Course Learning Outcomes (CLO)		Assessment
CLO1	Comprehend mathematical concepts of computing. (C2, PLO1)	Quiz 1, Quiz 2,Class Test (Sect A)
CLO2	Apply the concepts and theories of computing mathematics. (C3, PLO7)	Quiz 3, Class Test (Sect B),Final Exam

Final Exam (40%):

	Question No	Topics	Question Vs Taxonomy: Cognitive Level 1 SQ	2 SQ	3 SQ	4 SQ	5 SQ	6 SQ	PLO
	1	LOGIC ALGEBRA		10%	15%				7
	2	BOOLEAN ALGEBRA		10%	15%				7
	3	GRAPHS		10%	15%				7
	4	TREES		10%	15%				7
Total				40%	60%				100%

Class Test (25%):

Sections	Question No	Topics	Question Vs Taxonomy: Cognitive Level 1 SQ	2 SQ	3 SQ	4 SQ	5 SQ	6 SQ	PLO
A	A1	NUMBER BASE SYSTEM		8%					1
	A2	NUMBER BASE SYSTEM		8%					1
	A3	SET THEORY		8%					1
	A4	FUNCTIONS		8%					1
	B1	NUMBER BASE SYSTEM		20%					1
	B2	SET THEORY		20%					1
B	A5	DISCRETE PROBABILITY		8%					7
	B3	DISCRETE PROBABILITY			20%				7
Total				80%	20%				100%

Quiz Portfolio (35%)

Quiz	Topic	Question Vs Taxonomy: Cognitive Level 1 SQ	2 SQ	3 SQ	4 SQ	5 SQ	6 SQ	PLO
1	NUMBER BASE SYSTEM		30%					1
2	RELATIONS		30%					1
3	PROOF TECHNIQUES			40%				7
Total			60%	40%				100%

Answer All Questions

QUESTION 1 (25 Marks)

(a) Determine whether the following statements are propositions or not. State the truth values of the propositions.

(i) $x+2=3x$ when $x=-1$.

(ii) In computers, subtraction is generally carried out by 2's complement.

(iii) How far is it to the next town?

(5 marks)

(b) Write negation of the below statement by using DeMorgan's law.
"*Kenny is smart and hardworking*".

(3 marks)

(c) Rewrite the below statement in the form of "if condition (hypothesis) then conclusion".
"It is necessary to have a valid password to log on to the server".

(2 marks)

(d) Determine the truth value of the following statements.

(i) $(4^2-5^2\leq 0)\vee(\sqrt{2^3+4^2}\geq 0)$

(1 mark)

(ii) 151 is a prime number and palindrome number.

(1 mark)

(iii) if $x>5$ then $x^2<25$ for $1\leq x\leq 10$.

(1 mark)

(e) (i) Write the below statement symbolically using logical propositions and operators.
"If I study hard and do not get distracted, then I can score distinction in MCFC module".

(4 marks)

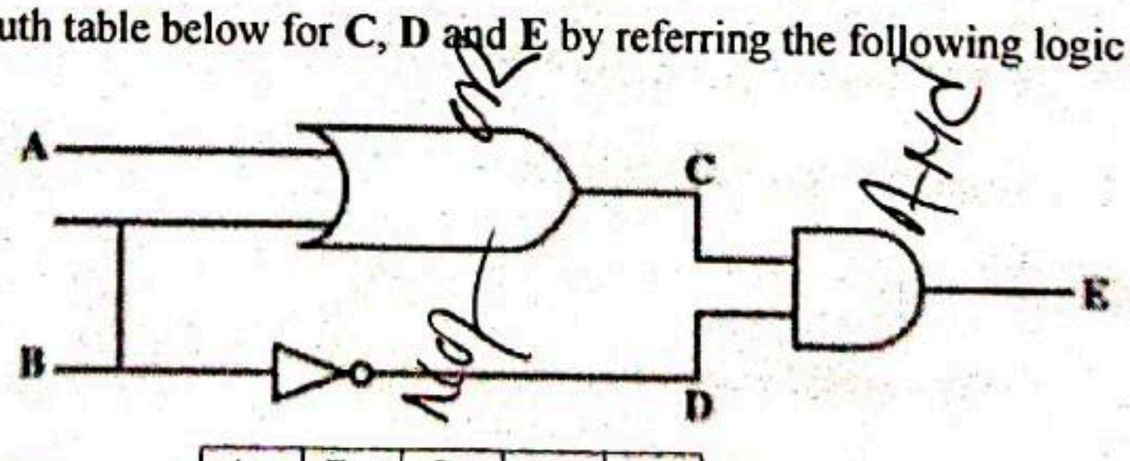
(ii) Construct a truth table for the compound proposition obtained in part (e) (i).

