TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Applied & Health Sciences

DEPARTMENT OF MATHEMATICS & PHYSICS

UNIVERSITY EXAMINATION FOR DEGREE OF:

BSSE

SMA 2472: OPERATIONS RESEARCH

SPECIAL/SUPPLEMENTARY EXAMINATION
SERIES: JUNE/JULY 2015
TIME ALLOWED: 2 HOURS

<u>**Instructions to Candidates:**</u>
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) Give the definition of operations research according to churchman. Ackoff and Arnoff **(2 marks)**

b) A person wants to decide on the constituents of a diet which will fulfill his daily requirements of proteins, facts and carbohydrates at the 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	Proteins	Fats	Carbohydrates	Cost per Unit
1	3	2	6	45
2	4	2	4	40
3	8	7	7	85
4	6	5	4	65
Min Requirement	800	200	700	

Formulate the linear programming model for the problem **(4 marks)**

c) Interpret the following final simplex tableau **(5 marks)**

	Cj	1	-	3	3	0	0	
C β	Basic	X_1	X_2	X_3	S_1	S_2	S_3	B
1	X_1	1	0	14/5	3/5	0	1/5	31/5
0	S_2	0	0	156/5	22/5	1	14/5	354/5
-3	X_2	0	1	32/5	4/5	0	3/5	58/5
	Zj	1	-3	-82/5	-9/5	0	-8/5	-143/5
	g-zj	0	0	97/5	-/5	0	8/5	

d) A self service store employs one cashier a the counter. Nine customers arrive on an average every 5 minutes while the cashiers can serve 10 customers in 5 minutes. Assuming poisson distribution for arrival rate and exponential distribution for serve time. Find:
   (i) Average number of customers in the system **(2 marks)**
   (ii) Average queue length **(3 marks)**
   (iii) Average time a customer spends in the queue **(2 marks)**

e) Consider the network shown below. The 3 times for activities are given along the arrows:
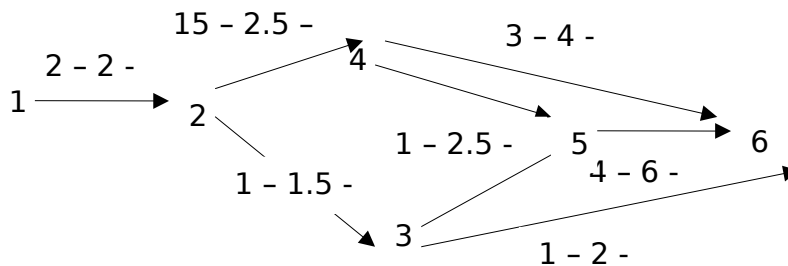
Find:
(i) The critical path **(3 marks)**
(ii) The probability that the project will be completed in 20 days **(4 marks)**

f) State any THREE limitations of simulation **(3 marks)**

g) Discuss briefly any TWO operating characteristics of queuing system **(2 marks)**

Question Two

a) Discuss the assumptions of linear programming **(6 marks)**

b) Use the simplex techniques to solve the following linear programming problem and interpret your results **(10 marks)**

$$2x_1 + 3x_2 + 2x_3 \, 440$$
$$4x_1 + 3x_3 \leq 470$$
$$2x_1 + 5x_2 \leq 430$$
$$x_1, x_2, x_3 \geq 0$$

c) State the assumptions of queuing model **(4 marks)**

Question Three

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

b) A company manufactures around 200 mopends depending upon the availability of raw materials and other conditions. The daily production has been varying from 196 mopends to 204 whose probability distribution is given below:

Production/Day	196	197	198	199	200	201	202	203	204
Probability	0.05	0.09	.12	.14	.20	.15	.11	.08	.06

The finished mopends are transported in a specially designed 3 storeyed lorry that can accommodate only 200 mopeds
Using the following random numbers 82, 89, 78, 24, 53, 61, 18, 45, 04, 23, 50, 77, 27, 54 and 10 simulate the process to find out.

    (i)   The average number of respect in the queue
    (ii) The number of empty spaces in lorry **(4 marks)**

c) On average 6 customers reach a telephone booth every hour to make calls. Determine the probability that exactly 4 customers will reach in 30 minute period assuming that service follows Poisson distribution **(4 marks)**

Question Four

a) Discuss the phases of operation research **(8 marks)**

b) Draw the network diagram for the following list of activities **(10 marks)**

Activity	Immediate Predecessor
A	-
B	A
C	B
D	C
E	D
F	E
G	E
H	C
I	G,F
J	GHI
K	J
L	K
M	K

N	K
O	D
P	O
Q	B
R	N
S	L, m
T	S
U	PQ
V	V

c) Express the following linear programming into canonical form:

$$z = 7x_1 + 5x_2$$

Maximize   subject to

$$2x_1 + 3x_2 \leq 20$$

$$3x_1 + x_2 \geq 10$$

$$x_1, \ x_2 \geq 0$$

(2 marks)

Question Five

A steel manufacturing company is concerned with the possibility of a strike. It will lose extra 20,000 to acquire an adequate stock pile if there is a strike and the company has not stock pile. Management estimate an additional expense of 60,000 an account of cost sales should the company stock pile or not if it is to use:

      (i) Optimistic criterion
      (ii) Wald criterion
      (iii)   Savage criterion
      (iv) Hurwi C3 criterion for x = 0.4
      (v) Laplace Criterion