

SECTION - A

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

1. (a) Consider the Gupta-Sproull algorithm for antialiased scan conversion of lines where we have to calculate D = perpendicular distance between pixel center and the line center. Now consider the following Figure 1(a). where we were at pixel $P(X_p, Y_p)$ in previous iteration. For the current iteration, you have chosen pixel NE. (12+10=22)

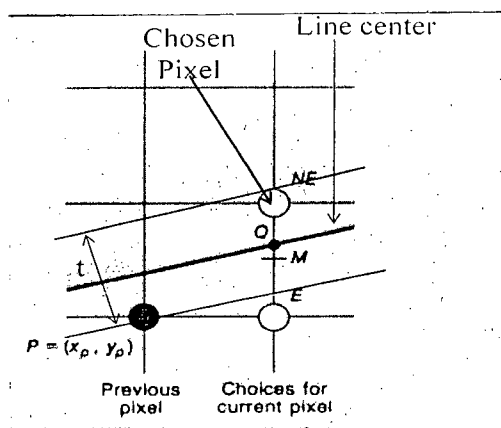


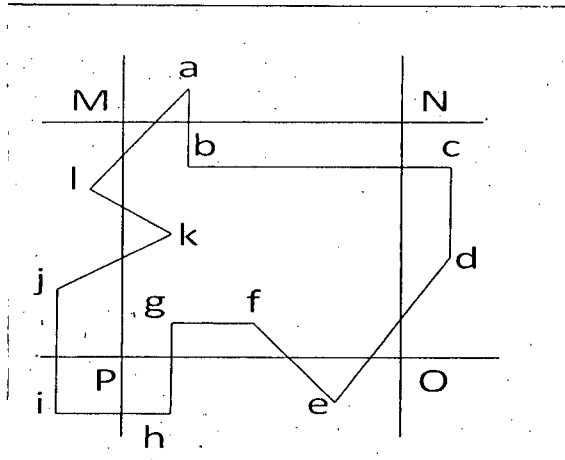
Figure - 1(a)

Perform the following tasks:

- (i) Show the calculation of D when NE is chosen.
- (ii) Also show the calculation of D for the pixel above NE and below NE.
- (b) Why does Cyrus-Beck Parametric Line Clipping algorithm not work with convex polygon? (7)
- (c) What is the problem of applying flat shading? When is flat shading applicable? (3+3=6)
2. (a) Let abcdefghijkl and MNOP are the polygon to be clipped and viewing window respectively as shown in the figure for question no. 2(a). Using Sutherland-Hodgman polygon clipping algorithm, show the steps of clipping the polygon in the following order of clipping edges: (7.5+7.5=15)

(i) Bottom clip edge PO

(ii) Left clip edge PM



Contd P/2

Figure - 2(a)

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Contd ... Q. No. 2

(b) Using an example show that the Dept Sort Algorithm for hidden surface removal may cause unnecessary split of polygons.

(10)

(c) Consider the top view of a scene containing four polygons A,B,C, and D (Figure 2(c)(i)). A Binary space partitioning is done and corresponding BSP tree (Figure 2(c)(ii)) containing nodes A, B1, B2, C1, C2, D1', D1'', and D2 is built. Considering this scene and BSP tree, write down the order of rendering/drawing the polygons for the given viewing direction.

(10)

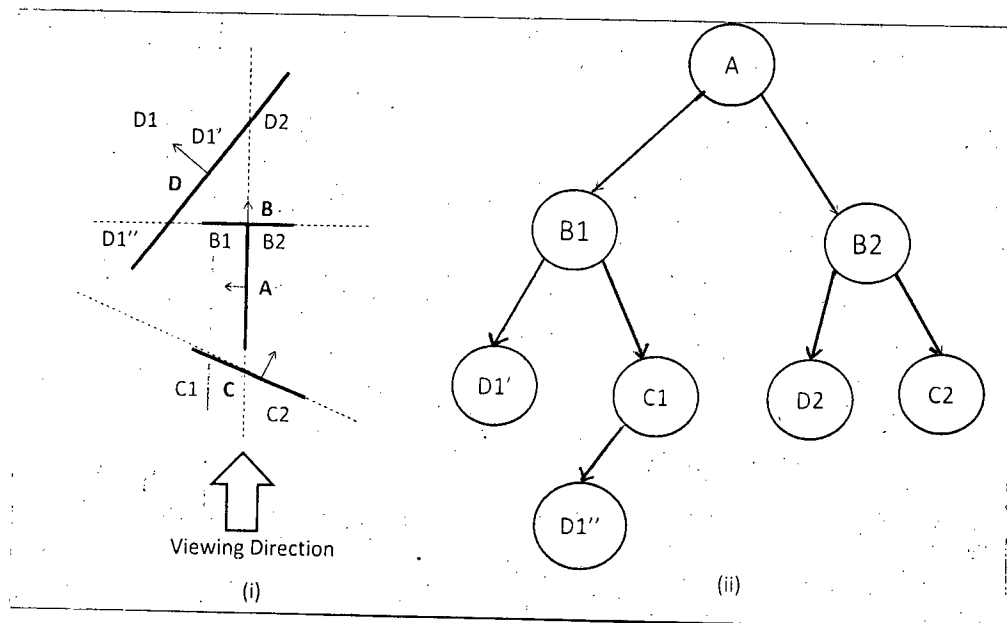


Figure- 2 (c)

3. (a) Explain the process of adding shadows of objects using shadow buffer.

(7)

(b) Derive the formula of finding the dimension of fractal. Then using the formula find the dimension of Quadratic Koch Curve and Dragon Curve (you can take help from following figures)

(10+2.5+2.5=15)

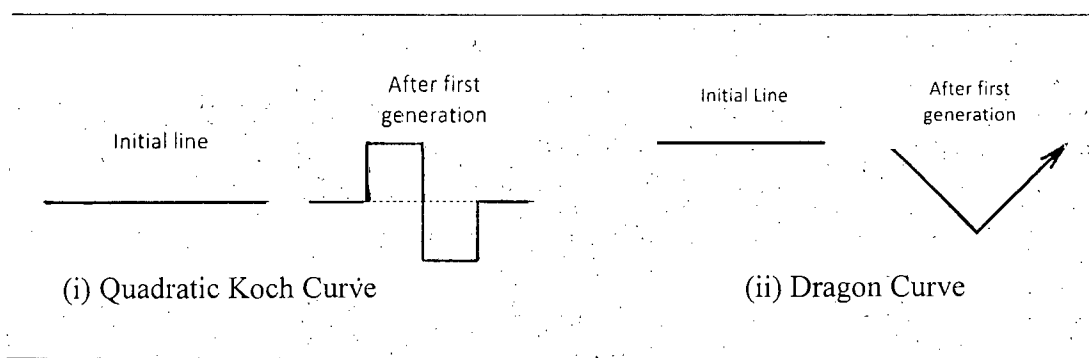


Figure - 3 (b)

(c) State whether the Dragon Curve is Peano curve or not. Also explain the reason.

(3)

(d) Consider the Pythagoras tree (fractal tree) that is defined by following rules:

(10)

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Contd ... Q. No. 3(d)

String Production Rules:

$0 \rightarrow 1[0]0$

$1 \rightarrow 11$

Atom: 0

Meaning of the symbols:

0 = Draw a line segment and stay at the end terminal

1 = Draw a line segment

[= Push current state (position and angle), then turn left 45°

] = Pop the last saved state (position and angle), then turn right 45°

Draw the second generation of the Pythagoras tree.

4. (a) We all are familiar with first person shooting game 'DOOM'. Which hidden surface removal approach should be applied for rendering the scenes in this game? (5)

(Note for those who are not familiar with 'DOOM': The game environment is usually indoor place with static geometric shapes like walls, doors, floors, ceilings etc. If z is the up axis, then all these geometric objects are either parallel or perpendicular with respect to x-y plane. Enemies appear at random place and player has to shoot them. The front view of the scene with respect to the player is projected on the screen and player can move at any direction. However, player's viewing direction is always parallel with respect to the floor.)

- (b) Consider Midpoint Ellipse Scan Conversion algorithm. (10+8+5=23)

(i) Show necessary calculation of decision variable d for drawing the arc of the ellipse that lies in the first quadrant.

(ii) Show how the decision variable d can be improved by second order difference.

(iii) Also show the calculation of initial value of d.

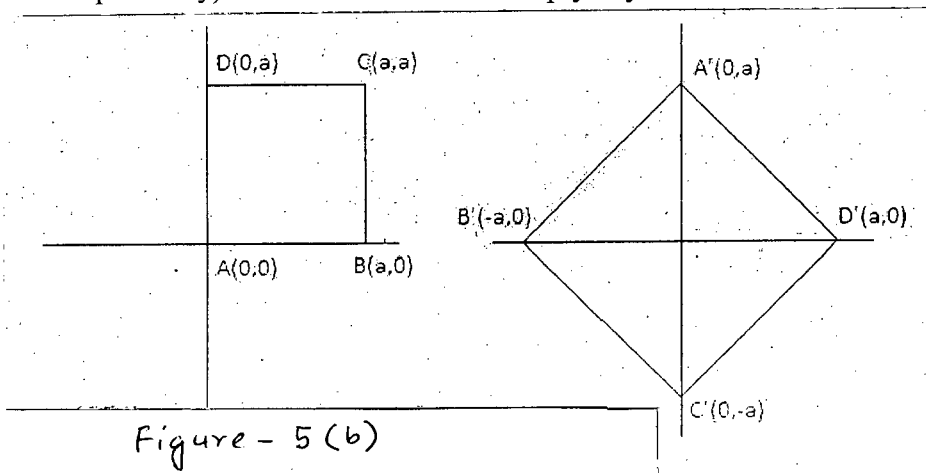
- (c) Derive the area of Koch Snowflake curve of n^{th} iteration. (7)

SECTION - B

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

5. (a) State and prove the vector form of Rodrigues formula. (12)

(b) [2D problem] Refer to the Fig. for Q. No. 5(b). Determine the composite transformation matrix that transforms the square ABCD on the left to the square A'B'C'D' on the right (i.e., points A, B, C and D are transformed to points A', B', C' and D' respectively). You don't need to multiply any matrices. (13)



Contd P/4

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Contd ... Q. No. 5

- (c) For a parallel projection, the projection plane is represented by the equation $y = 10$ and the direction of projection is given by the vector $2I + 3J + 6K$. Derive the corresponding projection transformation matrix. (10)

6. (a) State and prove the properties of rotation matrices. (12)

