BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2   B. Sc. Engineering Examinations 2013-2014

Sub : **CSE 409** (Computer Graphics)

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) Find the composite transformation matrix that would transform the vertices $A(1,2)$, $B(5,2)$, and $C(3,5)$ of a triangle into the vertices $A_1(-1, -2)$, $B_1(-4, -5)$, and $C_1(-4, -2)$ respectively. You do not have to perform matrix multiplication.   **(14)**

(b) You need to align the vector $V = 3i - 7j - 4k$ along **positive Y** axis. You can achieve this in two ways –

  • align **V** along **YZ** plane, then along **positive Y** axis

  • align **V** along **XY** plane, then along **positive Y** axis

Each of the ways requires two rotations. Find the angle of each of these rotations, along with the rotational axes and directions.   **(16)**

(c) Suppose you apply a rotational transformation as given by the following matrix –

$$\begin{pmatrix} \cos\theta & 0 & \sin\theta & 0 \\ 0 & 1 & 0 & 0 \\ -\sin\theta & 0 & \cos\theta & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}$$

Without performing matrix multiplication, find out the directions along which each of the principal axes will be aligned after this transformation. Briefly justify your answer.   **(15)**

2. (a) Sphere S_1 is centered at $(-5,0,0)$ and has a radius of 5 units. Ray l_1 originating from $(-10, 10, 0)$ and having direction parallel to $(5i - 5j)$ hits S_1; suppose the reflected ray is R_1. Sphere S_2 is centered at $(7,0,0)$ and has a radius of 10 units. Ray l_2 originating from $(20,20,0)$ and having direction parallel to $(-13i - 10j)$ hits S_2; suppose the reflected ray is R_2. Find out the point where R_1, and R_2 intersects.   **(15)**

(b) An axis-aligned cube centered at $(37,63,22)$ has a length of 10 units and is made of a material whose refractive index is 1.5. This cube resides in a medium whose refractive index is also 1.5. A ray originating from $(68,128,10)$ and having direction parallel to $(-4i - 10j + 2k)$ is incident upon the cube. Find out the hit points(s) and equation of the refracted ray which comes out of the cube.   **(15)**

(c) If reflected color is represented as $C_{reflected}$ and refracted color is represented as $C_{refracted}$, then their combined color $c_{combined}$ is given by the following equation –

$$c_{combined} = R \times C_{reflected} + (1 - R) \times C_{refracted}$$

What will be the value of R when total internal reflection occurs? Give an intuitive explanation supporting your answer.   **(5)**
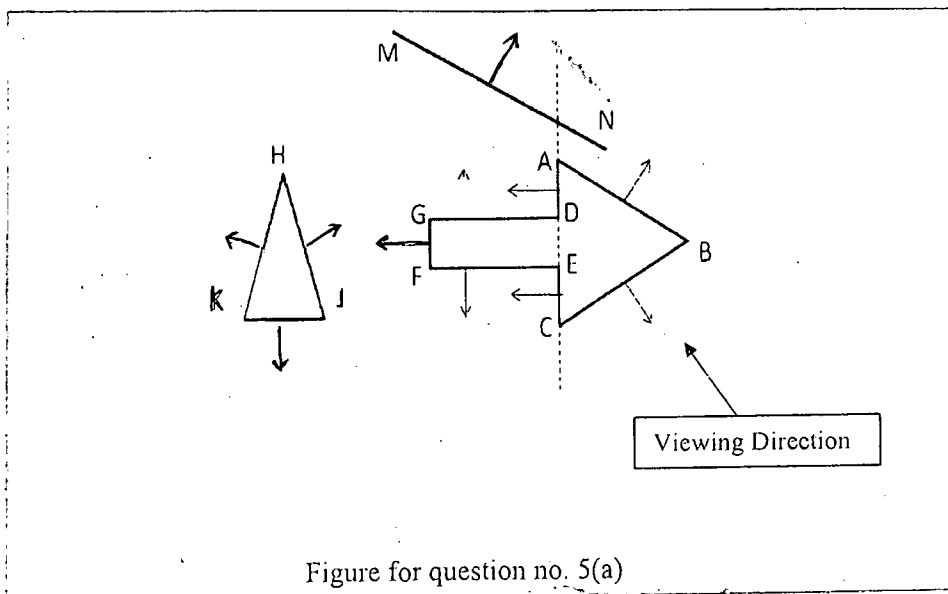
CSE 409

3. (a) Derive the basis matrix of cubic B-spline. **(15)**

(b) A quintic curve can be represented as $P(t) = at^5 + bt^4 + ct^3 + dt^2 + et + f$. Find all the forward difference variables needed to construct the forward difference table, assuming the interval is represented by δ. Using these variables, construct the forward difference table for the given curve from $t = 0$ to $t = 4$ with an interval of 0.4; provided that the values of a, b, c, d, e, and f are 1, 2, 3, 3, 2, and 1 respectively. **(15)**

(c) The four control points of a Bezier curve are $P_1(0, 0)$ and $P_2(1, 1)$. $P_3(2, 2)$ and $P_4(3, 3)$ Draw a rough sketch of the curve. Briefly justify your construction. **(5)**

4. (a) Camera's current position is at (14,25–16), the camera is looking at the point(37,42,20), and the up vector is along $(3i + 5j − 4k)$. Find the transformation matrix that would align the direction that the camera is looking at along the negative **Y** axis, and align the direction that points to the right of the camera along the negative **X** axis. **(15)**

(b) The center of projection is at the point $(− 15, − 7, 3)$ and the viewing plane is given by the equation $x = 0$. A line segment is defined by the two points $A(10,8,23)$ and $B(10,18,12)$. What is the length of the projection of AB? **(10)**

(c) Suppose camera is positioned at (5,3,7), it is looking at the point (9,3,7), and the up vector is $(3i + 2j)$. Can $(i + 3j)$ be a choice for another up vector? What about $(2i − f)$? Justify your answer. **(10)**

SECTION – B

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

5. (a) See the top view of a scene in figure for question no. 5(a) where surface normal is shown for each polygon face. So the edges are: AD, EC, AB, CB, GD, FE, GF, HK, KJ, HJ, and MN. Here, AD and CF are parallel and lie in the same plane, that is, coplanar. **(10+7=17)**

Figure for question no. 5(a)

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Contd ... Q. No. 5(a)

 (i) Construct a BSP tree considering the dotted line as the first division for the region. While selecting edge at any node for space division, minimize polygon splinting. In case of tie, select edges in a alphabetic order.

 (ii) For the viewing direction shown in figure, write down the order of displaying the polygons.

(b) Show the calculation for finding the Area of Koch Snowflake Curve for generation n.   **(12)**

(c) Why Cyrus-Beck Parametric Line Clipping Algorithm does not work with convex polygon clip region?   **(6)**

6. (a) Consider Midpoint ellipse scan conversion algorithm.   **(14+6=20)**

 (i) Show necessary calculation to derive the equation for decision variable **d**(first order difference only) for drawing the arc of the ellipse that lies in the **4th quadrant** (shown in the figure). Explain your answer with necessary figures.

