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1.)

a)

$$\left.\begin{array}{l}(a \vee b) \rightarrow c. \\ c \rightarrow (d \wedge e)\end{array}\right\} \text{Premis.}$$

$$a \rightarrow d. \} \rightarrow \text{result}.$$

take the negation of result.

$$(a \rightarrow d)$$
$$= \sim(a \rightarrow d)$$
$$= \sim(\sim a \vee d).$$
$$= a \wedge \sim d.$$

solving it by tree methode.

$$a$$
$$|$$
$$\sim d.$$

Premis.

$$(a \vee b) \rightarrow c = \sim(a \vee b) \vee c$$
$$= (\sim a \wedge \sim b) \vee c$$
$$= (\sim a \vee c) \wedge (\sim b \vee c)$$

$$c \rightarrow d \wedge e = (\sim c) \vee (d \wedge e)$$
$$= (\sim c \vee d) \wedge (\sim c \vee e)$$

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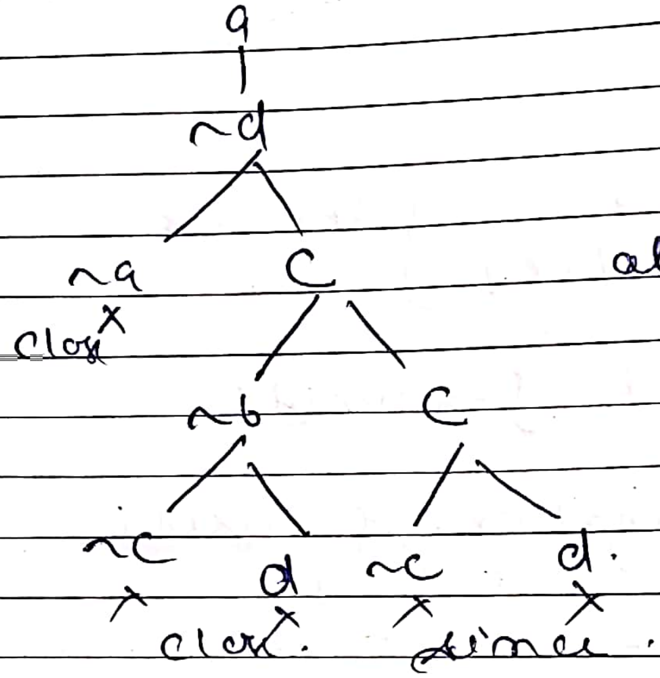
Date: / / Page no:

Solving it by graph method.



all branches are close

negatition of result is False.

of result is valid.

a.) Ans: valid.

b.) premes.

$c \to a.$ $= (\sim c \vee a)$

$\sim c \to b$ $= (c \vee b)$

result $a \vee b$.

take negation of result $= \sim(a \vee b)$

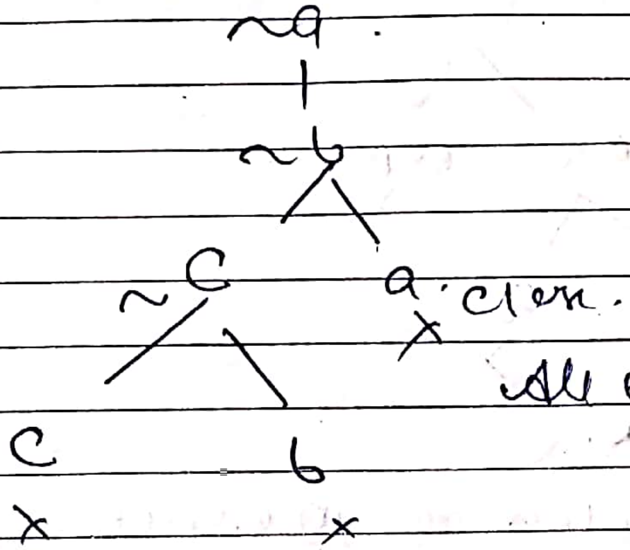
$= \sim a \wedge \sim b$.

Prachyumna
0801IT181059

Date: 1/7/ Page no:

b.)

Solving by graph Or tree methods.



All branches are close

Since negation of result is false.
of result is valid.

b.) Ans: valid.

c) $(P \to Q,\ P \to R,\ Q \to \sim R,\ P) \Rightarrow (R \to S)$

$P \to Q$	$(\sim P \vee Q)$
$P \to R$.	$(\sim P \vee R)$
$Q \to \sim R$	$(\sim Q \vee \sim R)$
P	P
$R \to S$.	$\sim R \vee S$

Take negation of result = $R \wedge \sim S$.

