MAT 202 **REG NO. ....**

CREDIT BASED SECOND SEMESTER B.C.A. DEGREE EXAMINATION

APRIL 2012

MATHEMATICS

FUNDAMENTALS OF MATHEMATICS-2

Duration: 3 hours **Max marks: 80**

Note: Answer any SIX questions from Part–A. Each question carries 2 marks.
Answer FOUR full questions from Part–B choosing ONE full question from each unit.

PART A

1. **2x6=12**

a) Let A = {1, 2, 3, 4}, B={2, 3, 7}, C={1, 2, 5, 7}.
Verify $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$.

b) Define equivalence relation. Give example.

c) If $\lceil x \rceil$ = the least integer greater than or equal to x, find $\lceil 3.33 \rceil$.

d) Show that the functions $f(x) = x^3$ and $g(x) = x^{1/3}$ for $x \in R$ are inverses of one another.

e) Write the following statement in symbolic form: "If either Jerry takes Calculus or Ken takes Sociology, then Larry will take English."

f) Construct the truth table for $(P \rightarrow Q) \wedge P$

g) Define a directed graph. Give example.

h) Define a binary tree. Give example.

PART B

UNIT 1

2 a) Define Cartesian product of two sets.
Let A = {α, β} and B = {1, 2, 3}. Find $A \times B, B \times A, A \times A$ and $B \times B$ (4)

b) Given the relation matrices $M_R = \begin{bmatrix} 1 & 0 & 1 \\ 1 & 1 & 0 \\ 1 & 1 & 1 \end{bmatrix}$ and $M_S = \begin{bmatrix} 1 & 0 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 \end{bmatrix}$ (5)

Find M_{RoS}, M_R, M_S and show that $M_{RoS} = M_{SoR}$

c) Let A be the set of factors of a particular positive integer m and let ≤ be the relation divides, i.e., $\leq = \{ <x, y> \mid x \in A \wedge y \in A \wedge (x \text{ divides } y)\}$
Draw Hasse diagram for m = 30 and m = 45. (8)

3 a) Define subset. For any two sets A and B, show that
(i) $A - B = A \cap \sim B$ (ii) $A \subseteq B \Leftrightarrow \sim B \subseteq \sim A$ (5)

d) Let X = {1, 2, 3, 4} and
R = {<1, 1>, <1, 4>, <4, 1>, <4, 4>, <2, 2>, <2, 3>, <3, 2>, <3, 3> }.
Write the matrix of R and sketch its graph (6)

e) Find the maximal compatibility blocks of the following relation and also draw the graph. (6)

2	1			
3	1	1		
5	0	0	1	
6	1	0	1	1
	1	2	3	5

UNIT 2

4 a) Let $f : R \to R$ and $g : R \to R$, where R is the set of real numbers. Find *fog* and *gof* where $f(x) = x^2 \quad 2$ and $g(x) = x + 4$. (6)

b) Let $*$ be a binary operation on X which is associative and which has the identity $e \in X$. If an element $a \in X$ is invertible, then prove that both its left and right inverses are equal. (6)

c) Define characteristic function of a set. Show that $\sim\sim A = A$. (5)

5 a) Let X = {1, 2, 3} and *f, g, h* and *s* be functions from X to X given by

f = {<1, 2>, <2, 3>, <3, 1>} g = {<1, 2>, <2, 1>, <3, 3>}

h = {<1, 1>, <2, 2>, <3, 1>} s = {<1, 1>, <2, 2>, <3, 3>}

Find *fog, sog and fohog.* (6)

b) Define one-to-one function and onto function.
If $f : R \to R$ be given by $f(x) = x^2 - 2$, then find f^{-1}. (5)

f) Let $g : I \times I \to I$, where I is the set of integers and $g(x, y) = x * y = x + y - xy$. Show that the binary operation is commutative and associative. Find the identify element. (6)