 (ii) Also show the calculation of initial value of **d**.

Figure for question no. 6(a)
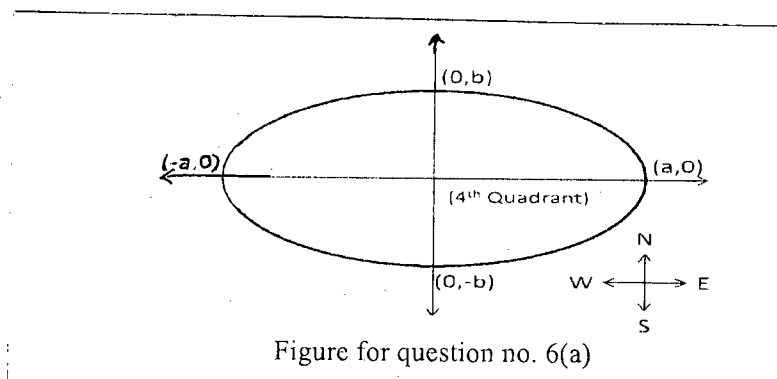
(b) Explain the approach of simulating roughness by Bump Mapping.   **(10)**

(c) Among the ambient, diffused, and specular reflected components of light, which component(s) is(are) responsible for the actual color of an object?   **(5)**

7. (a) See the following string production rules for drawing a kind of fractal:

Variables: A and B

  $A \rightarrow + B - A - B +$
  $B \rightarrow - A + B + A -$
  Atom = A
  Angle = 60°

Here, A and B both mean "draw forward", + means "turn **left** by Angle", and − means "turn **right** by Angle".   **(6+8=14)**

 (i) Write down the string of **first**, second, and third generation of this fractal.

 (ii) Draw only the second generation of this fractal. While drawing the fractal, you can consider the starting direction along the positive X axis.

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Contd ... Q. No. 7

(b) Consider Gupta-Sproull algorithm for antialiased scan conversion of lines. This algorithm uses weighting function Filter (D, t) where D is the perpendicular distance between chosen pixel center and the line center, and t is the thickness of the line. Let us think we are at any pixel $P(X_p, Y_p)$ and next chosen pixel is E. For clarification see the figure: **(9+6+6=21)**
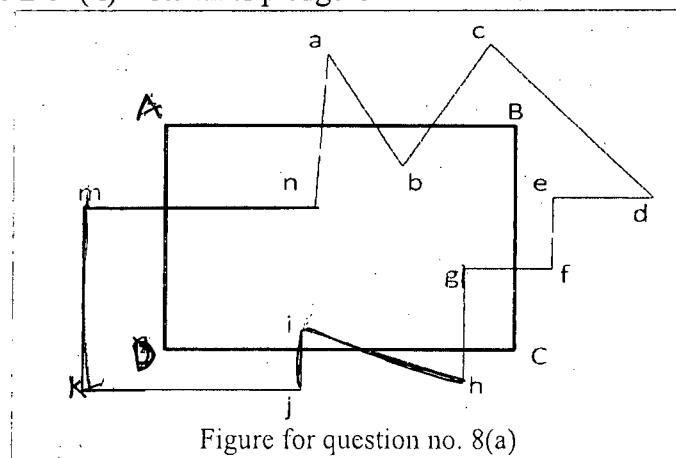

Figure for question no. 7(b)
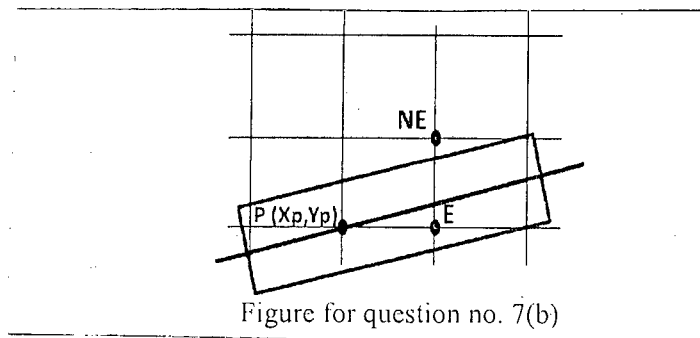
For this chosen pixel E, show the calculation for finding D, D_{up}, and D_{down}.

8. (a) Let abcdefghijkmn and ABCD are the polygon to be clipped and viewing window respectively as shown in the figure for question no. 8(a). Using Sutherlan-Hodgman polygon clipping algorithm, show the steps of clipping the polygon in the following order of clipping edges: **(7.5+7.5=15)**

(i) Right clip edge BC (ii) Bottom clip edge CD

Figure for question no. 8(a)

(b) You have a apply Gouraud shading for drawing the object shown in the figure for question no 8(b). Here, the polygon is ABNDCM and coordinate of each vertex is shown in figure. Color intensity of the vertices are given as Ca, Cb, Vn, Cd, Cc, Cm respectively. Two scan lines YS1 and YS2 are also shown. **(3+3+3+3=12)**

Figure for question no 8(b)
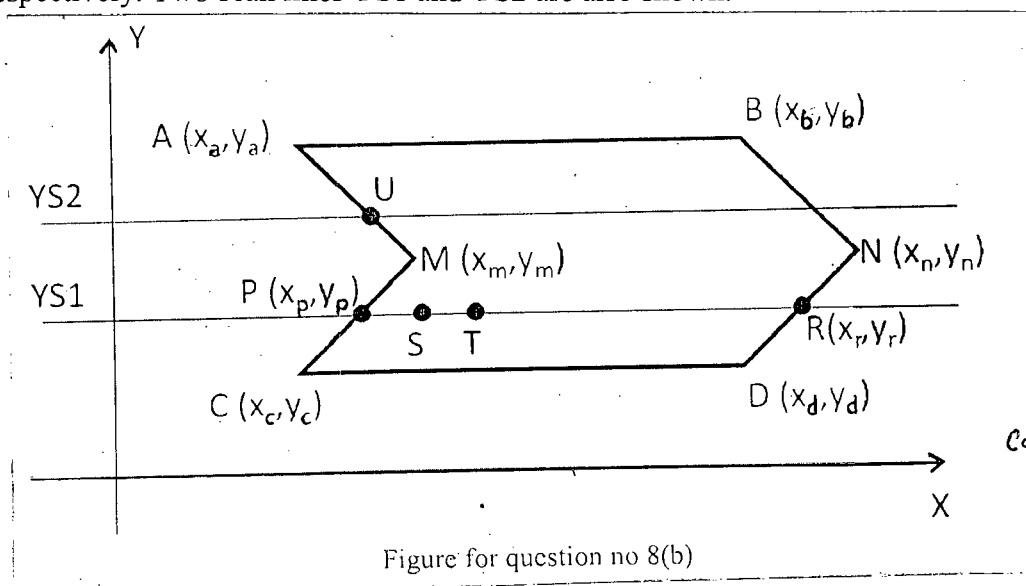
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Contd ... Q. No. 8(b)

(i) YS1 intersects the polygon at $P(X_p, Y_p)$ and . Derive the equation of calculating color intensity Cp at Cr at R.

