MAASAI MARA UNIVERSITY

REGULAR UNIVERSITY EXAMINATIONS

2018/2019 ACADEMIC YEAR

EXAMINATION FOR THE DEGREE OF BACHELOR OF STATISTICS AND MATHEMATICS

COURSE CODE: STA 2221

COURSE TITLE: OPERATIONS RESEARCH II

DATE: 17TH APRIL 2019 TIME:1100-1300HRS

INSTRUCTIONS:

Answer Question ONE And ANY THREE questions

Question One

1. A construction firm must complete a construction project comprised of 12 tasks, A-L. The firm of Engineers in consultation with Management has established the following dependencies and estimated durations.

Activity Code	Preceding activity	Duration (Weeks)
A	-	6
B	-	7
C	-	6
D	A,B	9
E	B	10
F	B, C	9
G	D	6
H	D	4
I	F	3
J	E,G,I	10
K	H	9
L	F	8

Required:

a) Draw the network and determine the critical path.
b) Management is interested in saving a total of 3 weeks on the project completion time.
   The following data have been collected

Activity	Possible Time Saving Week	Additional Cost per (shs)
A	2	900
B	3	1500
C	1	1700

D	2	500
E	2	1400
G	1	2000
H	2	2100
J	1	2500

Required:

What is the cheapest way to achieve the required time saving and what will be the additional cost incurred? (25 marks)

Question Two

2. The cost of transportation per unit from three sources and four destinations are given in the following table. Obtain the initial basic feasible solutions using the following methods. (15 marks)

i) North-West corner method

ii) Least cost method

iii) Vogel's approximation method

Transportation Model and Test for degeneracy

Source	**Destination**				**Supply**
	1	2	3	4	
1	4	2	7	3	250
2	3	7	5	8	450
3	9	4	3	1	500
Demand	200	400	300	300	1200

Question Three

A company produces three products A,B and C. Each product requires two raw materials: steel and aluminium. The following LP model describes the company's product mix problem.

Max $Z = 30X_A + 10X_B + 50X_C$

Subject to:

$6X_A + 3X_B + 5X_C \leq 450$ (Steel)

$3X_A + 4X_B + 50X_C \leq 300$ (Aluminium)

And $X_A, X_B, X_C \geq 0$

The optimal production plan is given in the following table:

Cj $\longrightarrow$ 30 10 50 0 0

Basic variables	Unit profit	Quantity	X_A	X_B	X_C	S_1	S_2
S_1	0	150	3	-1	0	1	-1
X_C	50	60	3/5	4/5	1	0	1/5
C_j-Z_j			0	- 30	0	0	-10

Where S_1 and S_2 are the slack variables for unused steel and aluminium quantity, respectively.

a) Determine the optimal product mix and interpret your answer (5 marks)

b) Determine and interpret the shadow prices of steel and aluminium (2 marks)

c) Suppose an additional 300 tonnes of Aluminium may be procured at a cost of $ 100 per tonne. Should the company procure the additional aluminium? (3 marks)

d) Unit profit of products A and B is $ 30 and $10 respectively. How much should this prices be increased so that products A and B are produced by the company? (5 marks)

Question Four

A team of 15 men is employed to unload lorries at a terminal. The team works a- 6 hour day during which 36 lorries arrive (i.e. 6 per hour) and it takes 7 ½ minutes to attend one lorry with the team acting as a single unit. Lorries are served on a FIFO basis. It has been estimated that the cost of keeping lorries waiting is $6 per hour. Members of the teams are each paid $ 2.50 per hour. It has been estimated that if the size of the team is increased to 20 men, the average service time would fall to 5 minutes.

Required:

Calculate the cost of the present system and the cost of the proposed system, and determine whether an increase in the size of the team would be justified on grounds of cost (15 marks)

Question Five

Best Sell Ltd has decided to launch a new product in addition to its range of products. The following information is available: (15 marks)

i) The new product may be distributed through any combination of the two company warehouse W_1 and W_2.

ii) The available monthly production capabilities for the new products are; 1000 units at plant A

2000 units at plant B

1000 units at plant C

iii) Three major concentration points of customer demand are at location E, F and G which are estimated to have a monthly demand of:

900 units at plant E

800 units at plant F

900 units at plant G

iv) The unit production costs amount to sh. 30, sh. 40, sh. 10 at A, B and C.

v) The unit transportation costs from plant to warehouse and unit delivery cost from ware house to customers as shown below

Transportation cost schedule

plants	**W1 Shs**	**W2 Shs**
A	60	60
B	50	50
C	130	40

Delivery costs schedule			
Warehouses	**E Shs**	**F Shs**	**G Shs**
W_1	30	60	80
W_2	5-	50	90

Determine the optimum production and distribution schedule to minimize total costs.

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