MACHAKOS UNIVERSITY

University Examinations for 2022/2023 Academic Year

SCHOOL OF BUSINESS, ECONOMICS AND HOSPITALITY AND TOURISM

MANAGEMENT

DEPARTMENT OF ECONOMICS

FOURTH YEAR FIRST SEMESTER EXAMINATION FOR

BACHELOR OF ECONOMICS AND FINANCE

BACHELOR OF ECONOMICS AND STATISTICS

BACHELOR OF ECONOMICS

EES 402: OPERATIONS RESEARCH II

DATE: **TIME:**

INSTRUCTIONS:

    (i)   Answer Question **ONE** and any other **TWO** questions

    (ii)   Show all your workings clearly

QUESTION ONE (COMPULSORY) (30 MARKS)

a) Briefly explain the following terms as applied in network analysis.

    i)   Transhipment

                                             (2 marks)

    ii) Dual price   (2 marks)

b) During COVID pandemic four people arrived every one hour in a certain hospital for vaccination. It took twelve minutes on average to have each one of them vaccinated. Assuming that the arrivals follow a Poisson distribution and the time it took to be vaccinated followed an exponential distribution, determine the following.

    i)   The percentage of time that there was no one being vaccinated for the vaccine

                                           (2 marks)

    ii) The average number of people who would be at the hospital for vaccination

                                           (2 marks)

    iii) The average time a person waited to be vaccinated

                                          (2 marks)

    iv) The average number of people waiting for their turn waiting to be vaccinated

                                          (2 marks)

    v)   The average time a person spent at the hospital

                                          (2 marks)

$$\rho = \frac{\lambda}{\mu} \qquad N_q = \frac{\lambda^2}{\mu(\mu-\lambda)} \quad N_s = \frac{\lambda}{\mu-\lambda} \quad T_q = \frac{\lambda}{\mu(\mu-\lambda)} \quad T_s = \frac{1}{\mu-\lambda}$$

c) A project has the following activities and characteristics.

Activity	Pre-requisite	Time		Cost	
		Normal	Crash	Normal	Crash
A	-	7	6	800	720
B	-	5	2	500	620
C	A	4	1	400	700
D	B	3	2	350	450
E	C & D	6	4	600	840

    i.   Draw the network diagram and identify the critical path   (2 marks)

    ii.   Crash the relevant activities systematically and determine the optimal Project time and cost.   (4 marks)

    iii.   Find the total float of critical activities   (2 marks)

d) Marz ltd produces two electronic products P and Q which requires two main inputs, that is labour and capital. Its daily allocations of labour and capital are six and ten units respectively. Product P requires two units of labour and six units of capital daily. Product Q requires two units of labour and two units of capital daily. The selling prices per unit for product P and Q are KShs 100 and KShs 80 per unit respectively.
    i) Find the optimal product mix   (4 marks)
    ii) Determine the dual/shadow price for labour and interpret it.   (2 marks)
    iii) Determine the feasibility range for capital and interpret it.   (2 marks)

QUESTION TWO (20 MARKS)

a) State five objectives of inventory control.   (5 marks)
b) A company manufactures 50 items per day. The sale of these items depends upon

demand which has the following distribution:

SALES (UNITS)	PROBABILITY
47	0.10
48	0.15
49	0.20
50	0.35
51	0.15
52	0.05

The production cost and selling price of each unit are 20 and 40 dollars respectively. Any unsold products are disposed at a loss of 10 dollars per unit. There is a penalty of 5 shillings if demand is not met.

Using the following random numbers estimate the total profits/loss for the company for the next 10 days: 15, 99, 60, 57, 95, 05, 80, 18, 44, 23 (15 marks)

QUESTION THREE (20 MARKS)

a)   A trader has to supply his customers with 14400 bags of maize per year. The unit cost of maize is KES 1000 per bag and the inventory carrying charges are 10% per annum. The cost of one procurement amounts to KES 200.
Determine the following the economic order quantity and number of orders per year
(4 marks)

b)   A company processes three types of products A, B and C using three kinds of machines, P, Q, and R which have different processing capacities. The time requirement in hours for each unit of the three products for each of the type of machine; time allocated daily for each machine and prices in dollars for each product are recorded below.

Resource requirement per unit

Resources	A	B	C	Daily availability
Machine P	2	1	1	15 hours
Machine Q	1	1	4	20 hours
Machine R	2	3	1	32 hours
Price per unit	24	16	8	

Solve the linear program above to find the number of units for each product that the company should make in order to maximize its revenue.   (13 marks)

ii)   Determine and interpret the dual price for each machine.   (3 marks)

QUESTION FOUR (20 MARKS)

Three cement firms, A, B and C supply 180, 150 and 190 bags of cement weekly to five construction sites, P, Q, R, S, and T. The weekly demands for the construction sites, P, Q, R, S, and T. are 140, 140, 150, 140 and 180 bags of cement respectively. The firms hire a transport company whose charges per unit of bag are given as follows

Firm/Site	P	Q	R	S	T
A	10	16	12	12	6
B	8	14	14	12	12
C	16	8	12	12	6

i)   Determine the initial feasible solution using Vogel's Approximation Method
(10 marks)

ii)   Find the optimum transport solution and its associated cost   (10 marks)

QUESTION FIVE (20 MARKS)

A company has four plants P_1, P_2, P_3 and P_4 manufacturing the same product. Production and raw materials costs differ from plant to plant and are given in the following table in the first two rows. The transportation costs from the plant to the warehouses, W_1, W_2, W_3 are also given. The last two columns in the table give the sales price and the total requirements at each warehouse. The production capacity of each factory is given in the last raw.

		P_1	P_2	P_3	P_4	Sales price Per unit	Requirement
Production cost per unit		15	18	14	13		
Raw materials/unit		10	9	12	9		
Transportation cost per unit	W_1	3	9	5	4	34	160
	W_2	1	7	4	5	32	240
	W_3	5	8	3	6	31	300
Supply		20	300	100	200		

Determine the most profitable production and the distribution schedule and the corresponding profit. The deficit production should be taken to yield zero profit.