(b) We want to align the vector $V = 6I - 2J + 3K$ with the vector J along the positive Y axis by performing two rotations about the principal axes. First we rotate V by an angle θ_1 about the X axis and then by an angle θ_2 about the Z axis. Find θ_1 and θ_2 . If we want to align V with J by performing just a single rotation, what will be the axis of rotation and the angle of rotation? (6+5)

(c) [2D problem] Find the intersection point of a ray R and a circle C , where $R = (1, 2) + (3, 4)*t$, where $t \geq 0$ (i. e., origin of R is $(1, 2)$ and direction of R is along $3I + 4J$) and C is represented by the equation $(x - 3)^2 + (y - 4)^2 = 5^2$ (i. e., center of C is $(3, 4)$ and radius of C is 5). (12)

7. (a) Split the Bezier curve at $t = \frac{1}{3}$ using de Casteljau construction and find the corresponding left and right division matrices. (11)

(b) A camera is located at the origin. Its viewing direction is given by the vector $2I + J - K$ and its up direction is along the vector $I - J + K$. Derive the view transformation matrix, so that the camera looks towards the negative X axis and its up direction remains along the positive Y axis. (10)

(c) If a plane and a sphere intersect, their intersection is a circle. Let C be the circle which is the intersection of a plane P and a sphere S , where P is represented by the equation $6x + 2y + 3z = 61$ and S is represented by the equation $(x - 1)^2 + (y - 2)^2 + (z - 3)^2 = 10^2$ (i.e., center of S is $(1, 2, 3)$ and radius of S is 10). Find the area of C . (14)

8. (a) For a perspective projection, the projection plane is represented in point(P_0)-normal(N) form, where $P_0 = (x_0, y_0, z_0)$ and $N = n_1I + n_2J + n_3K$. The center of projection is at $C(a, b, c)$. Derive the corresponding projection transformation matrix. (12)

(b) The basis for the Hermite curve is given. Find the basis for the Bezier curve.

$$\begin{bmatrix} 2 & -2 & 1 & 1 \\ -3 & 3 & -2 & -1 \\ 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 0 \end{bmatrix} \quad (9)$$

(c) Describe the special case when C^1 continuity does not imply G^1 continuity. (7)

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Contd ... Q. No. 8

(d) [2D problem] The matrix $\begin{bmatrix} 1 & a & 0 \\ b & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ represents simultaneous shearing. Determine

the condition under which simultaneous shearing converts the unit square ABCD into another square. Here, A = (0, 0), B = (1, 0), C = (1, 1) and D = (0, 1).

(7)

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2012-2013

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 – AThere are **FOUR** questions in this Section. Answer any **THREE**.

1. (a) “A variable cost is a cost that varies per unit of product, whereas a fixed cost is constant per unit of product” Do you agree? Explain. (3 ⅓)

- (b) Define the following cost concept with example (any two): (3)

- (i) Sunk cost.
- (ii) Discretionary cost.
- (iii) Non-manufacturing cost.
- (iv) Differential cost.

- (c) The Green View Company makes art prints. The following details are available for the year ended 31st December, 2014. (17)

Particulars	Amount (Tk.)
<u>Opening stock:</u>	
Direct material	26,000
Work-in-process	74,000
Finished goods	120,000
Direct material purchased	436,000
Direct labor	12,000
Indirect labor	44,000
Administrative expense	160,000
Depreciation on factory building	70,000
Selling expense	140,000
Factory, power, heat and light	20,000
Building rent (factory uses 80% of spaces, administration and sales uses the rest)	50,000
Sales promotion	10,000
Sales	100,000
Utility, factory	5,000
<u>Closing stock:</u>	
Direct material	42,000
Work-in-process	54,000
Finished goods	80,000

Required:

- (i) Prepare a cost of goods sold statement.
- (ii) Prepare an income statement.

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2. (a) What is meant by degree of operating leverage? Why is it calculated? (3)

(b) "Quality products" Company has the following information related to cost structure and other data- (20 $\frac{1}{3}$)

Cost Data	Amount (Tk.)
Direct material	115
Direct labor	10
Variable manufacturing overhead	5
Total variable cost per unit	130
Total fixed cost	180,000
Selling price per unit	150
Number of units Produced and sold	30,000

Required:-

- Calculate break-even-points in units and in amounts.
 - Compute degree of operating leverage.
 - Prepare a contribution margin format income statement if selling price increased by Tk. 2 per unit, fixed cost increases by Tk. 15,000 and sales volume decreases by 10%.
 - Calculate break-even-points in units if selling price increases by 10% and variable cost increases by 20%.
 - Compute margin of safety in units and value. (Consider original data)
 - Calculate break-even-points if target profit is Tk. 500,000 (Consider original data.)
 - The company estimates that sales will increase by Tk. 45,000 next year due to increased demand. By how much should net operating income increase (Use CM ratio to calculate your answer)
3. (a) What do you understand by mixed cost and cost formula? (5)
- (b) Consider the following information relation to Walton Manufacturing company for the period ended on December 31, 2013. (18 $\frac{1}{3}$)

Cost Information	Tk.
Direct material	25
Direct labor	12
Variable manufacturing overhead	13
Variable selling and administrative overhead	10
Fixed manufacturing overhead	250,000
Fixed selling and administrative overhead	150,000
Production and Sales Data:	
Unit Produced (unit)	25,000
Unit Sold (unit)	20,000
Unit selling price	Tk. 100

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Contd ... Q. No. 3(b)

Required:

- (i) Compute unit product cost under absorption costing and variable costing.
 - (ii) Prepare income statements under absorptions costing and variable costing.
 - (iii) Reconcile the amount of net income under two methods and interpret the situation.
4. (a) Berger company has two support departments – Administrative Services (AS) and Information Systems (IS) and two operating departments – Government Consulting (GOVT) and Corporate Consulting (CORP). For the first quarter of 2014, the following records are available-

(11 1/3)

Berger Company
From the first quarter, 2014

	Support Dept.		Operating Dept.		Total
	AS	IS	GOVT	CORP	
Budgeted overhead before Allocation	600,000	24,00,000	87,56,000	124,52,000	242,08,000
Support work supplied By AS	-	25%	40%	35%	100%
Support work supplied By IS	10%	-	30%	60%	100%

Required:

Allocate the two support departments cost to the two operating departments by using-

- (i) Direct method.
 - (ii) Step-down method.
- (b) Foley Company uses job-order costing system. The following data relate to the month of October, 2013-

(12)

- (i) Raw materials purchased on account Tk. 210,000.
- (ii) Raw materials issued to production Tk. 190,000. (80% direct and 20% indirect).
- (iii) Direct labor cost incurred Tk. 49,000 and indirect labor cost incurrent Tk. 21,000.
- (iv) The company applies manufacturing overhead cost to production on the basis of Tk. 4 per machine hour. There were 75,000 machine hours recorded for October.
- (v) Production orders costing Tk. 500,000 according to their job cost sheet were completed during October and transferred to finished goods.
- (iv) Production orders that had cost Tk. 450,000 to complete according to their job cost sheet were shipped to customers during the month. These goods were sold at 50% above cost. The goods were sold on account.

Required:

Prepare journal entries to record the information given above.

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SECTION – B

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

5. (a) What are the three basic forms of business organization based on ownership? (5)
- (b) Marry Stane opened a Cloth-store. Followings are the transactions on March, 2013. (14+4 1/3)
- Invested Tk. 20000 for the store.
 - Purchase cloths on account for Tk. 15000.
 - Provide rent fee in cash Tk. 5000.
 - Get order and sell cloths for Tk. 10000 cash and Tk. 5000 on credit.
 - Paid dues on cloth purchase.
 - Purchase furniture in cash Tk. 10000.
 - Get cash from receivable on credit sale.

Requirements:

- (i) Prepare a tabular analysis of the transactions.
- (ii) From the analysis compute the net Income or net loss for March, 2013.
6. (a) What is an account? Give examples. (3 1/3)
- (b) Bob Sample opened the Campus Laundromat on September 1, 2014. During the first month of operations the following transactions occurred: (14+6)

September -1:	Invested Tk. 20000 cash in the business.
September -2 :	Paid Tk. 1000 cash for store rent for September.
” - 3 :	Purchase washers, dryers for Tk. 25000, paying Tk. 10000 cash and signing a Tk. 15000 note payable.
„ - 4 :	Paid Tk. 1200 for a one-year accident Insurance Policy.
„ - 10:	Received a bill from the Daily News for advertising the opening of the shop Tk. 200.
„ - 20:	Withdraw Tk. 700 cash for personal use.
„ - 30:	Determined that cash receipts for laundry services for the month were Tk. 6200.

- Required:
- (i) Journalize the transactions.
- (ii) Prepare the cash ledger and Bob Sample' Capital ledger.

7. (a) What is the difference between accrual basis of accounting and cash basis of accounting? (3 1/3)
- (b) 'X' Companies trial balance on June 30, 2012 are as follows:- (20)

Account Name	Debit (Tk.)	Credit (Tk.)
Cash	7150	
Accounts Receivable	6000	
Prepaid Insurance	3000	
Supplies	2000	

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Contd ... Q. No. 7(b)

Office Equipment	15000	
Accounts payable		4500
Unearned Service Revenue		4000
'X' Capital		21750
Service Revenue		7900
Salaries expense	4000	
Rent expense	1000	
Total	<u>38150</u>	<u>38150</u>

Other Data:

- Supplies on hand at June 30 are Tk. 1100
- A utility bill for Tk. 150 has not been recorded and will not be paid until next month.
- The Insurance policy is for a year.
- Tk. 2500 of unearned revenue has been earned at the end of the month.
- Salaries of Tk. 1500 are accrued at June 30.
- The office equipment has a 5-year life. It is being depreciated Tk. 250 per month.
- Invoice representing Tk. 2000 of service performed during the month have not been recorded as of June 30.

Required: (i) Prepare adjusting entries.

(ii) Prepare an adjusted Trial Balance at June 30, 2012.

8. (a) At the end of the first months of operations, Bolt Service organization has the following unadjusted trial balance.

(20 1/3)

	Debit (Tk.)	Credit (Tk.)
Cash	5400	
Accounts Receivable	2400	
Prepaid Insurance	1300	
Supplies	2800	
Equipment	60000	
Notes payable		40000
Accounts payable		2400
Bolt, Capital		30000
Bolt, Drawings	1000	
Service Revenue		4900
Salaries Expense	3200	
Utilities Expense	800	
Advertising Expense	400	
Total	<u>77300</u>	<u>77300</u>

Other Information :

- Insurance expires at the rate of Tk. 200 per month.
- Tk. 1000 of supplies are on hand at September 30, 2010.
- Monthly depreciation on the equipment is Tk. 900.
- Interest of Tk. 500 on the notes payable has accrued during September.