(ii) Derive the equation of calculating color intensity Cs at S in term of CP and C_R

(iii) Derive the equation of calculating color intensity CT at T in term of CS using incremental approach

(iv) For he scan line YS2, can you find the color intensity at CU in term of CP using incremental approach? Explain Diffuse Reflectance.'

(c) Write short note on 'Ideal Diffuse Reflectance'   (8)

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2   B. Sc. Engineering Examinations 2013-2014

Sub : **CSE 461** (Algorithm Engineering)

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) Give an example of a graph for which APPOX-VERTEX-COVER always yields a suboptimal solution. **(3)**

   (b) Consider each of the following words as a set of letters: {arid, dash, drain, lost, slate, thread}. Show which set cover GREADY-SET-COVER produces when ties are broken in favor of the word that appears first in the dictionary. **(10)**

   (c) Prove that GREADY-SET-COVER is a polynomial time $\rho(n)$ - approximation algorithm with $\rho(n) = H (\max) \{|S|: S \in F\}$, where $H(n)$ is the nth harmonic number. **(22)**

2. (a) Design a Linear programming model for Set Cover problem. Describe a randomized rounding technique for your LP solution such that probability of an item not covered is inversely proportional to polynomial of size of the Universe Set. Provide proof of correctness. **(12)**

   (b) Write the algorithm for finding a maximum independent set in a graph. Using a branching tree illustrate the steps of the branch and reduce algorithm, and find all maximum independent sets of the graph given in Figure 1. Show that the time complexity of the algorithm is $O(3^{n/3})$. **(18)**

Figure 1 : The Graph mentioned in Q. 2(b).
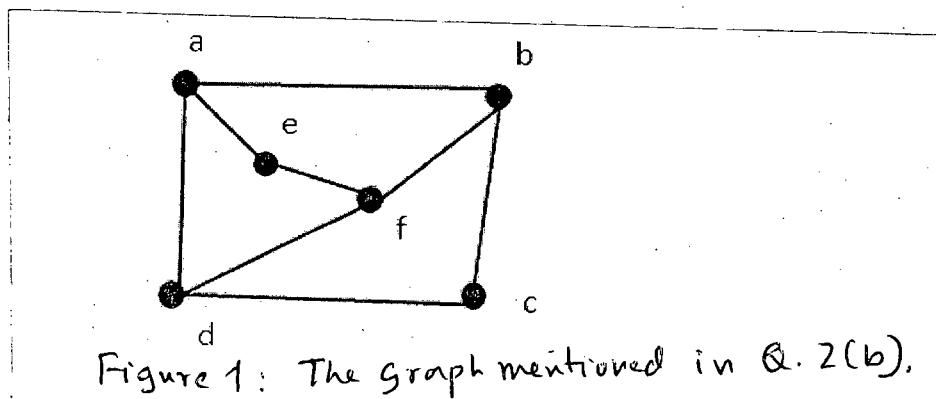
   (c) Design an exact algorithm for solving the Set Cover problem using the bit masking DP technique. **(5)**

3. (a) Define CLCS, IString, and ILCS. Design an efficient dynamic programming algorithm for ILCS problem and discuss the complexity of your algorithm. **(13)**

   (b) What is affine gap penalty? Write the recurrences for sequence alignment problem that think of affine gap penalty but runs in $O(n^2)$ complexity. **(7)**

   (c) What is block alignment problem? Discuss how Four Russian Speed Up technique makes the block alignment problem time efficient. **(15)**
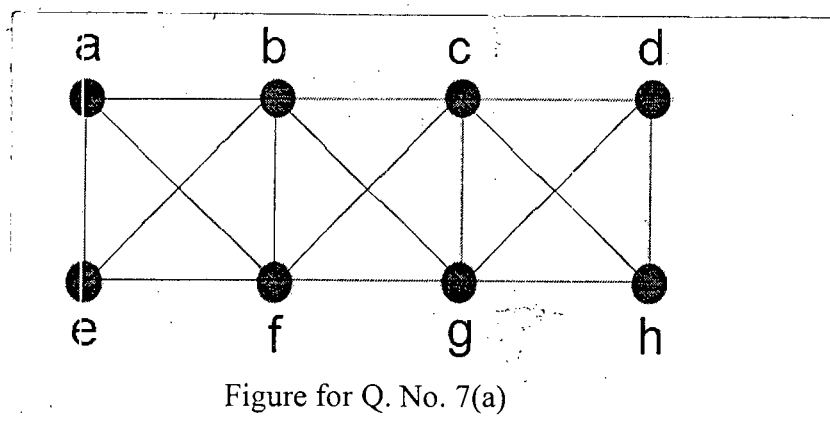
CSE 461

4. (a) Explain how to determine the occurrences of pattern **P** in the text **T** by examining only the prefix function π for the string **PT**. Discuss the complexity of this approach. **(10)**

(b) You are looking for a given m*m pattern in an n*n array of characters. How can you modify Rabin-Karp method to solve this pattern search problem? **(10)**

(c) For the given text "abacbba", solve the following problems and explain the time complexity of each. **(15)**

    (i) Construct string-matching automata.

    (ii) Construct the Suffix Trie.

    (iii) Using Suffix Trie find pattern "bacb" and "cbd".

    (iv) Using Suffix Trie build the Suffix Array.

    (v) Using Suffix Trie find out the value of lcp(1, 5) [0-indexing]

SECTION – B

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

5. (a) Show the relationship among P, NP, NP-complete, NP-hard, Co-NP and PSPACE problems. Discuss the general strategy for proving a new problem NP-complete. **(8+6)**

(b) What do you understand by Problem X $\leq_p$ problem Y? Prove that 3-SAT $\leq_p$ Independent Set. **(3+10)**

(c) Define Parallelism. Does it do any good using more processors that the parallelism of an algorithm? **(4+4)**

6. (a) How do you measure the performance of an online algorithm? Derive the CR of Moving to Front algorithm for linear list search. **(3+12)**

(b) Prove that Hamiltonian Cycle problem is NP-complete using a reduction from 3-SAT. **(12)**

(c) Draw the computation tree for recursively (without memorization) computing the 4th Fibonacci number fib(4). Classify its edges and find its span. **(8)**

7. (a) Simulate an iteration of Karger's Min-Cut algorithm for the graph in Figure for Q. No. 7(a). Always choose the edge with the highest probability as the next edge to contract. **(12)**

Figure for Q. No. 7(a)

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Contd ... Q. No. 7

(b) Suppose a Monte-Carlo algorithm for a problem has execution time T and probability of success p. Also assume that the correctness of the produced solution can be verified in time t. Can you find a Las Vegas algorithm for solving the same problem? What is the expected execution time of your algorithm? **(8)**

(c) Show that in an n-Queen problem, a greedy Las Vegas algorithm takes expected n attempts to reach success. **(7)**

(d) Derive the expected height of a skip list of n elements. **(8)**

8. (a) "While inserting element in a Dynamic Table, it is better to double the capacity than to increment by a constant amount, each time the Table is full" – Justify the above statement using aggregate and accounting methods of amortized analysis. **(10+10)**

