UNIVERSITI TEKNOLOGI MALAYSIA

ASSIGNMENT 2

(DISCRETE STRUCTURE)

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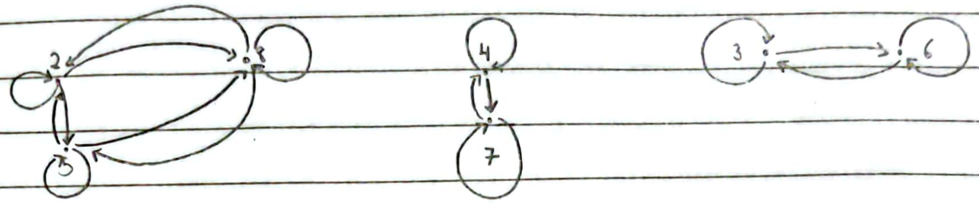
Q1. Relation

1) $R = \{ (2,2), (2,5), (2,8), (3,3), (3,6), (4,4), (4,7), (5,2),$
$(5,5), (5,8), (6,3), (6,6), (7,4), (7,7), (8,2), (8,5), (8,8$



- Reflexive : $x \in A$, $(x, x) \in R$
- symmetric : for each (x,y) there is (y,x)
- transitive : for all (a,b) & $(b,c) \in R$, $(a,c) \in R$

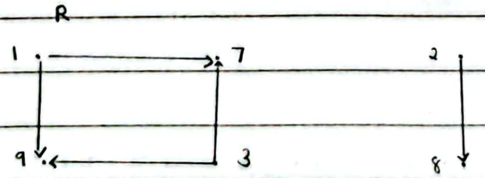
$\therefore$ R is equivalence relation

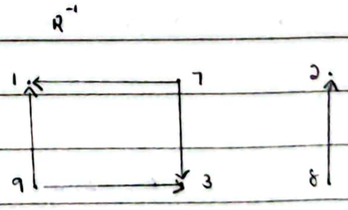
2) Determine R & R^{-1}

$R = \{ (1,9), (1,7), (2,8), (3,9), (3,7) \}$

$R^{-1} = \{ (9,1), (7,1), (8,2), (9,3), (7,3) \}$

b) Draw arrow diagram for both

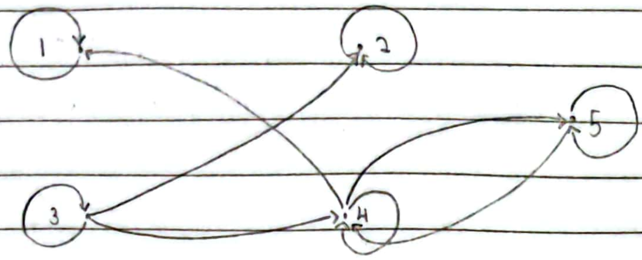




c) Describe R^{-1} in ~~one~~ word

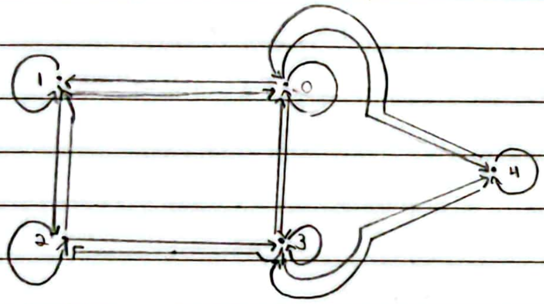
- for all $(b,a) \in B \times A$, $b R^{-1} a \leftrightarrow b+a$ is even

3) $R = \{ (1,1), (2,2), (3,2), (3,3), (3,4), (4,1), (4,4), (4,5), (5,4), (5,5)$



	1	2	3	4	5
in degree	2	2	1	3	2.
out degree	1	1	3	3	2

4



- reflexive : Yes because for each $x \in A$, $(x,x) \in R$
- symmetric : Yes because for each (x,y) there is (y,x)
- transitive : no because $(1,0)$ & $(0,3) \in R$, $(1,3) \notin R$