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Contd ... Q. No. 7(b)

Requirements:

- (i) Prepare a non-classified Income Statement.
 - (ii) Prepare owner's equity statement
 - (iii) Prepare a classified balance sheet assuming Tk. 35000 of the notes payable are long-term, as on September 30, 2010.
- (b) Determine the ratios from part (a) answer. (3)
- (i) Asset turnover ratio
 - (ii) Quick ratio.
-

SECTION-A

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

Use separate scripts for each section

1. (a) What are the assumptions of indifference curve analysis? (3 $\frac{1}{3}$)
 (b) Discuss the various properties of indifference curve. (8)
 (c) What do you understand by substitution effect and income effect of a price change? Derive a demand curve with the help of indifference curves and budget lines and show that price effect is equal to substitution effect and income effect. Present and explain all necessary diagrams. (12)

2. (a) Explain the concept of demand function. (3 $\frac{1}{3}$)
 (b) Distinguish between the concepts of “change in quantity demanded” and “change in demand”. Explain graphically the above changes with reference to the change in prices of substitute and complementary commodities. (7)
 (c) Define market equilibrium. Example graphically the price determination process of a commodity under competition. (7)
 (d) (i) Calculate the equilibrium price and quantity from the following demand and supply functions and graphically show the results. (6)

$$QD_x = 8000 - 1000P_x$$

$$Q S_x = -4000 + 2000P_x$$
 (ii) If a per unit tax of Tk. 0.90 is imposed, how will it affect the equilibrium price and quantity?
 (iii) If Government provides a subsidy of Tk. 2 per unit, what will happen to the equilibrium price and quantity?

3. (a) Discuss in detail the price elasticity of demand and cross elasticity of demand. (10)
 (b) What is meant by income elasticity of demand? Write down the formula for income elasticity of demand. “A commodity may be luxury at ‘low’ levels of income, a necessity at ‘intermediate’ levels of income and an inferior commodity at ‘high’ levels of income” – Explain the statement with suitable example. (8 $\frac{1}{3}$)
 (c) Explain how the state of technology affects the supply of a commodity. (5)

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4. (a) Distinguish between the concepts of total utility and marginal utility. Explain graphically. (5 $\frac{1}{3}$)
- (b) Starting with a utility function $U = f(A, B)$, where A and B refer, respectively, to the quantities of commodities A and B assuming a budget constrained derive the expressions for consumer equilibrium using calculus. (10)
- (c) What do you understand by production possibility frontier (PPF)? Illustrate how resource can be allocated in a society with the help of production possibility frontier. (8)

SECTION-B

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

Symbols indicate their usual meaning

Use separate scripts for each section

5. (a) What are the factors of production? Illustrate those in short. (8 $\frac{1}{3}$)
- (b) What do you know about an Isoquant? You are given some factors combinations on the below table, and draw an Isoquant just using these factors combinations. (7)

Factors Combinations	Labour	Capital
A	1	12
B	2	8
C	3	5
D	4	3
E	5	2

- (c) What are the properties of an Isoquant? Explain those in brief. (8)
6. (a) Explain about the features of perfect competition market. (5 $\frac{1}{3}$)
- (b) A given Short run Cost Function is $TC = 50 + 50q - 12q^2 + q^3$
Where TC is total cost and 'q' is level of output. (18)
- (i) Determine total fixed cost function, total variable cost function, average variable cost function and marginal cost function.
- (ii) Calculate total cost (TC), ATC, AVC and MC when the firm produces 10 units of output.
- (iii) Calculate the level of output at which AVC is minimum.
7. (a) What conditions are needed to reach in an equilibrium level of output under perfect competition market by a rationale producer? Is there any scope for this producer to earn some super profit under perfect competition market? Illustrate with graph. (15)

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Contd ... Q. No. 7

(b) What do you know about GNP, GDP, NNP, Disposable income and personal income?

Explain any two methods of measuring national income.

(8 $\frac{1}{3}$)

8. (a) What is Economic Planning? Why is an economic planning needed for LDCs like Bangladesh?

(8 $\frac{1}{3}$)

(b) Which factors are pre-requisites for successful planning in Bangladesh? Explain in details.

(15)

SECTION – AThere are **FOUR** questions in this Section. Answer any **THREE**.

1. (a) Give the examples of three computer applications for which machine learning approaches seem appropriate and three for which they seem inappropriate. Write justifications for each of them. (15)
- (b) “The choices of training data and target concepts are two important components in designing a machine learning system” – Justify the statement with appropriate examples. (13)
- (c) Explain the facilities and pitfalls of Find-S algorithm. (7)
2. (a) Give the sequence of S and G boundary sets computed by the Candidate Elimination algorithm for the training examples shown in the following table. Can you come with the ideas for ordering the training examples to minimize the sum of the sizes of the intermediate S and G sets? (18)

Exempl e	Sky	AirTem p	Humidit y	Wind	Water	Foreca st	EnjoySpo rt
1	Sunny	Warm	High	Strong	Cool	Change	Yes
2	Rainy	Cold	High	Strong	Warm	Change	No
3	Sunny	Warm	High	Strong	Warm	Same	Yes
4	Sunny	Warm	Normal	Strong	Warm	Same	Yes

- (b) Semi-supervised learning is suitable in many practical scenarios. Explain this fact with a suitable example. (7)
- (c) What are the differences between the t -test and Wilcoxon signed-rank test? Explain when the Wilcoxon signed-rank test is preferable than the t -test. (10)
3. (a) What is it a problem for a learner to learn from an imbalanced dataset? Explain two techniques to deal with this. (20)
- (b) Traditional classification techniques are not appropriate for stream data classification. Give some intuitive ideas how to modify such classifiers for stream data classification. (15)
4. (a) What is meant by PAC learnability? Show that

$$m \geq \frac{1}{\epsilon} \left(\ln |H| + \ln \left(\frac{1}{\delta} \right) \right)$$

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Contd ... Q. No. 4(a)

where m is the number of training example, H is the hypothesis spaces, ϵ is the error and δ is some threshold. What are the utilities of Vapnik-Chervonenkis (VC) dimension in machine learning?

(20)

(b) Give general expressions for the upper and lower one-sided $N\%$ confidence intervals for the difference in errors between two hypotheses tested on different samples of data.

(15)

SECTION – B

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

5. (a) Consider the Sequential-Covering algorithm shown in figure 5(a) for learning a disjunctive set of propositional rules.

```

SEQUENTIAL-COVERING(Target_attribute, Attributes, Examples, Threshold)
• Learned_rules ← {}
• Rule ← LEARN-ONE-RULE(Target_attribute, Attributes, Examples)
• while PERFORMANCE(Rule, Examples) > Threshold, do
    • Learned_rules ← Learned_rules + Rule
    • Examples ← Examples – {examples correctly classified by Rule}
    • Rule ← LEARN-ONE-RULE(Target_attribute, Attributes, Examples)
• Learned_rules ← sort Learned_rules accord to PERFORMANCE over Examples
• return Learned_rules
    
```

Figure- 5(a)

Here **LEARN-ONE-RULE** must return a single rule that covers at least some of the Examples. **PERFORMANCE** is a user-provided subroutine to evaluate rule quality. (10+3+7=20)

(i) Implement **LEARN-ONE-RULE** as a greedy general-to-specific search which begins by considering the most general rule precondition, then greedily adding the attribute test that most improves rule performance measured over the training examples. You have to write the corresponding pseudo-code only.

(ii) What is the main limitation of the implementation asked in (i)?

(iii) How can you extend the implementation asked in (i) to reduce the limitation identified in (ii)?

(b) Discuss the advantages of first-order representations over propositional (variable-free) representation with a suitable example.

(5)

(c) Consider learning rules to predict the target literal *GrandDaughter* (x, y), where the other predicates used to describe examples are *Father* and *Female*. The general-to-specific search in **FOIL** algorithm begins with the most general rule.

GrandDaughter (x, y) ←

Which asserts that *GrandDaughter* (x, y) is true of any x and y . List the candidate literals generated by **FOIL** to specialize this initial rule.

(10)

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6. (a) Consider the deterministic grid world shown in figure 6(a) with the absorbing goal-state G. Here the immediate rewards are 10 for the labeled transitions and 0 for all unlabeled transitions.

(10+10+5+5=30)

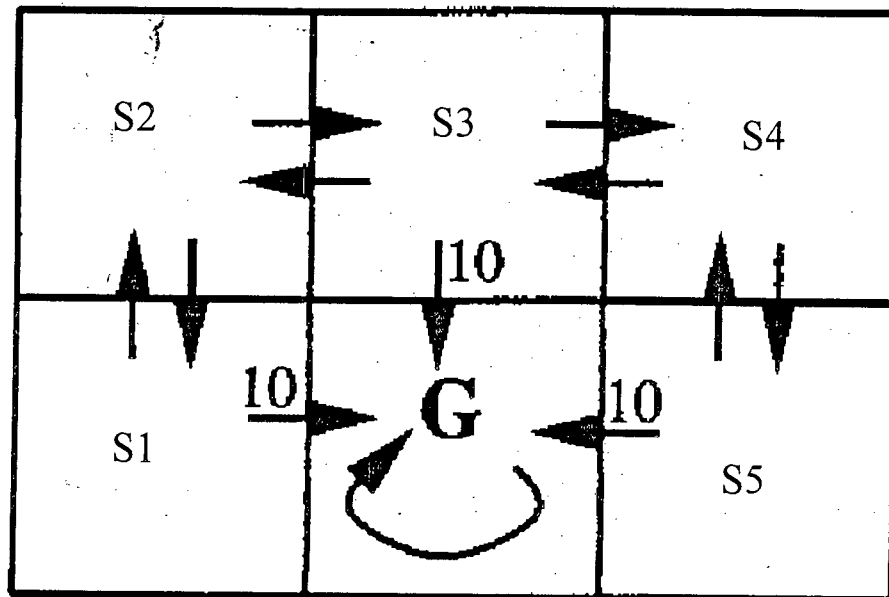


Figure - 6(a)

Q learning algorithm

For each s, a initialize the table entry $\hat{Q}(s, a)$ to zero.

Observe the current state s

Do forever:

- Select an action a and execute it
- Receive immediate reward r
- Observe the new state s'
- Update the table entry for $\hat{Q}(s, a)$ as follows:

$$\hat{Q}(s, a) \leftarrow r + \gamma \max_{a'} \hat{Q}(s', a')$$

- $s \leftarrow s'$

Figure - 6(b)

- Give the V^* value of every state in this grid world. Give the $Q(s, a)$ value for every transition. Finally, show an optimal policy. Use $\gamma = 0.9$.
- Now consider applying the **Q Learning algorithm** shown in figure 6(b) to this grid world, assuming the table of Q values is initialized to zero. Assume the agent begins in the bottom left grid square and then travels clockwise around the perimeter of the grid until it reaches the absorbing goal state, completing the first training episode. Describe which Q values are modified as a result of this episode, and give their revised values. Answer the question again assuming the agent now performs a second identical episode.
- Mention the conditions under which the algorithm of figure 6(b) will converge toward a \hat{Q} equal to the true Q function.

