The Co-operative University of Kenya

END OF SEMESTER EXAMINATIONS

EXAMINATION FOR THE DEGREE OF BACHELOR OF BUSINESS IN INFORMATION TECHNOLOGY

COURSE CODE: BSTA 3108

UNIT TITLE: OPERATION RESEARCH

DATE: JULY, 2022 Time: 2 Hours

INSTRUCTIONS

1. Answer question **ONE** and any other **TWO (2)** questions
3. Scientific Calculators and non-programmable calculators may be used
4. Use the provided statistical tables where applicable

QUESTION ONE (30 MARKS)

SECTION A(30 Marks)

1. (a) Define the following (**2** *marks*)

   i. corner-point feasible (CPF) solution

   ii. Feasible solution

   (b) Differentiate between Maximization problem and Minimization problem (**2** *mark*)

   (c) Give a detailed description on how to solve a question using the Column Minima method (**3** *marks*)

   (d) A patient consults a doctor to check on his ill health. The Doctor finds him to be having deficiency of two vitamins, A and D. The patient is advised to consume vitamins A and D regularly for some time so as to regain his health. The doctor prescribes tonics I and II, both of which contain vitamins A, and D in certain proportions. He is also advised to consume at least 40 units of vitamin A and 50 units of vitamin D Daily. The costs of tonics I and II and the proportions of vitamins A and D that they contain are given in the table below. Formulate the linear programming model that minimizes the cost of tonics

Vitamins/Tronic	I	II	Requirement
A	2	4	40
D	3	4	50

(**3** *marks*)

   (e) The arrivals at a telephone booth are considered to be following Poisson distribution with an average time of 10 minutes between one arrival and the next. Length of the phone call is assumed to be distributed exponentially with a mean of 3 minutes.

   i. What is the probability that a person arriving at the booth will have to wait? (**3** *marks*)

ii. What is the average length of queue that forms from time to time? (**2** *mark*)

(f) Solve the game (**4** *marks*)

Strategy/player	B1	B2
A1	5	1
A2	3	4

(g) Discuss types of errors that are commonly observed in drawing network diagrams(**3** *mark*)

(h) Solve the following linear programming problem using the simplex method

$$\text{Maximize } p = 240x + 300y + 360z$$

Subject to

$$\begin{aligned} 4x &+ 2y + 5z \leq 150, \\ 2x &+ 1y + 1z \leq 40, \\ 2x &+ 1y + 2z \leq 80, \end{aligned}$$

$$x \geq 0,\ y \geq 0,\ z \geq 0$$

(**8** *marks*)

QUESTION TWO (20 MARKS)

2. (a) Discuss the algorithm for solving $Mby2$ matrix games (**5** *marks*)
Then solve this using graphical method (**5** *marks*)

	B1	B2
A1	-2	0
A2	3	-1
A3	-3	2
A4	5	-4

(b) On a chicken farm, the poultry is given a healthy diet to gain weight. The chickens have to consume a minimum of 15 units of Substance A and another 15 units of Substance B. In the market there are only two classes of compounds: Type X, with a composition of one unit of A to five units of B, and another type, Y, with a composition of five units of A to one of B. The price of Type X is 10 and Type Y, 30.What are the quantities of each type of compound that have to be purchased to cover the needs of the diet with a minimal cost? Solve the problem by using graphical method (**10** *mark*)

QUESTION THREE (20 MARKS)

3. (a) List 3 characteristics of Linear programming (**3** *mark*)

(b) Solve the LPP by using simplex table and obtain the best strategy for the players (**7** *marks*)

$$A = \begin{pmatrix} 1 & -1 & -1 \\ -1 & -1 & 3 \\ -1 & 2 & -1 \end{pmatrix}$$

(c) The Kenya premier league has four football games on a particular night. Their office wants to assign four teams of officials to the four games in a way that will minimize the total distance traveled by the officials. The distances in miles for each team of officials to each game location are shown below. (**10** *mark*)

Official/Game Site	I	II	III	IV
A	210	90	180	160
B	100	70	130	200
C	175	105	140	170
D	80	65	105	120

QUESTION FOUR (20 MARKS)

4. (a) Use the Row Minima method method to find the minimum cost of the following transportation problem (**10** *marks*)

	D1	D2	D3	D4	D5
Q1	3	1	7	4	300
Q2	2	6	5	9	400
Q3	8	3	3	2	500
Demand	250	350	400	200	

(b) Vehicles arrive at the garage for services at an average rate of 2 per hour. The arrival of the vehicles follows the Poisson distribution. The service time of a vehicle on the garage follows an exponential distribution with a mean of 15 minutes. (**10** *marks*)

i. What is the average number of vehicles in the garage?

ii. What is the average number of vehicles waiting for service?

iii. What is the average waiting time in the queue of an arrival?

iv. What is the average time an arrival spends in the system?

v. Idle time (in hours) at the garage per shift will be?

QUESTION FIVE (20 MARKS)

5. (a) A project has the following times schedule. Construct the network (**7** *marks*)

Activity	Times in weeks
1-2	4
1-3	1
2-4	1
3-4	1
3-5	6
4-9	5
5-6	4
5-7	8
6-8	1
7-8	2
8-9	1
8-10	8
9-10	7

(b) Hence Compute

i. Earlier start and late start for each event (**7** *mark*)

ii. Float for each activity (**4** *mark*)

iii. Critical path and its duration (**2** *mark*)