(Knowledge for Development)

KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS

2020/2021 ACADEMIC YEAR

SECOND YEAR SECOND SEMESTER

MAIN EXAMINATION

FOR THE DEGREE OF BACHELOR OF EDUCATION AND BACHELOR OF SCIENCE

COURSE CODE: **MAA 222/MAT 322**

COURSE TITLE: OPERATIONS RESEACH 1

DATE: 7/10/2021 **TIME:** 9:00 AM – 11:00 AM

INSTRUCTIONS TO CANDIDATES

Answer Question One and Any other TWO Questions

TIME: 2 Hours

QUESTION ONE (30 MKS)

a) Define Operations research and give reasons why it is necessary [4mks]
b) Define a queue and name any three elements of queuing system [5mks]
c) Distinguish between primal and duality as used in operations research [4mks]
d) Express the LP problem in standard form

$$\text{Minimize } Z = 3x_1 + 4x_2$$
$$\text{s.t } x_1 + x_2 \leq 450$$
$$2x_1 + x_2 \leq 600$$
$$x_1, x_2 \geq 0$$

[3mks]

e) Solve the the LP in (**d**) above using simplex method [8mks]
f) Find the dual of the LP problem in (**d**) above. [3mks]
g) Briefly describe transportation problem as used in OR giving relevant examples [3mks]

QUESTION TWO (20MKS)

a) Explain any four characteristics of operations research [4mks]
b) Briefly describe the rules that form a dual problem from the primal problem [2mks]
c) Explain the advantages of duality in operations research [6mks]
d) A company manufactures two products A and B. It takes 30 minutes to process one unit of product A and 15minutes for one unit of product B. The maximum machine time available is 35 hours per week. One unit of product A requires 2kg of raw materials, while product B requires 3 kgs of raw materials per unit. The available raw material is limited to 180 kg per week. The products A and B have unlimited market potential and sell for 200 and 500 per unit respectively. If the manufacturing costs for products A and B are $2x^2$ and $3y^2$respectively, find how much of each product should be produced per week, where x and y are respectively the quantities of A and B to be produced. (8mks)

QUESTION THREE (20 MKS)

a. Kenya airways has 8 aircrafts of type I , 15 air crafts of type II and 12 aircrafts of type III with the carrying capacities of 4.5 tons , 7 tons and 4 tons respectively. The company dispatches aircrafts to town A which requires 20 tons and city B requiring 30 tons. With excess tonnage being of no

value. An aircraft flies once a day and the cost of sending a plane from the terminal to each city is given in the table below.

City	TYPE I	TYPE II	TYPE III
A	23	5	1.4
B	58	10	3.8

Formulate an LP model to minimize the air transport using

i. The North West method, [6mks]

ii. least cost method [6mks]

b. Kibabii University has four men available for work on four separate jobs. Only one man can work on any one job. The cost of assigning each man to each job is given in the following table.

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

Assuming that you are in charge of the job assignment, assign the men to jobs in such a way that the total cost of assignment is minimum. [8mks]

QUESTION FOUR (20MKS)

a) The arrival and service rate in a clinic follows poison process. Given that the arrival rate of clients is 8 per hour , and the service rate is 10 per hour, compute;

i. The system length [3mks]

ii. Queue length [3mks]

iii. The waiting time for a client to complete service [3mks]

b) Solve by simplex method the following L.P problem. [11mks]

Minimize Z= $x_1 - 3x_2 + 3x_3$ subject to;

$$3x_1 - x_2 + 2x_3 \leq 7$$

$$-4x_1 + 3x_2 + 8x_3 \leq 10$$

$$2x_1 + 4x_2 \geq -12$$

$$x_1, x_2, x_3 \geq 0$$

QUESTION FIVE (20MKS)

a) List any three methods used in solving LP problems [3mks]

b) Define optimization as used in operations research [2mks]

c) Express the following LP in standard form [5mks]

Maximize Z= $3x_1 + 5x_2 - 2x_3$ subject to the constrains

$$x_1 + 2x_2 - x_3 \geq -4$$

$$-5x_1 + 6x_2 + 7x_3 \geq 5$$

$$2x_1 + x_2 + 3x_3 = 10$$

$x_1, x_2 \geq 0$, x_3 unrestricted.

Hence solve the LP problem below by graphical method.

Maximize Z= $3x_1 + 2x_2$

Subject to $2x_1 + x_2 \leq 100$,

$$x_1 + x_2 \leq 80 ,$$

$x_1 \leq 40$, $x_1, x_2 \geq 0$ [4mks]

d) Consider the following N.L.P problem

Minimize -z= $2x_1^2 + 24x_1 + 2x_2^2 - 8x_2 + 2x_3^2 - 12x_3 + 200$ by separating this function into three one variable functions, show that the function is convex. Solve the problem by solving each one variable function by calculus. [6mks]