THE CO-OPERATIVE UNIVERSITY OF KENYA

END OF SEMESTER EXAMINATION DECEMBER -2022

EXAMINATION FOR THE DEGREE OF BACHELOR OF BUSINESS AND INFORMATION TECHNOLOGY, INFORMATION TECHNOLOGY
(YR III SEM II)

UNIT CODE: BCIT 3163

UNIT TITLE: BUSINESS SYSTEM MODELLING

DATE: WEDNESDAY, 14TH DECEMBER, 2022

TIME: 9:00 AM – 11:00 AM

INSTRUCTIONS:

- **Answer question ONE (compulsory) and any other TWO questions**

QUESTION ONE

(a) Explain Five principal phases of Business System Modelling **(5 marks)**

(b) Consider the following scenario, Mary has a 5-week commitment traveling between Nairobi and Mombasa. Weekly departure from Nairobi occurs on Mondays for return on Wednesdays. A regular roundtrip ticket costs Kshs 6,500, but a 20% discount is granted if the roundtrip dates span a weekend. A one-way ticket in either direction costs 75% of the regular price. Explain two feasible alternative of buying the ticket. (**4 marks)**

(c) Discuss two major properties/component of business systems model **(4 marks)**

(d) With aid of an illustration explain Four application of Linear Programming in business **(4 marks)**

(e) Distinguish between model Validation and Verification. **(2 Marks)**

(f) Enumerate Four conditions that a problem to be solved through Linear Programming must confirm to. **(4 Marks)**

(g) Discuss Three applications of of network models **(3 Marks)**

(h) Discuss Four most important information required to solve queuing problem **(4 Marks)**

QUESTION TWO

Amigos Car dealers is developing a replacement policy for its car fleet over a 4-year planning horizon. At the start of each year, a car is either replaced or kept in operation for an extra year. A car must be in service from 1 to 3 years. The below table provides the replacement cost as a function of the year a car is acquired and the number of years in operation.

Equipment acquired at the start of every year	Replacement cost ($) for given years in operation		
	1	2	3
1	4000	5400	9800
2	4300	6200	8700
3	4800	7100	-

4	4900	-	-

(a) Model the above scenario as a network **(4marks)**

(b) Mawazo LTD produces both interior and exterior paints from two raw materials, *M*1 and *M*2. The following table provides the basic data of the problem:

Tons of raw materials per ton of			
	Exterior Paints	Interior Paint	Maximum Daily Availability(Ton)
Raw Material M1	6	4	24
Raw Material M2	1	2	6
Profit Per ($1000)	5	4	

The daily demand for interior paint cannot exceed that for exterior paint by more than 1 ton. Also, the maximum daily demand for interior paint is 2 tons. Determine the optimum (best) product mix of interior and exterior paints that maximizes the total daily profit. **(5marks)**

(c) Discuss degeneracy problem, its consequences and how it can be overcomed **(4marks)**
(d) Solve the given transportation problem using Vogel's approximation method. **(7marks)**

Factories	**Destination Centres**				**Supply**
	D1	D2	D3	D4	
F1	3	2	7	6	50
F2	7	5	2	3	60
F3	2	5	4	5	25
Demand	60	40	20	15	

QUESTION THREE

(a) Explain Kendall and Lee notation for representing queuing models **(4marks)**

(b) Use the simplex method to solve the problem **(6marks)**

Max $Z = x_1 + 2x_3$
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$x_1 + 2x_2 + x_3 \leq 2$
$x_3 \leq 1$
$x_1 \geq 0, x_2 \geq 0, x_3 \geq 0$.

(c) There are seven jobs to be processed on a single machine. The following table indicates the jobs and corresponding processing time in hours. Obtain the optimum sequence of the jobs by Shortest Processing Time (STP) rule that minimize the mean flow time. Also obtain average in process inventory **(6 marks)**

(d) Jobs (J)	**(e) A**	**(f) B**	**(g) C**	**(h) D**	**(i) E**	**(j) F**	**(k) G**
(l) Processing time (tj) in hr	**(m)8**	**(n) 3**	**(o) 5**	**(p) 4**	**(q) 3**	**(r) 9**	**(s) 6**

(d) Discuss the significance of introducing the slack, surplus, and artificial variable in Linear Programming.

(4 Marks)

QUESTION FOUR

(a) A zero-sum game has the following payoff table for player 1:

Strategy		Player 2 1	2	3	4
Player 1	1	0	-2	2	1
	2	5	4	-3	5
	3	2	3	-4	3

i. Use the dominated strategies technique to eliminate rows and/or columns, if possible. **(4marks)**

ii. Use maximin/minimax to find a saddle point of the game resulting from (a), if there is one. **(4marks)**

iii. Express the solution to the game of (a) as a linear programming problem **(4Marks)**

(b) Consider the following Linear Programming problem:

Minimize $2x_1 + 3x_2$ subject to the constraints $x_i \geq 0$, $i = 1,2$, and

$$x_1 + 2x_2 \geq 4$$

$$x_1 + x_2 \geq 3.$$

i. Convert this problem to a maximization problem. **(4marks)**

ii. Solve the problem of by the graphical method. **(4marks)**

QUESTION FIVE

(a) The mean arrival rate to a service centre is 3 per hour. The mean service time is found to be 10mins per service. Assuming Poisson arrival and exponential service time find:

i. Utilization factor for the service facility **(2marks)**

ii. Probability of two units in the system **(2marks)**

iii. Queue Length **(2marks)**

iv. Expected waiting time in the system **(2marks)**

(b) Small Project consist of activities from A to I the following table indicates the precedence relationship among activities and the three time estimates-optimistic, most likely, pessimistic time for each activities in the day

Activity	**Predecessor Relationship**	**Optimistic time t_0**	**Most likely time t_m**	**Pessimistic time t_p**
A	-	2	5	8
B	A	6	9	12
C	A	6	7	8
D	B,C	1	4	7
E	A	8	8	8
F	D, E	5	14	17
G	C	3	12	21
H	F,G	3	6	9
H	H	5	8	11

i. Draw the project network. Determine the expected time and variance for each activity **(4marks)**

ii. Obtain the total expected duration of the project and critical path **(4marks)**

(c) Consider the problem

$$\text{Max } Z = 5x1 + 7x2$$

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$$x1 + 2x2 \le 4$$

$$x1 + x2 \le 3$$

$$x1 \ge 0, x2 \ge$$

Find the dual to the above Linear Programming **(4marks)**