(3 marks)

(iii) Hence, state the compound proposition in part (e) (ii) is tautology, contradiction or indeterminant.

(1 mark)

(f) Construct the truth table below for **C**, **D** and **E** by referring the following logic circuit.



A	B	C	D	E
1	0			
0	1			
1	1			
0	0			

(4 marks)

QUESTION 2 (25 marks)

(a) Show that $xy'+yz'+x'z = x'y+y'z+xz'$ for $x=0, y=1$ and $z=0$.

(2 marks)

(b) Find the output for Boolean expression $(0.1).1'+(1.0)'+(1\cdot1)'$.

(2 marks)

(c) Find the value(s) of the Boolean variables x and y that satisfy $x'y' = x'+y'$.

(2 marks)

(d) Show that the following Boolean expressions are equal by stating the Boolean laws.
$A'B'C'+A'BC'+AB'C'+AB'C+ABC = A'C'+B'C'+AC$

(5 marks)

(e) (i) Construct a truth table for the Boolean function $F(x,y,z)$ that equals to 1 if and only if $xy+z=1$.

(3 marks)

(ii) From the truth table in part (e) (i), obtain the Sum-of-Products (SOP) and Product-of-Sums (POS) expressions.

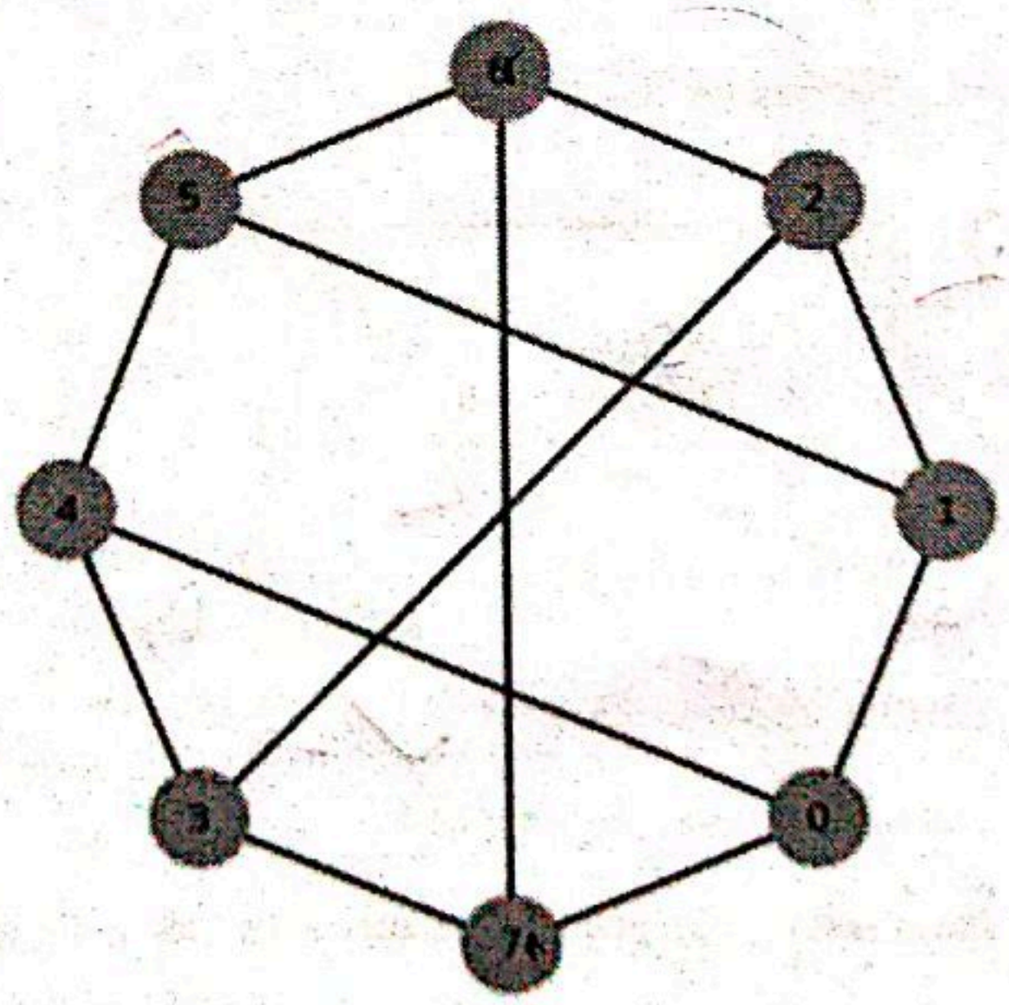
(6 marks)

(iii) Simplify the SOP expression in part (e) (ii) using Karnaugh map.

