, D from a convex quadrilateral then exactly one of the two diagonals is an illegal edge. (8)
(d) Draw Voronoi diagram for – (2+2+3=7)
(i) five cocircular sites.
(ii) Five collinear sites.
(iii) five sites where four of them are cocircular and another one is in the center of the circumcircle.

2. (a) Give an algorithm which will find the largest empty circle whose center is in the closed convex hull of a set of $n$ sites. Prove the correctness of the algorithm. (15)
(b) Prove that, size of a Voronoi diagram of a set of $n$ sites is $O(n)$. (10)
(c) What is the base case of the divide and conquer algorithm to compute the Voronoi diagram of $n$ sites. How will you compute Voronoi diagram for the base case? (5)
(d) Analyze the time complexity of the divide and conquer algorithm to compute the Voronoi diagram of $n$ sites. (5)

3. (a) Write down five properties of Delauny triangulation. (5)
(b) How you can implement Shift algorithm for straight line drawing of a plane graph in linear time? Briefly describe along with necessary mathematics. (15)
(c) What is canonical ordering of a triangulated plane graph? Prove that every triangulated plane graph has a canonical ordering. (15)
CSE 463

4. (a) Find a straight line drawing for the graph shown in Figure for Q. No. 4(a) using the Shift method showing every step.

(b) Why does straight line drawing algorithms usually deal with triangulated plane graph?

SECTION – B

There are FOUR questions in this section. Answer any THREE.

5. (a) Describe Chan’s algorithm for computing the convex hull of a set of points in 2D and derive its time complexity.

(b) Outline an algorithm to triangulate a strictly y-monotone polygon in linear time.

6. (a) Describe an algorithm for computing the minimum-area bounding rectangle of a convex polygon in linear time.

(b) Explain why the gift wrapping algorithm for computing the convex hull is “output-sensitive”.

(c) Describe how you can reduce the problem of sorting \( n \) numbers to the problem of constructing the convex hull of \( n \) points in 2D. How does this reduction provide a lower bound on the time complexity of computing the convex hull of \( n \) points in 2D?

7. (a) Let \( S \) be a set of \( n \) (possibly intersecting) unit circles (circles with radius 1) in the 2D plane. Give an \( O(n \log n) \) algorithm for computing the area of the convex hull of \( S \).

(b) Prove that a polygon is y-monotone if it has no split vertices or merge vertices.

(c) Give an example with 10 points for which the quickhull algorithm for computing the convex hull performs the worst.

8. (a) Prove that \( \lceil n/3 \rceil \) guards are sometime necessary and always sufficient for guarding a simple polygon of \( n \) vertices.

(b) Use divide and conquer strategy to compute the convex hull of a set of \( n \) 2D points in \( O(n \log n) \) time.
SECTION – A

There are FOUR questions in this section. Answer any THREE.

1. (a) Why does an Arduino Uno have two on-board ICSP headers? (10)
(b) "Unregulated power source must supply a voltage between 7V and 12 V to an Arduino Uno"—do you agree? Justify your answer. (10)
(c) Briefly explain the functionality of the IOREF pin on an Arduino Uno. (5)
(d) "Although six digital I/O pins of an Uno are dedicated for PWM, we can perform software PWM on any digital I/O pin"—do you agree? Justify your answer. (10)

2. (a) Construct the circuit diagram and write the corresponding code to measure temperature using LM35 and Raspberry Pi. (25)
(b) Explain how you can run Raspberry Pi in headless mode. (10)

3. (a) Suppose a serial Bluetooth receiver module is connected to your Arduino Uno. When you try to upload a sketch to your Uno from your computer, code burner reports an error. Assuming none of the components have any hardware fault, what might be a probable reason for this error? (10)
(b) Explain the daisy-chained configuration to interface multiple devices to a single SPI bus. What are the advantages and disadvantages of a daisy-chained SPI bus? (10)
(c) State a typical use of a Schottky diode. (5)
(d) Describe the concepts of repeated start state and clock stretching in I2C communication. (10)

4. (a) State the different ways to connect a Raspberry Pi to the Internet. Which mode of Internet connectivity would you choose if you were in the middle of the BUET Field, which may be considered to have a typical size of 400 m x 400 m. (10)
(b) What do you understand by IOT platforms? When would you want to use your own server rather than an IOT platform? (10)
(c) Give an example of a hardware project where you might need the help of data analytics. (5)
(d) "Due to resource constraints not all Machine Learning (ML) algorithms are applicable in embedded systems"—do you agree? Justify your answer. (10)
CSE 483

SECTION – B

There are FOUR questions in this section. Answer any THREE.

5. (a) What is a 'bus' in computer systems? What are different types of bus found in computers? Discuss them.  
   (5+4+11)
(b) Once ISA bus was extensively used in computers. Now-a-days it can not be found in computers. PCI bus drives out ISA bus from computers. What are the advantages of PCI bus?  
   (15)

6. (a) What are the advantages of AGP bus over PCI bus?  
   (12)
(b) What is PS/2? Where are they used? What are their advantages?  
   (12)
(c) Write a short note on MIDI.  
   (11)

7. (a) Mention the name of different types of barcode readers that are commercially available. Describe the operation of any one type.  
   (13)
(b) Calculate the check-digit for a product having UPC-A barcode of 02468135790. All the steps should be clearly shown.  
   (10)
(c) What makes an RTOS different from an OS that we generally use in general computers?  
   (12)

8. (a) What was the main aim in developing USB? What advantages does it offer over the then existing bus systems? If there are any limitations still in USB, mention them.  
   (15)
(b) What are new connector types specified in USB 3.0? Discuss them.  
   (10)
(c) The USB is based in a so-called 'tiered star topology'. Describe this topology.  
   (10)
SECTION – A

There are FOUR questions in this section. Answer any THREE.

