

**FINAL EXAMINATION****BACHELOR OF INFORMATION TECHNOLOGY (HONOURS) IN COMPUTER
APPLICATION DEVELOPMENT**

COURSE	:	DISCRETE MATHEMATICS 2
COURSE CODE	:	MAT2043
DURATION	:	3 HOURS

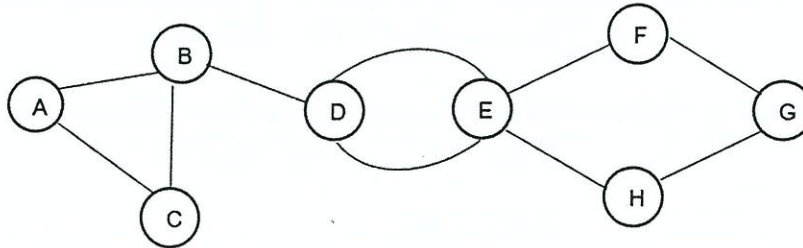
INSTRUCTIONS TO CANDIDATES:

1. This question paper consists of **SIX (6)** questions.
2. Answer ALL questions.
3. Please check to make sure that this examination pack consists of:
 - i. The Question Paper
 - ii. An Answer Booklet
4. Do not bring any material into the examination hall. Electronic calculator is allowed.
5. Please write your answer using permanent ink.

MYKAD/**PASSPORT NO :** _____**ID. NO. :** _____**LECTURER :** _____**SECTION :** _____**DO NOT OPEN THIS QUESTION PAPER UNTIL YOU ARE TOLD TO DO SO***This question paper consists of 6 printed pages including the front page*

QUESTION 1

Let Graph 1 given as below. Please answer the following questions.



Graph 1

- Find the size of the graph. (2 marks)
 - List the degree of each vertex. (3 marks)
 - Explain the difference between a Hamilton path and an Euler path. (4 marks)
 - Determine whether the graph has an Euler path, an Euler cycle or neither. Explain your answers with Euler's theorems. (6 marks)
 - Does this graph have any Hamilton cycle or Hamilton Path? If, yes, please list them all with starting point C. If no, please explain why. (6 marks)
- (Total: 21 marks)

QUESTION 2

The following network in Figure 1 shows the time, in milliseconds, to transfer data between eight servers in a computer network.

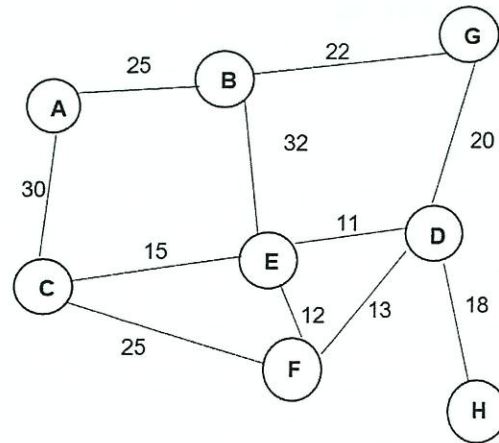


Figure 1

- a. Use Dijkstra's algorithm to find the shortest data transfer time from Server A to Server H.
(8 marks)
- b. Find the corresponding route.
(1 mark)
- (Total: 9 marks)

QUESTION 3

Solve the following linear equations.

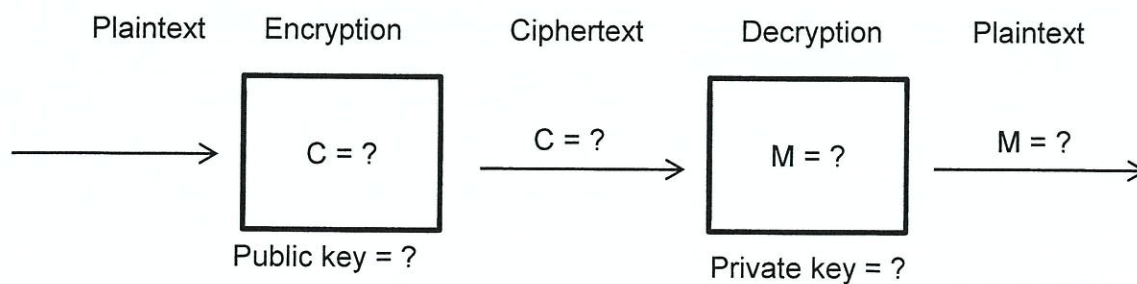
- a. $11x \equiv 4 \pmod{6}$
(5 marks)
- b. Use the Euclidean Algorithm to find the gcd (203,63).
(4 marks)
- (Total: 9 marks)

QUESTION 4

- a. Joanne displays random prime numbers $p = 3$ and $q = 11$. Bob chooses his encryption exponent $e = 7$. Joanne intends to send him the message $M = 5$.

Use the RSA algorithm to find the following:

- i. n (1 mark)
 - ii. $\varphi(n)$ (1 mark)
 - iii. the decryption exponent, $d = e^{-1}(\text{mod } \varphi(n))$ (8 marks)
 - iv. the public and private keys. (2 marks)
 - v. encryption and decryption. (6 marks)
- b. Fill in the above information in the table below.



(3 marks)

(Total: 21 marks)

QUESTION 5

A cargo ship has a list of containers with different weights that need to be loaded onto it. The ship has sections with a maximum weight capacity of 60 tons per section. The weights of the containers are: 45, 38, 22, 40, 28, 35, 48, and 30 tons.

- a. Calculate the minimum number of sections required to load all containers without exceeding the 60-ton weight limit per section.
(2 marks)
- b. Apply the first-fit bin-packing algorithm to determine the number of sections needed and the amount of waste weight.
(7 marks)
- c. Use the first-fit decreasing algorithm to find the number of sections needed and the amount of wasted weight.
(7 marks)
- d. Apply the full-bin packing algorithm to load all the containers.
(6 marks)
- e. State the best algorithm to apply for this problem. Justify your reason.
(2 marks)

(Total: 24 marks)

QUESTION 6

A graphic design company is using Huffman coding to compress the colour values in an image before storing it in a file. The image consists of the following colours and their respective frequencies as shown in Table 1.

Table 1

Colours	Red (R)	Green (G)	Blue (B)	Yellow (Y)	Cyan (C)	Magenta (M)	Black (K)
Frequency	31	16	13	10	9	7	4

- Construct the Huffman code tree for the characters in Table 1.
(6 marks)
- Provide the binary code word for each character based on the Huffman coding tree.
(3 marks)
- Decode the following bit string, 0010111011.
(1 mark)
- Encode the sequence, YMCG.
(1 mark)
- If the dataset exclusively comprises these characters, what would be the number of bits to be saved for transmission?
(5 marks)

(Total:16 marks)

(TOTAL: 100 MARKS)

END OF QUESTION PAPER