(5 marks)

QUESTION 3 (25 Marks)

(a) Given the following undirected graph.



(i) Find the degree of each vertex.

(2 marks)

(ii) Construct an adjacency list.

(4 marks)

(iii) Draw a planar graph without any crossing of edges.

(2 marks)

(iv) State the existence of Hamilton circuit.

(1 mark)

(v) From (a) (iv), justify your answer by drawing the circuit or stating the reason.

(2 marks)

(b) For the given degree sequence (1, 2, 1, 3, 3).

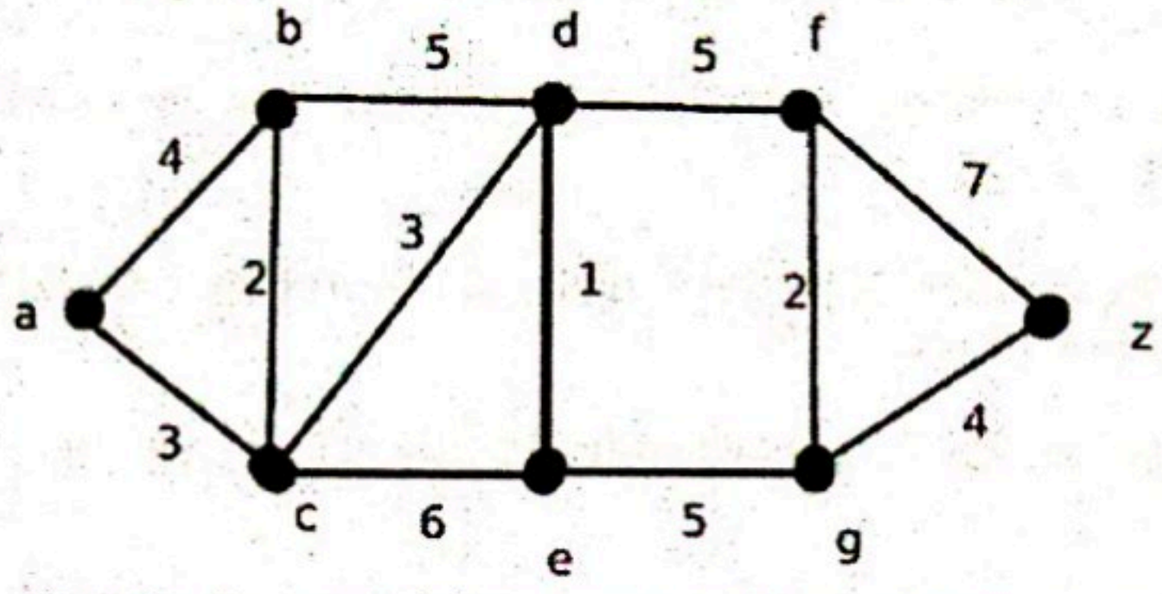
(i) Determine the number of edges using Handshaking theorem.

(2 marks)

(ii) Draw a simple graph for the given degree sequence if exists.

(3 marks)

(c) Given the following weighted graph.