1. (a) How does an SVM classifier differ from a perceptron though both of them can optimally classify a set of linearly separable examples?  
   (b) An aerial image covering a large geographical area needs to be segmented into an unknown number of regions. Justify which pattern recognition model can be used for this purpose. Differentiate this model from the other broad class of models.  
   (c) Define the three issues associated with an HMM with proper mathematical symbols. Explain the efficient calculations of the Evaluation problem with forward and backward recursions. Show the deductions of all mathematical steps with necessary explanations.

2. (a) Suppose a set of training samples consisting of two classes are separated by a non-linear (e.g., circular) decision boundary. How can you use the linear SVM to classify them with appropriate feature transformation? Discuss the issue you face in this model. How is the kernel trick useful here?  
   (b) Though 2D logarithmic search and hierarchical search are very efficient in template matching, they alone cannot be used to track a moving object in a video sequence. Explain the reason and possible remedies.

3. (a) What are the two main parameters of DBSCAN clustering algorithm. How can you estimate the values of these parameters from the data to be clustered?  
   (b) Explain hierarchical template matching approach. Why do you need smoothing operation in this approach? Explain the issues when the object size varies.  
   (c) With necessary definitions, formulate a contingency table that is used to calculate proximity measures between two discrete valued vectors. Represent the hamming distance in terms of the entries of this table.

4. (a) Explain maxmin clustering algorithm. How is this algorithm less order dependent than other sequential clustering algorithms? Justify whether incremental updating of centroids in k-means is order dependent. Why is this updating scheme used in k-means?  
   (b) Explain why an SVM classifier can learn from fewer training samples in contrast to many other classification models.

Contd ………. P/2
5. (a) Note the three straight-line equations:
\[
x + 2 = 0 \\
x - y - 2 = 0 \\
y - 5 = 0
\]
They realize three perceptrons. The positive regions for all these perceptrons are the regions where the origin lies. These straight-lines divide the entire Cartesian plane in a number of polyhedral regions.

(i) Draw the perceptrons.
(ii) The outputs of these perceptrons act as input to perceptron(s) in the next layer in an MLP (Multi-Layer-Perceptron). Therefore, each polyhedral region is mapped to a vertex of unit cube. Which region is mapped to which vertex? Show in the figure you have drawn in (i).
(iii) Determine the two polyhedral regions that contain (100, -100) and (-100, 100) respectively. Say those regions are R1 and R2. Now, we wish to design an MLP that classifies as follows:

if a point \( x \) is in R1 or R2: classify \( x \) as positive
else classify \( x \) as negative

Now determine the minimum number of layers and neurons you need in the MLP and calculate the synaptic weights. Finally draw the MLP.

(b) Explain why the cost function defined in the perceptron learning algorithm is piecewise-linear.

(c) Discuss the learning algorithm of an artificial neural network based on exact classification of training samples. What are the problems associated with this algorithm?

6. (a) There are three training samples. The feature vector is 1-dimensional. They are as follows:
\[
0.0 - \text{Class 1} \\
1.0 - \text{Class 2} \\
2.0 - \text{Class 3}
\]
We wish to build a linear classifier for this three-class case using Kesler’s construction. The composite feature vector will look like this:

\[
\begin{bmatrix}
\text{Class 1} & \text{Class 2} & \text{Class 3}
\end{bmatrix}
\]
Since the vector is \( 3 \times 2 = 6 \)-dimensional, the weight vector is 6-dimensional as well.

(i) Write down the composite training samples with their classes.
(ii) Using them, a normal perceptron is now trained. The initial weight vector is:
\[
[ 0.0 \ 1.0 \ 2.0 \ 3.0 \ 4.0 \ 5.0 ]
\]
Show the detailed iterations of the perceptron learning algorithm using the samples you have listed in (i) until the algorithm converges or five iterations are done. Use a learning rate of 0.5.
(ii) Using the final weight vector, classify the vector “3.0” to one of the three classes.

Contd ........... P/3
(b) Write an algorithm to check if two graphs are isomorphic. Determine if the following two graphs are isomorphic or not with appropriate arguments.

Graph 1

Graph 2

(c) In a block world, there are four blocks. These four are oriented into two stacks. Mr. A prefers that both stacks contain equal number of blocks. Mr. B, on the other hand, prefers that one stack has more blocks than the other. None of the stacks can be empty. "The grammar that captures the block world of Mr. B is context sensitive, whereas the grammar that captures the block world of Mr. A is not" – justify.

7. (a) Study the Bayesian Belief Network of Figure 7(a):

![Bayesian Belief Network](image)

Determine the probability \( P(\text{Hb} = \text{Yes} \mid \text{CP} = \text{no}, \text{D} = \text{Yes}) \).

(b) In a certain recognition problem, the patterns are represented by a single real number. There are two classes: Class 1 and class 2. The mean of the samples of these classes are 2.0 and 10.0 respectively. The posterior probability \( P(x \mid \text{class } i) \) follows Gaussian density for \( i = 1 \) and 2. The standard deviation of class 1 and class 2 are 4.0 and 3.0 respectively.

Determine the decision surface based on Bayesian classifier rule.
(c) For the two-class Bayesian classification problem, assume that the feature space is 1-dimensional (the x-axis) and the densities of two classes are

\[ P(x|\omega_1) = \frac{1}{2} e^{-|x-\mu_1|} \]

and

\[ P(x|\omega_2) = \frac{1}{2} e^{-|x-\mu_2|} \]

respectively. (10)

Let \( \mu_1 = 0 \) and \( \mu_2 = 2 \). The decision regions are given by \( R_1 = \{ x \mid x < 1 \} \) and \( R_2 = \{ x \mid x > 1 \} \). Compute the probability of error \( P(x \in R_2, w_1) \) when it is assumed that the prior probability of class 1 is twice that of class 2.

8. (a) Using CYK Parsing Algorithm, determine if the string “bbbaab” is well formed under the following grammar:

\[
S \rightarrow bA_1cA_2 \\
A_1 \rightarrow bA_2 \\
A_2 \rightarrow bAA_2
\]

(b) Explain parsing using Transition Network (TN). Look at the following grammar:

\[
S \rightarrow Sa|b
\]

Discuss the problems associated with using TN for the purpose of parsing in the context of this particular grammar. How do you solve the problem?

