MACHAKOS UNIVERSITY

FACULTY OF ENGINEERING AND TECHNOLOGY

FOURTH YEAR SECOND SEMESTER EXAMINATION FOR BACHELOR OF MECHANICAL ENGINEERING &BACHELOR ELECTRICAL AND ELECTRONICS ENGINEERING

EMM 413 OPERATIONS RESEARCH

DATE: APRIL 2019 EXAMS **TIME:2 HOURS**

INSTRUCTIONS

ANSWER QUESTION ONE AND ANY OTHER TWO QUESTIONS

QUESTION ONE- (30 MARKS)- COMPULSORY

QUESTION ONE- 30 MARKS

A. Explain the term Monte Carlo simulation (4mks)

B. Describe any four application of operation research (4mks)

C. Explain the following condition

   i. Decision making under certainty

   ii. Decision making under risk (4mks)

D. A breweries Ltd has two bottling plants, one located at Nakuru and the other at Nairobi. Each plant produces three drinks, whisky, beer and fruit juices named A, B and C respectively. The number of bottles produced per day are as follows;

	Plants at	
Drinks	Nakuru	Nairobi
Whisky(A)	1,500	1,500
Beer (B)	3,000	1,000
Fruit juices (C)	2,000	5,000

A market survey indicates that during the month of April, there will be a demand of 20,000 bottles of whisky, 40,000 bottles of beer and 44,000 bottles of fruity juices. The operating costs per day for Nakuru and Nairobi plants are 600 and 400 monetary units.

For how many days each plants will run in April so as to minimize the production cost while meeting the market demand?

(7mks)

E. Workers come to tool room to receive special tools for accomplishing a particular project assigned to them. The average time between two arrivals is 60 seconds and are assumed to be in Poisson distribution. The average service time is 40 seconds. Determine

i. Average queue length
ii. Average length of non – empty queues
iii. Average number of workers in the system
iv. Mean waiting time of an arrival
v. Average waiting time of an arrival (worker) who waits
vi. Determine whether to go in for an additional tool store attendants which will minimize the combined costs of attendants idle time and the cost of worker waiting, Assume the charges of a skilled worker is Ksh 4 per hour and that of tool room attendant is Ksh 0.75 per hour

(11mks)

QUESTION TWO – 20 MARKS

A. Describe any five characteristics of a queuing model

(5mks)

B. Formulate the following linear problem into a dual form

Minimize $Z = 3x_1 - 2x_2 + 4x_3$

S.t $3x_1 + 5x_2 + 4x_3 \geq 7$

$6x_1 + x_2 + 3x_3 \geq 4$

$7x_1 - 2x_2 - x_3 \geq 10$

$x_1 - 2x_2 + 5x_3 \geq 3$

$4x_1 + 7x_2 - 2x_3 \geq 2$

$x_1, x_2, x_3 \geq 0$ (3mks)

C. A manufacturing company produces three types of plastic fixtures. The time required for molding, trimming and packaging is give in Table 1 below

Table 1:Types of Plastic fixtures

Process	Type A	Type B	Type C	Total time available
Molding	1	2	3/2	12,000
Trimming	2/3	2/3	1	4,600
Packaging	1/2	1/3	1/2	2,400
Profit	Ksh 11	Ksh 16	Ksh 15	

Using Simplex method, determine how many of each type of fixture should be produced to obtain the maximum profit (12marks)

QUESTION THREE- 20 MARKS

A. Explain five characteristics of dynamic programming (8 marks)

B. A small scale factory has a machinist to process the jobs. The inter arrival time for the job is not fixed. The processing time on the jobs also varies. The times are described by frequency distribution given in Table 2 below

Table 2: inter arrival and processing time in minutes

Inter arrival time distribution		Processing time distribution	
Inter arrival time (min)	Frequency	Processing time (min)	Frequency
4	10	3	5
5	20	4	30
6	40	5	30
7	20	6	30
8	10	7	5

Assume the random numbers for inter arrivals jobs are 5, 5, 5, 7, 4, 8, 7, 5, 5, 6, 6, 6, 6, 6, 5, 7, 4, 5, 7, 6, 6, 6, 4, 8, and 7 minutes respectively while for processing times jobs are 6, 4, 4, 4, 6, 6, 6, 7, 6, 4, 4, 4, 4, 4 5, 4, 5, 5, 6, 7, 7, 5, 4, 4 and 7 minutes respectively

i. Determine the idle time of the machinist and the waiting time of jobs in a period of 2 hours.
ii. If machinist wages are Ksh. 20 per hour and the jobs waiting time cost Ksh. 30 per hour would it be economical to engage a second attendant?

(12 marks)

QUESTION FOUR- 20 MARKS

C. Explain four limitations of simulation techniques (8 marks)

D. The owner of a chain of four grocery stores has purchased six crates of fresh strawberries. Table gives the estimated profits at each store when it is allocated various numbers of boxes;

Table 3: Profit generated from each store

Stores					
No of boxes		1	2	3	4
	0	0	0	0	0
	1	4	2	6	2
	2	6	4	8	3
	3	7	6	8	4
	4	7	8	8	4
	5	7	9	8	4
	6	7	10	8	4

The owner does not wish to split crates between stores but is willing to make zero allocation. Find the allocation for six crates so as to maximize the profit (12 marks)

QUESTION FIVE- 20 MARKS

A. Table 4 below show the transportation problem

	Retail shops				
Factories	1	2	3	4	Supply
1	3	5	7	6	50
2	2	5	8	2	75
3	3	6	9	2	25
Demand	20	20	50	60	

Using the following method, determine the feasible solutions

i. North West Corner method

ii. Least cost method

iii. Vogel approximation method (12mks)

B. A newspaper boy has the following probabilities of selling magazine as shown in Table 5

Table 5: Copies of magazines sold

No of copies	Probability
10	0.10
11	0.15
12	0.20
13	0.25
14	0.30

Cost of a copy is ksh 30 and sale price is ksh 50. He cannot return unsold copies. How many copies should he order?

(8marks)