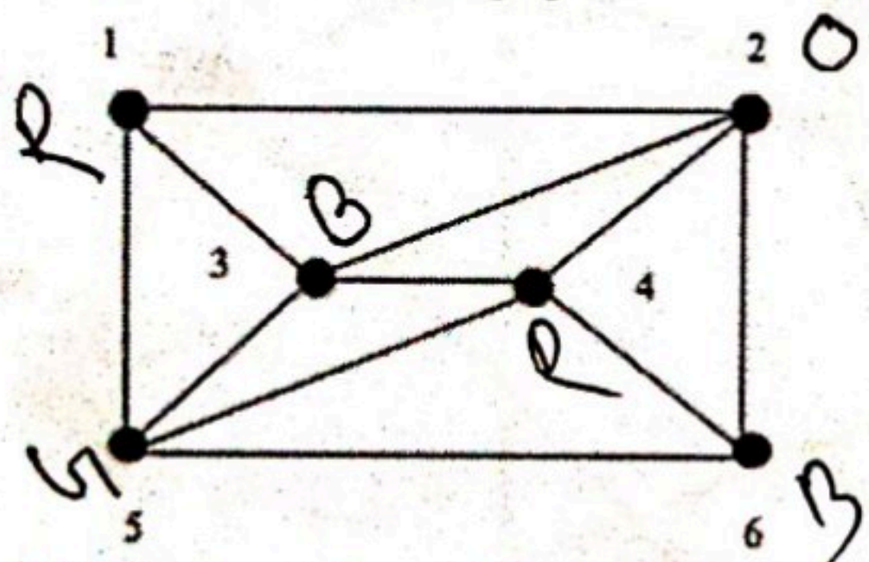
(i) State the shortest path between vertex *a* and vertex *z*.

(2 marks)

(ii) From part (c) (i), find the length of the shortest path.

(1 mark)

(d) Given the following undirected graph.



(i) Find the chromatic number.

(2 marks)

(ii) State the existence of Euler Path.

(1 mark)

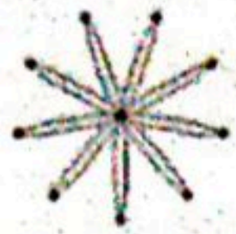
(iii) From part (d) (ii), justify your answer by stating the path or reason.

(3 marks)

QUESTION 4 (25 marks)

(a) State the reason if the following graphs are not a tree.

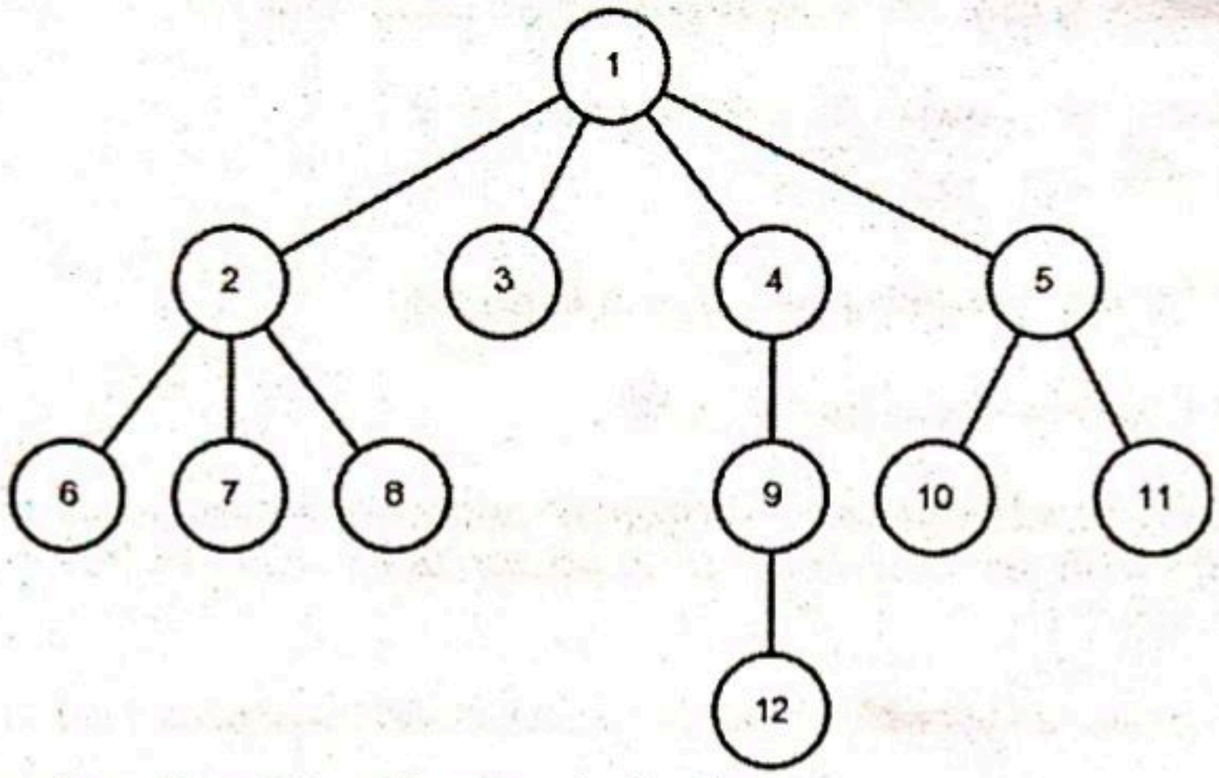
(i)



(ii)

(3 marks)

(b) Given a rooted tree as follows.