(c) Define FSG. Look at the following grammar:

\[
V_r = \{a, b\} \\
V_n = \{S, A_1, A_2\} \\
p = \{ S \rightarrow aA_2 \} \\
S \rightarrow bA_1 \\
A_1 \rightarrow a \\
A_1 \rightarrow AA_1 \\
A_2 \rightarrow b
\]

Draw its graphical representation.

(d) Note the following two graphs. (17)

Draw

(i) the corresponding attributed graphs,
(ii) match graph, and
(iii) maximal clique.

(iv) Mark the portions of the two graphs that were found as a match from the maximal clique.

Note that you must complete the entire match graph. Just drawing the maximal clique in the match graph will not get you any marks at all.
1. (a) Write down the vector form of Rodrigues' formula. Derive the matrix form of Rodrigues' formula from the vector form. 

(b) For each pair of 3D lines below, determine whether they are coincident, or parallel, or non-parallel and non-intersecting, or non-parallel and intersecting. If any pair is non-parallel and intersecting, find the corresponding intersection point. 

   (i) \((0, 0, 0) + t(1, 1, 1)\) and \((0, 0, 2) + s(-1, 1, 1)\) 
   (ii) \((-3, 2, 1) + t(2, 0, 1)\) and \((-2, -7, -3) + s(1, 3, 2)\) 
   (iii) \((-3, 2, 1) + t(2, 0, 1)\) and \((1, 2, 3) + s(-4, 0, -2)\) 

(c) What is the formal definition of Linear Transformation? According to the formal definition of linear transformation, test whether 2D rotation and 2D translation are linear transformations in Cartesian space. 

2. (a) Consider a straight line segment \(L\) in 3D space. The coordinates of the endpoints of \(L\) are \((3, 4, 5)\) and \((3, 4, 10)\). Determine the length of the projection of \(L\) in the following cases: 

   (i) A perspective projection where the projection plane is defined by equation \(z=2\) and the center of projection is \((-3, -4, 0)\) 
   (ii) A parallel projection where the projection plane is defined by the equation \(z=3\) and the direction of projection is \(6i-2j-3k\). 

(b) Prove that, \(R^T \cdot R = I\). Here, \(R\) is the transformation matrix for a 3D rotation, \(R^T\) denotes the transpose of \(R\), \((\cdot)\) denotes matrix multiplication, and \(I\) is the identity matrix. 

(c) Define affine and convex combinations of vectors. What is the physical significance of affine and convex combinations of vectors? 

3. (a) Describe the classification of projection. State the differences between perspective and parallel projections. 

(b) Consider shearing transformation along the X axis and shearing transformation along the Y axis in a 2D plane. Are they commutative? Describe with necessary proof.
(c) Describe the stages of raster based graphics pipeline.

4. (a) You need to transform the circle C to the ellipse E on the XY plane as shown in Figure 4. You are allowed to perform one translation, one rotation and one scaling (not necessarily in the given order). Write down the corresponding composite transformation matrix. You do not need to multiply the three matrices. Use homogeneous coordinates.

(b) The standard form of equation of a plane in 3D is $ax + by + cz + d = 0$. What is the significance of the coefficients $a$, $b$, $c$ and $d$ in this equation? Determine with proof.

(c) Consider a square $S$ with vertices $(1,1,0)$, $(1,-1,0)$, $(-1,-1,0)$ and $(-1,1,0)$ and a plane $P$ defined by $z=1$. Let the perspective projection of $S$ on $P$ is denoted by $S'$. (2+2+2+6)

(i) Provide a position (Cartesian coordinates) of the COP for which $S'$ is a square.

(ii) Provide a position of the COP for which $S'$ is a rectangle, but not a square.

(iii) Provide a position of the COP for which $S'$ is a rhombus, but not a rectangle.

(iv) What else can $S'$ be? Provide a position of the COP for each other case.

SECTION-B
There are FOUR questions in this section. Answer any THREE questions.

5. (a) In the following figure check the first 2 iterations of dragon curve.

Contd .......... P/3
(i) Write down the set of string production rules that can generate dragon curve like the above figure.

(ii) From your string production rule, generate 3rd order strings and draw it accordingly.

(iii) What is the dimension of this fractal?

(b) Consider a family of Koch snowflake having the following three iterations,

```
iteration 1
---•---
```
```
iteration 2
~.-~
```
```
iteration 3
.-~.
```

Suppose, in iteration 1, the length of the each line segment is 3. With each following iterations each line is replaced by standard Koch curve like the above figure. What could be the maximum possible area for this fractal?

(c) What are the advantages and disadvantages of Back-Face culling? Consider a list of polygons, sorted by farthest z in ascending order. Describe with necessary figures how “Depth Sort Algorithm” would resolve ambiguities.

6. (a) (i) Suppose a quadratic figure has the following equation,

\[ x^2 + y^2 + z^2 - 2x - 2y - 2z - 97 = 0 \]

Find the normal on point (1, 1, 11)?

(ii) Suppose a cylinder with radius \( r \) is oriented along line \( L = Cp + dt \). An implicit equation of a cylinder would be to validate whether a point \( P \) is on the cylinder or not. Find the implicit representation of the Cylinder.

(b) Use Cyrus Back Algorithm to clip the line {\(-2, -5\)} to {\(100, 20\)} where viewport is {\(0,0\)}, {\(0,50\)}, {\(50,50\)}, {\(50,0\)}.