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Contd ... Q. No. 6(a)

(iv) The algorithm of figure 6(b) does not specify how actions are chosen by the agent. Suggest a probabilistic scheme with parameter $p > 0$ for selecting actions. Larger value of p should cause the agent to exploit what it has learned whereas small values of p should lead the agent to explore actions that have not been tried often before.

(b) **Information gain** measure is biased towards attributes having a large number of values – can this bias lead to any trouble? Explain with a suitable example. (5)

7. (a) Suppose you are given some data regarding coal resource in Bangladesh as shown in table 7(a). Here location of each area is described using its latitude and longitude. Each area has an associated probability of containing coal field. This probability is unknown for the last 3 areas. (5+20=25)

Area	Latitude	Longitude	Probability of containing coal field
Natore	24.5	89.1	0.50
Kendua	24.7	91.1	0.62
Dinajpur	25.7	88.5	0.90
Dhaka	23.8	90.5	0.40
Sylhet	24.9	91.92	0.95
khulna	22.7	89.6	0.8
Sreemangal	24.53	91.9	0.56
Jessore	23.3	89.4	0.7
Bogra	24.8	89.45	?
Narshingdi	24.1	90.7	?
Satkhira	22.73	89.2	?

Table- 7 (a)

(i) Mention the assumptions necessary to apply **k-nearest neighbor** algorithm for finding the unknown probabilities. The **k-nearest** neighbor algorithm for approximating a discrete-valued function $f: \mathcal{X} \rightarrow V$ is shown in figure 7(a).

(ii) Apply **2-nearest neighbor** algorithm for finding the unknown probabilities. You must weight the contribution of each neighbor according to its distance to the query point. The weight of a neighbor is the inverse of its distance to the query point. You must show all the steps of calculation.

Training algorithm:

- For each training example $\langle x, f(x) \rangle$, add the example to the list *training_examples*

Classification algorithm:

- Given a query instance x_q to be classified,
 - Let $x_1 \dots x_k$ denote the k instances from *training_examples* that are nearest to x_q
 - Return

$$\hat{f}(x_q) \leftarrow \underset{v \in V}{\operatorname{argmax}} \sum_{i=1}^k \delta(v, f(x_i))$$

where $\delta(a, b) = 1$ if $a = b$ and where $\delta(a, b) = 0$ otherwise.

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Contd ... Q. No. 7

- (b) Both the k-nearest neighbors and locally weighted regression construct an explicit approximation of the target function over a local region surrounding the query point - are you agree with this statement? Provide justification. (5)
- (c) Radial basis function networks can be seen as a blend of instance-based approaches and neural network approaches – justify. (5)
8. (a) Construct the decision tree using ID3 algorithm (shown in figure 8a) with information gain to select the best attribute at each step for the customer database given in table 8(a). Here the target attribute **buys_computer** has two distinct values (yes, no). You must show all the steps of calculation. (25)

age	income	student	credit_rating	buys_computer
less than 30	high	no	fair	no
less than 30	high	no	excellent	no
between 30 and 40	high	no	fair	yes
greater than 40	medium	no	fair	yes
greater than 40	low	yes	fair	yes
greater than 40	low	yes	excellent	no
between 30 and 40	low	yes	excellent	yes
less than 30	medium	no	fair	no
less than 30	low	yes	fair	yes
greater than 40	medium	yes	fair	yes
less than 30	medium	yes	excellent	yes
between 30 and 40	medium	no	excellent	yes
between 30 and 40	high	yes	fair	yes
greater than 40	medium	no	excellent	no

Table – 8 (a)

ID3(*Examples*, *Target_attribute*, *Attributes*)

Examples are the training examples. *Target_attribute* is the attribute whose value is to be predicted by the tree. *Attributes* is a list of other attributes that may be tested by the learned decision tree. Returns a decision tree that correctly classifies the given *Examples*.

- Create a *Root* node for the tree
- If all *Examples* are positive, Return the single-node tree *Root*, with label = +
- If all *Examples* are negative, Return the single-node tree *Root*, with label = –
- If *Attributes* is empty, Return the single-node tree *Root*, with label = most common value of *Target_attribute* in *Examples*
- Otherwise Begin
 - $A \leftarrow$ the attribute from *Attributes* that best* classifies *Examples*
 - The decision attribute for *Root* $\leftarrow A$
 - For each possible value, v_i , of A ,
 - Add a new tree branch below *Root*, corresponding to the test $A = v_i$
 - Let $Examples_{v_i}$ be the subset of *Examples* that have value v_i for A
 - If $Examples_{v_i}$ is empty
 - Then below this new branch add a leaf node with label = most common value of *Target_attribute* in *Examples*
 - Else below this new branch add the subtree
ID3($Examples_{v_i}$, *Target_attribute*, $Attributes - \{A\}$)
- End
- Return *Root*

Figure – 8 (a)

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Contd ... Q. No. 8

(b) Suppose you are experimenting with ID3 algorithm for learning which medical patients have a form of diabetes. To visualize the performance of your generated decision tree you have drawn the plot of figure 8(b).

(5+5=10)

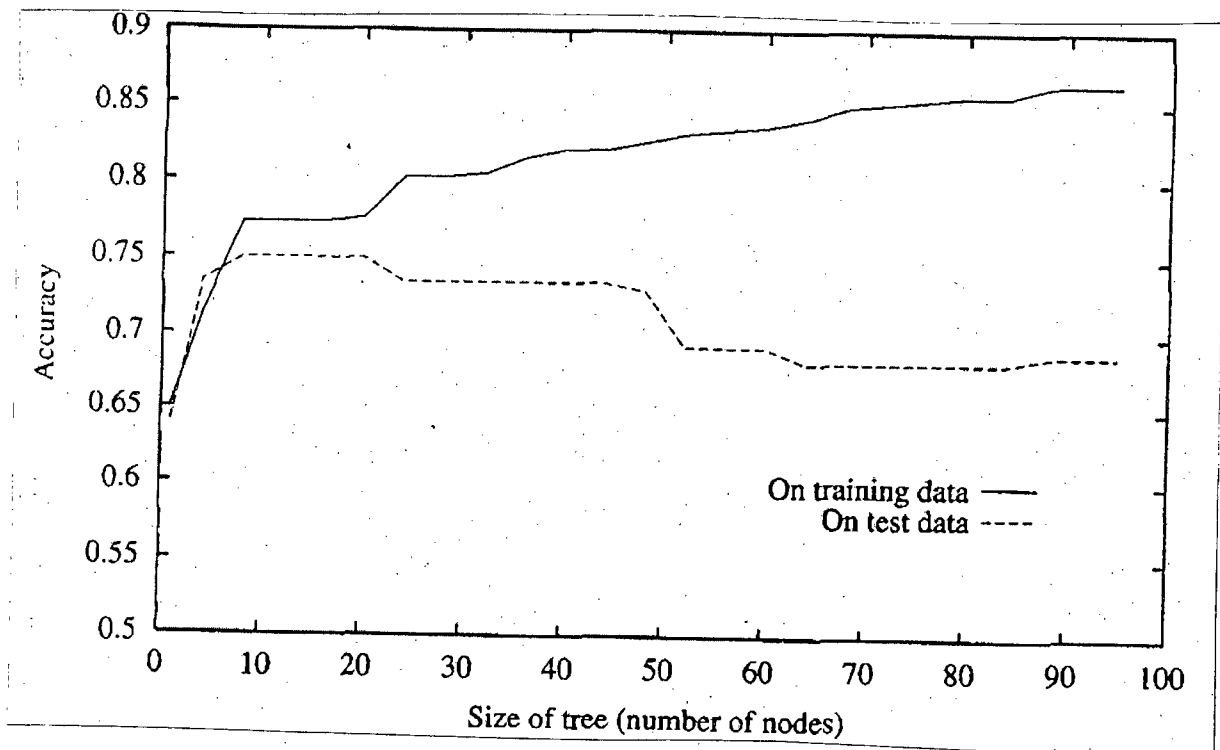


Figure - 8 (b)

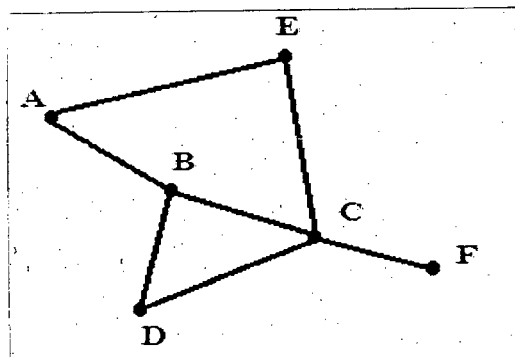
The horizontal axis of this plot indicates the total number of nodes in the decision tree, as the tree is being constructed. The vertical axis indicates the accuracy of predictions made by the tree. The solid line shows the accuracy of the decision tree over the training examples, whereas the broken line shows accuracy measured over an independent set of test example (not included in the training set).

- (i) Can you guess why did your decision tree behave in this way? Mention two possible reasons.
- (ii) Can you suggest some approaches to get rid of this behavior?

SECTION – A

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

1. (a) Describe problem classes P, NP, NPC, and NP-hard with examples. Also show the relation among them. (8)
- (b) Define Decision version of K-coloring problem. Show that k-coloring problem [for $k > 3$] is NP-Complete. (15)
- (c) How do you prove that Problem X and Problem Y are equally hard? Show that the vertex cover problem and the independent set problem are equally hard. (12)
2. (a) What is sequence alignment problem? Describe global and local alignment of two sequences. Write the dynamic programming based approach to solve global alignment problem and then efficiently modify it to solve the local one. (13)
- (b) What is block alignment problem? Describe how Four Russian Speedup technique reduces the running time of block alignment problem from quadratic to sub quadratic. (15)
- (c) Show that Independent Set \leq_p Set Packing. (7)
3. (a) Define Competitive ratio of an online algorithm. Explain the competitive ratio taking the Ski-rental problem as an example. (8)
- (b) Describe the k-server problem. Prove that the competitive ratio of Double Coverage algorithm for k-server on a line is at most k. (20)
- (c) Describe linear list search problem. Show that moving the searched item 2 positions forward is not a good approach to solve this problem. (7)
4. (a) Explain the key idea behind the branch and reduce algorithm for finding maximum independent set in a graph, and write the algorithm. Using the following example show the simulation of the algorithm with branching tree. Also show that the time complexity of the algorithm is $O(3^{n/3})$. (15)



Contd P/2

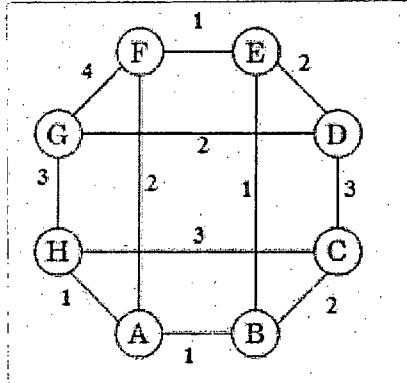
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Contd ... Q. No. 4

(b) Explain the basic principle of a branch-and-bound technique. Write an algorithm that uses branch-and-bound technique to solve TSP. Using the given graph simulate the steps with branching tree.