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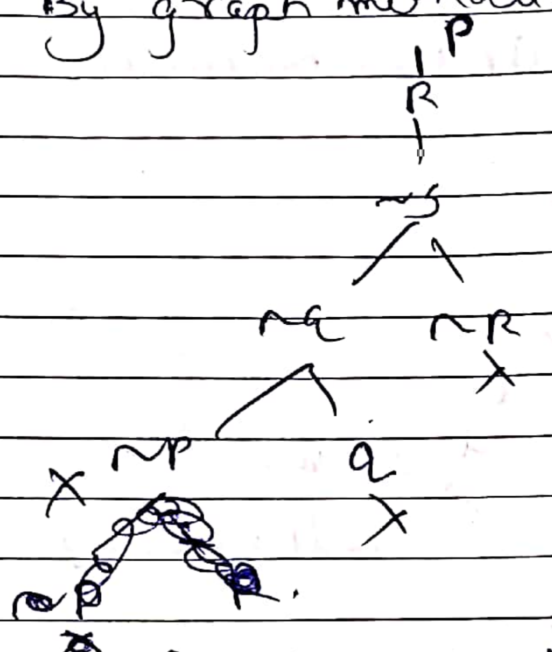
0801IT181059

Date: / / Page no:

By graph method.



negation of result is False.
of result is valid.

(2.) ans: valid.

Q.)

2.)

a.) $\exists_x (P(x) \land Q(x)) \Rightarrow \{\exists_x P(x) \land \exists_x Q(x)\}$

take negation of above.

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080177181059

Date: / / Page no:

Q3.)

3, b.)

Sol:

S2. An simple is connected if $\delta(G) = \frac{n-1}{2}$

$$|V(G_1)| \geq \frac{n-1}{2} + 1 = \frac{n+1}{2}$$

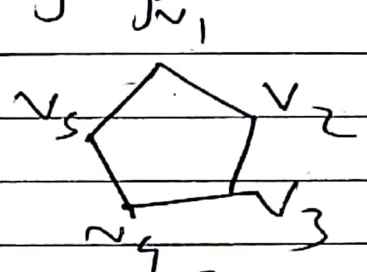
$$|V(G_2)| \geq \frac{n-1}{2} + 1 = \frac{n+1}{2}$$

$$V(G_1) + V(G_2) = n+1$$

Assumption → False.
Statement → True.

a.) S1

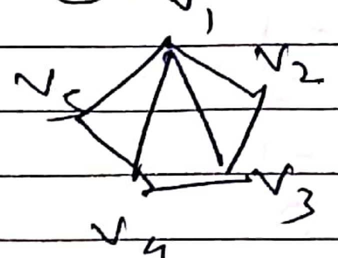
Ans: NO, the complement of a simple connected graph can be connected or disconnected.



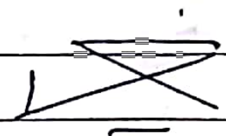
G_1

$\overline{G_1}$

But for a modified cycle graph.



G_2



$\overline{G_2}$

$\overline{G_1}$ is connected while $\overline{G_2}$ is not when both G_1 & G_2 were simple connected graph.

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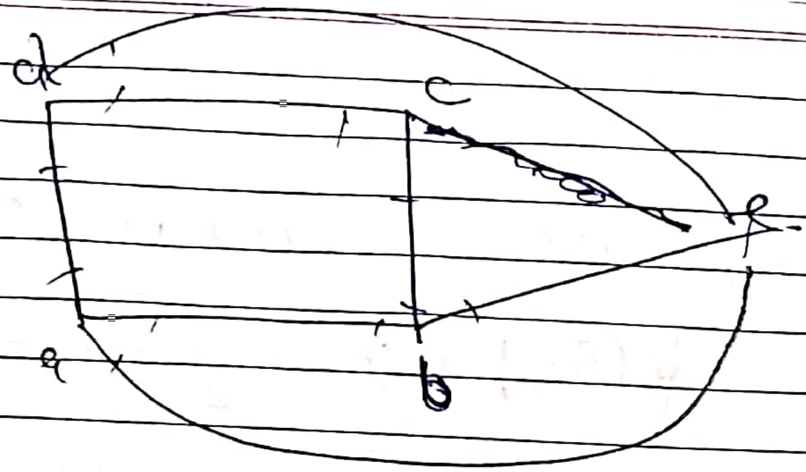
Q4.)