UNIT 3

6 a) Determine whether the following is a tautology, contradiction or neither.
(i) $((\neg Q \wedge \neg P) \wedge Q)$
(ii) $(P \to (P \vee Q))$
(iii) $(P \rightleftarrows Q) \rightleftarrows ((P \wedge Q) \vee (\neg P \wedge \neg Q))$ (6)

b) Show the following equivalences
i) $P \to (Q \vee R) \Leftrightarrow (P \to Q) \vee (P \to R)$
(ii) $\neg(P \rightleftarrows Q) \Leftrightarrow (P \vee Q) \vee \neg(P \wedge Q)$ (6)

c) Construct the truth table for
$\neg(P \vee (Q \wedge R)) \rightleftarrows ((P \vee Q) \wedge (P \vee R))$. (5)

7 a) Write the truth table for the following:
(i) Disjunction (ii) conditional (iii) Biconditional (6)

h) Show that $(\neg P \wedge (\neg Q \wedge R)) \vee (Q \wedge R) \vee (P \wedge R) \Leftrightarrow R$ (5)

i) Given the truth values of P and Q as T and those of R and S as F, find the truth values of the following:
(i) $(P \rightleftarrows R) \wedge (\neg Q \to S)$ (ii) $(P \vee (Q \to (R \wedge \neg P)) \rightleftarrows (Q \vee \neg S)$ (6)

UNIT 4

8 a) Define the following
(i) Adjacent nodes (ii) loop (iii) Path (iv) Leaf (v) Parallel edges (5)

b) Define adjacency matrix of the graph G.
Let S = {a, b, c, d} and let R be the relation on S represented by the matrix.

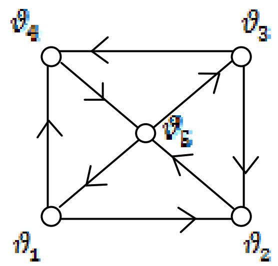
$$A = \begin{bmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 1 \\ 1 & 1 & 0 & 1 \\ 1 & 0 & 0 & 1 \end{bmatrix}$$

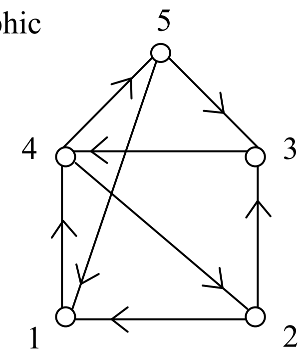
Construct the digraph of R. Find $A \cdot A^T$ and A^2. (6)

c) In a simple digraph G=<V,E>, prove that every node of the digraph lies in exactly one strong component. (6)

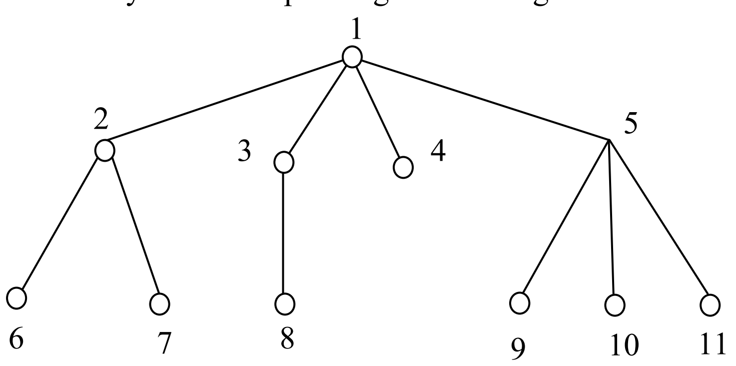
9 a) Define the following with an example.
i) Isolated node ii) Multigraph iii) Cycle (6)

b) Show that the following digraphs are isomorphic (6)





c) Obtain the binary tree corresponding to the tree given below. (5)



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MAT 202 **REG NO. ....**

CREDIT BASED SECOND SEMESTER B.C.A. DEGREE EXAMINATION
APRIL 2013

MATHEMATICS

FUNDAMENTALS OF MATHEMATICS-2

Duration: 3 hours **Max marks: 80**

Note: Answer any SIX questions from Part–A. Each question carries 2 marks.
Answer FOUR full questions from Part–B choosing ONE full question from each unit.