(15)



(c) Suppose you are planning to incorporate multithreading in a problem where you already using branch-and-bounding technique. What difficulty may arise explain with example?

(5)

SECTION – B

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

5. (a) Assume Saminur is currently working in Microsoft. Yesterday Bill Gates assigned Saminur to solve a NP-complete problem and promised that he will promote Saminur to Project Manager post on successful completion of the assignment. Saminur is very happy hearing about the big promotion and also a bit tensed as he knows there is no polynomial time exact algorithm to solve any NP-complete problem. Now, describe the ways by which Saminur can deal with the problem and get promotion.

(7)

(b) Show that the expected space required for a n-element skip list is $O(n)$.

(6)

(c) Write down the expected number of attempts to reach success in randomized 8-queen problem. Mathematically prove your answer.

(8)

(d) Consider the following multi-threaded algorithm for computing Fibonacci number

Fibonacci (n)

```

if n < 2 then return n;
x = spawn Fibonacci(n - 1);
y = Fibonacci(n - 2);
sync;
return x + y;
```

For the above algorithm do the followings

(7+3+4=14)

(i) Describe the computation for calculating Fibonacci(5) using a directed acyclic graph.

Contd P/3

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Contd ... Q. No. 5(d)

- (ii) Point out the following types of edge in your drawn DAG.
- p) Continuation edge
 - q) Spawn edge
 - r) Return edge
- (iii) Assuming that each strand takes unit time, find out the following metrics.
- p) Work
 - q) Span
6. (a) Describe travelling salesman problem. Give a 2-approximation algorithms for travelling salesman problem with triangle inequality. Analyze the approximation ratio. **(2+4+8=14)**
- (b) Briefly describe Monte Carlo algorithms. **(4)**
- (c) Briefly describe the followings with respect to multithreaded algorithms. **(2+2+2=6)**
- (i) Work law
 - (ii) Perfect linear speedup
 - (iii) Parallel slackness
- (d) Prove that, Karger's algorithm fails to find a global min-cut with probability
- $$p \leq 1 - \frac{1}{\binom{n}{2}} \quad (11)$$
7. (a) Show that, the expected searching time in a n-element skip list is $O(\log n)$. **(6)**
- (b) Show that, using RANDOMIZED-PARTITION the expected running time of quicksort is $O(n \lg n)$ when element values are distinct. **(17)**
- (c) Describe advantages of a Splay tree. Analyze the amortized cost of Zig step in a splay operation on a n-node Splay tree. **(3+6=9)**
- (d) Briefly describe greedy scheduler theorem with respect to multithreaded algorithms. **(3)**
8. (a) Is there any polynomial time optional solution for the vertex cover problem in any special case? If yes, give polynomial time optimal solutions for those special cases. **(10)**
- (b) Using potential method, prove that the worst-case cost of n stack operations (PUSH, POP, MULTIPOP) is $O(n)$ **(8)**
- (c) Briefly describe the span law with respect to multithreaded algorithms. **(2)**
- (d) Give a 4-approximation algorithms for Sorting by Reversals problem. Analyze the approximation ratio. **(15)**
-

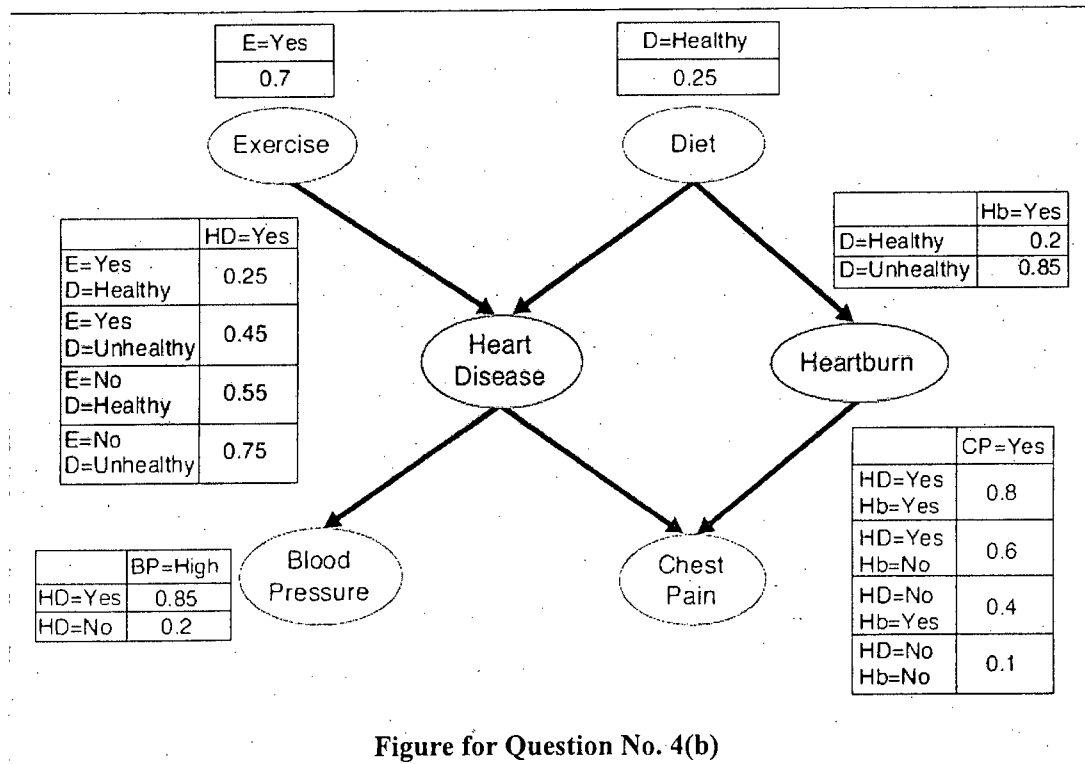
SECTION – A

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

1. (a) Suppose, you have been given a set of linearly non-separable training patterns to classify them 100% accurately into two classes using a multilayer perception (MLP) with any number of layers and nodes. Describe an algorithm for the said purpose. (12)
- (b) Formulate the expression for Bayesian classification of N objects into M classes where the classification of an object not only depends on its feature representation but also on the feature values of other objects and inter class relation. Find the complexity of a brute force approach to evaluate your expression. (17)
- (c) Explain the demerit of using unit step function as an activation function in neural networks. How is it solved? (6)
2. (a) What are the different variations of a perceptron algorithm? Discuss and justify the one which you will use to classify a set of linearly non-separable patterns. In case of a set of linearly separable patterns, can any of the variations provide a unique solution? Justify. (15)
- (b) Explain the margin maximization concept used in a support vector machine (SVM). (8)
- (c) Consider the task of minimum error Bayesian classification of benign and malignant tumors based on their gray values. The average gray values of a benign and malignant tumor are 15 and 12, respectively. Assuming that their gray value of both malignant and benign tumor follows a Gaussian distribution with a standard deviation equal to 2, find the decision boundary when (i) $P(\text{Benign}) = P(\text{Malignant})$ (ii) $P(\text{Benign}) = 2 \times P(\text{Malignant})$ (12)
3. (a) State the three basic problems of a hidden Markov model (HMM). Explain an efficient algorithm to find the probability of an observation sequence of an HMM. (20)
- (b) Derive all possible expressions of the variable that causes the reverse flow of information in back-propagation algorithm. (15)
4. (a) With an example show how a proper transformation function can transform a set of linearly non-separable objects into a set of linearly separable objects. What problem does this transformation introduce in SVM? How is kernel trick used to solve it? (18)
- (b) Given the following Bayesian belief network, find the following probabilities: (17)
- (i) $P(\text{CP} = \text{Yes})$, (ii) $P(\text{Hb} = \text{Yes} \mid \text{CP} = \text{Yes}, \text{D} = \text{No})$

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Contd ... Q. No. 4(b)



SECTION – B

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

5. (a) The production rules (of a Finite State Grammar G) given below are NOT in *Chomsky*

Normal Form (CNF).

(4+10=14)

$$S \rightarrow cA_1 \mid bA_2$$

$$A_1 \rightarrow bA_2$$

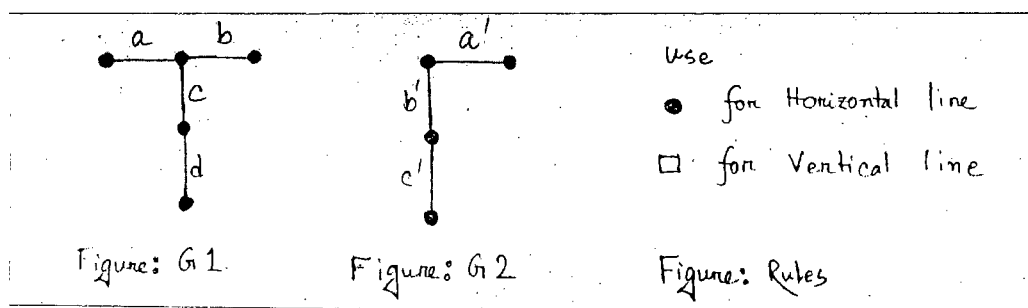
$$A_2 \rightarrow b \mid A_2$$

- (i) Convert the production rules into CNF form.

- (ii) Find whether “cbab” is defined in G using Cocke-Younger-Kasami (CYK) table.

- (b) Two patterns G1 and G2 are given below:

(4+10=14)



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

- (ii) Find all the assignments between the attributed graphs assuming G1 as the reference pattern and G2 as the test pattern.

- (c) “The computational complexity of a two-dimensional logarithmic search is $MN(8k+1)$, where M, N and k have their usual meaning” – briefly explain.

(7)

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6. (a) Find the edit distance between the word “pattern” and its misspelled version “petern”.

Assume all costs are equal. Draw the optimal path.

