QP CODE 2075527101 Reg. No

DMI-ST. EUGENE UNIVERSITY

ZAMBIA

DEGREE EXAMINATION – JUNE 2024

552 MA 71 OPERATIONS RESEARCH

Semester: VII

Time: 3:00 Hours **Max. Marks: 100**

Answer any FIVE Questions (5 x 20 = 100 Marks)

1. a) A dietician plans diet menu for a group of students. She concentrates on three basic components fat, carbohydrate and protein. She has two main foods A and B. Each 100 gram of A has 2 units of fat, 1 unit of carbohydrate and 5 units of protein. Each 100 gram of food B has 3 units of fat, 2units of carbohydrate and 3 units of protein. She wants that the diet must contain at least 18 units of fat, 20 units of carbohydrate and 24 units of protein. The basic cost of 100 gram of food A is K10 and K 12 for that of food B. Her problem is to make the proportionate combination of these types of food that satisfies the basic needs of the diet and minimizes the total cost on food. **(10 Marks)**

   b) What are the limitations of operation research? **(5 Marks)**

   c) Mr Hanry has K80,000 and he wants to invest the same amount in at least one of the two com[anise A and B. He wants to invest at least 20,000 in company A which pays 10% interest per year. He is also interested to invest some of the amount in company B but the amount must be at most 40,000. The company B pays 9% annual interest. He is interested in maximizing return on his investment. Write a mathematical model. **(5 Marks)**

2. a) Find the total cost of the following by using Vogel's Approximation Method. **(10 Marks)**

	1	**2**	**3**	**Supply**
1	1	2	6	**7**
2	0	4	2	**12**
3	3	1	5	**11**
Demand	**10**	**10**	**10**	

b) Find the total cost of the following by using Vogel's Approximation Method. **(10 Marks)**

	1	2	3	Supply
1	0	2	1	6
2	2	1	5	7
3	2	4	3	7
Demand	5	5	10	

3. a) Differences between CPM and PERT. **(5 Marks)**

   b) What are the steps CPM in planning process? **(5 Marks)**

   c) Construct the network for the following activity data:

Activity	Preceded by	Activity	Preceded by
A	-	-	-
B	-	H	F
C	B	I	H
D	A	J	I
E	C	K	D,E,G,J
F	C	L	I
G	F	M	K,L

(10 Marks)

4. a) John Industry needs 5,400 units/year of a bought-out component which will be used in its main product. The ordering cost is K. 250 per order and the carrying cost per unit per year is K. 30. Find; the economic order quantity (EOQ), the number of orders per year and the time between successive orders. **(10 Marks)**

   b) Alpha Industry needs 15,000 units per year of a bought out component which will be used in its main product. The ordering cost is K. 125 per order and the carrying cost per unit per year is 20% of the purchase price per unit. The purchase price per unit is K.75. Find economic order quantity, number of orders per year and time between successive orders. **(10 Marks)**

5. a) In a bolt factory machine A, B, C manufacture respectively 25%, 35% and 40% of the total. Of their output 5%, 4% and 2% are defective bolts. A bolt is drawn at random from the product and is found to be defective. What are the probabilities that it was manufactured by machines A,B and C. **(10 Marks)**

   b) In a public telephone booth having just one phone, the arrivals are considered to be Poisson with the average of 15 per hour. The length of a phone call is assumed to be distributed exponentially with mean 3 minutes. Find the

      (i) Average number of customers waiting in the system.

      (ii) Average number of customers waiting in the queue.

(iii) Probability that a person arriving at the booth will have to wait in the queue.

(iv) Expected waiting time of a customer in the system.

(v) Percentage of time that the telephone booth will be Idle. **(10 Marks)**

a) Solve the following LPP using Graphical Method. **(10 Marks)**

$Max\ Z = 6x + 8y$

Subject to Constaints

$5x + 10y \leq 60$

$4x + 4y \leq 40$

$x, y \geq 0$

b) Solve the following LPP using Graphical Method. **(10 Marks)**

$Min\ Z = 2x_1 + 3x_2$

Subject to Constaints

$x_1 + x_2 \geq 6$

$7x_1 + x_2 \geq 14$

$x_1, x_2 \geq 0$

7. a) An automobile factory manufactures a particular type of gear within the factory. This gear is used in the final assembly. The particulars of this gear are; demand rate r=14,000 units/year, production rate K=35,000 units/year, set up cost $C_o = K.500$ per set up and carrying cost, $C_c = K.15$/unit/year. Find the economic batch quantity (EBQ) and cycle time. **(10 Marks)**

b) The annual demand for a component is 7,200 units. The carrying cost is K.500/units/year, the ordering cost is k. 1,500 per order and the shortage cost is K. 2,000/units/year. Find the optimal values of economic order quantity, maximum inventory, maximum shortage quantity, cycle time(t), inventory period(t_1) and, shortage period (t_2). **(10 Marks)**