PART A

1. **2x6=12**

a) Represent the following using Venn diagram.
(i) A – B (ii) ~A

b) Define power set with example.

c) Let $f(x) = x + 2$, $g(x) = x - 2$ find *fog*.

d) If the function *f* is defined by $f(x) = x^2 + 1$ on the set {–2, –1, 0, 1, 2}. Find the range and domain of *f*.

e) Define negation of statement. Write the negation of "Bangalore is a city of Gardens".

f) Determine whether the statement $P \wedge \rceil P$ is a tautology or a contradiction.

g) Define cyclic and acyclic graphs.

h) Define Indegree and Outdegree of a node.

PART B

UNIT 1

2 a) Let A = $\{x/x$ is an integer and $0 \leq x \leq 5\}$, B = {3, 4, 5, 17} and C = {1, 2, 3}
Find (i) $A \cap B$ (ii) $A \cup B$ (iii) $A \cup C$ (iv) A – C (v) A – B (5)

g) Let X = {1, 2, 3, 4, 5, 6, 7} and R = {(x,y) | x–y is divisible by 3}. Show that R is an equivalence relation. Draw the graph of R. (6)

c) Given the relation matrices $M_R = \begin{bmatrix} 1 & 0 & 1 \\ 1 & 1 & 0 \\ 1 & 1 & 1 \end{bmatrix}$ and $M_S = \begin{bmatrix} 1 & 0 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 0 \end{bmatrix}$.

Find M_{RoS}, M_{R} , M_{S} and $M_{R\delta S}$ and show that $M_{R\delta S} = M_{SoR}$ (6)

3 a) Let A = {1}, B = {a, b} and C = {2, 3} Find

(i) B^2 (ii) $B^2 \times A$ (iii) $A \times B$ (iv) $A \times B \times C$ (5)

b) Let X = {1, 2, 3, 4} and

R = {(1, 1), (1, 4), (4, 1), (4, 4), (2, 2), (2, 3), (3, 2), (3, 3) }.

Write the matrix of R and sketch its graph (6)

c) Find the maximal compatibility blocks of the following relation and also draw the graph. (6)

2	0			
3	1	1		
4	1	0	1	
5	0	1	0	1
	1	2	3	4

UNIT 2

4 a) Let ∗ be a binary operation on X which is associative and which has the identity $e \in X$. If an element $a \in X$ is invertible, then prove that both its left and right inverses are equal. (5)

b) Let $f(x) = x + 2$, $g(x) = x - 2$ and $h(x) = 3x$ for $x \epsilon R$, where R is the set of real numbers. Find *fog, fof, goh, fogog* and *fohog.* (6)

c) Define one-to-one function and onto function.
If $f : R \to R$ be given by $f(x) = x^2 - 2$, then find f^{-1}. (6)

5 a) Let A = {1, 2, 3} and *f, g are* functions from A to A given by

f = {(1,2),(2, 2), (3, 4), (4, 1)} g = {(1, 3), (2, 1), (3, 3), (4, 3)}

Find *fog, gof and gog.* (6)

b) Let $g : Z \times Z \to Z$, where Z is he set of integers and $g(x, y) = x * y = x + y - xy$. Show that the binary operation is commutative and associative. Find the identity element. (6)

c) Define characteristic function of a set. Show that $\sim\sim A - A$. (5)

UNIT 3

6 a) Prove that $[(P \to R) \land (Q \to R)] \to [(P \lor Q) \to R]$ is a tautology. (6)

b) Write truth table of negation, conditional and biconditional statements. (5)

c) Prove the following:

(i) $(P \to Q) \Leftrightarrow (\neg Q \to \neg P)$

(ii) $P \wedge (P \rightarrow Q) \Rightarrow Q$ (6)

7 a) Show that $(\neg P \wedge (\neg Q \wedge R)) \vee (Q \wedge R) \vee (P \wedge R) \Leftrightarrow R$ (6)

b) Determine whether the following is a tautology, contradiction or neither.