(i) State the number of vertices in the tree.

(1 mark)

(ii) Find the height of the tree.

(1 mark)

(iii) Name all level 2 vertices.

(3 marks)

(iv) List the ancestors of "*vertex 10*".

(1 mark)

(v) Find the sibling of "*vertex 7*".

(2 marks)

(vi) Draw a subtree rooted at "*vertex 4*".

(2 marks)

(vii) List the internal vertices excluding root.

(2 marks)

(viii) List the order of the vertices of the tree, using traversals below:

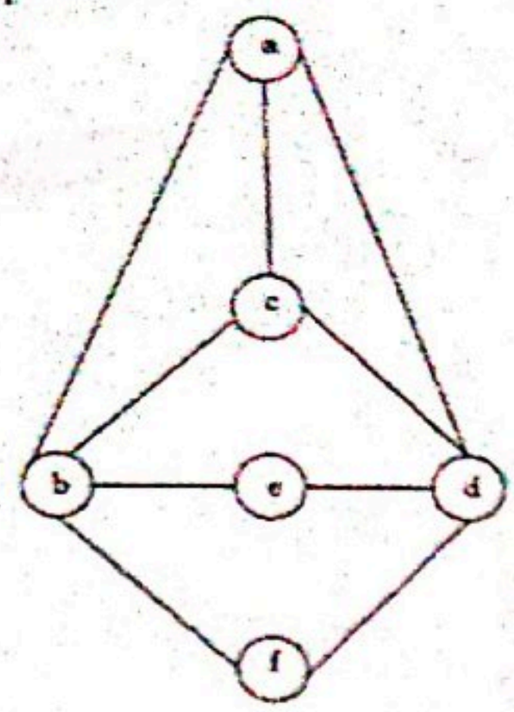
(A) pre-order traversal.

(3 marks)

(B) in-order traversal.

(3 marks)

(c) Find a spanning tree of the graph below.



(4 marks)

Formula:

Boolean algebra Laws

Law	Identity
1. Involution Law:	$(x')' = x$
2. Complementarity:	$x + x' = 1$ $x \cdot x' = 0$
3. Idempotent Laws:	$x + x = x$ $x \cdot x = x$
4. Identity Laws:	$x + 0 = x$ $x \cdot 1 = x$
5. Dominance Laws:	$x + 1 = 1$ $x \cdot 0 = 0$
6. Commutative Laws:	$x + y = y + x$ $xy = yx$
7. Associative Laws:	$x + (y + z) = (x + y) + z$ $x(yz) = (xy)z$
8. Distributive Laws:	$x + yz = (x + y)(x + z)$ $x(y + z) = xy + xz$
9. De Morgan's Laws:	$(xy)' = x' + y'$ $(x + y)' = x'y'$
10. Absorption Laws:	$x + (xy) = x$ $x(x + y) = x$
11. Redundancy Laws:	$x + x'y = x + y$ $x(x' + y) = xy$
12. Consensus Laws:	$xy + x'z + yz = xy + x'z$ $(x + y)(x' + z)(y + z) = (x + y)(x' + z)$

AQ010-3-1-Mathematical Concepts for Computing

Test Specification Table

	Course Learning Outcomes (CLO)	Assessment
CLO1	Comprehend mathematical concepts of computing. (C2, PLO1)	Quiz 1, Quiz 2,Class Test (Sect A)
CLO2	Apply the concepts and theories of computing mathematics. (C3, PLO7)	Quiz 3, Class Test (Sect B),Final Exam

Final Exam (40%)

	Question No	Topics	Question Vs Taxonomy: Cognitive Level 1	2	3	4	5	6	PLO
			SO	SO	SO	SO	SO	SO	
	1	LOGIC ALGEBRA		10%	15%				7
	2	BOOLEAN ALGEBRA		10%	15%				7
	3	GRAPHS		10%	15%				7
	4	TREES		10%	15%				7
Total				40%	60%				100%