(b) Prove that the amortized number of rotations by a Splay operation on an n-node BST is at most $(1 + 3\lg n)$. **(15)**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2   B. Sc. Engineering Examinations 2013-2014

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) Define the following basic principles of Machine Learning: (i) Occam's razor, (ii) sampling bias, and (iii) data snooping.   **(9)**

    (b) Show the major components of learning and their relationship using a block diagram.   **(10)**

    (c) For the linear support vector machine (SVM), derive the function with necessary constraints that we need to minimize the margin.   **(10)**

    (d) What is Hoefdding's inequality in learning theory?   **(6)**

2. (a) What function do you maximize in Markov decision process based re-enforcement learning?   **(5)**

    (b) Derive Bellman's equation for the optimal value function. How do you find the optimal policy from the derived equation?   **(10+5)**

    (c) Show that the expected out of sample error can be expressed as the summation of bias and variance.   **(10)**

    (d) What's the purpose of a soft margin SVM?   **(5)**

3. (a) Show that $K(x, x') = (1+x^T x')^2$ is a valid kernel for SVM, where x is a 2-dimensional data.   **(10)**

    (b) Define the growth function and break point. What is the relationship between the growth function and a break point?   **(5+5)**

    (c) How do you compute k principal components of the data? When the data dimension is big, what strategy should you take to find principal components?   **(10+5)**

4. (a) Let $\{x^{(1)}, x^{(2)}, ..., x^{(m)}\}$ be a given set of input and $z^{(i)}$s be the random variables that indicate which of the k Gaussians each $x^{(i)}$ come form. Write down the steps of Expectation Maximization (EM) algorithm for density estimation of unknown latent variables **z** in a mixture of Gaussians model. If the distribution dies not follows Gaussians, how should you modify the above algorithm using Jensen's inequality?   **(10+10)**

    (b) Show that the VC dimension, d_{vc} of perceptrons in a d dimensional dataspace is d+1.   **(10)**

    (c) Give a real-world learning example where a false accept should get a higher priority than a false reject.   **(5)**

CSE 471

SECTION – B

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

5. (a) Explain the reasons of choosing an ensemble method over a single classifier with a suitable example. **(7)**

(b) Write the differences between bagging and boosting methods of ensemble learning? **(7)**

(c) Define weak and strong classifiers. How does AdaBoost algorithm assign weights to different classifiers so that combined classification error is minimized? **(4+11)**

(d) Does AdaBoost algorithm cause overfitting of data? Justify your answer. **(6)**

6. (a) The following table contains training examples to determine whether or not Mashrafe enjoys cricket. **(18+5)**

	Sky	Temperature	Humidity	Wind	Play Cricket
1	Sunny	42	High	Weak	No
2	Sunny	35	High	Strong	Yes
3	Overcast	44	High	Weak	No
4	Rain	20	Normal	Weak	No
5	Rain	12	Normal	Strong	No
6	Overcast	25	Normal	Strong	Yes
7	Overcast	32	Normal	Weak	Yes

In the table temperature is continuous valued attribute and the rests are discrete valued attribute.

(i) Using ID3 algorithm construct a minimal decision tree that predicts whether or not Mashrafe enjoys cricket on a certain day. Show each step of your computation.

(ii) Translate your decision tree in 6(a). (i) to a collection of rules.

(b) Explain with examples how the following cases are handled in Decision Tree Learning Algorithm: **(4+4=8)**

(i) Attributes with missing values

(ii) Attributes with differing costs

(c) Describe the impact of high learning rate on stochastic gradient descent search? **(4)**

7. (a) Define likelihood in terms of probabilistic interpretation. What is the advantage of measuring log likelihood over pure likelihood in case of logistic regression? **(6)**

(b) What is overfitting of data? How overfitting of data can be avoided? **(8)**

(c) What will be the change in update rule of Newton's method if it is used to minimize rather than maximize a function? **(7)**

CSE 471

Contd ... Q. No. 7

(d) Suppose, you want to build an email spam filter using a machine learning technique. Here, messages are only classified according to whether they are spam or non-spam email. After learning to do this depending on a training set, we want our email reader to automatically filter out the spam messages and perhaps place them in a separate mail folder. Which machine learning technique do you prefer to use? Model the email filter depending on your learning technique. **(14)**

8. (a) When does logistic regression always show better performance than Gaussian Discriminant Analysis? Explain the reason. **(3+5=8)**

(b) Does a perception algorithm provide a unique classifier if the training examples are linearly separable? Justify your answer. **(10)**

(c) What do you want a regressor to do? **(5)**

(d) Briefly explain ruled post pruning and reduced error pruning? **(12)**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2   B. Sc. Engineering Examinations 2013-2014

Sub : **HUM 275** (Economics)

Full Marks : 140   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) Explain the concept of investment. Discuss the circular flow of income and expenditure in a two sector economy.   **(7)**

    (b) Discuss the various difficulties in the measurement of national income of a country.   **(6)**

    (c) Calculate national income from the following information: **(7)**

    GNP = Tk. 1,15,000 crore

    Depreciation = Tk. 10,500 crore

    Indirect tax = Tk. 11,000 crore

    Subsidy is 20% of indirect tax.

    (d) Briefly discuss the fiscal policy for controlling inflation in our country. $(3\frac{1}{3})$

2. (a) Illustrate the concept of production function. $(3\frac{1}{3})$

    (b) Explain the various returns to scale of production.   **(6)**

    (c) Write down the statement of application of Euler's theorem in the theory of distribution of production. How can you show the exhaustion of factor income according to the Euler's theorem?   **(7)**

    (d) Discuss the various internal and external economies of scale of production.   **(7)**

3. (a) What do you mean by the concept of optimization? How can it be achieved?   **(5)**

    (b) Discuss the short run equilibrium of a firm under monopoly market.   **(5)**

    (c) Given the following total revenue (TR) and total cost (TC) functions for a firm   **(7)**

    $$TR = 4000Q - 33Q^2$$

    $$TC = 2Q^3 - 3Q^2 + 400Q + 5000$$

    where Q is quantity of output.

    (i) Set up the profit function

    (ii) Find the quantity which makes the profit maximum

    (iii) Find the maximum profit and verify that is maximized.

    (d) Define the concept of long run. How will you derive the long run average cost (LAC) curve of a firm from its short run average cost curves? Why is LAC curve called the 'planning curve'? $(6\frac{1}{3})$

HUM 275/CSE

4. (a) What is meant by the concept of inflation? What are the causes of demand pull and cost push inflation? **(6)**

(b) Compare graphically the effects of demand pull and cost push inflation on the price level and output. **(6)**

(c) Make a comparison between the effects of demand pull and cost push inflation. What do you mean by stagflation? **($5\frac{1}{3}$)**

(d) How will you determine macroeconomic equilibrium with the help of aggregate demand and aggregate supply? **(6)**

SECTION – B
There are **FOUR** questions in this section. Answer any **THREE**.
Symbols indicate their usual meaning.

