MURANG'A UNIVERSITY OF TECHNOLOGY

SCHOOL OF PURE, APPLIED AND HEALTH SCIENCES

DEPARTMENT OF MATHEMATICS AND ACTUARIAL SCIENCE

UNIVERSITY ORDINARY EXAMINATION

2023/2024 ACADEMIC YEAR

THIRDYEAR **SECOND** SEMESTER EXAMINATION FOR BMC, BME, BBIT, BED (SCIENCE), BED (ARTS)

AMS 319 – OPERATIONS RESEARCH

DURATION: 2 HOURS

INSTRUCTIONS TO CANDIDATES:

1. Answer question one and any other two questions.
2. Mobile phones are not allowed in the examination room.
3. You are not allowed to write on this examination question paper.

SECTION A: ANSWER ALL QUESTIONS IN THIS SECTION

QUESTION ONE (30 MARKS)

a. Outline any three characteristics of operations research. (3marks)

b. State the fundamental theorem of duality. (2marks)

c. Given that the primal problem

$$\text{maximize } p = 2x + 6y + 4z$$

Subject to

$$2x + 5y + +2z \leq 38$$
$$\mathbf{4x + 2y + 3z \leq 57}$$
$$\mathbf{x + 3y + 5z \leq 57}$$
$$\mathbf{x, y, z, \geq 0}$$

While down its dual problem. (4marks)

d. The cost of transporting a certain commodity from three cities to three warehouses are given in the table below.

DESTINATION ORIGIN	W1	W2	W3	CAPACITY
Mombasa	5	2	3	100
Nairobi	8	4	3	300
Kisumu	9	7	5	300
DEMAND	300	200	200	

Apply North West corner method to obtain the initial feasible solution. (4marks)

e. A machine tool company decides to make four sub-assemblies through 4 contractors. Each contractor is to receive only one sub assembly. The cost of each sub-assembly is determined by the bids submitted by each contractor and its shown below in thousands KES. Assign the different sub-assemblies to contractors so as to minimize total cost. (6marks)

	Contractor			
Sub-assembly	C1	C2	C3	C4
B1	15	13	14	17
B2	11	12	15	13
B3	131	12	10	11
B4	15	17	14	16

f. Construct the network diagram for a project with the following activities. (6marks)

Activity	Name of Activity	Predecessor Activity
1-2	A	-
1-3	B	-
1-4	C	-
2-5	D	A
3-6	E	B
4-6	F	C
5-6	G	D

g. A dietician wants to design a breakfast menu for certain hospital patients. The menu is to include two items A and B. Each ounce of A provides 2 units of Vitamin C and2 units of iron and each ounce of B provides 1 unit of vitamin C and 2 units of iron. The cost of 4 is sh.40/unit and the cost of B is 30sh/unit. If the breakfast menu must provide at least 8 units of Vitamin C and 10 units of iron. Use graphical method to determine how many units of each item should be provided in order to meet the iron and Vitamin C requirements for the least cost. (5marks)

SECTION B – ANSWER ANY TWO QUESTIONS IN THIS SECTION

QUESTION TWO (20 MARKS)

a. Outline the draw backs of using graphical method in solving linear programming problems. (6marks)

b. A firm produces three types of pumps A, B, C each of which requires the four processes of turning drilling, assembling and testing. The processing information is given in the table.

Pump	Turning	Drilling	Assembling	Testing	Profit per pump
A	2	1	3	4	84
B	1	1	4	3	72
C	2	1	2	2	52
Total available time (hr/wk)	98	60	145	160	

From the information given, apply simplex method to determine the weekly output of each type of pump to maximize profit and state the maximum profit. (14marks)

QUESTION THREE (20 MARKS)

a. The cost ('000 KES) of transporting one ton of wheat from each gram store to each mol is given in the following table.

STORE	Unga	Maisha	Afya	Dola	Pembe	Supply
Nanyuki	4	1	2	6	9	100
Nakuru	6	4	3	5	7	120
Eldoret	5	2	6	4	8	120
Demand	40	50	70	90	90	

Apply Vogel's approximation method (VAM) to obtain the initial basic solution, hence apply MODI to obtain the optimal solution. (12marks)

b. A company is faced with the problem of assigning 4 jobs to 5 persons. The expected profit in KES for each job are given in the table below.

	Jobs			
Persons	P	Q	R	S
A	86	78	62	81
B	55	79	65	60
C	72	65	63	80
D	86	70	65	71
E	72	70	71	60

Find the optimal assignment of jobs to the persons that will result in maximum profit. (8marks)

QUESTION FOUR (20 MARKS)

a. Define a queue as used in queuing theory (2marks)
b. Outline any five benefits of queuing theory (5marks)
c. What is the difference between CPM and PERT as used in project management? (2marks)
d. The following table shows the jobs of a network along with their time estimates.

	Estimated duration weeks		
Activity	Optimistic	Most likely	Pessimistic
1-2	1	7	13
1-6	2	5	14
2-3	2	14	26
2-4	2	5	8
3-5	7	10	19
4-5	5	5	17
6-7	5	8	29
5-8	3	3	9
7-8	8	17	32

i. Draw the project network
ii. Determine the critical path
iii. Find the probability that the project is completed in 40 days. (11marks)