Q.

$$\begin{array}{c|ccccc} & A & B & C & D & E \\ \hline A & 0 & & & & \\ B & & 0 & & & \\ C & & & 0 & & \\ D & & & & 0 & \\ E & & & & & 0 \end{array}$$

	A	B	C	D	E
A	3	-1	0	-1	-1
B	-1	3	-1	0	-1
C	0	-1	2	-1	0
D	-1	0	-1	3	-1
E	-1	-1	0	-1	3

Drop 1 row and 1 column.

$$\begin{matrix} 3 & -1 & 0 & -1 \\ -1 & 2 & -1 & 0 \\ 0 & -1 & 3 & -1 \\ -1 & 0 & -1 & 3 \end{matrix}$$

Pradhyumna
0801IT141055

Find determinant of above matrix.

$$3\begin{vmatrix} 2 & -1 & 0 \\ -1 & 3 & -1 \\ 0 & -1 & 3 \end{vmatrix} + 1\times\begin{vmatrix} -1 & -1 & 0 \\ 0 & 3 & -1 \\ -1 & -1 & 3 \end{vmatrix}$$

$$+1\begin{vmatrix} -1 & 2 & -1 \\ 0 & -1 & 3 \\ -1 & 0 & -1 \end{vmatrix}$$

$$3\left|2(9-1)+1(-3)\right| + 1\left(-1(9-1)+1(-1)\right)$$

$$+1\left(-1(1)-2(+3)-1(-1)\right)$$

$$= 3(16-3)+1(-8-1)+1(\cancel{1}-6+\cancel{1})$$

$$= 13\times 3 - 9 - 6$$

$$= 39 - 9 - 6 = 30 - 6 = 24.$$

no of spanning tree = 24.

Prachyumna
0701IT171059

Date: / / Page no:

Q5.)
Sol:- $A = \{a, b, c, d\}$.

$R = \{(a,d), (b,a), (b,c), (c,a),$
$(c,d), (d,c)\}$.

	a	b	c	d
a	0	0	0	1
b	1	0	1	0
c	1	0	0	1
d	0	0	1	0

	I	II	III	IV
Col	{b,c}	ϕ	{b,d}	{a,c}
Raw	{d}	{a,c}	{a,d}	{c}

I	II	III	IV
(b,c)	ϕ	(b,a)	(a,c)
(b,d)		(b,d)	(c,c)
		(d,a)	
		(d,d)	

Ans:- (b,d) (d,a) (d,a) (a,c) (c,a)

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Q 2.)

a) $\exists x(P(x) \land Q(x)) \Rightarrow (\exists x(P(x) \land \exists_x(Q(x))]$

take negation of above.

Let us assume we have $\{a, b\}$ is universe

$\sim(\sim(\exists x(P(x) \land Q(x)) \lor [\exists x(P(x) \land \exists_x(Q(x)]))$

$\exists x(P(x) \land Q(x)) \land \sim(\exists x(P(x) \land \exists_x Q(x)].$

$[\because \sim(\exists_x) = \forall x]$

$\exists x(P(x) \land Q(x)) \land (\forall x (\sim P(x) \lor \forall x \sim Q(x))$

$(\because \exists x(P(x)) = P(a) \lor P(b)]$

$\Rightarrow \underbrace{(P(a) \land Q(a)) \lor (P(b) \land Q(b))}_{a} \land ((\sim P(a) \land \sim P(b)) \lor (\sim Q(a) \land \sim Q(b))]$

= since let $a = (P(a) \land Q(a)) \lor (P(b) \land Q(b))$

a' or $\sim a = (\sim P(a) \land \sim P(b)) \lor (\sim Q(a) \land \sim Q(b))$

so above statement is equal to

$= a \land a'$

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$[\because a \wedge a' = F]$

Since negation of statement is False so.
result or statement is true or valid.

So ans: valid.

6.) $\forall x(P(x) \to Q(x))$, $\exists x P(y) \Rightarrow \exists x Q(z)$
let us assum {a, b} in universal set.
Primes.

$$\begin{array}{l} \forall x(P(x) \to Q(x)) \\ \underline{\exists x \; P(y)} \end{array}$$

result $\exists x \, Q(z)$.