5. (a) Define demand function. **(5)**

(b) What are the main determinants of demand? Explain them. **(10)**

(c) Why do demand curves generally slope downward? **($8\frac{1}{3}$)**

6. (a) How could you measure price elasticity of demand at any point of a straight line demand curve? Explain graphically. **(10)**

(b) Show that any straight line supply curve passing through the origin has a unitary elasticity of supply. **($3\frac{1}{3}$)**

(c) From the following table calculate elasticity of demand if you move from point A to C and explain what you understand from the result. **(10)**

POINT	Y	Q
A	5000	500
B	6000	600
C	7000	700

7. (a) Explain the properties of an indifference curve. **(10)**

(b) Explain consumer's equilibrium with the help of budget line and indifference curve. **($8\frac{1}{3}$)**

(c) What are the assumptions of the indifference curve analysis? **(5)**

8. (a) How is price determined in an economy under competition? What will happen to the price and quantity due to simultaneous change in supply and demand? **(10)**

(b) From the following demand and supply functions, calculate equilibrium price and quantity and show the result in a graph. **($13\frac{1}{3}$)**

$$P = 0.20Q + 150$$
$$P = -0.60Q + 230$$

(i) What will happen to the equilibrium price and quantity if government imposes a unit tax of Tk. 10 per unit?

(ii) Describe the change in equilibrium. Show the equilibrium coordinates on the same graph.

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2   B. Sc. Engineering Examinations 2013-2014

Sub : **CSE 463** (Computational Geometry)

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) In Graham Scan algorithm for computing convex hull in 2D, how will you output   **(7+7)**
    (i) All points in the hull?
    (ii) Only the extreme points?

    (b) Given a set of n points in 2D, outline an algorithm of complexity $O(n^2)$ for computing the minimum area bounding rectangle. Give an idea for achieving an even faster algorithm.   **(10+5)**

    (c) Write pseudo-code for computing the lower tangent of two non-overlapping convex hulls in 2D.   **(6)**

2. (a) Given a set of n rectangles in 2D, write pseudo-code for an algorithm of complexity $O(n^2)$ to compute the union area of the rectangles. Can you achieve $O(n lg n)$ complexity?   **(15+5)**

    (b) In divide and conquer method for computing the voronoi diagram, which algorithm do you use to compute the convex hull? What will go wrong if you use any other algorithm?   **(4+5)**

    (c) Compare the complexity of Chan's algorithm and Quick Hull algorithm for computing convex hull in 2D, provided that the input set of points are randomly generated and uniformly distributed over the plane.   **(6)**

3. For the graph shown in Figure for Q. No. 3, find the Schnyder labeling, the Realizer and the planar straight line grid drawing of the graph using Realizer method. Show all steps.   **(35)**
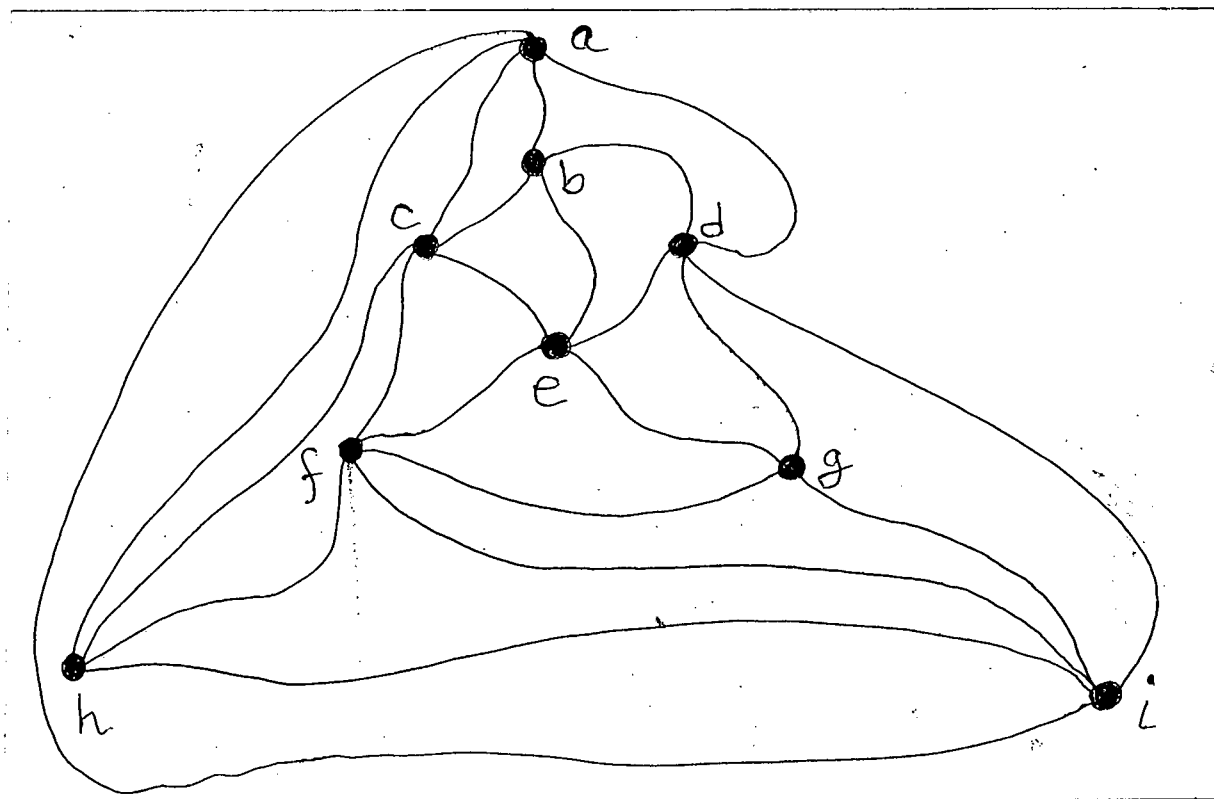

Figure for Q. No. 3

CSE 463

4. (a) Prove that every triangulated plane graph has a canonical ordering. **(10)**

(b) Show the correctness of the Shift method for planar straight line grid drawing. Briefly describe the basic idea behind achieving a linear time implementation. **(9+6)**

(c) Draw a set of 10 points in 2D for which the Quick Hull algorithm for computing convex hull has the worst complexity. **(10)**

SECTION – B

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

5. (a) Prove that every polygon P of n vertices may be partitioned into triangles by the addition of (zero or more) diagonals. Please note that if you need to use some results to prove this you have to prove that result as well. **(20)**

(b) Using the above theorem, develop an algorithm to find a triangulation of a polygon and deduce its running time. Can you briefly outline a simple modification to improve the running time by a factor of n? **(5+5+5)**

6. Using the result that a simple polygon with n vertices can be partitioned using Algorithm A into y-monotone polygons in $O(n \log n)$ time and linear space, discuss and develop an algorithm to triangulate a simple polygon efficiently. Deduce its running time and space complexity. Will your algorithm work on a planar subdivision? Justify your answer. **(12+12+11)**

7. (a) Formally define Voronoi diagram. Prove that the size of a Voronoi diagram of a set of n sites is $O(n)$. **(10)**

(b) Prove that a minimum spanning tree is a subset of the Delaunay triangulation. **(10)**

(c) Deduce the running time of Kruskal's minimum Spanning tree algorithm, when it is applied on a set of n points on the plane. Then, describe how the result of Question 7(b) can be used to improve that running time. **(15)**

8. Formally define a 2-D rectangular range query. Then propose and describe (with appropriate illustrations) a data structure which can be used to efficiently handle such queries. Describe an efficient construction algorithm for this data structure and deduce its running time and space complexity. **(5+10+10+10)**

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2   B. Sc. Engineering Examinations 2013-2014

Sub : **CSE 473** (Pattern Recognition)

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) *M/S Automating Fish Packers* (AFP) uses an automation system to pack **Hilsa** and **Rui** fishes. Having Hilsa in a packet of Rui makes customer happy thought the company loses money. On the other hand, labeling a Rui as a Hilsa makes more money for the company but creates customer's dissatisfaction. **(20)**

From the above statement, (i) design a Bayesian formulation for the classification task of M/S AFP, (ii) simplify the classification tasks if the company ignores customer's happiness or dissatisfaction due to misclassification of fishes.