(i) $((\neg Q \wedge P) \wedge Q)$

(ii) $(P \rightarrow (P \vee Q))$

(iii) $(P \leftrightarrow Q) \leftrightarrow ((P \wedge Q) \vee (\neg P \wedge \neg Q))$ (6)

c) Construct the truth table for the following statement.

$\neg (P \vee (Q \wedge R)) \rightleftarrows ((P \vee Q) \wedge (P \vee R))$. (5)

UNIT 4

8 a) Define the following with an example

(ii) Isomorphic graphs (ii) Weighted graphs (iii) Directed graphs

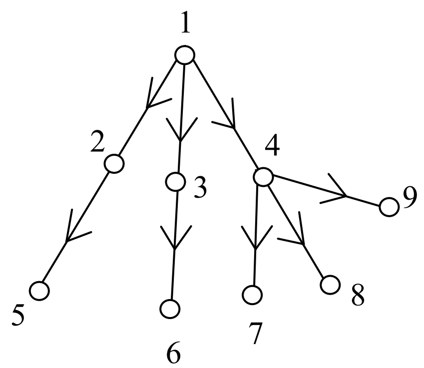
(iv) Multi graph (v) Null graph (10)

b) In a simple digraph $G = (V, E)$ Prove that every node of the digraph lies in exactly one strong component. (7)

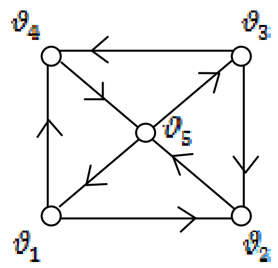
9 a) Define the following with an example

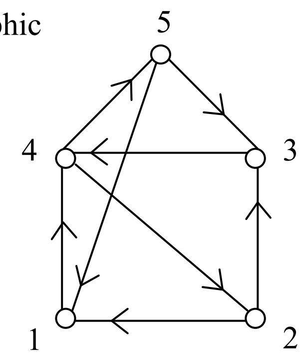
(i) Adjacent vertices (ii) loop (iii) Parallel edges (6)

b) Convert the following tree into a binary tree. (5)



b) Show that the following digraphs are isomorphic (6)





MAT 202 **Reg. No. ....**

CREDIT BASED SECOND SEMESTER B.C.A. DEGREE EXAMINATION APRIL 2014

MATHEMATICS

PAPER II: FUNDAMENTALS OF MATHEMATICS

Duration: 3 hours **Max Marks: 80**

Note: 1. Answer any SIX questions in Part A. Each question carries 2 marks.
2. Answer any FOUR full questions from Part B choosing ONE full question from each unit.

PART A **2x6=12**

1. a) Let A = {1, 2, 3}, B = {2, 3} and C = {1, 3}

prove that $(A \cap B) \quad UC = A \cap (B \cup C)$

b) Define power set of a set A. If A has n elements what is the number of elements in P(A).

p) Define function with an example.

q) Find f^{-1} if $f = x^3 - 4$.

r) Find the truth values of $P \vee (Q \wedge R)$ if the truth values of P.2 are T and that of R is F.

s) Construct the truth table for $(\neg P \vee Q)$.

t) Define binary tree with an example.

u) What is indegree and out degree of a node in a digraph.

PART - B

UNIT-I

2. a) If A = {1}, B = {a, b} and C = {2, 3} find
(i) B^2 (ii) $B^2 \times A$ (iii) $A \times B$ (iv) $A \times B \times C$ **(6)**

b) Define equivalence relation on a set.
If A = {1, 2,3, 4} write the following
(i) An equivalence relation on A
(ii) A relation which is not an equivalence relation non A. **(6)**

c) Define compatibility relative. Find the maximum compatibility blocks of the following relation. Also draw the corresponding graph. **(5)**