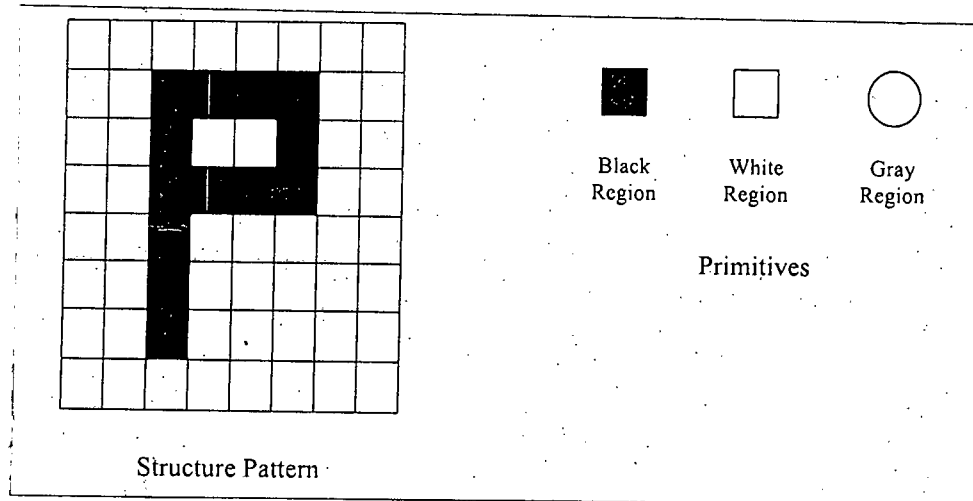
(15)

- (b) Briefly explain the Hierarchical search procedure.

(13)

- (c) Represent the following structure by a Tree.

(7)



7. (a) (i) What is the basic difference between partitional and hierarchical clustering? (3+4+8=15)

(ii) What are the basic difference between fuzzy, hard and probabilistic clustering?

(iii) Briefly discuss about five different types of clusters.

- (b) (i) What problems may occur in selecting the initial points (Centroids) in *k-means*? (4+7+4=15)

(ii) What are the solutions?

(iii) How *Bisecting k-means* can help to avoid initial Centroid problem?

- (c) Just draw the design cycle of a typical pattern recognition system.

(5)

8. (a) Give an example for each of the *Nominal*, *Original*, *Ratio-scaled* and *Interval-scaled* values.

(6)

(b) (i) Apply the *Basic Sequential Algorithmic Scheme*(BSAS) on the data points A1(0,5), A2(0,0), A3(1,1) and A4(5,0) 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 output.

(16+7=23)

(ii) Which problem of BSAS can be solved by *Modified Basic Sequential Algorithmic Scheme* (MBSAS)? How?

(c) What are the core points, noise points and border points in DBSCAN? Show with figures.

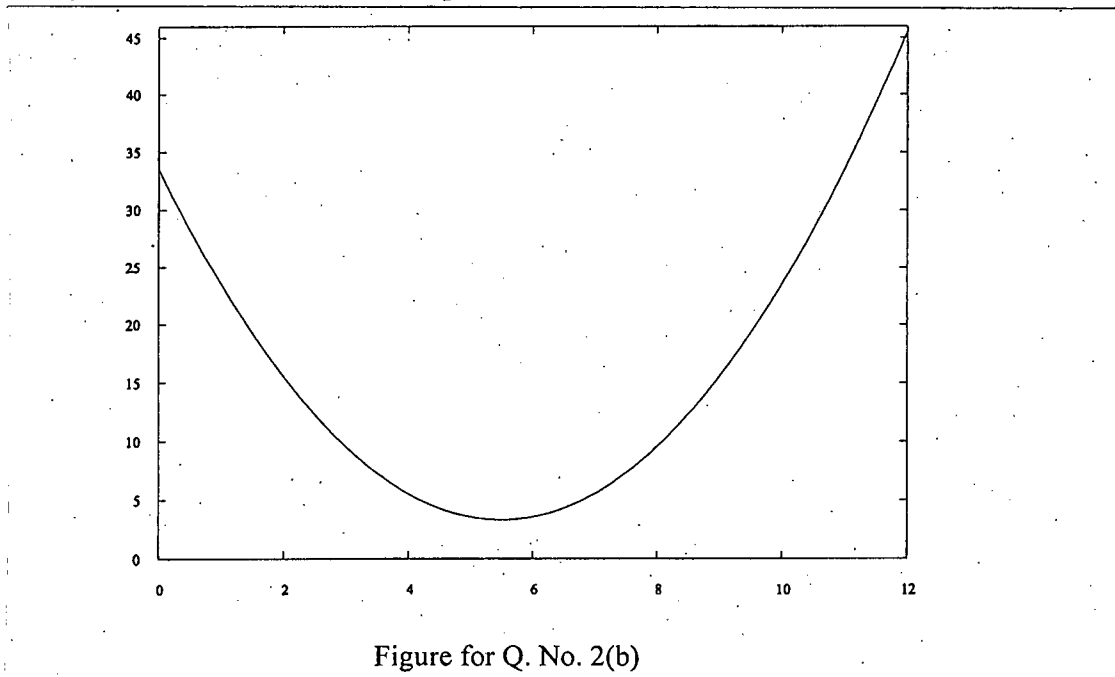
(6)

SECTION – A

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

1. (a) Derive the complexity of Chan's algorithm for computing convex hull in 2D. (15)
 (b) Suppose a desktop PC can perform an $O(1)$ operation in 1 sec. What will be the approximate execution times (in sec.) of Chan's algorithm and Graham Scan algorithm for a given set of 10^8 points? If the points are generated at random using a uniform random number generator, do you think any algorithm for computing convex hull in 2D has a chance to compete with Chan's algorithm? Which ones? Why? (6+6)
 (c) Given a set of n negative and non-negative integers $X = \{x_1, x_2 \dots x_n\}$ suppose that we place the points (x_i, x_i^3) in 2D plane. Can a single convex hull of these points be used to sort the given set of integers? If not, how would you fix the problem to sort the integers using an algorithm for computing the convex hull? (4+4)

2. (a) Given a set of m horizontal and n vertical line segments, suggest a line-sweep algorithm of complexity $O(mn)$ or faster for reporting the intersection points of the line segments. Assume that the horizontal segments (as well as the vertical segments) are non-overlapping. Also assume that no two endpoints coincide. (15)
 (b) For the curve shown in Figure for Q. No. 2(b), can the minima of the curve be accurately determined using a binary search instead of a ternary search? If we require the answer to be accurate only up to the integral part (discarding the fractional part), how can binary search be used to solve the problem? (3+7)



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Contd ... Q. No. 2

(c) Write the psedo-code for finding the upper tangent of two convex hull s during the merge step of the Divide and Conquer algorithm for computing convex hull in 2D. (10)

3. (a) Briefly describe the Gift Wrapping algorithm for computing convex hull in 2D. Show that the run time of this algorithm is output-size sensitive. (15)

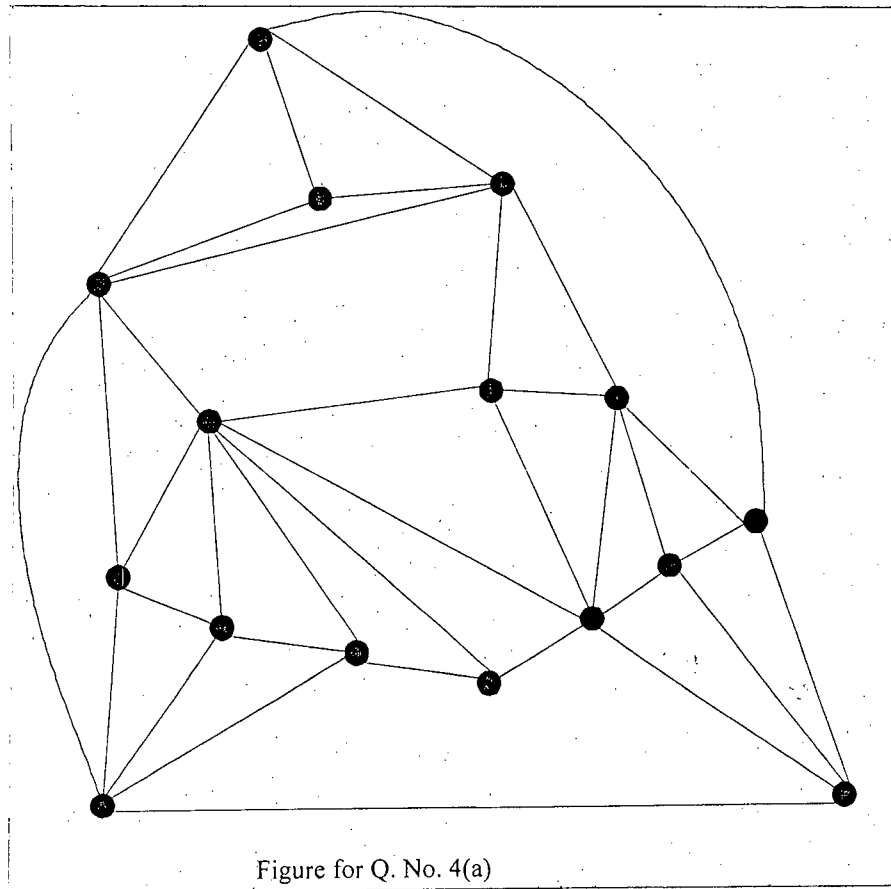
(b) In which of the following situations is segment tree and space quad-tree more suitable? Explain. (5)

(i) Small search space, large number of search and update queries

(ii) Large search space, small number of search and update queries.

(c) Given a set of n circular arc segments along the perimeter of a circle of radius R , suggest an algorithm of complexity $O(n)$ that finds the length along the perimeter, where all arc segments in the set overlap mutually. (15)

4. (a) For the graph shown in Figure for Q. No. 4(a) find a straight line grid drawing of the graph using the Shift method showing every step. (30)



(b) Prove that the straight line grid drawing of a graph of n vertices using the Shift method, has a maximum width of $2n-4$ and a maximum height of $n-2$. (5)

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SECTION – B

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

5. (a) Prove that $\lfloor \frac{n}{3} \rfloor$ guards are sufficient to guard any simple polygon with n vertices. (10)

(b) Show by an example that the Fisk's Proof of sufficiency is not the best one for all cases. That means show example where the above algorithm uses $\lfloor \frac{n}{3} \rfloor$ guards but actually much less number of guards are enough. (5)

(c) Prove the following in sequence and use earlier results to prove the next ones: (3×5=15)

 - (i) Every triangulation of a polygon has $n-3$ diagonals and $n-2$ triangles.
 - (ii) The sum of the interior angles of a polygon of n vertices is $(n-2)\pi$.
 - (iii) Every polygon of $n \geq 4$ vertices has at least two non-overlapping ears.