(b) Assume that the company described in 1(a) classifies M number of fishes of a lot into N categories, generalize the formation of 1(a) (i) if the classification depends on the feature distribution and classes of all fishes in the lot as well as their order of observations. What will be the complexity of the classification tasks? **(15)**

2. (a) Suppose you are given a set of linearly separable patterns to classify them into two classes. Can a single neuron classify them correctly? Justify with necessary proof. Why is the corresponding cost function piecewise linear? **(20)**

(b) Are all training samples equally important in support vector machine? Justify. **(8)**

(c) Why does SVM use 'kernel trick' to classify linearly non-separable training samples? **(7)**

3. (a) Draw the three lines in the two-dimensional space (You DO NOT need a graph paper) **(18)**

$$x_1 + x_2 = 0$$

$$x_2 = \frac{1}{4}$$

$$x_1 - x_2 = 0$$

For each of the polyhedra that are formed by their intersections, determine the vertices of the cube into which they will be mapped by the first layer of a multilayer perceptron, realizing the preceding lines. Combine the regions into two classes so that (i) a two-layer network is sufficient to classify them and (ii) a three-layer network is necessary. For both cases compute analytically the corresponding synaptic weights.

(b) Given a training observation sequences of an event as $O = \{o_1, o_2, ..., o_k\}$, formulate an *expectation maximization* (EM) algorithm to determine the parameters of a *hidden markov model* (HMM) that best fits the training data. Assume suitable structure of the HMM, e.g., the number of hidden and visible states. **(17)**

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4. (a) For a multilayer neural network, derive the expression to update of the synaptic weights. **(20)**

(b) The following Bayesian Belief Network models the conditional dependencies for an example concerning smokers (S), tendencies to develop cancer (C), and heart disease (H), together with variables corresponding to heart (H1, H2) and cancer (C1, C2) medical tests. Now assume that the patient undergoes the medical test H1 and that this turns out to be positive (True). Based on this test, compute the probability that the patient has developed cancer. **(15)**
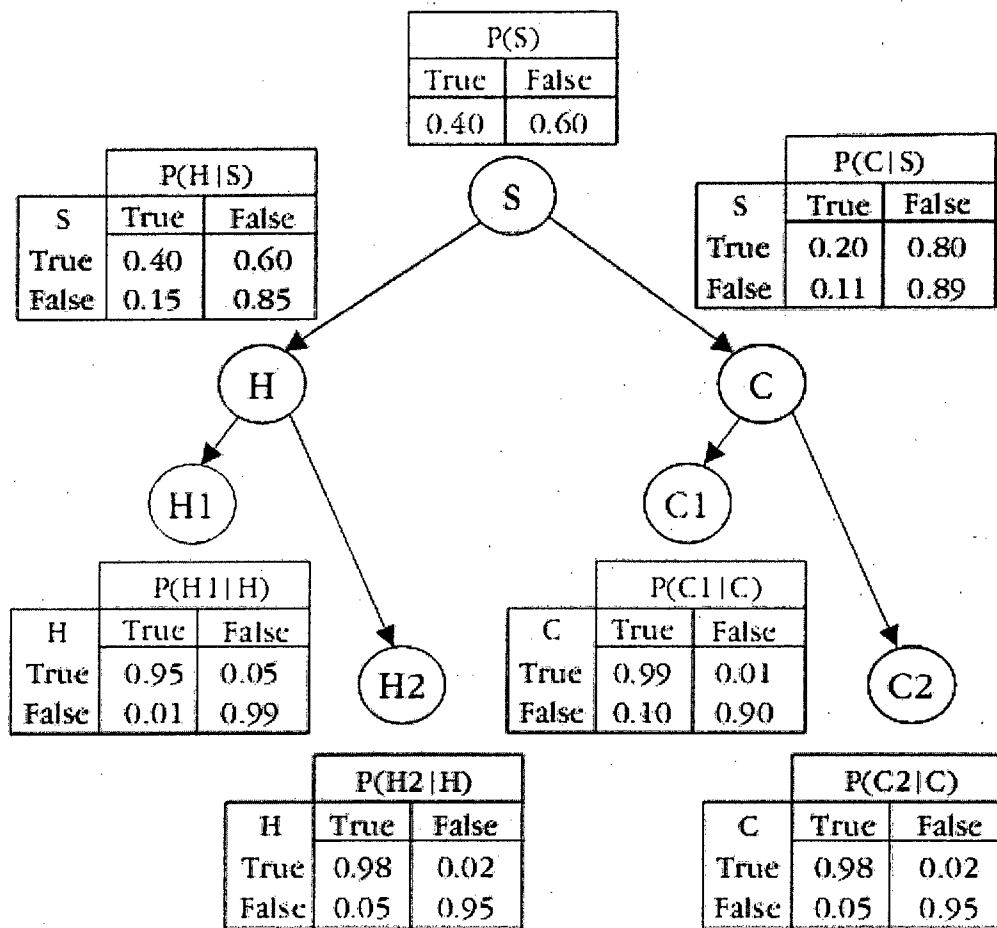
P(S)	
True	False
0.40	0.60

P(H|S)		
S	True	False
True	0.40	0.60
False	0.15	0.85

P(C|S)		
S	True	False
True	0.20	0.80
False	0.11	0.89

P(H1|H)		
H	True	False
True	0.95	0.05
False	0.01	0.99

P(C1|C)		
C	True	False
True	0.99	0.01
False	0.10	0.90

P(H2|H)		
H	True	False
True	0.98	0.02
False	0.05	0.95

P(C2|C)		
C	True	False
True	0.98	0.02
False	0.05	0.95

Figure for Question No. 4(b)

SECTION – B

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

5. (a) Two patterns G1 and G2 are given below: **(5+10=15)**

use
- for Horizontal line
□ for Vertical line

Figure: G1   Figure: G2   Figure: Rules
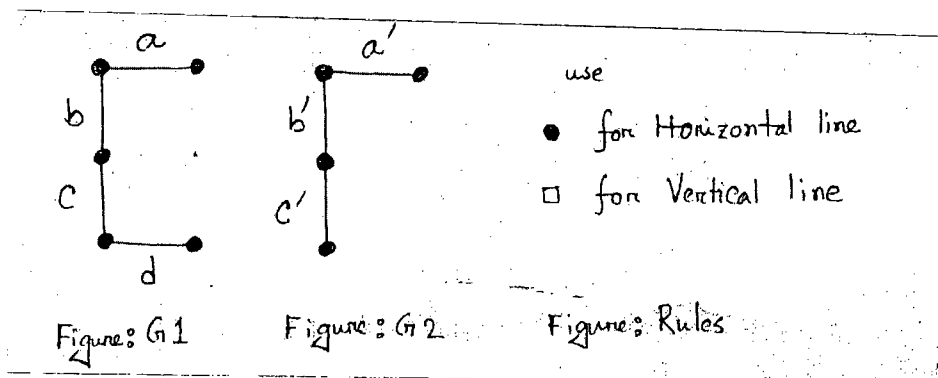
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Contd ... Q. No. 5(a)

(i) Find the attributed graphs for G1 and G2 using the rules.