2	0			
3	1	1		
4	1	0	1	
5	0	1	0	1
	1	2	3	4

3. a) Define subset. For any two sets A and B show that
(i) $A - B \Leftrightarrow A \cap$ □ B (ii) $A \leq B \Leftrightarrow$ □ $B \leq$ □ A **(6)**

b) Define the following
(i) Union of two sets (ii) Disjoint sets (iii) Universal set
(iv) Compliment of a set (v) intersection of two sets **(6)**

c) Let A be the set of factors of a particular positive integer m and let $\leq$ be the relative divides. That is $\leq = \{< x, y > / x \, \varepsilon \, A \wedge y \, \varepsilon \, A \wedge (x \text{ divides } y)\}$
Draw Harse diagrams for m = 12 and m = 45. **(5)**

UNIT-II

4. a) Show that the function $f : R_+ \rightarrow R$ defined by $f(x) = 2x^2 + 1$ is both one one and onto. Where R_+ is the set of positive real numbers and R is the set of real numbers. **(5)**

b) If f, g, h are three functions defined on the set of real numbers by $f(x) = x + 2, g(x) = x - 2$ and $h(x) = 3x$ find the following
(i) fog (ii) goh (iii) fogoh (iv) fogog **(6)**

c) Define characteristic function of a set show that □□ $A = A$. **(6)**

5. a) Let f and g be two functions on the set of real numbers defined by $f(x) = x^2 - 2$ and $g(x) = x + 4$. State whether these functions are injective, surjective and bijective.
(6)

d) Define identity element under a binary operation if e_e is the left identity element and e_r right identity element with respect to then prove that $e_e = e_r$ **(5)**

e) Using the properties of characteristic functions prove that
$A \cap (B \cup C) = A(\cap B) \cup (A \cap C)$ **(6)**

UNIT-III

6. a) Construct truth table for the formula $7(P \vee (Q \wedge R))$□ $(P \vee Q) \wedge (P \vee R)$ **(6)**

b) Show the implication $(P \to (Q \to R)) \Rightarrow (P \to Q) \to (P \to R)$ **(6)**

c) Prove the following equivalence
(i) $P \to (Q \to P) \Leftrightarrow 7P \to (P \to Q)$
(ii) $P \to (Q \vee R) \Leftrightarrow (P \to Q) \vee (P \to R)$ **(6)**

7. a) Translate the following statements in symbolic form. **(6)**
(i) Jack and Jill went up the hill
(ii) Twenty or thirty animals were killed in the fire today.
(iii) The crop will be destroyed if there is a flood.

b) Determine whether in following is a tautology.
(i) $(7Q \wedge 7P) \wedge Q$
(ii) $P \to (P \vee Q)$
(iii) $(P$□ $2)$□ $(P \wedge Q) \vee (7P \wedge 7Q)$ **(5)**

c) Given truth values of P, Q as T and that of R, S as F. Find the truth values of the following.
(i) $(P$□ $R) \wedge (7P \to S)$
(ii) $P \vee (Q \to (R \wedge 7P))$□ $(Q \vee 7S)$ **(5)**

UNIT-IV

8. a) In the given diagram identify the following i) an isolated vertex (node) (ii) a pair of parallel edges (iii) a loop (iv) a cycle (v) a path from v_1 and v_5 **(5)**

e_1 v_1 e_2 v_2
e_6 e_7 e_4 e_3 v_5
e_8 ∘ v_6
v_4 e_5 v_3

b) Define the following with example

(i) Strongly connected graph

(ii) Weakly connected graph

(iii) Unilaterally connected graph **(6)**

c) Let A = { w, x, y, z} and let R be a relation on A represented by the matrix.

$$M_R = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 \\ 1 & 1 & 1 & 0 \\ 0 & 1 & 0 & 1 \end{bmatrix}$$

Construct the digraph of R and list the indegree and outdegree of each node. **(6)**

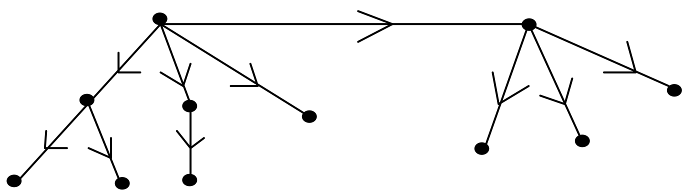
9. a) Define the following with one example each.