For your convenience, calculation table is provided, below

<table>
<thead>
<tr>
<th>Clip edge</th>
<th>Normal ( N_i )</th>
<th>( P_{Ei} )</th>
<th>( P_{F} - P_{E} )</th>
<th>( r = \frac{N_i \cdot (P_{F} - P_{E})}{-N_i \cdot D} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>left: ( x = x_{min} )</td>
<td>((-1, 0))</td>
<td>((x_{min}, y))</td>
<td>((x_{min} - x_{min}, y_{0} - y))</td>
<td>(-\frac{(x_{min} - x_{min})}{-(y_{0} - y)})</td>
</tr>
<tr>
<td>right: ( x = x_{max} )</td>
<td>((0, 1))</td>
<td>((x_{max}, y))</td>
<td>((x_{max} - x_{min}, y_{0} - y))</td>
<td>(-\frac{(x_{max} - x_{min})}{-(y_{0} - y)})</td>
</tr>
<tr>
<td>bottom: ( y = y_{min} )</td>
<td>((0, -1))</td>
<td>((x, y_{min}))</td>
<td>((x - x_{min}, y_{0} - y_{min}))</td>
<td>(-\frac{(x - x_{min})}{-(y_{0} - y_{min})})</td>
</tr>
<tr>
<td>top: ( y = y_{max} )</td>
<td>((0, 1))</td>
<td>((x, y_{max}))</td>
<td>((x - x_{min}, y_{0} - y_{max}))</td>
<td>(-\frac{(x - x_{min})}{-(y_{0} - y_{max})})</td>
</tr>
</tbody>
</table>
CSE 409
Contd... Q. No. 6

(c) The shading process can be categorized into following categories. Write short notes about their methodologies and problem.

- Shading
  - Flat Shading
  - Smooth Shading
  - Gouraud Shading
  - Phong Shading

7. (a) Derive the equations of Phong Illumination model with necessary figures and explanations.
(b) For scan converting lines, find mid-point incremental relation for selecting pixels when slope is greater than 1 (similar to the following).

(c) Use Cohen-Sutherland line clipping procedure to clip the line CD, with respect to the box as shown in the following figure. Show necessary steps.

(d) How would you efficiently compute Z values, in Z buffer algorithm? What are some of the disadvantages of Z buffer algorithm?

8. (a) For scan converting ellipses, with necessary figures and equations, find the incremental relation for selecting pixels in any quadrant.
(b) How would you incrementally calculate $D$ (perpendicular distance from the pixel to be illuminated and line) for a line with slope $>1$.

For weighted area sampling, where you consider each pixel base as a circle with radius 1px width, on average three pixels are needed to be illuminated. Find the incremental relation of $D$ values of the three pixels when line slope is greater than 1. Draw necessary figures and calculations.

(c) What is Ray-Casting? In un-weighted area sampling based anti-aliasing procedure, the intensity of a pixel depends on the overlapping area as shown in the following figure. How could you effectively compute this area?
L-4/T-2/CSE

Date: 13/08/2017

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA
Sub: HUM 371 (Financial and Managerial Accounting)

Full Marks: 140  Time: 3 Hours

USE SEPARATE SCRIPTS FOR EACH SECTION
The figures in the margin indicate full marks.

SECTION – A

There are FOUR questions in this section. Answer any THREE.

1. (a) Explain any two assumptions according to generally accepted accounting principles (GAAP).

(b) Mr. "A" and his associates started their manufacturing business on July 1, 2016.
The following transactions took place during the first month of operation:

July 1:  Invested Tk. 180,000 in cash to start the business.
July 5:  Purchase office equipment in cash Tk. 50,000.
July 7:  Hired a managing director to manage the business efficiency. He will be paid salary Tk. 20,000 per month.
July 12:  Incurred advertising expense on account Tk. 5,000.
July 14:  Withdrawn by Mr. "A" for his personal use in cash Tk. 8,000.
July 18:  Employee salary expense was due for Tk. 10,000.
July 22:  Paid the amount due related to advertising expense.
July 26:  Earned Tk. 80,000 by selling the products, Tk. 40,000 is received in cash and the remaining on account.
July 28:  Received cash from previous customer on transaction July 26.

Required:
(i) Show the effects of the above transactions on the accounting equation for the month of July, 2016.
(ii) Also prepare owners equity statement for the month.

2. (a) Explain the basic accounting equation: Asset (A) = Liability (L) + Owners Equity (OE) with example.

(b) Mr. "S" opened a business. During May the following transactions occurred:

May 1:  Service performed but not received Tk. 50,000.
May 5:  Purchased furniture on account Tk. 25,000.
May 15:  Received Tk. 80,000 cash advance from a client for consultancy services to be provided in July.
May 19: Received Tk. 50,000 cash from a local bank by signing a note.
May 22: Unpaid salary Tk. 8,000.
May 24: Due salary paid in cash Tk. 8,000.
May 27: Ordered for special supplies required for providing services Tk. 20,000.
May 30: Paid for a one year insurance policy purchased in cash Tk. 12,000.

Required:
(i) Journalize the above transactions.
(ii) Post the journals to the respective ledger accounts.

3. (a) State the differences between the following concepts with examples:
   (i) Event and Transaction.
   (ii) Revenue and Profit.
   (iii) Fiscal Year and Calendar Year.

   (b) What is a Trial Balance and what is its purpose?

   (c) Following are the account balances of Standard Construction Company Limited for the year ended on 31st December, 2016:
   Cash Tk. 500,000; Accounts receivable Tk. 250,000; Accounts payable Tk. 180,000; Land and Building Tk. 10,00,000; Equipment Tk. 300,000; Bank loan Tk. 150,000; Furniture and fittings Tk. 300,000; Salaries Tk. 360,000; Insurance Tk. 180,000; Rent Tk. 240,000; Wages Tk. 150,000; Construction site expenses Tk. 60,000; Office expense Tk. 90,000; Revenue Tk. 15,00,000; Purchase of supplies Tk. 900,000; Capital Tk. 25,00,000.

   Required: Prepare a trial balance.

4. (a) Write down the categories of adjusting entries.

