Laiba Fatima
22K-5195

Date: M T W T F S S

DS Assignment 1

Q1.

a) A Proposition that is true

b) A Proposition that is false, since Tallahassee is the capital of Florida

c) A proposition that is true $(2+3=5)$

d) A proposition that is false $(5+7=10)$

e) It is not a proposition since value of x is not defined $(x+2=11)$

f) It is not a proposition because it is an imperative statement

Q2.

a) Smartphone B has the most RAM of 288 MB so that is true $(T \wedge T \wedge T = T)$

b) Smartphone B has 288 Ram & 64 GB Rom (T) & resolution of 4 Mp (T). $(T \wedge T = T)$

c) Smartphone B has not more solution than A so $(T \wedge F = F)$

d) Again Smartphone B has greater Ram & Rom but lesser resolution $(p \to q, T \to F = F)$

e) First statement of smartphone A is false and other statement is true $(p \leftrightarrow q, F \leftrightarrow T = F)$

Q3. a) P; a proposition is not True	P: Annual Revenue of Acme Comp 138B
b) $S \wedge U$, $T \wedge T = T$	Q: Acme Comp net profit 8B
c) $Q \vee U$, $F \vee T = T$	R: A.R of Nadir Software 87B
d) $U \to P$, $F \to T = T$	S: N.S net profict 5B
e) $S \leftrightarrow P$, $T \leftrightarrow T = T$	T: A.L of Quixote Media 111B
	U: Q.M net profit 13B

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Q4. p: you have flu q: you miss final exam

r: you pass the course

a) $p \rightarrow q$

if you have the flu, then you will miss the final exams

b) $\neg q \leftrightarrow r$

You will not miss the final exam if and only if you have pass the course

c) $q \rightarrow \neg r$

if you miss the final exam, then you will not pass this course

d) $p \vee q \vee r$

You have the flu OR you miss the final exam OR you pass the course

e) $(p \rightarrow \neg r) \vee (q \rightarrow \neg r)$

if you have the flu then you ~~will not pass the course~~ ~~And you miss the final exam~~ OR ~~you will not pass~~ if you miss the final exam, you will not pass the course.

~~Q5~~. f) $(p \wedge q) \vee (\neg q \wedge r)$

You have the flu and you miss the final exam OR you will not miss the final exam And you pass the course

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b) Smartphone B has 288 Ram & 64 GB Rom (T) & resolution of 4 Mp (T). $(T \wedge T = T)$

c) Smartphone B has not more solution than A so $(T \wedge F = F)$

d) Again Smartphone B has greater Ram & Rom but lesser resolution $(p \to q,\ T \to F : F)$

e) First statement of smartphone A is false and other statement is true $(p \leftrightarrow q,\ F \leftrightarrow T = F)$

Q3.

a) P; a proposition is not True
b) $S \wedge U$, $T \wedge T = T$
c) $Q \vee U$, $F \vee T = T$
d) $U \to P$, $F \to T = T$
e) $S \leftrightarrow P$, $T \leftrightarrow T = T$

P: Annual Revenue of Acme Comp 138B
Q: Acme Comp net profit 8B
R: A.R of Nadir Software 87B
S: N.S net profict 5B
T: A.L of Quixote Media 111B
U: Q.M net profit 13B

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c) $q \rightarrow \neg r$

if you miss the final exam, then you will not pass this course

d) $p \vee q \vee r$

You have the flu OR you miss the final exam OR you pass the course

e) $(p \rightarrow \neg r) \vee (q \rightarrow \neg r)$

if you have the flu then you will not ~~pass the course~~ ~~And you~~ miss the final exam OR ~~you will not pass~~ if you miss the final exam, you will not pass the course.

~~Q5.~~ f) $(p \wedge q) \vee (\neg q \wedge r)$

You have the flu and you miss the final exam OR you will not miss the final exam And you pass the course

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Q5

a) $R \land \neg Q$

b) $P \land Q \land R$

c) $P \to R$ (R necessary for P)

d) $P \land \neg Q \land R$

e) $(P \land Q) \to R$ (P and Q is sufficient for R)

f) $R \leftrightarrow (P \lor Q)$

Q6.

a) p and only if q

if you ~~have~~ send me an email, then I will remember to send you the address.

b) q is sufficient for p

if you were born in US, then you citizen of this country

c) if p, q

if you keep your text book, then it will be useful reference in your future course

d) q if p

if the Red wing's' goalie plays well, then they win the Stanley Cup.

e) p implies q

if you get the job, then you had the best credential.

