



MACHAKOS UNIVERSITY

University Examination For 2023/2024 Academic Year

SCHOOL OF ENGINEERING AND TECHNOLOGY

FOURTH YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE IN ELECTRICAL AND TELECOMMUNICATIONS

ENGINEERING

BACHELOR OF MECHANICAL ENGINEERING

EMM 413: OPERATION RESEARCH

DATE:

TIME:

INSTRUCTIONS

ANSWER QUESTION ONE AND ANY OTHER TWO QUESTIONS

QUESTION ONE- 30 MARKS (COMPULSORY)

- a) Explain four classifications of simulation (4marks)
- b) Explain four types of customer behaviour (6marks)
- c) A company purchasing scrap material has two types of scrap materials available. The first type has 30% of material X, 20% of material Y and 50% of material Z by weight. The second type has 40% of material X, 10% of material Y and 30% of material Z. The costs of the two scraps are 120 Ksh and 160 Ksh per kg respectively. The company requires at least 240 kg of material X, 100 kg of material Y and 290 kg of material Z. Find the optimum quantities of the two scraps to be purchased so that the company requirements of the three materials are satisfied at a minimum cost. (10marks)
- d) An organization has three machine shops namely A, B and C and it produces three products X, Y and Z using these three machine shop. Each product involves the operation of the machine shops. The time available at machine A, B and C are 100, 72 and 80 hours respectively. The profit per unit X, Y and Z are 22 Ksh, 6 Ksh and 2 Ksh respectively.

The following table 1 shows the time required for each operation for unit amount of each product.

Table 1: Operation in Machine shop

	A	B	C	Profit(Ksh)
X	10	7	2	22
Y	2	3	4	6
Z	1	2	1	2
Availability	100	72	80	

- Formulate Linear programming models (3 marks)
- Generate Simplex tableau and determine an appropriate product mix so as to maximize the profit (7 marks)

QUESTION TWO- 20 MARKS

- A manufacturing company owns three factories and distribute his products to five different destinations. The following Table 2 shows the capacities of the three factories and the quantity of products required as well as cost of shipping one unit of the products from each of the three factories to each five retail agencies.

	Retail Agencies					
Factories	1	2	3	4	5	Capacity
1	1	9	13	36	51	50
2	24	12	16	20	1	100
3	14	33	1	23	26	150
Requirement	100	60	50	50	40	300/300

Determine the cheapest route using

- North West Corner method (5 marks)
- Least Cost Method (6 marks)

- b) Consider the following transportation problem in Table 3

Origin	Destinations				ai
	1	2	3	4	
1	20	22	17	4	120
2	24	37	9	7	70
3	32	37	20	15	50
bi	60	40	30	110	240

Using Vogel Approximation cost determine the minimum cost (10 marks)

QUESTION THREE- 20 MARKS

- a) Explain any four the applications of operation research (8marks)
- b) At one man barber shop, customers arrive according to poison distribution with mean arrival rate of 5 per hour and the hair cutting time was exponentially distributed with an average hair cut taking 10 minutes. It is assumed that because of his excellent customer's reputation, customers were always willing to wait. Calculate the following
- Average number of customers in the shop (3 marks)
 - Average number waiting for haircut (3 marks)
 - Percentage of time arrival can walk in straight without having to wait (3 marks)
 - The percentage of customers who have to wait before getting into barber's chair (3marks)

QUESTION FOUR- 20 MARKS

- a) Explain the following condition
- Decision making under certainty
 - Decision making under risk (8marks)
- b) A firm has divided its marketing area into three zones. The amount of sales depends upon the number of salesmen in each zone. The firm has been collecting the data regarding

sales and salesmen in each area over a number of past years. Information in table 4 is the summary. For the next year firm has only 9 salesmen and problem is to allocate these sales to three different zones so that the total sales are maximum

Table 4 profit in thousands shillings

No of salesmen	Zone 1	Zone 2	Zone 3
0	30	35	42
1	45	45	54
2	60	52	60
3	70	64	70
4	79	72	82
5	90	82	95
6	98	93	102
7	105	98	110
8	100	100	110
9	90	100	110

(12 marks)

QUESTION FIVE- 20 MARKS

- Explain five characteristics of dynamic programming (8 marks)
- A company is engaged in manufacturing different types of equipment for various consumers. The company has two assembly lines to produce its products. The processing time for each of the assemble lines is regarded as random variable and is described by the following distribution shown in Table 5. Using the following random numbers, generate data on the processing times for 10 units of product and compute the expected processing time for the products: 4236, 7573, 4943, 1283, 2014, 3604, 9344, 5316, 7606 and 0089

Processing time (min)	Assembly X	Assembly Y
40	0.10	0.20
42	0.15	0.40
44	0.40	0.20
46	0.10	0.15
48	0.25	0.05

(12 marks)