



UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2023/2024**

- COURSE NAME : OPERATIONAL RESEARCH
- COURSE CODE : BWB 22203
- PROGRAMME CODE : BWQ
- EXAMINATION DATE : JULY 2024
- DURATION : 3 HOURS
- INSTRUCTIONS :
1. ANSWER ALL QUESTIONS
 2. THIS FINAL EXAMINATION IS CONDUCTED VIA
 - Open book
 - Closed book
 3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF FIVE (5) PAGES

Q1 There is always a large demand for cement products from different areas in Lagos State, Nigeria. Ikeja, Ajagunle, Apapa, Idi-Araba, and Agege Town are among the five towns in Lagos State that demand 1010, 970, 980, 1250 and 890 units respectively. In Lagos State, MAISANGO Cement Nigeria Plc operates Depot A, B, C, and D for cement depots. The quantities that can be supplied by each depot are 1100, 1220, 950 and 1830 units respectively. Depending on the distance the truck needs to travel from the depot to the destination, the cost of one bag of cement will vary as shown in **Table Q1.1**.

Table Q1.1

	Ikeja	Ajagunle	Apapa	Idi-Araba	Agege Town	Supply
Depot (A)	68	36	26	31	62	1100
Depot (B)	35	72	36	28	54	1220
Depot (C)	40	55	41	30	28	950
Depot (D)	25	35	40	80	34	1830
Demand	1010	970	980	1250	890	5100

- (a) Determine the initial solution and total transportation cost using Vogel's Approximation Method (VAM). (15 marks)
- (b) From your answer in **Q1(a)**, calculate the optimal solution using Modified Distribution (MODI) method and compare the result obtained. (11 marks)

Q2 A nationalised telephone company has four service counters at its service center providing services related to new connections, bill payment, resolving billing problems, etc. The average number of arrivals is 12 customers per hour during an 8-hours working day. Service time varies according to customer, but on average, it is 15 minutes per customer. Assume the service cost of the workers is RM5 per hour and the cost of customers waiting in line is RM9 per hour. Calculate

- (a) the probability that there are zero customers in the system, (3 marks)



- (b) the average number of customers in the system, (2 marks)
- (c) the average number of customers waiting for service, (2 marks)
- (d) the average time a customer spends in the system, (2 marks)
- (e) the average waiting time per customer, (2 marks)
- (f) the percent of idle time, (2 marks)
- (g) the total daily cost in the queuing system. (3 marks)

Q3 In one project, the manager aims to find the maximum amount of material that can flow through a network starting with Node 1 as the origin and Node 5 is destination or sink from the origin. He suggests using the Maximal-Flow Technique to determine the maximum number of items that can flow through a network as shown in **Figure Q3.1**. Therefore, illustrate your suggested routes and calculate the total of material that can flow using the Maximal Flow Technique.

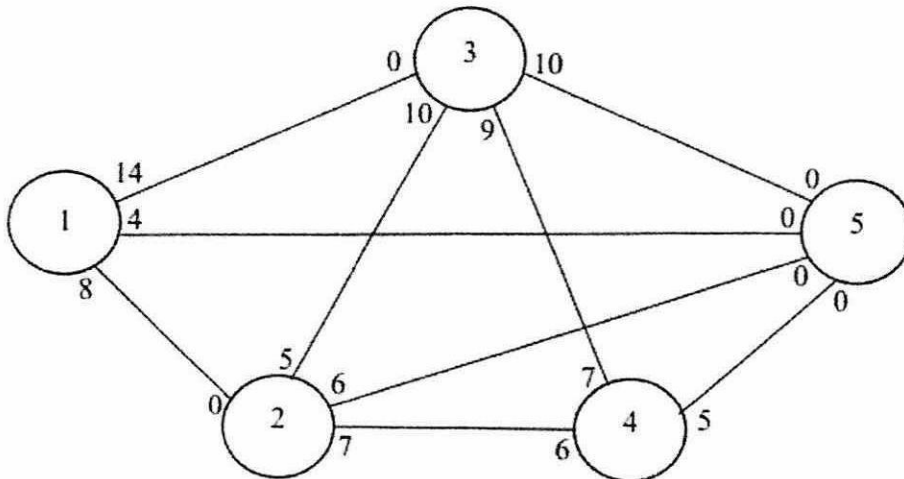


Figure Q3.1

(10 marks)



Q4 The activities in the following **Table Q4.1** describes the construction of a new house.

Table Q4.1

Activity	Predecessor(s)	Duration (days)
A: Clear site	—	1
B: Bring utilities	—	2
C: Excavate	A	1
D: Pour foundation	C	2
E: Outside plumbing	B, C	6
F: Frame house	D	10
G: Do electric wiring	F	3
H: Lay floor	G	1
I: Lay roof	F	1
J: Inside plumbing	E, H	5
K: Shingling	I	2
L: Outside sheathing insulation	F, J	1
M: Install windows and outside door	F	2
N: Do brick work	L, M	4
O: Insulate walls and ceiling	G, J	2
P: Cover walls and ceiling	O	2



Q:	Insulate roof	I, P	1
R:	Finish interior	P	7
S:	Finish exterior	I, N	7
T:	Landscape	S	3

- (a) Prepare and illustrate the network diagram using Program Evaluation Review Technique (PERT).
(20 marks)
- (b) Illustrate and determine the critical path using Critical Path Method (CPM) and calculate the total project completion time.
(8 marks)

- END OF QUESTIONS -