$\therefore$ Thus R are reflexive and symmetric

-) $R = \{ (1,3), (2,6), (3,9), (4,12) \}$

$(1,1) \notin R$, $(2,2) \notin R$, Reflexive : $\forall x \in A$, $(x,x) \in R$

$\therefore$ R is not reflexive

) $R = \{ (1,3), (2,6), (3,9), (4,12) \}$

$(1,3) \in R$, $(3,1) \notin R$

$\therefore$ R is not symmetric

$R = \{ (1,3), (2,6), (3,9), (4,12) \}$

- $(1,3)$ & $(3,9) \in R$ but $(1,9) \notin R$

$\therefore$ R is not transitive

6 (a) RS

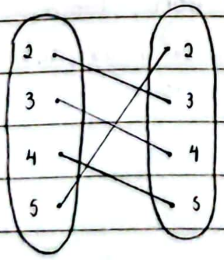
$$= \begin{bmatrix} 0 & 0 & 1 & 1 \\ 1 & 1 & 0 & 0 \\ 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 1 \end{bmatrix} \times \begin{bmatrix} 1 & 0 & 0 & 1 \\ 0 & 1 & 0 & 1 \\ 0 & 1 & 1 & 0 \\ 0 & 0 & 1 & 1 \end{bmatrix} = \begin{bmatrix} 0 & 1 & 1 & 1 \\ 1 & 1 & 0 & 1 \\ 0 & 1 & 1 & 1 \\ 0 & 0 & 1 & 1 \end{bmatrix}$$

b SR

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

7) Relation shows the relationship between input and output, and a function a relation which derives one output for each given input. Every function is relation but not every relation is a function.

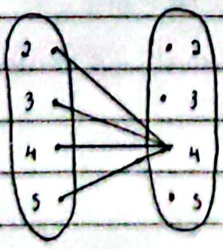
8 (i) { (2,3), (3,4), (4,5), (5,2) }



∴ function becouse its one to one relation

∴ function because each domain have assigned to one value only.

ii) { (2,4), (3,4), (5,4), (4,4) }



∴ function because it's many to one functio

∴ function because each domain have assign

to one value only

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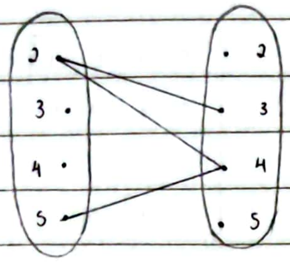
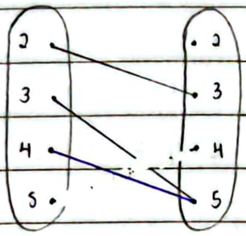
iii) $\{ (2,3), (2,4), (5,4) \}$



∴ not a function because it's many to many relations.

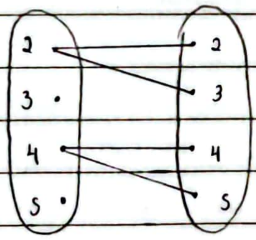
∴ not a function, there is 2 domains "3" & "4" didn't assigned value, Besides, domain 2 has assigned to more than 1 value

iv) $\{ (2,3), (3,5), (\overset{4,5}{\cancel{5,4}}) \}$



∴ not a function because ~~it's one to one relations~~ domain "5" didn't assigned value

v) $\{ (2,2), (2,3), (4,4), (4,5) \}$



∴ not a function because it's many to one function

∴ not a function, domain "3" and "5" didn't assigned value, and domain "2" & "4" is assigned to more than 1 value

9) R = $\{ (1,6), (2,7), (3,8), (4,9), (5,10) \}$

Domain : $\{ 1,2,3,4,5 \}$

Range : $\{ 6,7,8,9,10 \}$

0 (v) Let $f(x_1) = f(x_2)$ injective / one to one

$1 - 2x_1 = 1 - 2x_2$ since its injective and onto

$-2x_1 = -2x_2$ ∴ bijective

$x_1 = x_2$

$y \in R$

Let $f(x) = y$ $x = -\frac{y-1}{2}$ onto

$y = 1 - 2x$

vi $f(x) = 5x^2 - 1$, $f = R \to R$

let $f(x_1) = f(x_2)$

$5x_1^2 - 1 = 5x_2^2 - 1$

$5x_1^2 - 5x_2^2$

$x_1^2 = x_2^2$

since $x_1 = -x_2$ is possible

- not injective (one to one)

