MUEO
MOI UNIVERSITY

OFFICE OF THE DEPUTY VICE CHANCELLOR, ACADEMIC AFFAIRS, RESEARCH & EXTENSION

UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR

END OF SEMESTER EXAMINATIONS

FOR THE DEGREE
IN BACHELOR OF BUSINESS AND ECONOMICS

EXAM CODE : BBM 351/BPM 316/BSM 302D/ECF 311

COURSE TITLE: OPERATIONS RESEARCH/GAME THEORY/QUANTITATIVE METHODS

DATE: - MONDAY 11TH APRIL, 2022 TIME: - 2.00P.M-5.00P.M

INSTRUCTION TO CANDIDATES

1. **SEE INSIDE.**
2. **THIS PAPER CONSISTS OF (5) PRINTED PAGES**
3. **PLEASE TURN OVER**

END OF SEMESTER EXAMINATION

INSTRUCTIONS:-

1. *Answer **Question ONE** and any other **THREE.***
2. *Time allowed: **3 hours.***

QUESTION ONE - COMPULSORY [25 MARKS]

(a) *"Operations Research (OR) increases the creative capabilities of a decision-maker."* Explain this statement with examples. **[4marks]**

(b) Briefly discuss the importance of models in the solution of operations research problems. **[3 marks]**

(c) Distinguish between solutions derived from simulation models and solutions derived from analytical models. **[4 marks]**

(d) In a railway marshalling yard, goods trains arrive at a rate of 30 trains per day. Assuming that the interarrival time follows an exponential distribution and the service time (the time taken to hump a train) distribution is also exponential with an average of 36 minutes.

Required:

(a) Expected queue size (line length). **[2 marks]**

(b) Probability that the queue size exceeds 10. **[2 marks]**

(c) If the input of trains increases to an average of 33 per day, what will be the change in (i) and (ii)? **[2 marks]**

(e) A firm produces three products: P_1, P_2 and P_3. The products require varying proportion of two materials: M_1 and M_2. The firm wishes to produce at least 150 units of P_1, 200 units of P_2 and 60 units of P_3. Each bag of M_1 yields 3 of P_1, 5 of P_2 and 3 of P_3. Each bag of M_2 yields 5 of P_1, 5 of P_2 and 1 of P_3.

Required:

(i) If M_1 costs KSh. 40 per bag and M_2 costs Ksh. 50 per bag, advise the management on how many units of each of the products should be produced so as to minimise the cost. **[6 marks]**

(ii) From the optimum solution, determine the status of each resource. **[2 marks]**

QUESTION TWO [15 MARKS]

(a) Define the following terms as used in the network analysis:

(i) Crash time. **[1 mark]**

(ii) Optimistic time. **[1 mark]**

(iii) Forward pass. **[1 mark]**

(b) A project has the following activity durations and resource requirements.

Activity	Preceding activity	Duration (days)	Resource requirement (man power)
A	-	6	3
B	-	3	2
C	-	2	2
D	C	2	1
E	B	1	2
F	D	1	1

Required:

(i) What is the networks critical path? **[4 marks]**

(ii) Draw a Gantt chart diagram indicating activity times, using their estimate. **[3 marks]**

(iii) Show resource requirement on a day to day basis assuming all events commence at their estimates. **[3 marks]**

(iv) Assuming that only six employees are available, how will the activities be planned for? **[3 marks]**

QUESTION THREE [15 MARKS]

(a) Game theory provides a systematic quantitative approach for analysing competitive situations in which the competitors make use of logical processes and techniques in order to determine an optimal strategy for winning: Comment. **[3 marks]**

(b) A company management and the labour union are negotiating a new three year collective bargaining agreement. Each of these has 4 strategies:

1: Hard and aggressive bargaining.
2: Reasoning and logical approach,
3: Legalistic strategy.
4: Conciliatory approach.

The costs to the company are given for every pair of strategy choice:

		Management's Strategies			
		M_1	M_2	M_3	M_4
Union's Strategies	U_1	20	15	12	35
	U_2	25	14	8	10
	U_3	40	2	10	5
	U_4	-5	4	11	0

Required:

(i) The best strategy for each side to adopt. **[5 marks]**

(ii) The value of the game. **[1 marks]**

(c) Consider the two person zero sum game between players A and B given the following payoff table:

		Player B Strategies	
		B_1	B_2
Player A Strategies	A_1	1	2
	A_2	4	5
	A_3	9	7
	A_4	-3	-4
	A_5	2	1

Required:

Determine the optimal strategies for the players and the value of the game using graphical method.