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f) q whenever p

if there is a storm, then the beach erodes

g) q is necessary for p

if you log on to the server, then you have a valid password

h) q unless ¬p

if you do not begin your climb too late, then you will reach the summit

Q7.

a) ways to write conditional statement are:

→ if p, q

→ q if p

→ q when p

→ p implies q

→ p only if q

→ q whenever p

→ q is necessary for p

→ p is sufficient for q

→ q unless ¬p

b) Converse : swaps the statement

$p \to q$ to $q \to p$

if p then q to if q then p

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inverse : negation of both statements

$p \to q$ inverse is $\neg p \to \neg q$

if negation of p, then negation of q

Contrapositive : swaps & inverse

$p \to q$ contrapositive is $\neg q \to \neg p$

c) If it is sunny tomorrow, then I will go for a walk in the woods

Converse :

if i go for a walk in the woods, then it is sunny tomorrow

inverse :

if it is not sunny tomorrow, then I will not go for a walk in the woods

Cotrapositive :

if i donot go for a walk in the woods, then it is not sunny tomorrow.

inverse of inverse :

if it is sunny tomorrow, then I will go for a walk in the woods

inverse of its converse :

if i donot go for the walk in the woods, then it is not sunny tomorrow.

inverse of its contrapositive

if i go for the walk in the woods, then it is sunny tomorrow.

Date:

Q8.

$\neg(P \wedge Q) = \neg P \vee \neg Q$
$\neg(P \vee Q) = \neg P \wedge \neg Q$ } De-morgan's law

a) Jam is not rich or unhappy
b) Carlos will not cycle and does not run tomorrow
c) The fan is fast and it is very cold.
d) Akram is fit or saleem is not injured

Q9.

a) OR exclusive since only one thing could be done to have true ($F \oplus T = T$)

b) OR inclusive since both conditions can be true for true ($T \vee T = T$, $T \vee F = T$)

c) OR inclusive since both the statements need to be true in order to be true. It contradicts the exclusive case

d) OR inclusive since both statements can become true for the output true

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Q10

a) $(p \wedge (\neg(\neg p \vee q))) \vee (p \wedge q) \equiv p$

$(p \wedge (p \wedge \neg q)) \vee (p \wedge q)$ De-morgan

$((p \wedge p) \wedge \neg q) \vee (p \wedge q)$ associative

$(p \wedge \neg q) \vee (p \wedge q)$ idempotent

$p \wedge (\neg q \vee q)$ negation

$p \wedge T \equiv p$ identity

b) $\neg(p \longleftrightarrow q) \equiv (p \longleftrightarrow \neg q)$

$\neg(p \longleftrightarrow q)$ Bi-implication law

$\neg((p \rightarrow q) \wedge (q \rightarrow p))$

$\neg(\neg p \vee q) \vee \neg(\neg q \vee p)$ implication law

$(p \wedge \neg q) \vee (q \wedge \neg p)$ De-morgan

$p \longleftrightarrow \neg q$

c) $\neg p \longleftrightarrow q \equiv p \longleftrightarrow \neg q$

$(\neg p \longleftrightarrow q) \wedge (q \rightarrow \neg p)$ Bi-impliCation

$(\neg\neg p \vee q) \wedge (\neg q \vee \neg p)$ implication

$(p \vee q) \wedge (\neg q \vee \neg p)$ Double negation

$(q \vee p) \wedge (\neg p \vee \neg q)$ commutative law

$(\neg q \rightarrow p) \wedge (p \rightarrow \neg q)$ rearrange & implication

$(p \rightarrow \neg q) \wedge (\neg q \rightarrow p)$ Bi-implication again

$p \longleftrightarrow q$

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d) $(p \wedge q) \rightarrow (p \rightarrow q) \equiv T$

