SECI1013: DISCRETE STRUCTURES
SESSION 2024/2025 – SEMESTER 1

ASSIGNMENT 2 (CHAPTER 2 AND 3)

INSTRUCTIONS:

1. This assignment must be conducted in a group (3 or 4 students). Please clearly write the group members name & matric number in the front-page of the submission.
2. Solutions for each question must be readable and neatly written on plain A4 paper. Every step or calculation should be properly shown. Failure to do so will result in rejection of the submission of assignment.
3. For submission, scan and combine all answer/solution sheets as one PDF file. Then only **ONE** group member needs to submit on behalf of the group via e-learning **(Refer deadline in elearning)**
4. This assignment has 70 marks contribute 5% of overall course marks.

STRUCTURES:

1. Chapter 2 (2.3): Recurrence Relation [20 Marks]
2. Chapter 3 (3.1): Counting Methods [20 Marks]
3. Chapter 3 (3.2 and 3.3): Permutation & Combination [20 Marks]
4. Chapter 3 (3.4): Pigeonhole Principle [10 Marks]

Chapter 2 (2.3): Recurrence Relation [20 Marks]

1.

The price of a stock is initially RM50. Suppose that each morning the stock price increase by 2% and then in the afternoon decreases by 2%. Let a_n be the price of the stock at the end of day n.

i) Define the recurrent relation

ii) Stock price and end of day 4, a_4

[14 Marks]

2.

Given an arithmetic sequence 5, 37/7, 39/7, 41/7 ....

a. Find the sequence recursive formula
b. Write a Pseudo-code for function a(n)

[6 Marks]

Chapter 3 (3.1): Counting Methods [20 Marks]

1. Iman and Faiha love to play snake game. They need to roll the dice to move forward. Then, two fair dice are rolled, one red and one blue. How many ways that:

[6 Marks]

   i. They can get the sum of dice rolled is 6 and 10. [2M]
   ii. They can get at least one dice shows the number of 3. [2M]
   iii. They can get the red dice which shows the number of 3. [2M]

2. An ambulance is given a route to reach patient's house (R3) from the hospital (R1) via route 2 (R2). To reach R2, there are possible 2 ways from R1 and to reach R3, there are possible 3 ways from R2.

[4 Marks]

   i. How many ways it is possible to pass through R1 to R3 via R2. [2M]
   ii. How many different round-trip routines are there from R1 to R3 and back to R1. [2M]

3. Nina would like to buy burger. She went to the restaurant and has been offered to buy a meal-deal. The meal-deal set can only have one main menu and one side or one beverage. Below shows the details of the menu:

[6 Marks]

Main menu	Side	Beverage
• Burger – Meat mania • Burger – Egg special • Burger - Single cheese • Burger – Double cheese	• Crispy Fries • Potato Wedges • Cheesy Pop • Chicken Fries • Onion Ring • Sweet Potato Fries	• Coca-Cola • 7 UP • Lemonade • Peach Tea • Lemon Tea

   i. How many ways a meal-deal can be formed if Nina prefer a set that contain Burger? [2M]
   ii. How many ways a meal-deal can be formed if Nina does not like peach tea or lemon tea? [2M]
   iii. How many ways a meal-deal can be formed if Nina does prefer to choose main and side only [2M]

4. Irsyad's Bakery provides different types of cakes: 7 chocolate cakes, 2 cheesecake, 6 fruity cake and two-layer cakes. How many options a customer can buy a cake from this shop?

[4 Marks]

Chapter 3 (3.2 and 3.3): Permutation & Combination [20 Marks]

1. Suppose in a university, each subject offered to students has a subject code consisting of three letters followed by five digits.

[10 Marks]

   i. How many different subject codes are possible? [3M]
   ii. How many subject codes could begin with CS and end with digit 3 or 2? [4M]
   iii. How many subject codes are possible in which all the letters and the digits are distinct? [3M]

2. Answer the following below:

[6 Marks]

   i. In how many ways can 3 runners be selected from a group of 10 athletes?
   ii. You have 15 chocolates in your hands. Unfortunately, you can only give 9 chocolates to your sister. In how many ways can could you give to your sisters?
   iii. How many strings can be formed in the length of 5 strings from the word DISCRETE?
   iv. There are 10 girls and 7 boys in a class and need to select 4 students as a school representative. In how many ways can we select of 2 girls and 2 boys?

3. A teacher has prepared 20 questions of permutation and 15 questions of combination from the topic learned. How many ways are there to setup the quiz which consists of 3 permutation and 2 combination questions.

