



THE CATHOLIC UNIVERSITY OF EASTERN AFRICA

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MAIN EXAMINATION

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MAY – AUGUST 2021

Ext 1022/23/25

FACULTY OF ARTS AND SOCIAL SCIENCES

DEPARTMENT OF ECONOMICS

REGULAR PROGRAMME

ECN 305: OPERATIONS RESEARCH

Date: AUGUST 2021

Duration: 2 Hours

INSTRUCTIONS: Answer Question ONE and any other TWO Questions

Q1.

- a) Briefly explain the following concepts
- i) Dominated strategies (1 Marks)
 - ii) Dominant strategies (1 Marks)
 - iii) Unbalanced transportation problem (1 Marks)
 - iv) Degeneracy in transportation (1 Marks)
- b) A company makes two kinds of leather belts, belt A and belt B. Belt A is a high quality belt and belt B is a lower quality. The respective profits are Ksh 4 and Ksh 3 per belt. The production of each of type A requires twice as much time as belt of type B, and if all belts were of type B the company could make 1,000 belts per day. The supply of leather is sufficient for only 800 belts per day (both A and B combined), belt A requires a fancy buckle and only 400 of this are available per day. There are only 700 buckles a day available for belt B.
- i) Formulate this problem as a linear programming (5 Marks)
 - ii) What should be the daily production of each type of belt? Use simplex method to solve (8 marks)
 - iii) Interpret your solution as thoroughly as possible. Be sure to interpret the shadow prices/ marginal values for the resources (4 Marks)

- c) Consider the following project details. The proposed project cost for each activity was Ksh 60,000

Activity	Proceeding activities	Duration - weeks
A	None	9
B	None	8
C	None	10
D	B	3
E	B	4
F	A	4
G	A	3
H	G	5
I	G	4
J	E, C, F, H	8

After the eleventh week, the following data has been forwarded to management concerning the project status.

Activity	Actual cost (Ksh)	% complete
A	62,000	100
B	57,000	100
C	56,000	90
D	0	0
E	10,000	25
F	50,000	75
G	20,000	50
H	0	0

I	0	0
J	0	0

Required

- i) Does the total expenditure to date represent an overall cost over – run or overall cost under – run? **(5 Marks)**
- ii) Is the project being completed on time **(2 Marks)**
- iii) What correction action if any, do you recommend **(2 Marks)**

Q2.

- a) A company has received a contract to supply gravel to three new construction projects located in town A ,B and C. the construction engineers have estimated that the required amounts of gravel which will be needed at these construction projects are:

Project location	Weekly requirement (truckloads)
A	72
B	102
C	41

The construction company has three gravel pits located in towns X, Y, and Z. the gravel required by the constructions projects can be supplied by three pits. The amount that can be supplied by each pit

Plant	X	Y	Z
Amount available (Truck loads)	76	82	77

The company has computed the delivery cost from each pit to each project site the costs are in Ksh as shown in the following table

		PROJECT LOCATION		
		A	B	C
PIT	X	4	8	8
	Y	16	24	16
	Z	8	16	24

Required

- i) Schedule the shipment from each pit to each project in such a manner that it minimizes the total transportation cost within the constraints imposed by pit capacities and project requirements **(10 Marks)**
- ii) Find the minimum cost **(10 Marks)**

Q3.

- a) A testing laboratory has seven samples to test for some properties. Each test is in two parts. Each sample is always subjected to test 1 first then test 2. The laboratory has only one machine of the type required for each part of the test the time in minutes it takes for every sample in each test is given below

Sample	1	2	3	4	5	6	7
Test 1	2	7	10	5	6	4	8
Test 2	3	9	8	2	11	3	11

Determine the order in which the samples should be tested to minimize the total elapsed time and the total elapsed time. **(10 Marks)**

- b) The Kenya army is testing four anti – tank missiles against five targets. As its proving ground in Nanyuki, the ‘effective damage’ ratings shown below were ascertained.

	Target	A	B	C	D	E
	Python	26	36	40	30	28
Missile	Rattler	18	50	34	40	22
	ASP	28	40	30	42	20
	Coral	20	30	36	32	18

If each missile is devoted to only one type of target, what would be the best assignments? **(10 Marks)**

Q4.

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

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

- i) identify whether or not there are dominated strategies **(4 Marks)**
 ii) use maximin/ minimax to find a saddle point of the game resulting from
 (a) if there is one **(4 Marks)**
- b) a company has four men available for work on four separate jobs. Only one man can work on any one job. The cost of assigning each man to each job is given in table below

		JOB			
		I	II	III	IV
PERSON	A	20	25	22	28
	B	15	18	23	17
	C	19	17	21	24
	D	25	23	24	24

Assign men to jobs in such a way that the total cost of assignment is minimum **(12 Marks)**

Q5.

The RELIABLE CONSTRUCTION COMOPANY has just made the winning bid of 5.4 million to construct a new plant for a major manufacturer. The manufacturer needs the plant to go into operation within a year. Therefore, the contract includes the following provisions.

- A penalty of \$300,000 if reliable has not completed construction by the deadline 47 weeks from now
- Provide additional incentive for speedy construction, a bonus of \$150,000 will be paid to Reliable if the plant is completed within 40 weeks

RELIABLE is assigning its best construction manager David James, to this project to ensure that it stays on schedule. Mr David will need to arrange for a number of crews to perform the various construction activities at different times. The table below shows his list of the various activities

Activity	Description	Immediate predecessors	Estimated duration in weeks
A	Excavate	-	2
B	Lay foundation	A	4
C	Put up rough wall	B	10

D	Put up the roof	C	6
E	Install exterior plumbing	C	4
F	Install interior plumbing	E	5
G	Put up exterior siding	D	7
H	Do the exterior painting	E, G	9
I	Do electrical work	C	7
J	Put up the wall board	F, I	8
K	Install the flooring	J	4
L	Do interior painting	J	5
M	Install the exterior fixtures	H	2
N	Install interior fixtures	K, L	6

REQUIRED

- i) Briefly explain three functions of project management **(6 Marks)**
- ii) Construct a network diagram for the above project **(10 Marks)**
- iii) Determine the critical path of the project. How long is the project expected to take? Which provision did Mr. David achieve on behalf of RELIABLE CONSTRUCTION COMPANY? **(4 Marks)**

END