$\neg(p \wedge q) \vee (\neg p \vee q)$ — implication law

$(\neg p \vee \neg q) \vee (\neg p \vee q)$ — De-Morgan

$(\neg p \vee \neg p) \vee (\neg q \vee q)$ — idempotent law

$\neg p \vee T$ — negation

T — universal bound

e) $\neg(p \vee \neg(p \wedge q)) \equiv F$

$\neg p \wedge (p \wedge q))$ — De-Morgan

$q \wedge (\neg p \wedge p)$ — associative

$q \wedge F$ — negation

F — universal

Q11

a) $(p \rightarrow r) \wedge (q \rightarrow r)$ and $(p \vee q) \rightarrow r$

P	Q	R	P → R	Q → R	(P → R) ∧ (Q → R)
T	T	T	T	T	T
T	T	F	F	F	F
T	F	T	T	T	T
T	F	F	F	T	F
F	T	T	T	T	T
F	T	F	T	F	F
F	F	T	T	T	T
F	F	F	T	T	T

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P	Q	R	P ∨ Q	(P ∨ Q) → R
T	T	T	T	T
T	T	F	T	F
T	F	T	T	T
T	F	F	T	F
F	T	T	T	T
F	T	F	T	F
F	F	T	F	T
F	F	F	F	T

logically equivalent $(P \to R) \wedge (Q \to R) \equiv (P \vee Q) \to r$

5) $(p \to q) \vee (p \to r)$ and $p \to (q \vee r)$

P	Q	R	P→Q	P→R	(P→Q) ∨ (P→R)
T	T	T	T	T	T
T	T	F	T	F	T
T	F	T	F	T	T
T	F	F	F	F	F
F	T	T	T	T	T
F	T	F	T	T	T
F	F	T	T	T	T
F	F	F	T	T	T

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P	Q	R	(Q∨R)	P→(Q∨R)
T	T	T	T	T
T	T	F	T	T
T	F	T	T	T
T	F	F	F	F
F	T	T	T	T
F	T	F	T	T
F	F	T	T	T
F	F	F	F	T

logically equivalent $(p \to q) \vee (p \to r) \equiv p \to (q \vee r)$

c) $(p \to q) \to (r \to s)$ and $(p \to r) \to (q \to s)$

P	Q	R	S	(P→Q)	(R→S)	(P→Q)→(R→S)
T	T	T	T	T	T	T
T	T	T	F	T	F	F
T	T	F	T	T	T	T
T	T	F	F	T	T	T
T	F	T	T	F	T	T
T	F	T	F	F	F	T
T	F	F	T	F	T	T
T	F	F	F	F	T	T
F	T	T	T	T	T	T
F	T	T	F	T	F	F
F	T	F	T	T	T	T
F	T	F	F	T	T	T

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P	Q	R	S	(P→Q)	(R→S)	(P→Q) → (R→S)
F	F	T	T	T	T	T
F	F	T	F	T	F	F
F	F	F	T	T	T	T
F	F	F	F	T	T	T

P	Q	R	S	(P→R)	(Q→S)	(P→R)→(Q→S)
T	T	T	T	T	T	T
T	T	T	F	T	T	T
T	T	F	T	F	F	T
T	T	F	F	F	F	T
T	F	T	T	F	T	T
T	F	T	F	T	T	T
T	F	F	T	F	T	T
T	F	F	F	F	T	T
F	T	T	T	T	T	T
F	T	T	F	T	F	F
F	T	F	T	T	T	T
F	T	F	F	T	F	F
F	F	T	T	T	T	T
F	F	T	F	T	T	T
F	F	F	T	T	T	T
F	F	F	F	T	T	T

Not logically equivalent $(p \to q) \to (r \to s) \neq (p \to r) \to (q \to s)$

Date:
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Q12 P(m,n) "m divides n" U = +ve integer.

a, P(4,5) F, because 4 does not divide 5 into a whole no.

b, P(2,4) T, 4 divide by 2 is 2

c, ∀m ∀n P(m,n) F, because not all value of m can divide all values of n

d, ∃n ∀m P(m,n) F, because some value of n is not divisible by all values of m, as it increases.

e, ∃m ∀n P(m,n) T, because one value exist that is 1 that divides each value of n

f, ∀n P(1,n) T, because all values of n, 1 divides them all

Q13 U = real no.

a, ∃x ($x^2 = 2$) T because some values ($\pm\sqrt{2}$) exist that makes existential quantifies true $x = \pm\sqrt{2}$

b, ∃x ($x^2 = -1$) F, the function contradicts the domain and values belong to imaginary.