(i) Digraph

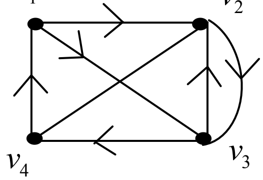
(ii) isomorphic graphs

(iii) Weighted graph **(6)**

b) Represent the following tree by a binary tree. **(6)**



c) Define adjacency matrix of a digraph and write the adjacency matrix of the following graph. **(6)**



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MAT 202 Reg. No. ....

CREDIT BASED SECOND SEMESTER B.C.A. DEGREE EXAMINATION APRIL 2015

MATHEMATICS

PAPER II: FUNDAMENTALS OF MATHEMATICS

Duration: 3 hours **Max Marks: 80**

Note: 1. Answer any SIX questions in Part A. Each question carries 2 marks.
2. Answer any FOUR full questions from Part B choosing ONE full question from each unit.

PART A **2x6=12**

1. a) Represent the following using Venn diagram (i) $\square(A\cup B)$ (ii) $\square A\cap B$

b) Write the power set of A if A = {1, 2, 3}.

vv) If f and g are two functions on the set of real numbers defined by $f(x)=x-2$ and $g(x)=x+4$ find $f\circ g$.

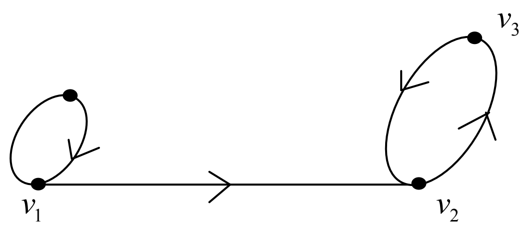
ww) Define characteristic function of a set A.

xx) Construct the truth table for the compound proposition $P\wedge(P\vee Q)$.

yy) Write in symbolic form "The crop will be distroyed if there is a flood".

zz) What is length of a path? Explain with an example.

aaa) Write the in-degree and out-degree of each of the nodes in the following graph.



PART - B

UNIT-I

2. a) If A = {1, 2, 4, 6, 8}, B = {2, 4, 5, 9} and
C = {x | x is a positive integer and $x^2\le 16$},
find (i) $A\cap(B\cup C)$ (ii) $(A\cup B)\cap(A\cup C)$ **(5)**

b) Define equivalence relation. Find an equivalence relation on the set
A = (1, 2, 3, 4}. **(6)**

c) If $M_R=\begin{bmatrix}1&0&1\\1&1&0\\1&1&1\end{bmatrix}$ and $M_S=\begin{bmatrix}1&0&0&1&0\\1&0&1&0&1\\0&1&0&1&0\end{bmatrix}$

are two relation matrices find $M_{R\circ\tilde{S}}$, $M_{R\tilde{\circ}S}$ and $M_{\tilde{S}\circ\tilde{R}}$ **(6)**

3. a) If A = {x | x is an integer and $0 \le x \le 3$} and B = {4, 5}, find the following.
(i) $A \times B$ (ii) number of elements in $P(A \times B)$
(iii) number of relations from A to B. **(6)**

b) If X = {1, 2, 3, 4} and
R = {<1, 1>, <1, 4>, <4, 1>, <4, 4>, <2, 2>, <2, 3>, <3, 2>, <3, 3>} write the matrix of R and sketch the graph. **(6)**

c) Let X = {2, 3, 6, 12, 24, 36} and the relation $'\le'$ be such that $x \le y$ if x divides y. Draw the Hasse diagram of $(X, \le)$ **(5)**

UNIT-II

4. a) Let f and g be two functions on the set of real numbers defined by $f(x) = x^2 - 2$ and $g(x) = x + 4$. Show that $g(x)$ is a bijective function. Also find $g \circ f \circ f$. **(6)**

b) Define inverse of a function. If $f : R \to R$ is defined by $f(x) = x^3 - 2$ find f^{-1} **(5)**

c) Let * be a binary operation on a set X which is associative and has the identity element 'e'. If an element $a \in X$ is invertible, then prove that both left inverse and right inverse of a are equal. **(6)**