INSTRUCTION:
Answer ALL the questions

QUESTION 1 (25 Marks)

(a) (i) Proposition, False
(a2: a1 for proposition, a1 for False)

(ii) Proposition, True
(a2: a1 for proposition, a1 for true)

(iii) Not a proposition
(a1)

(b) Kenny is not smart or not hardworking.
(a3: a2 for not, a1 for "or")

(c) If you have a valid password then you can log on to the server.
(a2: a1 for condition, a1 for conclusion)

(d) (i) True
(ii) True
(iii) False
(a3: a1 for each)

(e) (i) p: I study hard
q: I get distracted
r: I can score distinction in MCFC module
(m1 for propositions p, q, r)

Note: Accept any other variables.
Logical expression: $(p \wedge \square q) \rightarrow r$
(a3: a1 for each logical connectivity)

(ii) Truth table

p	q	r	$\sim q$	$p \wedge \sim q$	$(p \wedge \sim q) \rightarrow r$
T	T	T	F	F	T
T	T	F	F	F	T
T	F	T	T	T	T
T	F	F	T	T	F
F	T	T	F	F	T
F	T	F	F	F	T
F	F	T	T	F	T
F	F	F	T	F	T

(a1) (a1) (a1)

(iii) Indeterminant.

(a1)

(f) Truth table

A	*B*	*C*	*D*	*E*
1	0	1	1	1
0	1	1	0	0
1	1	1	0	0
0	0	0	1	0

(a4: a1 for each row)

QUESTION 2 (25 Marks)

(a) $xy'+yz'+x'z=x'y+y'z+xz'$

$0.1'+1.0'+0'.0=0'.1+1'.0+0.0'$

$1=1$ (Hence showed)

(m2)

(b) $(0.1).1'+(1.0)'+(1\cdot1)'=0+1+0=1$

(m1, a1)

Note: Method is optional. Accept direct answer.

(c) $x=1, y=1$ or $x=0, y=0$

(a2: a1 for x value and a1 for y value/ accept either one of them)

(d) $A'B'C'+A'BC'+AB'C'+AB'C+ABC$

$=A'C'(B'+B)+AB'C'+AC(B'+B)$ Distributive Law

$=A'C'.1+AB'C'+AC.1$ Complementarity Law

$=A'C'+AB'C'+AC$ Identity Law

$=C'(A'+AB')+AC$ Distributive Law

$=C'(A'+B')+AC$ Redundancy Law

$=A'C'+B'C'+AC$ (Shown) Distributive Law

(m3 for simplification, m2 for naming of laws)

Note: Accept other appropriate method.

(e) (i) Truth table

x	y	z	F
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

(a1 for all possible values of x, y, z)

(a2: a1 for each 4 correct values of function F)

(ii) SOP expression: $x'y'z+x'yz+xy'z+xyz'+xyz$

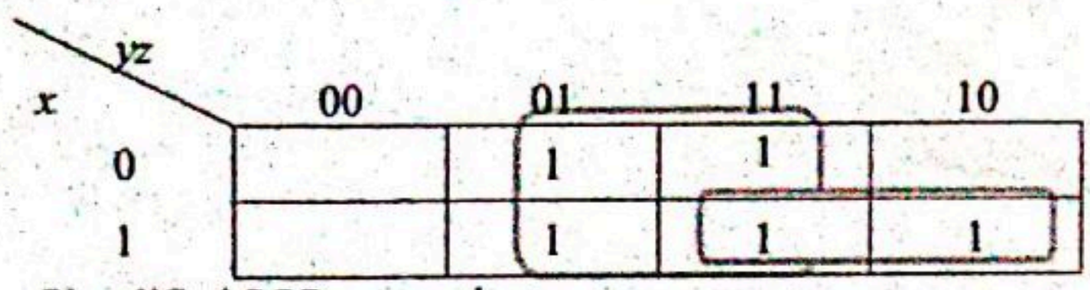
(a3: a1-for each correct two minterms, a1 for sum and one minterm)

POS expression: $(x+y+z)(x+y'+z)(x'+y+z)$

(a3: a1-for each correct two maxterms)

Note: Boolean AND operator (.) is not mandatory. Reduce 1 mark if Boolean OR operator (+) used.