[6 marks]

QUESTION FOUR [15 MARKS]

(a) Explain **four** factors that must be considered when designing a simulation experiment.

[4 marks]

(b) A book store wishes to carry a particular book in stock. The demand of the book is not certain and there is a lead time of 2 days for stock replenishment. The probabilities of demand are given below:

Demand (units/day)	0	1	2	3	4
Probability	0.05	0.10	0.30	0.45	0.10

Each time an order is placed, the store incurs an ordering cost of Sh. 10 per order. The store also incurs a carrying cost of Sh 0.5 per book per day. The inventory carrying cost is calculated on the basis of stock at the end of each day. The manager of the book store wishes to compare two options for his inventory decision.

A: Order 5 books when the present inventory plus any outstanding order falls below 8 books.

B: Order 8 books when the present inventory plus any outstanding order falls below 8 books.

Currently (beginning of 1st day) the store has a stock of 8 books plus 6 books ordered two days ago and are expected to arrive the next day.

Required:

Carryout simulations run for 10 days to recommend an appropriate option. You may use random numbers in the sequences, using the first number for day one. 89, 34, 78, 63, 61, 81, 39, 16, 13, 73.

[11 marks]

QUESTION FIVE [15 MARKS].

(a) Briefly explain **three** areas of management that transportation model can be effectively used.

[3 marks]

(b) A dairy firm has three plants located in a county. The daily milk production at each plant is as follows:

Each day, the firm must fulfill the needs of its four distribution centres. The minimum requirement of each centre is as follows:

Distribution centre 1 : 7 million litres, Distribution centre 2 : 5 million litres, Distribution centre 3 : 3 million litres, and Distribution centre 4 : 2 million litres.

Cost (in million Shillings) of transporting one million litres from each plant to each distribution centre is as given in the table below:

		Distribution centre			
		C_1	C_2	C_3	C_4
Plant	P_1	2	3	11	7
	P_2	1	0	6	1
	P_3	5	8	15	9

Required:

Find the initial basic feasible solution for given problem by using following methods:

(i) North-west corner rule. **[2 marks**

(ii) Least cost method. **[2 marks]**

(iii) Vogel's approximation method. **[2 marks]**

(c) A marketing manager has five sales-representatives and five sales districts. Considering the capabilities of the salesmen and the nature of districts, the marketing manager estimates that the sales per month (in thousands Shillings) for each sales-representative in each district would be as follows:

		Districts				
		D_1	D_2	D_3	D_4	D_5
Sales-representatives	S_1	32	38	40	28	40
	S_2	40	24	28	21	36
	S_3	41	27	33	30	37
	S_4	22	38	41	36	36
	S_5	29	33	40	35	39

Required:

Assign the sales-representatives to districts so as to maximise sales. **[7 marks]**

QUESTION SIX [15 MARKS]

(a) What is replacement? Describe some important replacement situations. **[4 marks]**

(b) Let the value of the money be assumed to be 10 per cent per year and suppose that machine A is replaced after every three years, whereas machine B is replaced every six years. The yearly costs (in Sh) of both the machines are given below:

Year	**1**	**2**	**3**	**4**	**5**	**6**
Machine A	1,000	200	400	1000	200	400
Machine B	1,700	100	200	300	400	500

Required:

Determine which machine should be purchased. **[11 marks]**

END

Formulae for use (Single Server Queues)

$P(n \geq k) = (\frac{\lambda}{\mu})^k$

U = Utilization ratio = $\frac{\lambda}{\mu}$

$$P_o = \text{Prob}\begin{bmatrix}\text{system is}\\ \text{empty (idle)}\end{bmatrix} = 1 - \frac{\lambda}{\mu}$$

$$L_q = \begin{matrix}\text{average number}\\ \text{in the queue}\end{matrix} = \frac{\lambda^2}{\mu(\mu - \lambda)}$$

$$L = \begin{matrix}\text{average number}\\ \text{in the system}\end{matrix} = \frac{\lambda}{\mu - \lambda}$$

$$W_q = \begin{matrix}\text{average time}\\ \text{in the queue}\end{matrix} = \frac{\lambda}{\mu(\mu - \lambda)}$$

$$W = \begin{matrix}\text{average time}\\ \text{in the system}\end{matrix} = \frac{1}{\mu - \lambda}$$

Note:

λ is the arrival rate.

μ is the service rate.