(ii) Find all the assignments between the attributed graphs and connect the compatible ones. Assume G1 as the reference pattern and G2 as the test pattern.

(b) Briefly describe the *Bisecting k-means* technique.   **(10)**

(c) Explain the significance and the relation of internal energy and external energy in deformable template matching.   **(10)**

6. (a) The production rules (of a Finite State Grammar G) given below are <u>NOT</u> in *Chomsky Normal Form (CNF)*.   **(4+10=14)**

$$S \rightarrow bA_1$$

$$A_1 \rightarrow bA_2 \mid cA_2$$

$$A_2 \rightarrow c \mid aA_2$$

(i) Convert the production rules into CNF form.

(ii) Find whether "bbac" is defined in G using *Cocke-Younger-Kasami (CYK)* table.

(b) Briefly explain the 2-D Logarithmic Search procedure.   **(13)**

(c) Briefly describe the proximity measures for missing data.   **(8)**

7. (a) Apply the Basic *Sequential Algorithmic Scheme (BSAS)* on the data points A(1,1), B(5,5), C(6,6) and D(10,10) in a 2-D space, where the number of clusters m = 3 and threshold $\theta = 2$. Use Euclidean distance as the dissimilarity (distance) measure. Show the steps.   **(22)**

(b) Draw the design cycle of a typical pattern recognition system.   **(6)**

(c) Briefly discuss about the solutions of initial Centroid problem of *k-means* clustering.   **(7)**

8. (a) Find the edit distance between the word "maximum" and its misspelled version "meximm". Assume all the costs are equal. Put the calculated values for all the points of the graph and draw the optimal path. [N.B.: You need NOT show the calculation details].   **(15)**

(b) Show the steps to determine whether the following two graphs are isomorphic or not.   **(11)**

Figure: Graph 1   Figure: Graph 2
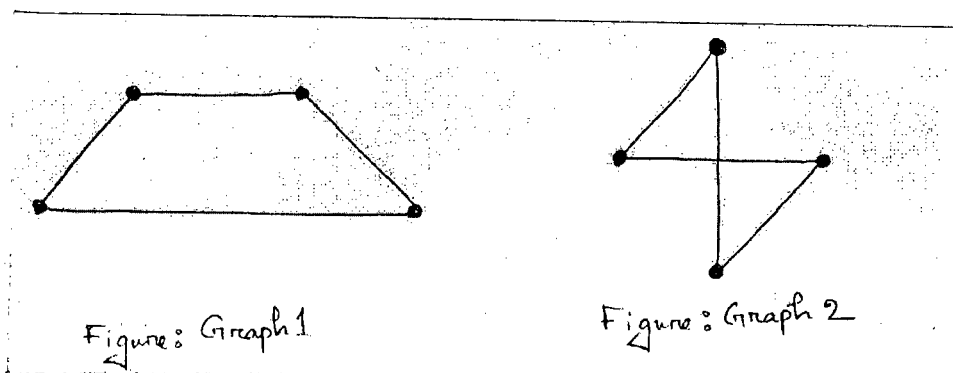
(c) Write short note on   **(9)**

    (i) Core point

    (ii) Noise point

    (iii) Border point

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2   B. Sc. Engineering Examinations 2013-2014

Sub : **HUM 371** (Financial and Managerial Accounting)

Full Marks : 140   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 Full disclosure principle and Going concern assumption according to Generally Accepted Accounting Principle? Give examples.   **(4)**

   (b) Write down the components of an accounting equation.   **(3⅓)**

   (c) "Blue View Hotel" had the following transactions on July, 2015 –   **(16)**

   July 1:   The owner invested Tk. 11,00,000 cash in the business.

   July 2:   Gave an advertisement in "Daily Star" for Tk. 20,000 on account.

   July 5:   Purchased supplies for cash Tk. 50,000

   July 10:   Purchased office equipment for Tk. 300,000; paying Tk. 50,000 in cash with the remaining on account.

   July 11:   Provided services and billed on client for Tk. 500,000.

   July 16:   Paid utility expenses in cash Tk. 30,000.

   July 20:   Paid balance due to "Daily Star".

   July 25:   Received from customers related to transaction July 11.

   July 28:   Withdrawal of cash by owner Tk. 40,000.

   Required:

   (i) Prepare a tabular summary from the above transactions.

   (ii) Prepare an income statement.

2. (a) What is a trial balance and what is its purpose?   **(5⅓)**

   (b) On December 1, 2015 Mr. "A" started his business. He completed the following transactions during December –   **(18)**

   December 1:   Started his product delivery services by investing Tk. 90,000 cash.

   December 4:   Purchased office equipment on credit Tk. 50,000.

   December 5:   Purchased supplies Tk. 10,000 in cash.

   December 6:   Completed work for a client and immediately received Tk. 80,000 in cash.

   December 8:   Paid full amount for the purchase of office equipment on December 4.

   December 12:   Completed work for "ABC Co." on credit Tk. 50,000.

   December 15:   Received payment in half from "ABC Co." for the work completed on December 12.

   December 17:   Received an electricity bill for Tk. 5,000 for the current month.

   December 20:   Paid Tk. 6,000 in cash for salary expenses.

   Required:

   (i) Give journal entry from the above transactions in general form.

   (ii) Prepare "Accounts Receivable" and "Service Revenue" ledger accounts.

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3. (a) Why do we need adjusting entries? (5⅓)

(b) The following information is available for "Red Construction" Company for the month of May – (18)

"Red Construction"
Trail Balance
May 31, 2015

Accounts Title	Debit (Tk)	Credit (Tk)
Cash	10,000	
Accounts receivable	5,000	
Prepaid insurance	2,400	
Supplies	1,500	
Office furniture	15,000	
Accounts payable		5,500
Unearned service revenue		6,000
Capital		22,500
Service revenue		5,900
Salary expense	2,000	
Rent expense	1,000	
Maintenance expense	2,000	
Drawings	1,000	
Total	**39,900**	**39,900**

Other Information:
- Accrued rent is Tk. 600.
- Maintenance expense incurred but not paid on May 31, Tk. 8000.
- Tk. 3,000 of service performed during the month but has not been recorded as on May 31.
- Unearned service revenue of Tk. 1,500 has been earned.
- Tk. 1000 of supplies has been used during the period.
- Office equipment is being depreciated at Tk. 250 per month.
- Accrued salary Tk. 1,000.