c, ∀x ($x^2+2 \geq 1$) T, all values of x, even 0, satisfies the function $x^2+2 = 1$

d, ∃x ($x^2 = x$) T, there is a value such that x = 1 exists that makes it true

Q14 F(x,y) "x can fool y" U = all people.

a, ∀x F(x, Bob)
b, ∀y F(Alice, y)
c, ∀x ∀y F(x,y)
d, ¬∃x ∀y F(x,y
e, ∀y ∃x (x,y)

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Q15 $P(x)$ = "x can speak Russian"
$Q(x)$ = "x knows the computer language C++"
U = all students at your school

a, $\exists x\, (P(x) \land Q(x))$

c, $\forall x\, (P(x) \lor Q(x))$

b, $\exists x\, (P(x) \land \neg Q(x))$

d, $\neg \exists x\, (P(x) \lor Q(x))$

Q16 $Q(x, y)$ "x has sent an email msg to y"
U = all the students in the class

a, $\exists x \exists y\, Q(x, y)$ There is atleast a student x who has sent an email to atleast a student y

b $\exists x \forall y\, Q(x, y)$ They is atleast a student x who sent emails to all students (y)

c $\forall x \exists y\, Q(x, y)$ All of the students (x) in the class has sent atleast an email to someone in the class

d $\exists y \forall x\, Q(x, y)$ There is atleast a student (y) in the class who has been sent an email in the class

e $\forall y \exists x\, Q(x, y)$ Every student y has been sent an email from atleast a student in the class

f, $\forall x \forall y\, Q(x, y)$ Every student in the class has sent an email to every student in the class

Date:

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Q17 $P(x,y)$ "Student x has taken class y"

$U(x)$ = students in the class

$U(y)$ = computer science students

a $\exists x \exists y\, P(x,y)$ There is ~~atleast~~ a student in the class who has taken ~~all~~ ~~of the~~ a computer science courses

b $\exists x \forall y\, P(x,y)$ There is a student in the class who has taken all of the computer science courses

c $\forall x \exists y\, P(x,y)$ All of the students in the class have taken a course in computer science.

d, $\exists y \forall x\, P(x,y)$ There is a computer science course that every student has taken

e $\forall y \exists x\, P(x,y)$ Every cs course has been taken by a student in the class

f $\forall x \forall y\, P(x,y)$ All the students in the class have taken all cs courses

Q18

a, p = Alice is a maths major

q = Alice is a computer science major

using the rules of inference: addition $\therefore \dfrac{p}{p \vee q}$

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b, P = jerry is a maths major
q = jersy is a computer science major

using rule of inference : simplification $\dfrac{p \wedge q}{\therefore p}$ $(\therefore q)$

c, p = It is rainy
q = pool is closed

using antecedent to check the implication (modus ponen)

$p \to q$
$\dfrac{p}{\therefore q}$ (order does not matter unless the consequent q changes its position)

d, p = It shows
q = university is closed

using consequent to check the implication (modus tollen)

$p \to q$
$\dfrac{\neg q}{\therefore \neg p}$

e, p = I go swimming
q = I go in the sun too long
r = I will sunburn

using the rule of inference hypothetical syllogism

$p \to q$
$\dfrac{q \to r}{\therefore p \to r}$

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Q19 P = Today is Tuesday
Q = I have a test in maths
R = I have a test in Eco
S = My eco professor is sick

$P \to (Q \vee R)$
$S \to \neg R$
$\underline{P \wedge S}$
$\therefore Q$

$P \wedge S$ using simplification law
P

$P \to (Q \vee R)$
$Q \vee R$ using modus ponens
S using S.L
$S \to \neg R$
$\neg R$ using m.p
$R \vee Q$ using commutative law
Q using elimination law.

Argument is valid (Tautalogy)

b, P = Ali is a lawyer
Q = He is ambitious
R = He is an early riser
S = He likes chocolates.

