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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2021/2022**

COURSE NAME : DISCRETE STRUCTURE
COURSE CODE : BIC 10103
PROGRAMME CODE : BIS / BIP / BIW / BIM
EXAMINATION DATE : JANUARY / FEBRUARY 2022
DURATION : 3 HOURS
INSTRUCTION : 1. ANSWER ALL QUESTIONS.
2. THIS FINAL EXAMINATION IS
CONDUCTED ONLINE AND
OPEN BOOK.

THIS QUESTION PAPER CONSISTS OF FOUR (4) PAGES

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- Q1** (a) Suppose that a function, f is defined recursively by

$$\begin{aligned}f(0) &= 3 \\f(n+1) &= 2f(n) + 3\end{aligned}$$

Find the first five terms of the function.

(5 marks)

- (b) Use mathematical induction to prove that

$$1^2 - 2^2 + 3^2 - \dots + (-1)^{n-1} n^2 = \frac{(-1)^{n-1} n(n+1)}{2}$$

for all positive integers, n .

(15 marks)

- Q2** (a) Let x and y be sets. Discuss the notation of $x R y$.

(2 marks)

- (b) Identify **TWO (2)** ways to represent a relation.

(2 marks)

- (c) Let R be a relation on $\{1, 2, 3, 4, 5\}$ defined by as follow:

$$R = \{(x, y) \mid x > y \wedge x + y \text{ is odd and prime}\}$$

- (i) Write down the domain and range of R .

(12 marks)

- (ii) Sketch the graph of R .

(4 marks)

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- Q3** (a) A male usurer lends money at unreasonable rates of interest. He demands to be paid 10% interest on a loan, compounded weekly. Suppose you borrow RM500 from him.

Calculate the total of money you owe if you wait two months to pay him back.

(5 marks)

- (b) Formulate a solution to the following recurrence relations.

(i) $a_n = 3a_{n-1} - 2a_{n-2}$ where $a_0 = 1$ and $a_1 = 2$.

(8 marks)

(ii) $a_n = 6a_{n-1} - 9a_{n-2}$ where $a_0 = 1$ and $a_1 = 6$.

(7 marks)

- Q4** (a) Estimate the time complexity, $T(n)$ and Big-O notation, $O(n)$ of the algorithm in **Figure Q4(a)**.

```

i = 1;
sum = 0;
while (i <= n)
{
    j = 1;
    while (j <= n)
    {
        sum = sum + 1;
        j = j + 1;
    }
    i = i + 1;
}

```

Figure Q4(a)

(10 marks)

- (b) Write a pseudocode of an algorithm that calculates the sum of all integers in a list.

(5 marks)

- (c) Estimate the time complexity, $T(n)$ of the algorithm in **Q4(b)**.

(5 marks)

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- Q5** (a) Five computers are connected in a network, and the given adjacency matrix indicates the cable connections between those computers.

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

- (i) Draw a graph to illustrate the network configuration. (5 marks)
- (ii) Based on the graph in **Q5(a)(i)**, analyze whether the network is a Eulerian or Hamiltonian. (5 marks)
- (b) **Figure Q5(b)** shows some major roads in New Jersey with their distances between cities.

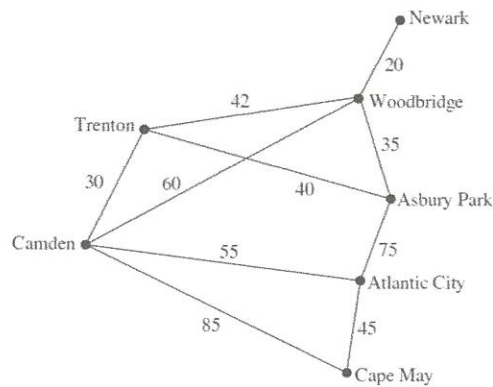


Figure Q5(b)

Find the shortest route between Newark and Camden using these roads. (10 marks)

- END OF QUESTIONS -

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