   (b) The trial Balance of "Rangs Electronics" at June 30, 2016 is given below:

   **Rangs Electronics**
   **Trial Balance**
   **June 30, 2016**

<table>
<thead>
<tr>
<th>Accounts Title</th>
<th>Debit (Tk.)</th>
<th>Credit (Tk.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash</td>
<td>26,000</td>
<td></td>
</tr>
<tr>
<td>Supplies</td>
<td>2,500</td>
<td></td>
</tr>
<tr>
<td>Prepaid insurance</td>
<td>30,000</td>
<td></td>
</tr>
<tr>
<td>Office equipment</td>
<td>10,000</td>
<td></td>
</tr>
<tr>
<td>Notes payable</td>
<td></td>
<td>50,000</td>
</tr>
</tbody>
</table>

Contd ........... P/3
Contd... Q. No. 4(b)

<table>
<thead>
<tr>
<th>Accounts Title</th>
<th>Debit (Tk.)</th>
<th>Credit (Tk.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Furniture</td>
<td>20,000</td>
<td></td>
</tr>
<tr>
<td>Accounts payable</td>
<td>1,000</td>
<td></td>
</tr>
<tr>
<td>Unearned revenue</td>
<td>12,000</td>
<td></td>
</tr>
<tr>
<td>Capital</td>
<td>21,000</td>
<td></td>
</tr>
<tr>
<td>Drawings</td>
<td>500</td>
<td></td>
</tr>
<tr>
<td>Service revenue</td>
<td>12,500</td>
<td></td>
</tr>
<tr>
<td>Salary expense</td>
<td>5,000</td>
<td></td>
</tr>
<tr>
<td>Utility expense</td>
<td>1,000</td>
<td></td>
</tr>
<tr>
<td>Interest expense</td>
<td>1,000</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>96,500</strong></td>
<td><strong>96,500</strong></td>
</tr>
</tbody>
</table>

Other Information:
- Insurance policy is for 5 years.
- One third of the unearned revenues is earned at the end of the period.
- Supplies on hand at June 30, 2016 Tk. 1200
- Service provided to the customers but not recorded amount Tk. 2,000.
- Depreciation is Tk. 500 per month.
- Interest accrued at June 30, Tk. 2,500.

Required:
(i) Prepare necessary adjusting entries.
(ii) Prepare an adjusted trial balance as at June 30, 2016.

SECTION-B
There are FOUR questions in this section. Answer any THREE.
Symbols have their usual meaning.

5. (a) What is the main difference between the unit cost under variable costing and absorption costing?

(b) Dexter Corporation produces and sells a single product, a wooden handloom for weaving small items such as scarves. Selected cost and operating data relating to the product for two years are given below:

<table>
<thead>
<tr>
<th>Selling price per unit</th>
<th>Tk. 50</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing costs:</td>
<td></td>
</tr>
<tr>
<td>Variable cost per unit produced:</td>
<td></td>
</tr>
<tr>
<td>Direct materials</td>
<td>Tk. 11</td>
</tr>
<tr>
<td>Direct labor</td>
<td>Tk. 6</td>
</tr>
<tr>
<td>Variable overhead</td>
<td>Tk. 3</td>
</tr>
<tr>
<td>Fixed cost per year</td>
<td>Tk. 120,000</td>
</tr>
<tr>
<td>Selling and administrative costs:</td>
<td></td>
</tr>
<tr>
<td>Variable cost per unit sold</td>
<td>Tk. 4</td>
</tr>
<tr>
<td>Fixed cost per year</td>
<td>Tk. 70,000</td>
</tr>
</tbody>
</table>

Contd .......... P/4
HUM 371
Contd..., Q. No. 5(b)

<table>
<thead>
<tr>
<th></th>
<th>Year-1</th>
<th>Year-2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Units in beginning inventory</td>
<td>0</td>
<td>2,000</td>
</tr>
<tr>
<td>Units produced during the year</td>
<td>10,000</td>
<td>6,000</td>
</tr>
<tr>
<td>Units sold during the year</td>
<td>8,000</td>
<td>8,000</td>
</tr>
<tr>
<td>Units in ending inventory</td>
<td>2,000</td>
<td>0</td>
</tr>
<tr>
<td>Units produced during the year</td>
<td>10,000</td>
<td>6,000</td>
</tr>
</tbody>
</table>

Required:
(I) Assume the company uses absorption costing.
   i. Compute the unit product cost in each year.
   ii. Prepare an income statement for each year.
(II) Assume the company uses variable costing
   i. Compute the unit product cost in each year.
   ii. Prepare an income statement for each year.
(III) Reconcile the variable costing and absorption costing net operating incomes.

6. (a) Explain the meanings of the terms "cost" and "expense" as used for cost accounting purpose.
   (b) Indicate whether each item listed below is a variable (V), Fixed (F) or Mixed Cost (M) and whether it is a product or service cost or a period cost. If some items have alternatives answers, indicates the alternatives and a reasons for them: (Number (i) is a model solution for your question)
   (i) Wages of tractor/trailer operator who move finished goods from a central warehouse to local distribution points. (Answer: F and Period cost)
   (ii) Hand soap used in factory restrooms.
   (iii) Property taxes paid on the manufacturing company headquarters.
   (iv) Drafting paper used in an architectural firm.
   (v) Cost of levels attached to shirts made by a company.
   (vi) Wages of factory maintenance workers.
   (vii) Insurance premiums on raw materials from suppliers.
   (viii) Freight costs of acquiring raw materials from supplies.
   (ix) Salaries of secretaries in a CPA firm.
(c) The following data are forming the accounts of Millville Company:

