TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Applied & Health Sciences

DEPARTMENT OF MATHEMATICS & PHYSICS

UNIVERSITY EXAMINATION FOR DEGREE OF:

BACHELOR OF SCIENCE IN MATHEMATICS & COMPUTER SCIENCE

AMA 4305: OPERATIONS RESEARCH I

END OF SEMESTER EXAMINATION

SERIES: APRIL 2015

TIME ALLOWED: 2 HOURS

Instructions to Candidates:

You should have the following for this examination

- *Mathematical tables*
- *Scientific Calculator*

This paper consist of **FIVE** questions

Answer question **ONE (COMPULSORY)** and any other **TWO** questions

Maximum marks for each part of a question are as shown

This paper consists of **FOUR** printed pages

Question One (Compulsory)

a) Given the definition of operation research according to the following **(4 marks)**

(i) Church Mann Achoff, Arnott

(ii) Operation Research Society

b) Highlight the limitations of OR **(3 marks)**

c) Express the following L.P problem in the standard form:

$$z = 3x_1 + 2x_2 + 5x_3$$

$$2x_1 + 3x_2 - 2x_3 \leq 40$$

$$4x_1 - 2x_2 + x_3 \leq 24$$

$$x_1 - 5x_2 - 6x_3 \geq 2$$

$$x_1,\ x_2,\ x_3 \geq 0$$

(3 marks)

d) A person repairing radios finds that the time spent on the radio set has exponential distribution with mean 20 min. If the radios are repaired in the order in which they come in and the arrival is approximately Poisson with an average rate of 15 for 8 hour day. Calculate the repair man's idle time each day **(4 marks)**

e) Given the following payoff function for each act a1 and a2

$$Q_1 = -25 + 40x$$

$$Q_2 = -80 + 29x$$

(i) Find the break even value of x **(3 marks)**
(ii) If x = 5 which is the better act **(2 marks)**

f) Define the following terms as used in OR:
(i) Activity **(2 marks)**
(ii) Path **(2 marks)**
(iii) Dummy **(1 mark)**

g) The activities along with their dependency relationships are given below. Draw the arrow diagram: **(4 marks)**

Activity	Immediate Predecessor
A	-
B	-
C	-
D	A
E	A, B
F	B, C
G	C
H	E, F
I	G, H
J	H

h) Write the dual of the following r.p problem maximize $z = x_1 + 2x_2 + 3x_3$ subject to: **(2 marks)**

$$3x_1 + 4x_2 - 8x_3 \geq 6$$

$$2x_1 - 3x_2 + 7x_3 \leq 7$$

$$4x_1 + 6x_2 + 8x_3 \leq 14$$

$$x1,\ x2,\ x3 \geq 0$$

Question Two

a) A person wants to decide the constituents of a diet which will fulfill his daily requirements of protein, fats and carbohydrates at minimum cost. The choice is to be made from four different types of foods. The yields per unit of these foods are given below:

Food Type	Yield		Per Unit	
	Proteins	Fats	Carbohydrates	Cost per Units
1	3	2	6	45

2	4	2	4	40
3	8	7	7	85
4	6	5	4	65

Min requirements
800 200 700

Formulate this as L.P problem **(4 marks)**

b) Solve the following L.P problem by the method of simplex **(8 marks)**

$$E = 12x_1 + 20x_2 \ \phi$$

Maximize E

Subject to:

$$6x_1 + 8x_2 \leq 10$$

$$7x_1 + 12x_2 \leq 120$$

$$x_1 \quad x_2 \geq 0$$

c) Carefully discuss the phases of Operations Research **(8 marks)**

Question Three

a) Define simulation **(2 marks)**

b) Two persons x and y work on a two-station assembly line. The distribution of activity times at the station are:

Time in seconds	Time frequency for x	Time frequency for y
10	4	2
20	7	3
30	10	6
40	15	8
50	35	12
60	18	9
70	8	7
80	3	3

(i) Simulate operation for the line for 8 times. Use the following random numbers, 0.6, 0.4, 12, 70, 59, 46, 54, 83 **(6 marks)**

(ii) Assuming y must wait until x completes the first item before starting work, will he have to wait to process any of the other 7 items? What is the average waiting time of items for y. Use the following random numbers:

For x	83	70	06	12	59	46	54	04
For y	57	99	84	81	15	36	12	54

(iii) Determine the inventory of items between the two stations **(4 marks)**

(iv) What is the average production rate **(3 mark)**

Question Four

a) The utility data for a network are given below. Determine the total free, independent and interfering floats and identify the critical path. **(10 marks)**

Activity	Duration
0-1	2
1-2	8
1-3	10
2-4	6
2-5	3
3-4	3
3-6	7
4-7	5
5-7	2
6-7	8

b) Consider the network shown below. The 3 line estimation for the activity are given along the arrows:

2 – 2- 8

(i) Determine the critical path **(4 marks)**

(ii) Find the probability that the project will be completed in 20 days **(6 marks)**

Question Five

a) Solve the following transportation problem where cell entries are unit cost:

	D1	D2	D3	D4	D5	Available
01	68	35	4	74	15	18
02	57	88	91	3	88	17
03	91	60	75	45	60	19
04	52	53	24	7	82	13
05	51	18	82	13	7	15
Required	16	18	20	14	14	82/82

(10 marks)

b) Four different jobs can be done on four machines. The set up and take down time cost are assumed to be prohitively high for charge over. The matrix below gives the cost in shs of producing hob I on machine j. How should the job be assigned to the various machines so that the total cost is minimized? Formulate also the Mathematical model for the problem **(10 marks)**

	M_1	M_2	M_3	M_4

J_1	5	7	11	6
J_2	8	5	9	6
J_3	4	7	10	7
J_4	10	4	8	3

Use the Hungarian method