[4 Marks]

Chapter 3 (3.4): Pigeonhole Principle [10 Marks]

1. In a group of 40 people, at least how many must have been born in the same month?
   [2 Marks]

2. In a quiz taken by 35 students, the score ranges of grade A+ is from 90 to 100. At least how many students must have the same score?
   [2 Marks]

3. Given X = {1,2,3,4,5,6,7,8,9,10}. Show that if you pick six number from set X, the sum of two of them is exactly 11.
   [2 Marks]

4. There are 53 different time periods during each class at a university can be scheduled. How many different rooms will be needed if there are 115 different classes are available?
   [2 Marks]

5. There are 25 computers in a lab. Each computer is directly connected to at least one of the computers. Show there are at least two computers in the network that are directly connected to the same number of other computers.
   [2 Marks]

ASSIGNMENT 2 DISCRETE STRUCTURE
CHAPTER 2.3 (MICHELLE)

Chapter 2 (2.3 Recurrence Relation)

Question 1

i) * assume RM 50 is day 0 (before day 1 starts)

$50 \times 1.02 \times 0.98 = 49.98$

$a_n = a_{n-1}(1.02 \times 0.98)$

$a_n = a_{n-1}(0.9996)$, $a_0 = 50$, $n \geq 1$

ii) day 4, $n = 4$

$a_1 = a_0(0.9996) = 50(0.9996) = 49.98$

$a_2 = a_1(0.9996) = 49.98(0.9996) \approx 49.96$

$a_3 = a_2(0.9996) = 49.96(0.9996) \approx 49.94$

$a_4 = a_3(0.9996) = 49.94(0.9996) \approx 49.92$

$\therefore$ Stock price at the end of the day 4, a_4 is RM 49.92.

Question 2

a) $\overset{n_1}{5}, \overset{n_2}{\frac{37}{7}}, \overset{n_3}{\frac{39}{7}}, \overset{n_4}{\frac{41}{7}}$

$+\frac{2}{7}$ $+\frac{2}{7}$

$a_1 = 5$ | $d = \frac{37}{7} - 5$

$a_2 = \frac{37}{7}$ | $= \frac{2}{7}$

$\therefore a_n = a_{n-1} + \frac{2}{7}$, $a_1 = 5$, $n \geq 2$

b) ~~Kapot~~

input = n

output = a_n

```
an {
  if (n = 1)
    return 5
  else
    return an-1 + 2/7
}
```

CHAPTER 3.1 (JAY)

Assignment 2 - Chapter 3.2 and 3.3

1. (i) Choosing 3 letters = $P(26,3)$

Choosing 5 digits = $P(10,5)$

Subject codes possible = $P(26,3) \cdot P(10,5)$

$= (26^3)(10^5)$

$= 1\,757\,600\,000$ codes

(ii) Begin with CS = $P(1,1) \cdot P(1,1)$

Choose 1 letter = $P(26,1)$

Choose 4 digits = $P(10,4)$

Choose 3 or 2 = $P(2,1)$

Total subject codes = $P(1,1) \cdot P(1,1) \cdot P(26,1) \cdot P(10,4) \cdot P(2,1)$

$= (1)(1)(26)(10^4)(2)$

$= 520\,000$ codes

(iii) All letters and digits are distinct:

Total subject codes = $P(26,1) \cdot P(25,1) \cdot P(24,1) \cdot P(10,1) \cdot P(9,1) \cdot P(8,1) \cdot P(7,1) \cdot P(6,1)$

$= (26)(25)(24)(10)(9)(8)(7)(6)$

$= 471\,744\,000$ codes

CHAPTER 3.2 (KAVI)

2. (i) $C(10,3) = 120$ ways

(ii) $C(15,9) = 5005$ ways

(iii) Total strings $= P(8,5)$
$= 8^5$
$= 32\,768$ strings.

(iv) Select 2 girls: $C(10,2) = 45$ ways
Select 2 boys: $C(7,2) = 21$ ways
Select 2 girls and 2 boys $= (45)(21)$
$= 945$ ways

3. Select 3 permutation questions: $C(20,3) = 1140$ ways
Select 2 combination questions: $C(15,2) = 105$ ways
Select 3 permutation questions and 2 combination questions
$= (1140)(105)$
$= 119\,700$ ways

Chapter 3 (3.4): Pigeonhole Principle

1. $n = 40$ (Pigeon – People)
   $k = 12$ (Pigeonhole – month)

   $m = \lceil \frac{n}{k} \rceil$

   $m = \lceil \frac{40}{12} \rceil = 4$

   ∴ at least 4 people

2. Possible score : 90 to 100
   = 11 numbers

   (Pigeon = number of students) $n = 35$

   (Pigeonhole = possible score) $k = 11$

   $m = \lceil \frac{n}{k} \rceil$

   $= \lceil \frac{35}{11} \rceil$

   $= 4$

3. To make sum of 2 numbers is 11, possible combinations are :
   $\{1,10\}, \{2,9\}, \{3,8\}, \{4,7\}, \{5,6\}$

   There is 5 possible combinations (Pigeonhole).
   If we had to pick 6 numbers (Pigeon), by the pigeonhole principle, at least one of the above combination must be chosen.
   Hence, at least 2 numbers will sum to 11.

4. Pigeonhole = time periods that can be schedule, $k = 53$.
   Pigeon = number of classes to be schedule, $n = 115$.
   To prevent overlapping of classes, minimum number of classroom required, $m = \lceil \frac{n}{k} \rceil$

   $= \lceil \frac{115}{53} \rceil$

   $= 3$

   ∴ at least 3 rooms will be needed.

5. Pigeon : number of computer, $n = 25$

Pigeonhole : numbers of connection each computer can made

= 1 to 24 connections (a computer can't connect to itself)

$k = 24$

$m = \lceil \frac{n}{k} \rceil$

$= \lceil \frac{25}{24} \rceil$

$= 2$

$\therefore$ hence, there are at least 2 computers in the network that are directly connected to same number of other computers according to Pigeonhole Principle.
Since there are 25 computers but only 24 possible connections.