Required:
  (i) Prepare necessary adjusting entries.
  (ii) Prepare an adjusted trial balance as on May 31, 2015.

4. (a) What is intangible asset? Give example. (5⅓)

(b) The following accounts are taken from the ledger balances of "Q" Company Ltd on 31st December, 2015 – (18)

"Q Company Ltd"
Trail Balance
31st December, 2015

Accounts Title	Debit (Tk)	Credit (Tk)
Cash	60,800	
Accounts receivable	20,500	
Accounts payable		21,000

Accounts Title	Debit (Tk)	Credit (Tk)
Capital		71,000
Land	25,000	
Sales revenue		30,200
Salary expense	12,000	
Prepaid expense	4,000	
Utility expense	1,000	
Commission expense	3,000	
Supplies	1,000	
Notes payable		7,100
Drawings	2,000	
Goodwill	20,000	
Machinery	100,000	
Long term investment	50,000	
Bond payable		155,000
Wage payable		15,000
Total	**299,300**	**299,300**

Adjustment data:

   (i) Accrued salary is Tk. 500.

   (ii) Tk. 5,000 of the notes payable will be paid in the year 2017?

Required:

   (i) Prepare a single step income statement for the year ended December, 2015.

   (ii) Prepare an owners' equity statement and a classified balance sheet on 31st December, 2015.

   (iii) Calculate the following ratios – Current ratio, Quick ratio and Profit margin ratio.

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

5. (a) Define the terms (i) cost behavior and (ii) relevant range.   (5 $\frac{1}{3}$)

   (b) Parker Company manufactures and sells a single product. A partially completed schedule of the company's total and per unit costs over a relevant range of 60,000 to 100,000 units produced and sold each year is given below: **(10)**

	Units Produced and Sold		
	60,000 Units	80,000 Units	100,000 Units
Total costs:			
Variable costs	$150,000	?	?
Fixed costs	360,000	?	?
Total costs	$510,000	?	?
Cost per unit:			
Variable cost	?	?	?
Fixed cost	?	?	?
Total cost per unit	?	?	?

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Contd ... Q. No. 5(b)

Required:

Complete the above schedule of the company's total and unit costs.

(c) The Edelweiss Hotel in Colorado, has accumulated records of the total electrical costs of the hotel and the number of occupancy-days over the last six months. An occupancy-day means a room rented out for one day. The hotel's business is highly seasonal, with peaks occurring during the summer season.   **(8)**

Month	Occupancy-days	Electrical Costs
January	2,604	$6,257
February	2,856	$6,550
March	3,534	$7,986
April	1,440	$4,022
May	540	$2,289
June	1,116	$3,591

Required:

(i) Using the high-low method, estimate the fixed cost of electricity per month and the variable cost of electricity per occupancy-day. Round off the fixed cost to the nearest whole dollar and the variable cost to the nearest whole cent.

(ii) What would be the estimated total cost for producing 2,000 units?

(iii) What other factors than occupancy-days are likely to affect the variation in electrical costs from month to month?

6. (a) What is prime cost? Exemplify. $(3\frac{1}{3})$

(b) The following data (in thousands of dollars) have been taken from the accounting records of Larsen Corporation for the just completed year.   **(12)**

Sales	$860
Purchases of raw materials	$150
Direct labor	$110
Manufacturing overhead	$210
Administrative expenses	$130
Selling expenses	$180
Raw materials inventory, beginning	$40
Raw materials inventory, ending	$80
Work in process inventory, beginning	$20
Work in process inventory, ending	$80
Finished goods inventory, beginning	$80
Finished goods inventory, ending	$150

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Contd ... Q. No. 6(b)

Required:

(i) Prepare a Schedule of Cost of Goods Manufactured in good form.

(ii) Compute the Cost of Goods sold.

(c) Super Sales Company is the exclusive distributor for a revolutionary bookbag. The products sells for $60 per unit and has a CM ratio of 40%. The company's fixed expenses are $360,000 per year. The company plans to sell 17,000 bookbags this year. **(8)**

Required:

(i) What are the variable expenses per unit?

(ii) What is the break-even points in units and in sales dollars?

(iii) What sales level in units and in sales dollars is required to earn an annual profit of $90,000?

(iv) Assume that through negotiation with the manufacturer the Super Sales Company is able to reduce its variable expenses by $3 per unit. What is the company's new break-even point in units and in sales dollars?

7. (a) What is the basic difference between absorption costing and variable costing? **(3)**

(b) Are selling and administrative expenses treated as product costs or as period costs under variable costing? **(3)**

(c) Farron Company, which has only one product, has provided the following data concerning its most recent month of operations: **(17 $\frac{1}{3}$)**

Selling price	$92
Units in beginning inventory	0
Units produced	8,700
Units sold	8,300
Units in ending inventory	400
Variable costs per unit:	
Direct materials	$13
Direct labor	55
Variable manufacturing overhead	1
Variable selling and administrative	5
Fixed costs:	
Fixed manufacturing overhead	$130,500
Fixed selling and administrative	8,300

Required:

(i) What is the unit product cost for the month under variable costing?

(ii) What is the unit product cost for the month under absorption costing?

(iii) What is the net income for the month under variable costing?

(iv) What is the net income for the month under absorption costing?

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8. (a) What is relevant cost? Are variable costs always relevant cost? Explain. **(3⅓)**

(b) Solex Company manufactures three products from a common input in a joint processing operation. Joint processing costs up to the split-off point total $100,000 per year. The company allocates these costs to the joint products on the basis of their total sales value at the split-off point. These sales values are as follows: product X, $50,000; product Y, $90,000; and product Z, $60,000. **(10)**

Each product may be sold at the split-off point or processed further. Additional processing requires no special facilities. The additional processing costs an the sales value after further processing for each product (on an annual basis) are shown below:

Product	Processing Costs	Further Processing
X	$35,000	$80,000
Y	$40,000	$150,000
Z	$12,000	$75,000

Required:

Which product or products should be sold at the split-off point, and which product or products should be processed further? Show computations.

(c) When Mr. Ding L. Berry, president and chief executive of Berry, Inc., first saw the segmented income statement below, he flew into his usual rage; "When will we ever start showing a real profit? I'm starting immediate steps to eliminate those two unprofitable lines!" **(10)**

Product Lines

	Total	U	V	W
Sales	$250,000	$100,000	$75,000	$75,000
Variable expenses	119,000	37,500	35,000	47,000
Contribution margin	131,000	63,000	40,000	28,000
Traceable fixed expenses*	98,000	31,000	37,000	30,000
Common expenses, allocated	32,900	18,000	10,500	4,400
Operating income (loss)	$100	$14,000	$(7,500)	$(6,400)

* These traceable expenses could be eliminated if the product lines to which they are traced were discontinued.

Required:

Recommend which segments, if any, should be eliminated. Prepare a report in good form to support your answer.