Take negation of result.

$$\exists x \, Q(z) = \sim \exists x(Q(z))$$

$$= \forall x(\sim Q(z))$$

$$= \sim Q(a) \wedge \sim Q(b)$$

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Premis 1 = $\forall x\,(\sim P(x) \vee Q(x))$

$= \forall x\,(\sim P(x) \vee Q(x))$

$= (\sim P(a) \vee Q(a)) \wedge (\sim P(b) \vee Q(b))$

Premis 2 = $\exists x\, P(y)$

$= P(a) \vee P(b)$

By graph methode.

$\sim Q(a)$

$\sim Q(b)$

$\sim P(a)$ $\quad$ $Q(a)$ ×

$\sim P(b)$ $\quad$ $Q(b)$ × $\quad$ All brach are close.

$P(a)$ × $\quad$ $P(b)$ ×

Since ~~result is~~ negation of result is false so result is true.

So statement is valid.

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0801IT181059

c.) Premises.

$\exists x\, P(x)$, $\forall x\, Q(x)$

result:

$\exists x \{P(x) \wedge q(x)\}$.

let us assume we have $\{a, b\}$ in universal set.

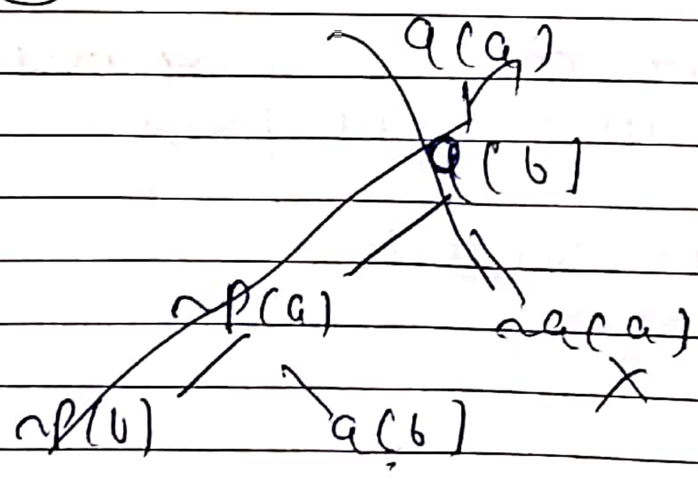
take negation of result.

$$\sim(\exists x (P(x) \wedge q(x)))$$
$$= \forall x (\sim P(x) \vee \sim q(x))$$
$$= (\sim P(a) \vee \sim q(a)) \wedge (\sim p(b) \vee \sim q(b))$$

Premises.

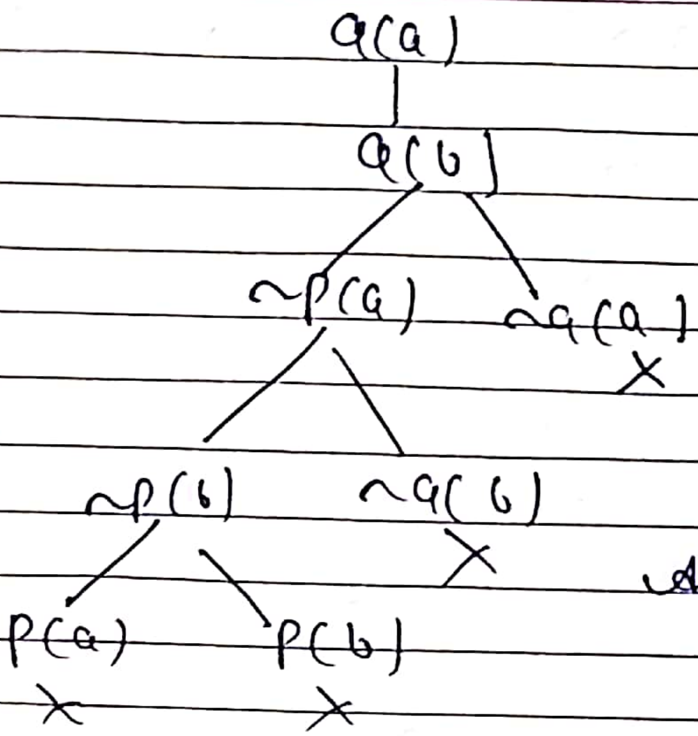
$$\exists x\, P(x) = (P(a) \vee P(b))$$
$$\forall x\, q(x) = q(a) \wedge q(b)$$

By tree method.



Pradhyumna
0801IT181059

Date: / / Page no:



All branches are close.

Since negation of statement is false so above statement is valid or true.