(iii)



Simplified SOP expression: $z + xy$

(a5: a2 for answer; a1-for 1's, a2- for grouping)

QUESTION 3 (25 Marks)

(a) (i) $\deg(0) = 3, \deg(1) = 3, \deg(2) = 3, \deg(3) = 3$
$\deg(4) = 3, \deg(5) = 3, \deg(6) = 3, \deg(7) = 3$

(a2: a1 for each four correct degree)

(ii) Adjacency list

Vertex	Adjacent vertices
0	1, 4, 7
1	0, 2, 5
2	1, 6, 3
3	4, 2, 7
4	0, 5, 3
5	1, 6, 4
6	7, 5, 2
7	0, 3, 6

(a4: a1 for each two correct rows)

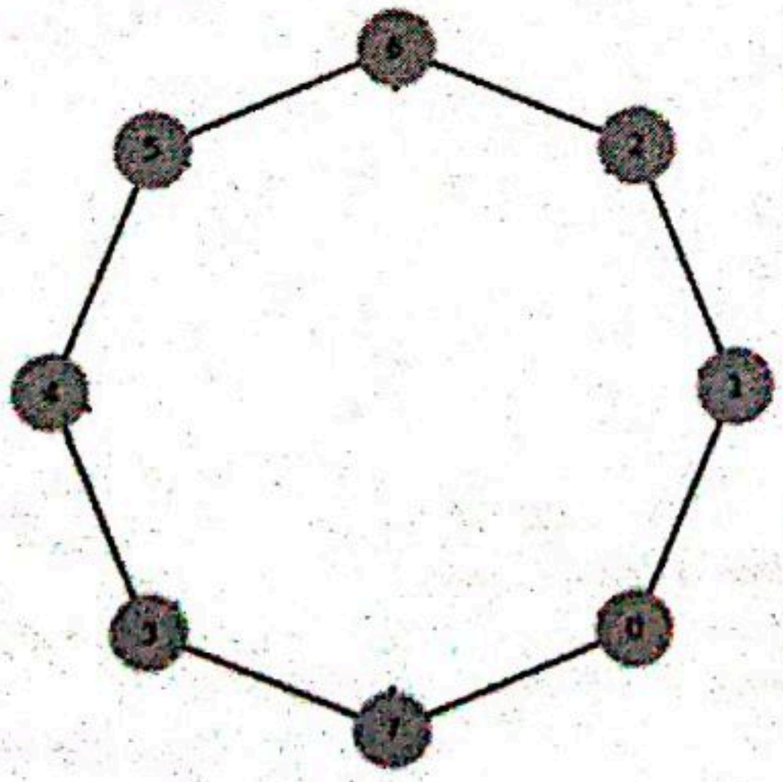
(iii) Planar graph does not exist.

(a2)

(iv) Yes, Hamilton circuit exists.

(a1)

(v)

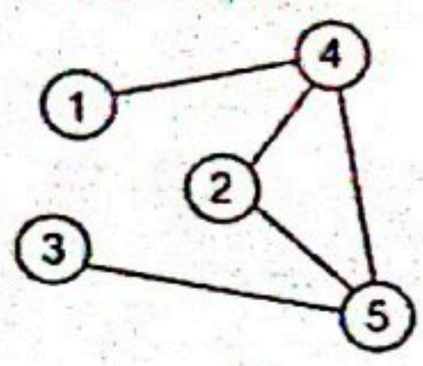


(a2)

(b) (i) $2e = 10 \Rightarrow e = 5$

(m1 for Handshaking theorem, a1)

(ii) Simple graph



(a3, accept any other possible graph)

(c) (i) Shortest path = a, c, d, e, g, z

(a2)

(ii) Length of the shortest path = $3+3+1+5+4=16$

(a1)

(d) (i) 3

(a2)

(ii) Yes. Euler path exist.

(a1)

(iii) Euler path: 1, 2, 3, 4, 2, 6, 4, 5, 1, 3, 5, 6.

(a3: a1 for each correct 4 vertices)

QUESTION 4 (25 Marks)

(a) (i) Not a tree because there is a simple circuit between vertices.

(a2: a1 for "No", a1 for reason)

(ii) Yes.