$P \to Q$
$R \to \neg S$
$Q \to R$
$\therefore P \to \neg S$

$P \to Q$
$Q \to R$

$P \to R$ using hypothetical syllogism
$R \to \neg S$
$P \to \neg S$ using H.S

Argument is valid (tautalogy)

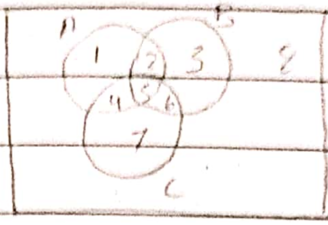
Date: M T W T F S S

Q20 $U = \{1,2,3,4,5,6,7,8\}$

$A = \{1,2,4,5\}$

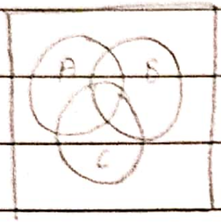
$B = \{2,3,5,6\}$

$C = \{4,5,6,7\}$



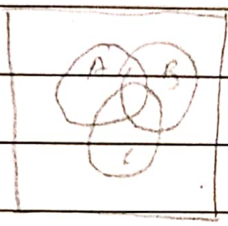
a, $(A \cap B) \cap C$

$= \{5\}$



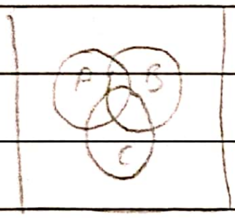
c, $(A - B) \cap C$

$= \{4\}$



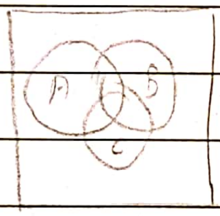
b, $A \cup (B \cup C)$

$= \{2,3,4,5,6,7,8\}$



d, $(A \cap' B) \cup' C$

$= \{1,2,3,4,8\}$



Q21

a, $(A - (A \cap B)) \cap (B - (A \cap B)) = \phi$

$(A \cap (A \cap B)') \cap (B \cap (A \cap B)')$ $\qquad (A - B) = (A \cap B')$

$(A \cap (A' \cup B')) \cap (B \cap (A' \cup B'))$

$((A \cap A') \cup (A \cap B')) \cap ((B \cap A') \cup (B \cap B'))$ Distributive law

$(\phi \cup (A \cap B')) \cap ((B \cap A') \cup \phi)$ Complement law.

$(A \cap B') \cap (B \cap A')$

$(A' \cap A) \cap (B' \cap B)$

$\phi \cap \phi$

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b) $(A-B) \cup (A\cap B) = A$ $\qquad (A-B) = (A\cap B')$

$(A\cap B') \cup (A\cap B)$

$A \cap (B \cup B')$ Distributive law

$A \cap U$ Identity law

A

c) $(A-B)-C = (A-C)-B$

$((A-B) \cap C')$

$((A\cap B') \cap C')$ $\qquad (A-B) = (A\cap B')$

$((A\cap C') \cap B')$ Associative law

$(A\cap C')-B$

$(A-C)-B$

d) $(B' \cup (B'-A))' = B$

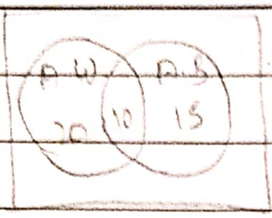
$(B' \cup (B' \cap A'))'$ $\qquad (A-B) = A\cap B'$

$(B \cap (B' \cap A')')$ De Morgan law

$(B \cap (B \cup A))$ Absorption law

B

Date:

Q22a) 

$(A.W \cup A.B) = ?$

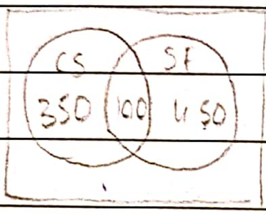
$U = 100$

$|A \cup B| = |A| + |B| - |A \cap B|$

$= 20 + 15 - 10$

$= 25$

$100 - 25 = 75$ (those apples can be sold)

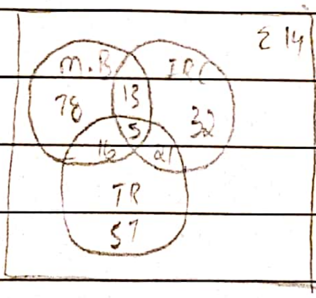
b) 

$U = 1000$

$|A \cup B| = 350 + 450 - 100$

$= 700$ (either of CS or SF)

$(A \cup B)' = 1000 - 700 = 300$ (neither of CS or SF)

c) 

