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**MASINDE MULIRO UNIVERSITY OF
SCIENCE AND TECHNOLOGY
UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR
FIRST YEAR FIRST SEMESTER MAIN EXAMINATIONS
FOR THE DEGREE
IN
BACHELOR OF SCIENCE (SST, SMT, SME)**

COURSE CODE: MAT 322

COURSE TITLE: OPERATIONS RESEARCH I

DATE: 26/04/2022

TIME: 8.00AM – 10.00AM

INSTRUCTIONS TO CANDIDATES

- Section A is compulsory any other THREE questions from section B
- Do all the rough work in the answer booklet

TIME: 2 hours

QUESTION ONE (30 MARKS)

- a) What is operations research? (2 Marks)
- b) Use the least cost method to determine the initial basic solution of the following transportation problem. (6 Marks)

Retail agency						
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
Requirements	100	60	50	50	40	300

- c) Discuss the steps in the shortest path problem. (4 Marks)
- d) List and explain the different types maintenance. (4 Marks)
- e) The following details are available regarding a project.

Activity	Predecessor activity	Duration (week)
A	-	3
B	A	5
C	A	7
D	B	10
E	C	5
F	D,E	4

Determine the critical path, the critical activities and the project completion time.

(6 Marks)

- f) Two experts *A* and *B* examined an activity and arrived at the following time estimates.

Expert	Time estimate		
	t_o	t_m	t_p
A	4	6	8
B	4	7	10

- Determine which expert is more certain about his estimates of time. (5 Marks)
- g) List the three types of probabilistic time estimate. (3 Marks)

QUESTION TWO (20 MARKS)

- a) Solve the following linear programming problem. (14 Marks)

Maximize:

$$60x_1 + 70x_2$$

Subject to:

$$2x_1 + x_2 \leq 300$$

$$3x_1 + 4x_2 \leq 509$$

$$4x_1 + 7x_2 \leq 812$$

$$x_1, x_2 \geq 0$$

- b) Describe the six steps of the stages of development of operations research. (6 Marks)

QUESTION THREE (20 MARKS)

- a) Solve the following linear programming problem using the big-M method. (14 Marks)

Maximize

$$12.5x_1 + 14.5x_2$$

Subject to:

$$x_1 + x_2 \geq 2000$$

$$0.4x_1 + 0.75x_2 \geq 1000$$

$$0.075x_1 + 0.1x_2 \leq 200$$

$$x_1, x_2 \geq 0$$

b) Describe the North west corner metho used for solving the transportation problem.

(6 Marks)

QUESTION FOUR (20 MARKS)

a) Suppose an industry is manufacturing two types of products P_1 and P_2 . The profits per kg of the two products are Ksh. 30 and Ksh. 40 respectively. These two products require processing in three types of machines. The following table shows the available machine hours per day and the time required on each machine to produce one kg of P_1 and P_2 .

Profit /kg	P_1	P_2	Total av. Machine hrs/day
	Ksh. 30	Ksh. 40	
Machine 1	3	2	600
Machine 2	3	5	800
Machine 3	5	6	1100

i) Formulate the problem in the form a linear programming problem. (4 Marks)

ii) Solve the linear programming problem in (i) using the graphical method. (10 Marks)

b) Use the simplex method to verify that te following linear program has an unbounded solution. (6 Marks)

Maximize

$$5x_1 + 4x_2$$

Subject to:

$$x_1 - x_2 \leq 8$$

$$x_1 \leq 7$$

$$x_1, x_2 \geq 0$$

QUESTION FIVE (20 MARKS)

a) A firm is considering replacement of an equipment whose first cost is Ksh. 1,750 and the scrap value is negligible at any year. Based on experience, it is found that maintenance cost is zero during the first year and it increases by ksh. 100 every year thereafter. When should the equipment be replaced if the interest rate is 0%. (7 Marks)

- b) A workshop contains four persons available for work on the four jobs. Only one person can work on any one one job. The following table shows the cost of assigning each person to each job. The objective is to assign a person to jobs such that the total assignment cost is a minimum. (13 Marks)

Persons		Jobs			
		1	2	3	4
A		20	25	22	28
B		15	18	23	17
C		19	17	21	24
D		25	23	24	24