MURANG'A UNIVERSITY OF TECHNOLOGY

SCHOOL OF PURE AND APPLIED SCIENCE

DEPARTMENT OF APPLIED SCIENCE

UNIVERSITY ORDINARY EXAMINATION

2017/2018 ACADEMIC YEAR

THIRD YEAR **THIRD** SEMESTER EXAMINATION FOR DEGREE OF BACHELOR OF SCIENCE IN MATHEMATICS AND COMPUTER SCIENCE AND BACHELOR OF BUSINESS AND INFORMATION TECHNOLOGY (BBIT)

AMS 319 – OPERATIONS RESEARCH

DURATION: 2 HOURS

DATE: 18TH APRIL, 2018

TIME: 9.00 – 11.00 A.M.

Instructions to Candidates:

1. Answer **Question 1** and **Any Other Two** questions.
2. Mobile phones are not allowed in the examination room.
3. You are not allowed to write on this examination question paper.

SECTION A – ANSWER ALL QUESTIONS IN THIS SECTION

QUESTION ONE

a) Define operations research and briefly explain its historical background (5 marks)

b) Find the dual to the following maximization problem Max $Z = 3x_1 + 2x_2 + 5x_3$

Subject to:

$x_1 + 2x_2 + 3x_3 \leq 430$

$3x_1 + x_3 \leq 460$

$x_1 + 4x_2 \leq 420$

$x_1, x_2, x_3 \geq 0$ (4 marks)

c) State and explain four application areas of linear programming in management (4 marks)

d) The following table gives activities of a construction project and duration

Activity	1-2	1-3	2-3	2-4	3-4	4-5
Duration (Days)	20	25	10	12	6	10

Draw a network for the project and find the critical path (5 marks)

e) A company had four tasks to be performed ad three subordinates. The estimates of the time of each subordinates would take to be performed is as given in the matrix below

	MEN		
TASKS	A	B	C
1	9	26	15
2	13	27	6
3	35	20	15
4	18	30	20

What is the optimal allocation of tasks (one task to one man) so as to minimize the total man hours? (6 marks)

f) A company manufactures two products A and B. The profit contribution of A and B are Ksh.3/= and Ksh.4/= respectively. The products A and B require the services of four facilities. The capacities of the four facilities W, X, Y and Z are limited and the available capacities in hours are 200 hrs, 150 hrs, 100 hrs and 80 hours respectively. Similarly the requirement of product A are 5,3,5 and 8 hours of facilities W,X,Y and Z respectively. The requirement of product B is

4,5,5 and 4 hours respectively on W,X,Y and Z. Using graphical method, find the optimal product mix to maximize the profit (6 marks)

SECTION B – ANSWER ANY TWO QUESTIONS IN THIS SECTION

QUESTION TWO

a) Consider the following data for a project

Activity	Optimistic Time (t_o)	Most likely Time (t_m)	Pessimistic Time (t_p)
1,2	10	13	22
1,4	12	15	18
1,3	8	11	20
2,4	4	7	16
2,9	2	5	8
3,6	12	18	36
3,5	6	12	18
4,6	9	12	27
4,9	4	6	8
5,7	4	8	12
6,8	4	7	10
7,8	1	2	3
6,9	0	0	0
9,10	5	8	11
8,10	9	12	33

i. Construct the network for the project and determine the critical path and its duration. Also determine expected completion time for each activity (13 marks)

ii. Find the variance of the expected duration (4 marks)

iii. What is the probability of the task being completed within a period of 20 days? (3 marks)

QUESTION THREE

a) A company has three factories in different locations, Nyeri, Kisumu and Mombasa. It supplies goods to four dealers in Kisii, Kiambu, Meru and Kinoo. The production capacities of these factories are 200, 500 and 300 per month respectively

Factory	Kisii	Kiambu	Meru	Kinoo
Nyeri	12	18	6	25
Kisumu	8	7	10	18
Mombasa	14	3	11	20
Demand	180	320	100	400

i. Using a suitable method, determine a suitable allocation to maximize the total net return (6 marks)

ii. Test the solution obtained in (i) above for optimally using MODI Method (8 marks)

b) Six different machines can process any of the six required jobs with different profits resulting from each assignment. Find the maximum profit possible through optimum assignments.

Job	Machine					
	A	B	C	D	E	F
1	42	48	50	38	50	54
2	50	34	38	31	46	48
3	51	37	43	40	47	51
4	32	48	51	46	46	48
5	39	43	50	45	49	42
6	37	47	44	46	47	52

(6 marks)

QUESTION FOUR

a) A manufacturer produces three products A,B and C. Each product requires processing on two machines I and II. Time required to produce one unit of each product is given below:

Product	Machine I	Machine II
A	0.5	0.6
B	0.7	0.8
C	0.9	1.05

There are 850 hours available in every machine. The operating cost is 5 for machine I and 4 for machine II. The market requirements are at least 90 units of A, at least 80 units of B and at least 60 units of C. The manufacturer wishes to meet the requirement at minimum cost. Solve the problem by simplex method. (14 marks)

b) A mini supermarket has a cashier who serves 48 customers per hour on average during the rush hour. The customers arrive at the rate of 40 customers per hour. Assuming a single channel queuing model, determine the:

i. probability that the cashier is idle (2 marks)

ii. average number of customers in the queuing system (2 marks)

iii. average time a customer spends in the system (2 marks)

QUESTION FIVE

a) Give a brief overview of queuing theory (3 marks)

b) List four characteristics/assumptions of a single channel queuing model (4 marks)

c) Outline three applications of transport models (3 marks)

d) You are provided with data in the following table

Locations/ Plants	Mtwapa	Mariakani	Kilifi	Watamu	Supply
Plant 1	3	5	7	6	50
Plant 2	2	5	8	2	65
Plant 3	3	6	9	2	25
Demand	20	20	50	60	

Using the above table, find the initial solution and estimate the total cost using LCM and VAM. Which of the two methods gives the minimal cost (10 marks)