$U = 2$

$|A \cup B \cup C| = |A| + |B| + |C| - |A \cap B| - |B \cap C| - |A \cap C| + |A \cap B \cap C|$

$= 78 + 32 + 57 - 13 - 16 - 21 + 5$

$= 122 + 4$

$= 136$

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b d. $A \times (B \cap C) = (A \times B) \cap (A \times C)$

Set builder notation

$= \{(a,b) \mid a \in A \wedge b \in B \cap C\}$

$= \{(a,b) \mid a \in A \wedge (b \in B \wedge b \in C)\}$

$= \{(a,b) \mid (a \in A \wedge a \in A) \wedge (b \in B \wedge b \in C)\}$ Idem Patent law

$= \{(a,b) \mid a \in A \wedge (a \in A \wedge (b \in B \wedge b \in C))\}$ Associative law

$= \{(a,b) \mid a \in A \wedge ((a \in A \wedge b \in B) \wedge b \in C)\}$ Commutative law

$= \{(a,b) \mid a \in A \wedge ((b \in B \wedge a \in A) \wedge b \in C)\}$ Associative law

$= \{(a,b) \mid a \in A \wedge (b \in B \wedge (a \in A \wedge b \in C))\}$ Associate law

$= \{(a,b) \mid (a \in A \wedge b \in B) \wedge (a \in A \wedge b \in C)\}$ Associative law

$= \{(a,b) \mid (a,b) \in A \times B \wedge (a,b) \in A \times C\}$ Cartesian product

$= \{(a,b) \mid (a,b) \in (A \times B) \cap (A \times C)\}$ intersection

$= (A \times B) \cap (A \times C)$

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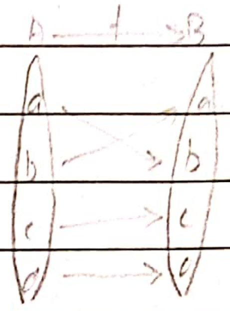
Q23 $A = \{a,b,c,d\}$ $B = \{a,b,c,d\}$

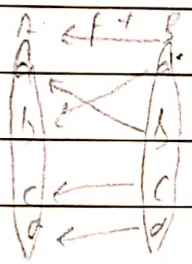
a) $f(a) = b$, $f(b) = a$, $f(c) = c$, $f(d) = d$



i) $f(A)$ (domain) $= \{a,b,c,d\}$
$f(B)$ (co-domain) $= \{a,b,c,d\}$
range $\{a,b,c,d\}$ all mapped elements

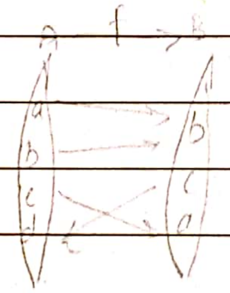
ii) Bijective because it has the property of both injective (one-to-one) and subjective (onto)

iii)



inverse exists.

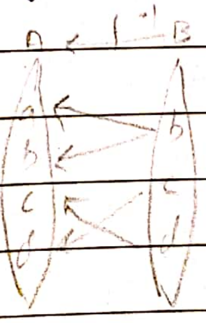
b) $f(a) = b$, $f(b) = b$, $f(c) = d$, $f(d) = c$



i) Domain $\{a,b,c,d\}$ Co-domain $= \{b,c,d\}$
Range $\{b,c,d\}$

ii) function but it is neither one-to-one nor onto since a,b has both image of b

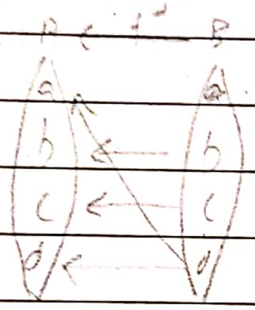
iii)



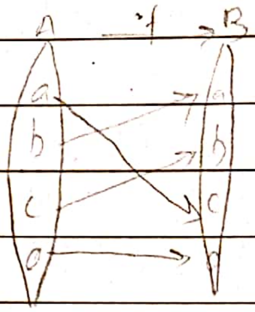
Inverse does not exist since a,b both are the images of b under f which is invalid for a function c, f(a) = d , f(b) = b , f(c) = c , f(d) = d

i, domain {a, b, c, d}   co-domain = {b, c, d}
range {b, c, d}

ii, It is subjective cause a, d both have a image of d



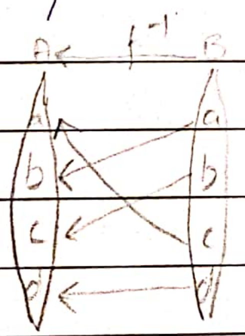
iii   inverse does not exist since a, d are both the images of d value f which is invalid for a function.