$f(x) = 5x^2 - 1$

$5x^2 - 1 \neq -2$

- not onto

- not bijective

vii $f = R \to R$, $f(x) = x^4$

Let $f(x_1) = f(x_2)$

$x_1^4 = x_2^4$

since $x_1 = x_2$ is possible,

- not injective

$f(x) = x^4$, range $[0, +\infty]$

$x^4 \neq -2$

- not onto

- not bijective

viii $f = R \to R$, $f(x) = \left(\frac{x-2}{x-3} \right)$

$\left(\frac{x_1 - 2}{x_1 - 3} \right) = \left(\frac{x_2 - 2}{x_2 - 3} \right)$

$(x_2 - 3)(x_1 - 2) = (x_1 - 3)(x_2 - 2)$

$x_1 x_2 - 3x_1 - 2x_2 + 6 = x_2 x_1 - 3x_2 - 2x_1 + 6$

$x_1 = x_2$

- injective , one to one
- Bijective ,
- onto because real number can be obtained

(ix) $f(x) = 3x - 1$ $g(x) = x^2 - 1$

$f(g(x)) = 3(x^2 - 1) - 1$

$= 3x^2 - 3 - 1$

$fg(x) = 3x^2 - 4$

$fg(0) = 3(0)^2 - 4 = -4$

$fg(1) = 3(1)^2 - 4 = -1$

$fg(2) = 3(2)^2 - 4 = 8$

$fg(3) = 3(3)^2 - 4 = 23$

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x $f(x) = x^2 \quad , \quad g(x) = 5x - 6$

$fg(x) = (5x-6)^2$

$fg(x) = 25x^2 - 60x + 36$

$fg(0) = 25(0)^2 - 60(0) + 36 =$

$fg(1) = 25(1)^2 - 60(1) + 36 = 1$

$fg(2) = 25(2)^2 - 60(2) + 36 = 16$

$fg(3) = 25(3)^2 - 60(3) + 36 = 81$

xi $f(x) = x - 1 \quad , \quad g(x) = x^3 + 1$

$fg(x) = (x^3+1) - 1$

$fg(x) = x^3$

$fg(0) = 0^3 = 0$

$fg(1) = 1^3 = 1$

$fg(2) = 2^3 = 8$

$fg(3) = 3^3 = 27$

12) xii) $a_n = 6a_{n-1} - 9a_{n-2}$; $a_0 = 1$, $a_1 = 6$

$a_0 = 1$

$a_1 = 6$

$a_2 = 6(6) - 9(1)$

$= 27$

$a_3 = 6(27) - 9(6)$

$= 108$

$a_4 = 6(108) - 9(27)$

$= 405$

$a_5 = 6(405) - 9(108)$

$= 1458$

xiii) $a_n = 6a_{n-1} - 11a_{n-2} + 6a_{n-3}$; $a_0 = 2$, $a_1 = 5$, $a_2 = 15$

$a_0 = 2$

$a_1 = 5$

$a_2 = 15$

$a_3 = 6(15) - 11(5) + 6(2)$

$= 47$

$a_4 = 6(47) - 11(15) + 6(5)$

$= 147$

$a_5 = 6(147) - 11(47) + 6(15)$

$= 455$

$a_6 = 6(455) - 11(147) + 6(47)$

$= 1395$

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xiv $a_n = -3a_{n-1} - 3a_{n-2} + a_{n-3}$; $a_0 = 1$, $a_1 = -2$, $a_2 = -1$

$a_0 = 1$

$a_1 = -2$

$a_2 = -1$

$a_3 = -3(-1) - 3(-2) + 1$

$= 10$

$a_4 = -3(10) - 3(-1) + (-2)$

$= -29$

$a_5 = -3(-29) - 3(10) + (-1)$

$= 56$

$a_6 = -3(56) - 3(-29) + 10$

$= -71$

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13 a_1 , a_2 , a_3 , a_4

$a_{n+1} = 5a_n - 3$; $a_1 = k$

a_4 in term of k

$a_2 = 5a_1 - 3$ $a^2 = 5k - 3$

$a_3 = 5a_2 - 3$ $a_3 = 5(5k - 3) - 3$

$a_4 = 5a_3 - 3$ $a_4 = 5(5(5k - 3) - 3) - 3$

$a_4 = 5(25k - 1k) - 3$

$a_4 = 125k - 90 - 3$

$a_4 = 125k - 93$

ii) $a_4 = 7$

$7 = 125k - 93$

$125k = 7 + 93$

$125k = 100$

$k = \frac{4}{5}$