OFFICE OF THE DEPUTY VICE CHANCELLOR
ACADEMICS, RESEARCH AND STUDENT AFFAIRS

UNIVERSITY EXAMINATIONS

2024 /2025 ACADEMIC YEAR

THIRD YEAR SECOND SEMESTER MAIN EXAMINATION

FOR THE OF BACHELOR OF BUSINESS MANAGEMENT DEGREE

COURSE CODE: BBM 351

COURSE TITLE: OPERATIONS RESEARCH

DATE:7TH APRIL 2025 **TIME: 8 TO 11 A.M**

INSTRUCTION TO CANDIDATES

- SEE INSIDE

THIS PAPER CONSISTS OF 3 PRINTED PAGES PLEASE TURN OVER

STREAM: BBM **DURATION: 3 Hours**

INSTRUCTIONS TO CANDIDATES

i. *Answer Question **ONE** and any other **TWO** questions.*
ii. *Maps and diagrams should be used whenever they serve to illustrate the answer.*
iii. *Do not write on the question paper.*

QUESTION ONE (30 MARKS)

a. Discuss two ways a model can be classified **(4mks)**

b. Discuss three problems encountered during operation research process **(6mks)**

c. A chemical company manufactures two types of fertilizer, super-nitrate and phosphate-R. Both fertilizers make use of the same three chemicals, in different proportions. These chemicals, the proportion (as a percentage by weight) of each that are used in the two fertilizer and the total quantity of each chemical available for the year are listed in the following table:

CHEMICAL	SUPER-NITRATE%	PHOSPHATE-R %	MAX. QUANTITY AVAILABLE(TONS)
NITRATE	20	10	2500
PHOSPHATE	10	15	2000
SULPHATE	20	20	3000

The company is under contract to supply 3000 tons of phosphate-R to one of its customers, but it is otherwise free to apportion its production between the two types of fertilizer in the most profitable manner. Each ton of Super nitrate sells at sh.3000 while each ton of phosphate-R sells sh.4000.
Formulate this Linear programming Model and give the initial solution if you were to use simplex method. **(20mks)**

QUESTION TWO (20 MARKS)

a. Kenya Sukari Company has four factories in Sonny, Chemelil, Mumias and Nzoia , producing and supplying sugar in western Kenya. The factories supply to four depots in homa bay, Kisumu, Kakamega and bungoma for eventual distribution to retailers.

The management wants to determine, the minimum- cost transportation schedule for the monthly output of sugar. Factory supply depot demands and transportation costs per ton of sugar are shown below;

Data for sugar transportation
Transportation costs per Ton(sh) to

Factory	Monthly supply (tons)	KNTC depots	Monthly demand (tons)	From i	Homabay	Kisumu	Kakamega	bungoma
Sonny	15	Homabay	10	Sonny	25	35	36	60
Chemelil	6	Kisumu	12	Chemelil	55	30	45	38
Mumias	14	Kakamega	15	Mumias	40	50	26	65
Nzoia	11	bungoma	9	Nzoia	60	40	66	27

Set up a transportation matrix, test for feasibility, and find the total transportation cost Kenya sukari will incur using the VOGEL'S Approximation Model. **(15mks)**

b. List five characteristics of operation research **(5mks)**

QUESTION THREE (20 MARKS)

a. An engineering company, intends to produce a batch of machines to be used by a pharmaceutical firm in the mass production of drugs for PTA market.
The activities required in the design and manufacture of the machines are listed below together with duration.

Activity D_{ij}	Preceded by	Duration (weeks)
A draw up estimates of cost	-	2
B Agree on estimate	A	1
C Prepare internal machinery	B	4
D Prepare design drawings	B	6
E Construction of main frame	D	3
F Assemble machinery	C,E	3
G Test machinery	F	4
H Determine model type	D	2
I Determine outer casing	D	3
J Construct outer casing	H,I	8
K Final assembly	G,J	2
L Final check	K	2

- Draw the network and determine critical path **(12mks)**
- What would be the effect:
  i. Of a strike at the factory supplying the internal machinery, thereby causing delay in its delivery by four weeks? **(1mks)**
  ii. If the test on machinery had been done incorrectly and had to be redone, taking another four weeks (consider the two events independently) **(1mks)**

b. Discuss three models of arrival **(6mks)**

QUESTION FOUR (20 MARKS)

a. Discuss six importance of inventory control **(6mks)**

b. Discuss two areas where operation research could be applied to solve a problem, citing solutions. **(4mks)**

c. Consider the following project with the following activities and their respective durations in days and draw the network and determine the critical path. **(5mks)**

ACTIVITY	ACTIVITY TIME ESTIMATE IN DAYS		
	a	m	b
1-2	3	6	15
1-5	1	2	9
2-6	2	3	10
3-5	0	0	0
5-7	10	15	50
1-3	0.5	1	7.5
2-4	0.5	1	7.5
3-4	1	3	11
4-7	6	10	32
6-7	3	5	25

d. Kamongo fishing company has boats in Lake Victoria, Lake Turkana and Lake Naivasha. Fish caught from these lakes are transported to the following towns for marketing: Kisumu, Eldoret, Busia, Kapedo, Lokichogio, Naivasha and Gilgil.

The supplies from the lakes, the requirements for each market and the cost of transporting each fish from each lake to each market are as follows:

Lakes	Markets 'shs.							
	Kisumu	Eldoret	Busia	Kapedo	Lokicho	Naivasha	Gilgil	capacity
L. victoria	6	7	5	4	8	6	5	7000
L.turkana	10	5	4	5	4	3	2	4000
L.naivasha	9	5	3	6	5	9	4	10000
Required	1000	2000	4500	4000	2000	3500	3000	

Required:

Set up a transportation matrix for the above movement **(5mks)**

QUESTION FIVE (20 MARKS)

a. Discuss three categories of inventory costs **(6mks)**

b. In a newly created level three hospital in Busia, there is Angorom health Centre. The Centre has a single medical doctor to take care of the patients arriving from the rural community. The government is convinced that the situation faced here is a single server queuing situation with Poisson arrivals and Poisson service. After all, the calling units are the members of the community and service mechanism is the doctor attending them.

From the minister's record, it has been established that patients arrive randomly at a rate of 0.20 patients per hour. Each patient require different amount of time for treatment.

The doctor reckons, however, that he treats his patient at an average rate of 0.21 patients per hour.

Calculate:

i. The average number of patients in the queuing system **(2mks)**

ii. The number of patients actually waiting in the queue **(2mks)**

iii. The average amount of time the patients spends in the queuing system **(2mks)**

iv. The average amount of time the patient spends in the queue **(2mks)**

v. The probability of having exactly zero patients in the queuing system **(2mks)**

vi. The probability that there would be 10 (ten) or more patients in the queuing system **(2mks)**

vii. The utilization ratio with the doctor functioning as the service mechanism **(2mks)**