(d) How many overlapping ears can a polygon of n vertices have? Give an example. (5)
6. (a) Consider a polygon where a vertex i ($1 \leq i \leq n$) is an ear-tip, n is number of vertices. (15)
 - (i) Give an example of the polygon where the vertex $i-1$ was an ear-tip but after the deletion of the ear i it becomes a non-ear tip vertex.
 - (ii) Prove that if vertex $i-1$ was an ear-tip, then after the deletion of the ear i , it must remain an ear-tip.
 - (iii) Prove that any vertex other than, i , $i-1$ and $i+1$ cannot change its property? You must prove that if ear-tip then remains ear-tip and if not, then remain non-ear tip.

(b) Give a linear time algorithm for triangulating a monotone polygon. In this algorithm, what are the numbers of PUSH and POP in the stack? How do these numbers help in analyzing the $O(n)$ running time of the algorithm? In this algorithm, what do you do if the vertex j and $j-1$ are in different chains? What is in the same chain? (20)
7. (a) How many nodes of the 1D Height Balanced Binary Search Tree (HBBST) do you visit for a query? Why? Justify how this number is related to the number of resulting points? (10)

(b) Describe the construction for a 2D HBBST? Give an example for 10 nodes. (15)

(c) Explain, How do you get the recurrence $Q(n) = 2 + 2Q(n/4)$, when you search a single node from HBBST? How do you get the first and second "2" in this recurrence? How do you get "4" in this same recurrence? (10)
8. (a) Describe five applications of Voronoi Diagram (VD). (5)

(b) Describe five properties of Delaunay Triangulation (DT). (5)

(c) Prove that a Minimum Spanning Tree (MST) is a subset of the DT. (10)

(d) Suppose you have a DT of three points. So, you have only one DT and one Delaunay circle. Now you want to insert a new point P . How would the DT change if the point p is inserted as follows? Justify the changes. (15)

 - (i) P is inserted outside the Delaunay circle.
 - (ii) P is inserted inside the circle but outside the triangle.
 - (iii) P is inserted inside the triangle.

L-4/T-2/NAME

Date : 06/08/2015

BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY, DHAKA

L-4/T-2 B. Sc. Engineering Examinations 2012-2013

Sub : **NAME 423** (Power and Propulsion Systems)

Full Marks : 210

Time : 3 Hours

The figures in the margin indicate full marks.

The symbols have their usual meaning. Assume reasonable value in case of data missing.

USE SEPARATE SCRIPTS FOR EACH SECTION

SECTION – A

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

1. (a) With figure define effective power, thrust power, delivered power and shaft power. Also define indicated power and brake power. Hence prove, $\eta_T = \eta_H \cdot \eta_B \cdot \eta_S \cdot \eta_M$. (18)
(b) With figure show simplified picture of the ship drive train. (10)
(c) A patrol craft encounters resistance of 12,500 lb at 14 knots. If the shaft horse power is 900 HP, calculate the propulsion coefficient. (7)
2. (a) How can you distinguish slow speed, medium speed and high-speed diesel engines? (6)
(b) Give some values of reduction gear ratios for propulsion reduction gearing driven by medium speed engines. (9)
(c) Give a comparison of the size, density and weight per kW for a slow speed diesel and marine gas turbine having same output of 22,000 kW. (10)
(d) Give a comparison of the size, density and weight per kW for a slow speed diesel of 7000 kW at 100 r.p.m. and high speed diesel of 7000 kW at 1300 r.p.m. (10)
3. (a) With figure describe the hydraulic jet propulsion. Derive the expression for efficiency of hydraulic jet propulsion as (20)

$$\eta_{Jet} = \frac{2V_s}{V_J + V_s}$$

Where the symbols have their usual meaning.

- (b) A ship of length 40 m is fitted with hydraulic jet propulsion, where the inlet water to the pump is taken in from ahead. Calculate the efficiency of propulsion. (15)

Given:

Diameter of jet = 0.85 m

Ship speed = 8 knots

Thrust required = 5.5 kN.

Density of water = 1000 kg/m³.

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4. The open-water propeller performance data of a propeller is given below:

(35)

J	k_T	$10 K_Q$
0.8	0.27	0.56
0.9	0.22	0.48
1.0	0.17	0.39
1.1	0.12	0.31
1.2	0.07	0.22

For advance coefficient, $J = 0.925$ and shaft inclination, $\epsilon = 7^\circ$ deg. calculate,

- (i) thrust coefficient
- (ii) torque coefficient and
- (iii) normal force coefficient.

SECTION – B

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

5. (a) The design conditions of a contra-rotating propeller are as follows:

(23)

Ship speed, $V_s = 16$ knots.

Wake fraction, $\omega = 0.12$.

Number of Blades, $Z = 3$.

Shaft horse power = 380 Hp.

Number of revolutions of the engine $N = 1800$ r.p.m.

Calculate the following items assuming that the thrust of front and rear propellers being the same with equal number of revolution.

- (i) Diameter of both front and aft propeller.
 - (ii) Blade area ratio of front and aft propeller.
 - (iii) Pitch of front propeller and rear propeller.
 - (iv) Optimum efficiency, η_p of the system.
- (b) Compare the efficiency of the above mentioned contra-rotating propeller with a single screw design and a twin screw design at the same design condition as mentioned in Q. No. 5(a).

(12)

6. (a) Draw an isometric view and a plan view of a controllable-pitch propeller, showing all the hydrodynamic forces over the blade surface and their distances to the initial spindle axis of the blade.

(10)

- (b) For a controllable-pitch propeller, calculate the differential hydrodynamic component of blade spindle torque about the spindle axis at blade section, $x = 0.7$. The blade section used in the propeller is assumed to be NACA 66 section with parabolic tail and $a = 0.8$ mean line.

(25)

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

The design conditions for the controllable-pitch propeller is given as follows:

Ship Speed, $V_s = 21$ knots

Propeller diameter, $D = 25$ ft

Centre of pressure, $C_c = 47.2\%$ of chord

Position of \max^m thickness, $C_m = 46\%$ of chord

Drag co-efficient, $C_D = 0.009$

Rake angle, $\delta = 8.2^\circ$

Hub diameter = 0.3 of propeller dia.

Density of water, $\rho = 1.99 \text{ lb sec}^2/\text{ft}^4$.

x	l (ft)	S_k (ft)	$\phi_{(\text{deg})}$	$I-W_x$	$\beta_{(\text{deg})}$	$\beta_{i(\text{deg})}$	C_L
0.7	5.964	0.103	28.455	0.8	20.82	26.52	0.285

7. (a) Design a fully cavitating propeller to develop a thrust of 2400 kg at a speed to 45 knots. The following particulars are given:

(25)

Wake fraction = 0.12

Number of blades, $z = 3$

Screw diameter, $D = 0.53$ m

Calculate the following items:

- (i) For optimum efficiency, the required r.p.m of the propeller.
- (ii) the corresponding pitch of the propeller.
- (iii) Optimum efficiency.
- (iv) Thrust per unit of projected area.
- (v) If $\text{BAR} = 0.65$, calculate the projected Area, A_p .

- (b) Differentiate between contra-rotating and fully cavitating propeller.

(10)

8. (a) Describe the design features of a kort nozzle propeller.

(15)

- (b) The following data of a harbour tug are known:

(20)

Engine powe = 800 Hp

Enigne r.p.m, $N_{\text{engine}} = 750$ r.p.m

Number of revolutions of the screw with reduction gear = 250 r.p.m.

propeller diameter, $D = 8.325$ ft

propeller pitch, $H_o = 6.129$ ft

Density of water, $\rho = 102 \text{ kg sec}^2/\text{m}^4$.

Thrust deduction fraction, $t = 0.035$

Using the open water test result with the B4-55 screw series in nozzle. Calculate:

- (i) the tow rope force at bollard pull condition
- (ii) the propeller diameter, pitch and efficiency at a speed of 7.5 knots.