<table>
<thead>
<tr>
<th>Inventories</th>
<th>July 1, 19A</th>
<th>June 30, 19B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Finished Goods</td>
<td>Tk. 20,000</td>
<td>Tk. 28,000</td>
</tr>
<tr>
<td>Work in process</td>
<td>60,000</td>
<td>36,000</td>
</tr>
<tr>
<td>Materials</td>
<td>40,000</td>
<td>48,000</td>
</tr>
<tr>
<td>Sales discounts</td>
<td></td>
<td>Tk. 8,000</td>
</tr>
<tr>
<td>Purchase discounts</td>
<td></td>
<td>3,200</td>
</tr>
<tr>
<td>Sales</td>
<td></td>
<td>1,800,000</td>
</tr>
<tr>
<td>Purchase returns and allowances</td>
<td>20,000</td>
<td></td>
</tr>
<tr>
<td>Depreciation-factory machinery</td>
<td>160,000</td>
<td></td>
</tr>
<tr>
<td>Factory insurance</td>
<td></td>
<td>50,000</td>
</tr>
<tr>
<td>Freight out</td>
<td></td>
<td>8,000</td>
</tr>
<tr>
<td>Other factory expenses</td>
<td></td>
<td>16,000</td>
</tr>
<tr>
<td>Bond interest expenses</td>
<td></td>
<td>50,000</td>
</tr>
<tr>
<td>Sales salaries</td>
<td></td>
<td>100,000</td>
</tr>
<tr>
<td>Freight in</td>
<td></td>
<td>12,000</td>
</tr>
<tr>
<td>Direct factory labor</td>
<td></td>
<td>800,000</td>
</tr>
<tr>
<td>Materials purchases</td>
<td></td>
<td>400,000</td>
</tr>
<tr>
<td>Advertising expenses</td>
<td></td>
<td>12,000</td>
</tr>
</tbody>
</table>

Required:

(i) Prepare a Cost of Goods Sold statement for the year ended June 30, 19B
(ii) Calculate profit for the year ended June 30, 19B

7. (a) What is the rationale behind the NPV method? According to NPV, which project or projects should be accepted if they are independent? Mutually exclusive?

(b) Your Company is considering two mutually exclusive projects, X and Y, whose costs and cash flows are shown below:

<table>
<thead>
<tr>
<th>Year</th>
<th>X (Tk. 1,000)</th>
<th>Y (Tk. 1,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>(Tk. 1,000)</td>
<td>(Tk. 1,000)</td>
</tr>
<tr>
<td>1</td>
<td>300</td>
<td>50</td>
</tr>
<tr>
<td>2</td>
<td>400</td>
<td>50</td>
</tr>
<tr>
<td>3</td>
<td>700</td>
<td>50</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
The projects are equally risky, and their cost of capital is 12 percent. You must make recommendation, and you must base it on the modified IRR (MIRR). What is the MIRR of the better project?

(c) A firm with the cost of capital of 10 percent is considering the following mutually exclusive projects:

<table>
<thead>
<tr>
<th>Year</th>
<th>Project A</th>
<th>Project B</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>(Tk. 400)</td>
<td>(Tk. 600)</td>
</tr>
<tr>
<td>1</td>
<td>55</td>
<td>300</td>
</tr>
<tr>
<td>2</td>
<td>55</td>
<td>300</td>
</tr>
<tr>
<td>3</td>
<td>55</td>
<td>50</td>
</tr>
<tr>
<td>4</td>
<td>225</td>
<td>50</td>
</tr>
<tr>
<td>5</td>
<td>225</td>
<td>50</td>
</tr>
<tr>
<td>6</td>
<td>225</td>
<td>50</td>
</tr>
</tbody>
</table>

(i) According to the payback criterion, which project should be accepted?
(ii) According to the discounted payback criterion, which project should be accepted?
(iii) According to the NPV criterion, which project should be accepted?
(iv) According to the IRR criterion, which project should be accepted?

8. (a) What is meant by a product's contribution margin ratio? How is this ratio useful in planning business operations?

(b) Write short notes on the followings:
   (i) Break-even point, (ii) Margin of Safety, (iii) Contribution Margin

(c) The following information is given for the calculation of break-even-point:

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Selling price per unit</td>
<td>Tk. 5</td>
</tr>
<tr>
<td>Variable cost per unit</td>
<td>3</td>
</tr>
<tr>
<td>Contribution margin per unit</td>
<td>2</td>
</tr>
<tr>
<td>Fixed costs</td>
<td>24,000</td>
</tr>
</tbody>
</table>

You are required to calculate break-even point and desired sales volume if (i) the desired profit is Tk. 30,000 and (ii) desired profit after income tax is Tk. 20,000 and income tax rate is 40%.
(d) Here is the data of XYZ Ltd.:

<table>
<thead>
<tr>
<th>Per-unit</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sales ($20 per unit) .......... $270,000</td>
<td>20</td>
</tr>
<tr>
<td>Variable expenses .......... (189,000)</td>
<td>?</td>
</tr>
<tr>
<td>Contribution Margin .......... 81,000</td>
<td>?</td>
</tr>
<tr>
<td>Fixed expenses .......... (90,000)</td>
<td></td>
</tr>
<tr>
<td>Net operating loss .......... $(9,000)</td>
<td></td>
</tr>
</tbody>
</table>

(i) Fill up missing (?) figure in the above statement.
(ii) Draw a graph identifying BEP and profit and loss region. (using graph paper is not necessary)
(iii) If actual sales are $400000 then find out margin of safety and comment about the company.
1. (a) Discuss the running time of block alignment problem using Four Russian Speedup technique. (7)

(b) Define i-string, ILCS and CILCS. For the alphabet $\Sigma$, discuss the steps of determining ILCS in $O\left(|\Sigma| + n^2|\Sigma|^{0.376}\right)$ time with all preprocessing steps. (13)

(c) Give a 4-approximation algorithm for Sorting by Reversals problem. Analyze the approximation ratio. (15)

2. (a) (i) Discuss the amortized cost analysis using Potential Method. (5 + 5 = 10)

(ii) Using Accounting Method, prove that the worst-case cost of $n$ stack operations (PUSH, POP, MULTIPOP) is $O(n)$.