d, f(a) = c , f(b) = a , f(c) = b , f(d) = d

i, Domain = {a, b, c, d}
Co-domain = {a, b, c, d}   range {a, b, c, d}

ii, Bijective because both co-domain and range is same.



iii   inverse exist since each value of domain has a unique image and no domain is being left alone.

Date: M T W T F S S

Q24 a) $f(x) = \left\lfloor \frac{x^2}{3} \right\rfloor$ $f(s) = ?$

i. $s = \{-2, -1, 0, 1, 2, 3\}$

$f(s)$ = Image of all the domain of s

$f(-2) = \left\lfloor \frac{(-2)^2}{3} \right\rfloor = \left\lfloor 4/3 \right\rfloor = 1$ $\qquad f(s) = \{0, 1, 3\}$

$f(-1) = \lfloor 1/3 \rfloor = 0$ $\qquad f(2) = \lfloor 4/3 \rfloor = 1$

$f(0) = \lfloor 0 \rfloor = 0$ $\qquad f(3) = \lfloor 3 \rfloor = 3$

$f(1) = \lfloor 1/3 \rfloor = 0$

ii. $s = \{0, 1, 2, 3, 4, 5\}$

$f(0) = 0$ $\qquad f(2) = 1$ $\qquad f(4) = 5$ $\qquad f(s) = \{0, 1, 3, 5, 8\}$

$f(1) = 0$ $\qquad f(3) = 3$ $\qquad f(5) = 8$

iii. $s = \{1, 5, 7, 11\}$

$f(1) = 0$ $\qquad f(s) = \{0, 8, 16, 40\}$

$f(5) = 8$

$f(7) = 16$

$f(11) = 40$

iv. $s = \{2, 6, 10, 14\}$

$f(2) = 1$ $\qquad f(s) = \{1, 12, 33, 65\}$

$f(6) = 12$

$f(10) = 33$

$f(14 = 65$

b i, $[3/4]$ floor $= 0.75 = 1$

ii $[7/8]$ ceiling $= 0.875 = 0$

iii $[-3/4]$ floor $= -0.75 = 0$

iv $[-7/8]$ ceiling $= -0.875 = -1$

v, $[3]$ floor $= 3$

vi $[-1]$ ceiling $= -1 = -1$

vii $[1/2 + [3/2]]$ floor $= 3/2 = 1.5 = 2$

ceiling $= 2 = 2$

viii, $[1/2 \cdot [5/2]]$ ceiling $= 5/2 = 2.5 = 2$

$2 \times 0.5 = 1$

c $[-u] = -[u]$ and $[-u] = -[u]$

$u = 1.25$

$[-1.25] = -2$

$[1.25] = -2$

$[u] = -[u]$ valid

$u = 0.5$

$[-0.5] = 0$

$-[0.5] = 0$

$[-u] = -[u]$ valid

Q25 $f(a) = 2a + 3$ $\quad g(a) = 3a + 2$

a i, fog

fog $= 2(3a+2) + 3$

$6a + 4 + 3$

$6a + 4$

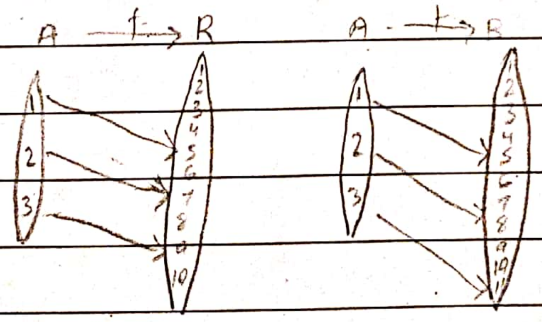
ii gof

gof $3(2a+3) + 2$

$6a + 9 + 2$

$6a + 11$

b,



Both are not injective (one-to-one) functions or subjective or bijective.

Date:
M T W T F S S

c) Both are not invertible because their inverse does not make a bijective function and their inverse do not make a function either