(a1)

(b) (i) 12

(a1)

(ii) 3

(a1)

(iii) 6, 7, 8, 9, 10, 11

(a1)

(iv) 1, 5

(a3: a1 for each 2 correct vertices)

(v) 6, 8

(a1)

(vi) subtree

(a2: a1 for each)

(a2)

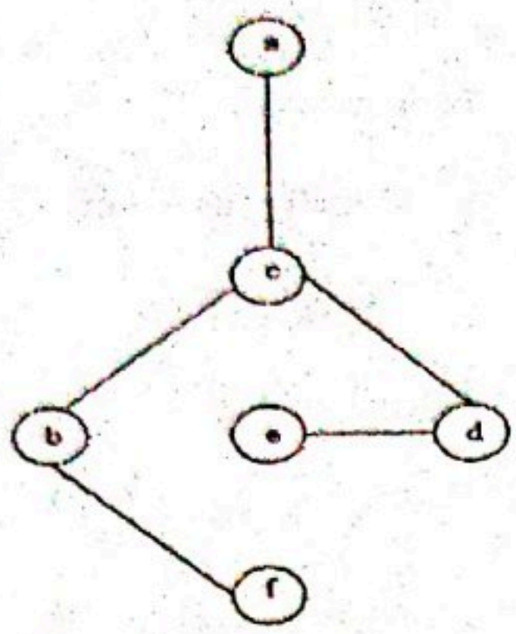
(vii) 2, 4, 5, 9

(a2: a1 for each 2 vertices)

(viii) (A) Pre-order traversal: 1, 2, 6, 7, 8, 3, 4, 9, 12, 5, 10, 11
(a3: a1 for 4 consecutive vertices)

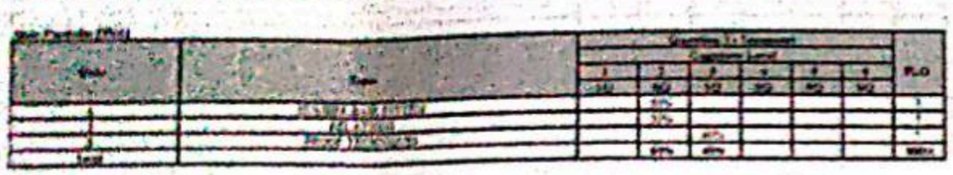
(B) In-order traversal: 6, 2, 7, 8, 1, 3, 4, 9, 12, 10, 5, 11
(a3: a1 for 4 consecutive vertices)

(c)



(a4: a1 for 6 vertices, a3 for 5 edges)

Note: Accept any other spanning tree.



Duration: 30 minutes

Answer all questions. Each question carries 5 marks.

1. Give a direct proof, "If n is an odd integer then $n^3 - 2n + 3$ is an even integer".

Proof:

We assume that n is an odd integer. (Hypothesis)

Let $n = 2k + 1$ (Definition of an odd integer where k is some integer)

(m1)

$$n^3 - 2n + 3 = (2k+1)^3 - 2(2k+1) + 3$$
$$= 4k^3 + 1 + 4k - 4k - 2 + 3$$
$$= 4k^3 + 2 = 2(2k^3 + 1)$$

(m2)

$n^3 - 2n + 3 = 2m$, where $m = 2k^3 + 1$ (m is an integer)

Therefore, $n^3 - 2n + 3$ is an even integer.

(m1)

Therefore, "If n is an odd integer then $n^3 - 2n + 3$ is an even integer". (Conclusion)

(a1)

2. Use proof by contradiction to prove that "if $x^3 \le 144$, then $|x| \le 12$".

Proof:

If $x^3 \le 144$, then we need to show that $|x| \le 12$. Suppose on contrary we have $|x| > 12$.

Then either $x > 12$ or $x < -12$.

(m1)

If $x > 12$ then $x^3 > 144$,

If $x < -12$ then $x^3 > 144$,

(m2: m1 for each)

In either case, we have a contradiction. Hence $|x| \le 12$.

(m1)

Therefore, we have proved that "if $x^3 \le 144$ then $|x| \le 12$".

(a1)

3. Give an indirect proof, if x is a real number and $x^3 - 5x^2 + 6x - 30 = 0$, then $x = 5$ using proof of contrapositive.

Proof:

We assume that the conclusion of the statement is false. If $x^3 - 5x^2 + 6x - 30 = 0$ then $x = 5$ is false.

(m1)

Assume $x \neq 5$, then

$$x^3 - 5x^2 + 6x - 30 = x^2(x-5) + 6(x-5) = (x^2+6)(x-5) \neq 0$$
$$x^2 + 6 \neq 0 \text{ or } x - 5 \neq 0$$

(m3)

Therefore, we have proved that if $x^3 - 5x^2 + 6x - 30 = 0$ then $x = 5$.

(m1)