(b) What is Load Factor of a Dynamic Table? Using Potential Method, prove that the amortized cost of $n$ operations (INSERT, DELETE) on a Dynamic Table data structure is $O(n)$. (20)

(c) Prove that amortized number of rotations by a splay operation on an $n$-node Splay tree is at most $3\log n + 1$. (5)

3. (a) How does splaying improve the performance of a Splay tree? Describe the advantages of a Splay tree. Draw different stages of the following Splay tree during the insertion of value 12. (10)

(b) Does the greedy algorithm provide the guarantee to take optimal number of steps to sort a permutation using reversals of length $n$? Explain your answer with a brief example.
(c) (i) Explain the basic principle of a branch-and-bound technique. (10)

(ii) Write an algorithm that uses branch-and-bound technique to find the optimal TSP tour. For the given graph, simulate the steps with branching tree. Assume the starting node is "A". (3+12=15)

4. (a) Suppose you need to search a given target text T for an occurrence of any one of a given set of k pattern strings. Assume that all the k patterns have the same length. How can you extend the Finite Automata method to solve problem? Write the extended algorithm of the Finite Automata method. (15)

(b) (i) Write down the algorithm for finding maximum independent set in a graph using branch and reduce technique.

(ii) Prove that the time complexity of the algorithm is $O(3^{n/3})$.

(iii) Using a branching tree show the steps of the algorithm and find a maximum independent set of the graph in the following figure. (5+5+5=15)

(c) Briefly describe how the Weighted Vertex Cover can be solved problem using bitmasking DP technique. Also mention the complexity of the algorithm. (5)
CSE 461

SECTION – B

There are FOUR questions in this Section. Answer any THREE questions.

5. (a) What is meant by approximate algorithms? Discuss performance ratio in the context of approximation algorithm. (4+8)
   (b) Give a polynomial time 2-approximation algorithm for the Travelling Salesman Problem. Prove the approximation ratio of the algorithm. (13)
   (c) Give an approximation algorithm for the Vertex Cover Problem. Deduce the performance ratio of your given algorithm. (10)

6. (a) Write down the expected number of attempts to reach success in randomized 8-queen problem. Given mathematical proof. (8)
   (b) How is the analysis of a randomized algorithm from an average case analysis of a deterministic algorithm? (7)
   (c) Analyze the expected searching time and the expected space required for a skip list of n elements. (12)
   (d) Define the skip list data structure using an example. Describe how a skip list is built for a given set of a sorted elements. (8)

7. (a) Mention the approximation ratio of the GREEDY-SET-COVER algorithm. Suppose the approximation ratio is ρ(n). Prove that the GREEDY-SET-COVER algorithm is a polynomial time ρ(n)-approximation algorithm for that ρ(n). (13)
   (b) Give a Linear Programming based solution for the Set cover Problem. (12)
   (c) Explain Karger’s Min-cut Algorithm with an example. (10)

8. (a) What is Monte Carlo algorithm? Discuss its properties. (10)
   (b) Explain Fermat’s Little Theorem. (10)
   (c) Give a randomized algorithm for finding Hamiltonian paths in a given graph. Prove correctness of your algorithm. (10)
   (d) What is the best, worst and average number of comparisons in a randomized Quick Sort algorithm? (5)
L-4/T-2/CSE  

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA


Sub: **CSE 471** (Machine Learning)

Full Marks: 210  

Time: 3 Hours

The figures in the margin indicate full marks.

USE SEPARATE SCRIPTS FOR EACH SECTION

**SECTION – A**

There are **FOUR** questions in this section. Answer any **THREE**.

1. (a) What is the objective function to optimize when finding the first principal component of a non-square data matrix? How does this objective function capture the direction of maximum variance in data? (5+5)

   (b) Derive the loss function for sparse matrix factorization. Write the pseudocode of alternating least square algorithm handling sparsity. (10+5)

   (c) When should we not use nearest-neighbor non-parametric models? How can we handle such situation? (5+5)

2. (a) Probability of a person having no family history of diabetes (no history) is 0.70

   Probability of having Diabetes when the corresponding person has no history is 0.25
   has history is 0.65

   Probability of having Hyperglycemia when a person has Diabetes is 0.85
   no Diabetes is 0.20

   Probability of having Hypertension when a person has Diabetes is 0.60
   no Diabetes is 0.40

   You can safely ignore all other possible dependencies. From the above information, draw and annotate the corresponding Bayesian network with conditional probability tables. For this Bayesian network, infer the marginal distribution of P (Diabetes, Hyperglycemia) when we have evidence that the person has a family history of Diabetes and is diagnosed with Hypertension. (5+10)

   (b) For the Bayesian network in question 2(a) with same evidence variables, find the conditional distributions of other two unknown variables. Write the pseudocode of a Gibb's sampler for the inference of marginal distribution of these two unknown variables. (10+10)

Contd .......... P/2
3. (a) What is the latent variable in a mixture model? Write the generative model of a mixture of generic distributions $P$.  
(b) Derive analytical solution of the M-step for a univariate Gaussian mixture model (GMM).  
(c) Write the expected complete log-likelihood for a GMM with a Dirichlet prior over the mixture proportions.  

4. (a) What are the four inference tasks in the context of state-space model? Give their mathematical formulations.  
(b) Draw an LSTM with input, forget and output gate. How these gates control information flow through time?  
(c) Why do we need pooling layer in a deep convolutional network? Which two parameters do you need for a max-pooling layer?  

**SECTION - B**

There are **FOUR** questions in this section. Answer any **THREE**.

5. (a) What is the key difference between traditional algorithms and machine learning algorithms? Briefly explain five real world applications of machine learning algorithms.  
(b) What is the significance of generalization in the context of machine learning algorithms? Differentiate between supervised learning and unsupervised learning.  
(c) Briefly explain the Binomial and multivariate Gaussian probability distributions.  
(d) Briefly explain the maximum likelihood estimation technique.  

6. (a) How does the cross-validation technique evaluate machine learning algorithms? Explain.  
(b) What is stacking in the context of ensemble learning?  
(c) Explain the bagging approach in ensemble learning. What is the key difference between random forest bagging and traditional bagging approaches?  
(d) From the confusion matrix given below, calculate the following: sensitivity, specificity, precision, recall, and F1 score.  