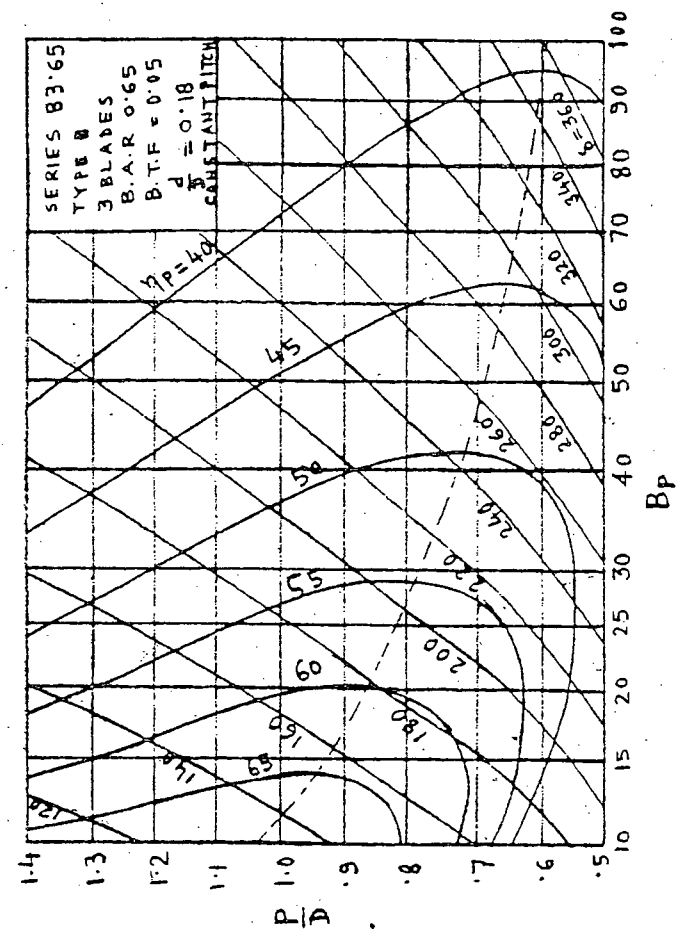
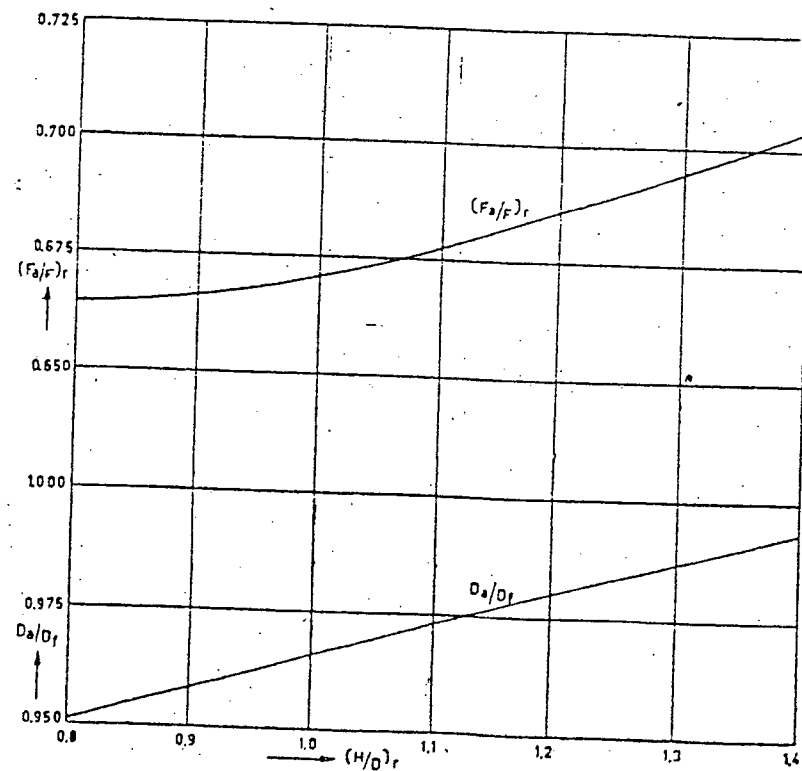
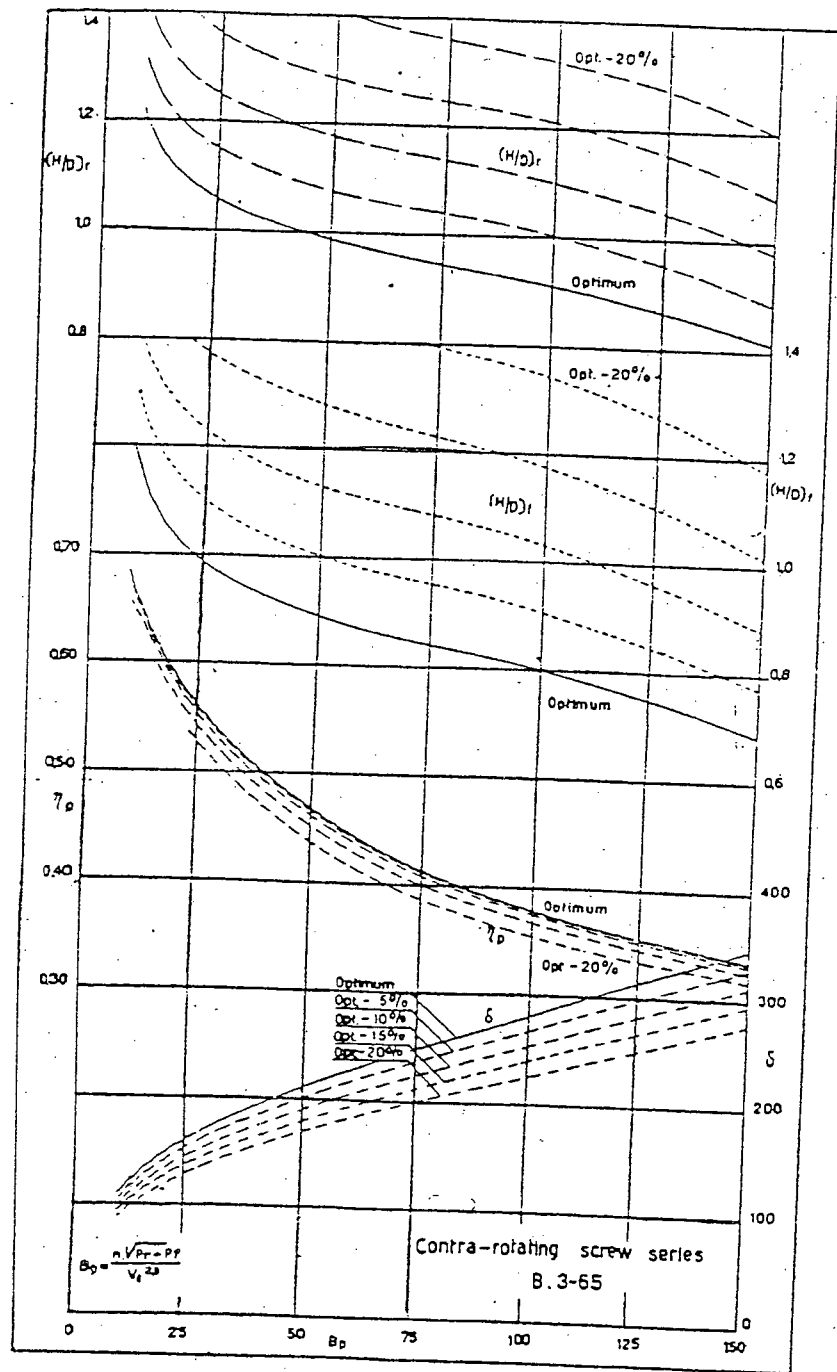


FIG. B4. BP-8 diagram 3 bladed screw type B3-65.

for Question No 5(a)

$J = \frac{V_A}{nD}$
 $C_T = \frac{T}{\frac{1}{2} \rho \frac{\pi}{4} D^2 V_A^2}$

The graph plots Efficiency (Y-axis, 0 to 1.2) against Tip Speed Ratio J (X-axis, 0 to 1.5). Curves are shown for P/D ratios: 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1.0, 1.2, 1.4, 1.6, 1.8, 2.0, 2.5. A dashed line indicates the maximum efficiency for constant C_T .

B 4-55 Screw series in nozzle N° 7

$$K_s = \frac{\text{Screw - Nozzle}}{f \cdot D \cdot n}$$

$$K_{im} = \frac{M}{f \cdot D \cdot n}$$

$$\text{I profile} = 0.50$$

$$U_{\text{screw}}$$

$$\alpha_1 = 12.7^\circ$$

$$\eta = \frac{K_s \cdot \Lambda}{K_{im} \cdot 2\pi}$$

$$\Lambda = \frac{V_e}{n \cdot D}$$

The graph plots efficiency η (y-axis, 0 to 0.8) against the screw coefficient K_s (x-axis, 0 to 1.4). A secondary y-axis on the right shows $10 K_{im}$ (0 to 0.8). Solid curves represent constant efficiency values ($\eta = 0.2, 0.4, 0.5, 0.6, 0.8$). Dashed curves represent constant angles α_1 ($10^\circ, 12^\circ, 14^\circ$). The curves show that efficiency increases with K_s and decreases with K_{im} .

For Question No 8(b)

6

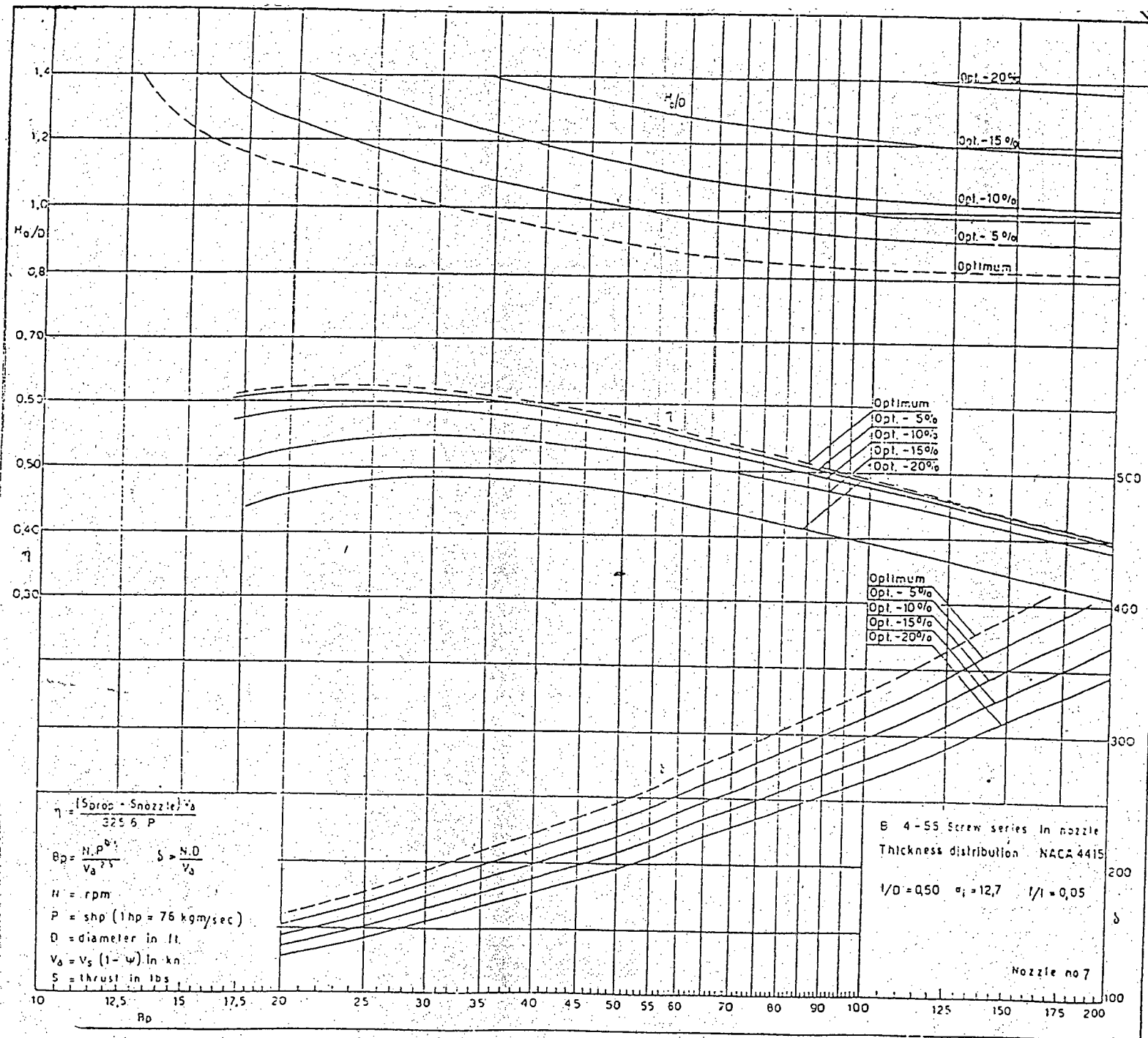


Fig. C1 $B_p - \delta$ diagram for the B 4-55 screw series in a nozzle

for question No 8(b)