

UNIVERSITY EXAMINATIONS

1ST SEMESTER 2022/2023 ACADEMIC YEAR

THIRD YEAR EXAMINATION FOR THE DEGREES OF
BACHELOR OF SCIENCE (STATISTICS), BACHELOR
OF SCIENCE (GENERAL)

MATH 317: OPERATIONS RESEARCH I

STREAM: R

TIME: 2 HRS

DAY: TUESDAY [8.30AM – 10.30AM]

DATE: 20/12/2022

THIS QUESTION PAPER CONSISTS OF FIVE (5) PAGES

PLEASE DO NOT OPEN UNTIL THE INVIGILATOR SAYS SO.

INSTRUCTIONS: DO QUESTION ONE AND ANY OTHER TWO QUESTIONS.**QUESTION ONE (30 MARKS)**

- a) Define Operations research. Hence develop a flow chart explaining the methodology of operations research.
(6 mrks)
- b) Provided is a solution of LPP by simplex method. Give the interpretation/analysis related to the solutions

Solution variable	Product			Slack variable				Solution quantity
	x_1	x_2	x_3	x_4	x_5	x_6	x_7	
x_4	0	0	-3	1	0	-1	-3	50
x_5				0	1	$-\frac{1}{2}$	0	
x_1	0	0	-1			$\frac{1}{2}$	0	50
x_2				0	0	$\frac{1}{2}$	0	
	1	0	2	0	0	0	1	100
	0	1	0					50
Z	0	0	-6	0	0	-4	-5	-1050

(12mrks).

- c) Using the given table, find the estimate time, hence draw the network indicating the time estimate for each activity.

Activity	Optimistic	Most likely	Pessimistic
1 – 2	9	12	21
1 – 3	6	12	18
2 - 4	1	1.5	5
3 – 4	4	8.5	10
2 – 5	10	14	24

4 – 5

1

2

3

(6mrks)

- d) Define the following terms as used in OR. (i) Lead Time (ii) Slack variable (iii) Dummy activity. Hence list the content of cost function in the inventory cost. (6 mrks)

QUESTION TWO (20 MARKS)

- (a) The graphic method provides an intuitive grasp of the concepts that are used in the simplex technique. Discuss steps that are involved. (6 marks)
- (b) A factory is about to buy some machines to produce boxes and has a choice of type X or type Y. Machines £160,000 has been budgeted for the purchase of machines. Type X machines cost £5,000 each, requires 25 hours of maintenance and produce 1,500 units a week.

Type Y machines cost £10,000 each, require 10 hours of maintenance a week and produce 2,000 units a week. Each machine X or Y needs 50 square metres of floor area. There are availability of 1000 square metres of floor area and 400 of maintenance time each week. Since all production can be sold, the factory management wishes to maximize output. You are required.

- To list objective function and constants
- To graph the constraints, locating the feasible region.
- To state the optimum mix of machines to buy, with reasons. (14marks)

QUESTION THREE (20MKS)

- (a) Explain the conditions under which network analysis required in a project. Hence distinguish between activity and dummy activity. ((8 marks)
- (b). The construction of science complex has been going on in Laikipia University, and the tender was awarded to a Nairobi construction firm. The project has been broken down into a number of activities

Activity	Preceding Activity	Duration in Months
1	—	8
2,3,4	1	2,1,3
5	2	3
6	3	7
7	5	5
8	6	9
9	7,8	2
10	3	4
11	4	3
12	9,10,11	2

Required.

- i) Represent the project by means of a network diagram.
- i. Show the earliest and latest time for each activity.
- ii. Determine the critical path and minimum completion time of the project. (12mks)

QUESTION FOUR (20 MARKS)

- (a) The queuing models can be categorized as being deterministic or probabilistic. Discuss the statement; hence identify the two parameters that constitute the queuing models. (8mks)
- b) The manager of a bank observes that, on the average 18 customers are served by a cashier in an hour. Assuming that the service time has an exponential distribution, what is the probability that:
 - (i) A customer shall be free within 3 minutes.
 - (ii) A customer shall be serviced in more than 12 minutes?. (6mks)

QUESTION FIVE (20MKS)

a) A firm owns facilities at seven places. It has manufacturing plant at places A, B and C with daily output of 500, 300 and 200 units of an item respectively. It has warehouses at places P, Q, R and S with daily requirements of 180, 150 350 and 320 units respectively. Per unit shipping charges on different routes are given below.

	TO	P	Q	R	S
From	A	12	10	12	13
	B	7	11	8	14
	C	6	16	11	7

The firm wants to send the output from various plants to warehouses involving minimum transportation cost. How should it route the product so as to achieve this objective? Use North-West corner rule and Vogel's approximation method, hence compare the results. (10mks)

b) Using the following cost matrix, determine; (a) Optimal job assignment. (b) The cost of assignment.



		Job				
		1	2	3	4	5
Machinist	A	10	3	3	2	8
	B	9	7	8	2	7
	C	7	5	6	2	4
	D	3	5	8	2	4
	E	9	10	9	6	10

(10 marks)