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MATH OBA-1

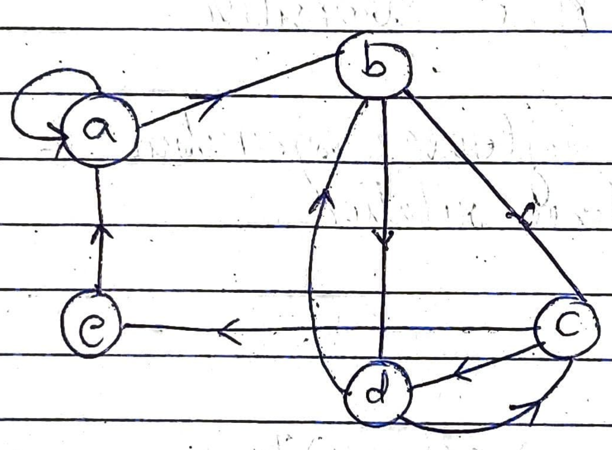
3.)

i.) $A = \{a, b, c, d, e\}$

$$M(R) = \begin{bmatrix} 1 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 1 & 0 \\ 0 & 0 & 0 & 1 & 1 \\ 0 & 1 & 1 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 \end{bmatrix}$$

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

b]



c]

Vertices	In-degree	Out degree
a	2	2
b	2	2
c	2	2
d	2	2
e	1	1

3.) ii.) Given relation $R = \{(1,1), (2,2), (3,3)\}$

~~Reflexive: If a relation does~~

By observing Relation R

a.) $\forall a \in A, (a,a) \in R$, Hence R is reflexive

b.) $\forall (a,b) \in R$, (b,a) also belongs to R
Hence R is symmetric

c.) It can be observed in relation R there is no existence where $(a,b) \in R$ & $(b,c) \in R$ since (b,c) is not present & only (a,b) is present.
Hence R is transitive.

Since R is reflexive, symmetric & transitive, R is equivalence relation.

1.)

ii.) $[(p \vee q) \wedge (p \rightarrow r) \wedge (q \rightarrow r)] \rightarrow r$

$= (p \vee q) \wedge ((p \vee q) \rightarrow r)) \rightarrow r$

$= (F \vee (p \vee q) \wedge r) \rightarrow r$

$= ((p \vee q) \wedge r) \rightarrow r$

$= \neg((p \vee q) \wedge r) \vee r$

$= \neg(((p \wedge r) \vee (q \wedge r)) \vee r$

$= (\neg(p \wedge r) \wedge \neg(q \wedge r)) \vee r$

$= (\neg(p \wedge r) \vee r) \wedge (\neg(q \wedge r) \vee r)$

$= (\neg p \wedge \neg r \vee r) \wedge (\neg q \vee \neg r \vee r)$

$= (\neg p \wedge T) \wedge (\neg q \wedge T)$

$= T \wedge T$

1 i) Given that,

$$[\{(p \to q) \to q\} \to q] \to (p \vee q)$$

LHS $= \{(p \to q) \to q\} \to q$

$\equiv \{(\sim p \vee q) \to q\} \to q$ $[\because p \to q \equiv \sim p \vee q]$

$\equiv \{\sim(\sim p \vee q) \vee q\} \to q$ $[\because p \to q \equiv \sim p \vee q]$

$\equiv \{(\sim(\sim p) \wedge \sim q) \vee q\} \to q$ [$\because$ De-Morgans law]

$\equiv \{(p \wedge \sim q) \vee q\} \to q$

$\equiv \{p \wedge (\sim q \vee q)\} \to q$ [$\because$ Associative law]

$\equiv \{p \wedge (q \vee \sim q)\} \to q$ [$\because$ Commutative law]

$\equiv (p \wedge T_0) \to q$ [$\because$ Inverse law]

$\equiv p \to q$ [$\because$ Identity law]

$\equiv \sim p \vee q$

$\equiv$ RHS

2] i) $(\exists x \in S, \sim p(x)) \wedge \{\forall x \in S, q(x)\}$

Negation is,

$\sim[(\exists x \in S, \sim p(x)) \wedge (\forall x \in S, q(x))]$

$\sim(\exists x \in S, \sim p(x)) \vee \sim(\forall x \in S, q(x))$

$\forall x \in S, p(x) \vee \exists x \in S, \sim q(x)$

2] (ii) $\exists x \in S \{\sim p(x) \to q(x)\}$

Negation is,

$\Rightarrow \sim [(\exists x \in S, \sim p(x)) \wedge (\forall x \in S, q(x))]$

$\Rightarrow \sim (\exists x \in S, \sim p(x)) \vee \sim (\forall x \in S, q(x))$

$\Rightarrow \forall x \in S, p(x) \vee \exists x \in S, \sim q(x)$

$\Rightarrow \sim [(\exists x \in S, p(x)) \vee (\exists x \in S, q(x))]$

(iii) $\sim (\exists x \in S, p(x)) \wedge \sim (\exists x \in S, q(x))$

$\Rightarrow \forall x \in S, \sim p(x) \wedge \forall x \in S, \sim q(x)$

(iii.) No real no. is greater than its square : $p(x)$

Symbollically : $\forall x \in R, \sim p(x)$

Negation is

$\sim [\forall x \in R, \sim p(x))$

$\exists x \in R, p(x)$

$\therefore$ For some real number x, x is greater than its square.