<table>
<thead>
<tr>
<th>Predicted</th>
<th>Buyer</th>
<th>Non-Buyer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actual</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Buyer</td>
<td>516</td>
<td>25</td>
</tr>
<tr>
<td>Non-Buyer</td>
<td>10</td>
<td>725</td>
</tr>
</tbody>
</table>

Contd ........... P/3
7. (a) Define entropy and information gain. Build a decision tree using ID3 algorithm from
the following data.

<table>
<thead>
<tr>
<th>Day</th>
<th>Weather</th>
<th>Hunger</th>
<th>Location</th>
<th>Bought Food</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Hot</td>
<td>Hungry</td>
<td>Home</td>
<td>No</td>
</tr>
<tr>
<td>2</td>
<td>Hot</td>
<td>Hungry</td>
<td>Not Home</td>
<td>Yes</td>
</tr>
<tr>
<td>3</td>
<td>Cold</td>
<td>Not Hungry</td>
<td>Home</td>
<td>No</td>
</tr>
<tr>
<td>4</td>
<td>Hot</td>
<td>Not Hungry</td>
<td>Not Home</td>
<td>No</td>
</tr>
<tr>
<td>5</td>
<td>Cold</td>
<td>Hungry</td>
<td>Home</td>
<td>No</td>
</tr>
<tr>
<td>6</td>
<td>Cold</td>
<td>Not Hungry</td>
<td>Not Home</td>
<td>No</td>
</tr>
<tr>
<td>7</td>
<td>Hot</td>
<td>Hungry</td>
<td>Not Home</td>
<td>Yes</td>
</tr>
<tr>
<td>8</td>
<td>Cold</td>
<td>Hungry</td>
<td>Not Home</td>
<td>Yes</td>
</tr>
<tr>
<td>9</td>
<td>Cold</td>
<td>Not Hungry</td>
<td>Home</td>
<td>No</td>
</tr>
<tr>
<td>10</td>
<td>Hot</td>
<td>Not Hungry</td>
<td>Home</td>
<td>No</td>
</tr>
</tbody>
</table>

(b) Describe an approach to solve the overfitting problem in the context of decision trees.
(c) Briefly explain the kernel density estimation approach.

8. (a) Define the least squares linear regression model. Explain how we can obtain the
optimized weight vector for this model without considering regulation.
(b) What is the importance of regularization in risk minimization? Briefly explain the
ridge regression model.
(c) What is the advantage of online learning over offline learning?
(d) Estimate the parameter \( \theta \) for a Bernoulli distribution using the maximum a posteriori
estimation approach where \( \theta \) denotes the probability of head. Assume that the prior
distribution of \( \theta \) is an uniform distribution over the interval \((0, 1)\).
SECTION – A
There are FOUR questions in this section. Answer any THREE.

1. (a) What is a demand function? Which factors would you consider to construct a comprehensive demand function for CC TV camera in Bangladesh? Give reasons in favour of your answer. (13 1/3)
   (b) State the assumptions of the cardinal theory of utility analysis and illustrate the law of diminishing marginal utility. (10)

2. (a) Define price elasticity and cross-price elasticity of demand. How would you derive the formulae for measuring these two types of elasticity of demand? (13 1/3)
   (b) Given the demand function of a commodity X.
   \[ Q_d = 1180 - 15P_x + 0.008M + 2.4P_y - 4.5P_z \]
   Where price, of X, \( P_x = \text{tk. 25} \), price of Y, \( P_y = \text{tk. 55} \), price of Z, \( P_z = \text{tk. 13} \) and income, \( M = \text{tk. 50000} \). Find the cross-price elasticities and income elasticity of X. State the implications of the results you have obtained. (10)

3. (a) Define indifference curve. Construct an indifference curve from a hypothetical utility schedule for two commodities say, mango and apple. Show the relationship between Marginal Rate of Substitution (MRS) and Marginal Utility (MU). (13 1/3)
   (b) What do you know about an indifference map? Show the optimum consumption point of a 'rational' consumer given the price of the commodities and budget line of the consumer. (10)

4. Write short notes on any THREE of the following (23 1/3)
   (i) Substitution effect and income effect
   (ii) Movements along and shifts in the supply curve
   (iii) Market demand curve and market equilibrium
   (iv) Basic economic problem

Contd .......... P/2
HUM 275

SECTION – B

There are FOUR questions in this section. Answer any THREE.

5. (a) A manufacturer has a fixed cost of $40,000 and a variable cost of $1.60 per unit made and sold. Selling price is $2 per unit.

   i) Find the revenue, cost and profit functions using q for the number of units.
   
   ii) Compute profit if 150,000 units are made and sold.
   
   iii) Find the break-even quantity.
   
   iv) Construct the break-even chart. Label the cost and revenue lines, the fixed cost line, and the break-even point.

   (b) Complete the following table and sketch the graph explaining the relations among the various short run cost curves.

   
<table>
<thead>
<tr>
<th>Quantity of output</th>
<th>Total fixed cost</th>
<th>Total variable cost</th>
<th>Total cost</th>
<th>Average fixed cost</th>
<th>Average variable cost</th>
<th>Average Total cost</th>
<th>Marginal cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>70</td>
<td>30</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>70</td>
<td>40</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>70</td>
<td>45</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>70</td>
<td>55</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>70</td>
<td>75</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>70</td>
<td>120</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6. (a) From the following revenue and cost functions calculate the profit maximizing level of output and maximum profit.

   \[ R = 111Q - 2Q^2 \]
   \[ C = \frac{1}{3}Q^3 - 8Q^2 + 122Q + 50 \]

   (b) Graphically explain the short run equilibrium of a firm under perfect competition.

7. (a) Explain producer's equilibrium with the help of iso-cost ad isoquant curves.

   (b) From the following functions calculate the amount of labour and capital that maximize output. What is the maximum amount of output?

   \[ Q = 200L^{0.5}K^{0.5} \]

   \[ 3000 = 35L + 45K \]

8. (a) What do you understand by localization of industries? What are the causes of localization of industries?

   (b) Explain the advantages and disadvantages of localization of industries.

   (10)