5. a) Let A = {1, 2, 3), f and g are functions on A given by f = {<1, 2>, <2, 2>, <3, 4>, <4, 1> and g = {<1, 3), <2, 1>, <3, 3>, <4, 3>}, then find the following
(i) $f \circ g$ (ii) $g \circ f$ (iii) $g \circ g$ **(5)**

j) Define characteristic function of a set and using the properties of characteristic functions prove that $A \cap (B \cup C) = (A \cap B) \cup (A \cap C)$ **(6)**

k) Let $f : z \times z \to z$ be defined by $f(x, y) = x * y = x + y - xy$ show that the operation * is commutative and associative. Also find the identity element under * **(6)**

UNIT-III

6. a) Show that $\left(\neg P \wedge (\neg Q \wedge R)\right) \vee (Q \wedge R) \vee (P \wedge R) \Leftrightarrow R$ **(6)**

b) Define tautology and contradiction. Find whether $(P \vee Q) \wedge (P \wedge Q)$ is a tautology or not. **(5)**

d) Give the truth values of P and Q as T and that of R and S are F. find the truth value of the following.
(iii) $\left(\neg(P \wedge Q) \vee \neg R\right) \vee \left(Q \square \neg P\right) \to R \vee (\neg S)$
(iv) $(P \vee (Q \to (R \wedge \neg P) \square (Q \vee \neg S)$ **(6)**

7. a) Write the truth table for the following **(5)**
(i) Disjunction (ii) Conditional (iii) Biconditional

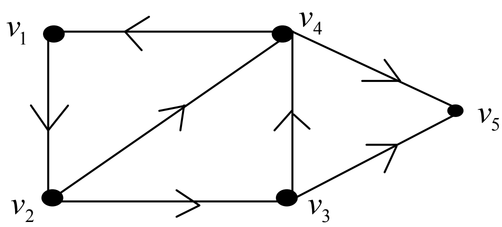
b) Construct truth table for the following implications.
(i) $Q \wedge (P \to Q) \to P$
(ii) $\neg(P \vee (Q \wedge R)) \Rightarrow (P \vee Q) \wedge (P \vee R)$ **(6)**

c) Prove that $\big((P \vee Q) \wedge \neg(\neg P \wedge (\neg Q \vee \neg R))\big) \vee (\neg P \wedge \neg Q) \vee (\neg P \wedge \neg R)$ is a tautology **(6)**

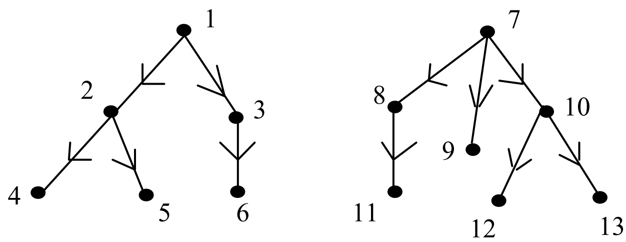
UNIT-IV

8. a) Explain the following with example
(i) isolated vertex (ii) parallel edges (iii) Indegree and outdegree **(6)**

b) Define reachable set of a set S of nodes in a digraph. Also find the reachable set of the sets $\{v_1, v_4\}$, $\{v_4, v_5\}$ and $\{v_3\}$ in the following graph **(6)**



c) Convert the following forest into a binary tree **(5)**

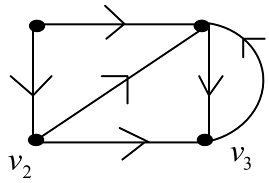


9. a) Define the following.
(i) Path
(ii) Path length
(iii) Simple path
(iv) Elementary path
(v) Cycle **(6)**

b) If $A = \begin{bmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 1 \\ 1 & 1 & 0 & 1 \\ 1 & 0 & 0 & 0 \end{bmatrix}$ is the adjacency matrix of a digraph G, then represent the digraph $\overline{G}$, the converse of G, graphically. **(6)**

c) Define node base in a digraph and find the node base of the following graph **(5)**

v_1 v_4


v_2
v_3

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