TECHNICAL UNIVERSITY OF MOMBASA

A Centre of Excellence

Faculty of Applied & Health Sciences

DEPARTMENT OF MATHEMATICS AND PHYSICS

MAY 2016 SERIES EXAMINATION

UNIT CODE: SMA 2472 UNIT TITLE: OPERATIONAL RESEARCH

SPECIAL/SUPPLEMENTARY EXAMINATION

TIME ALLOWED: 2HOURS

INSTRUCTIONTO CANDIDATES:

You should have the following for this examination

- Mathematical tables
- Scientific Calculator

This paper consists of **FIVE** questions

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

Maximum marks for each part of a question are as shown

QUESTION ONE (30 MARKS)

a. Define the following terms as used in replacement problem

   i. Economic service life (1 marks)

   ii. The challenger (1 mark)

   iii. The defender (1 mark)

b. Find the optimal solution for the following transport problem.

	Requirements				
	1	2	3	4	supply
X	13	11	15	20	2
Y	17	14	12	13	6
Z	18	18	15	12	7
demand	3	3	4	6	

Where the cost is given in pounds $ (6 marks)

c. Posta corporation must make a rectangular steel box whose three dimensions have a sum of 120cm. what is the maximum volume of the box and what are its dimensions (5 marks)

d. Use graphical method to minimize the cost of transporting electrical poles if the linear programme is defined by

minimize cost $C = 12x + 20y$

subject to $4x + 6y \geq 48$

$3x + 9y \geq 45$

$14x + 7y \geq 84$

$x, y, \geq 0$ (8 marks)

e. A firm has developed a new product X. they can either test the market or abandon the project. The details are set out below. Test market cost $50000; likely outcomes are favorable (p=0.7) or failure (p=0.3). if favorable, they could either abandon or produce it when demand is anticipated to be.

Low	p=0.25	loss	$ 100 000
Medium	p=0.6	profit	$ 150 000
High	p=0.15	profit	$450 000

If the test market indicates failure the project would be abadondoned. Abandonment at any stage results in a gain of $30000 from the special machining used. Draw the decision tree showing the nodes and probabilities and evaluate the decision tree (8 marks)

QUESTION TWO (20 MKS)

a. Use simplex method to

maximize $p = 4x + 3y$

subject to $-x + y \leq 4$

$x + 2y \geq 14$

$2x + y \leq 16$

$x, y \geq 0$

b. Free laptops for schools requires Engineers to do the installations. Some four sampled schools are shown with four available Engineers. The distances to the schools are given in kilometers and an assignment to minimize mileage is required. Give the best assignment

Engineers	Schools where installation is to be done				
		Makau pry school	Chengo pry school	Cheruyot pry. School	Makokha pry school
	Ouma	25	18	23	14
	Kariuki	38	15	53	23
	Khadija	15	17	41	30
	leting	26	28	36	29

(6 marks)

c. The following data relate to a given stock item

Normal usage	1300 per day
Minimize usage	900 per day
Maximize usage	2000 per day
Lead time	15-20 DAYS
ROQ	30000

Calculate the various control levels hence state **two** advantages and **one** disadvantage of the periodic review system of inventory control (8 marks)

QUESTION THREE (20 MKS)

a. KPLC is considering investing in one of three investment opportunities A, B, C under uncertain conditions. The pay off matrix for the situation is given as below

Investment opportunity	1$	2$	3$
A	5000	7000	3000
B	-2000	10000	6000
C	4000	4000	4000

Determine the best investment opportunity using the following criteria

i. Maximin (2 marks)

ii. Maximax (1 marks)

iii. Minimax (2 marks)

iv. Hurwicz (alpha=0.3) (3 marks)

b. A wholesaler stocks an item for which demand is uncertain. He wishes to access two reordering policies i.e orders 10 units at a reorder level of 10, or order i5 units at a reorder level of 15 units, to see which is most economical over a 10 day period.
The following information is available

Demand per day (units)	probability
4	0.1
5	0.15
6	0.25
7	0.3
8	0.2

Carrying costs $15 per unit per day. Ordering costs $50 per order. Loss of goodwill for each unit out of stock $30. Lead time 3 days. Opening stock 17 units. The probability distribution is to be based on the following random numbers.

41	92	5	44	66	7	0	0	14	62
20	7	95	5	79	95	64	26	6	48

Noting that reorder level is level is physical stock plus any replishment orders outstanding
(6 marks)

c. Pole demand is 5000 units per year. Ordering costs are $100 per order and the basic unit price is $5 carrying costs are 20% p.a
Discounts are available thus:

1200-1399	less 10%
1400-1499	less 15%
1500 and over	less 20%

KPLC wishes to make the most economical order. Find the number of poles to order
(6 marks)

QUESTION FOUR (20 MARKS)

a. Find the time series analysis for α=0.1 and α =0.5 by the method of exponential smoothing for the data below (5 marks)

MON	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	JAN
SALES	450	440	460	410	380	400	370	360	410	450	470	490	460

b. Calculate the cost slopes and the critical path of the following network hence construct a least cost schedule for the network showing all the durations from normal time- normal cost to cash time –crash cost. (9 marks)

ACTIVITY	Preceding	time		Cost $	
	activity	normal	crash	Normal	crash
1	_	5	3	500	620
2	_	4	2	300	390

3	1	7	6	650	680
4	1	3	2	400	450
5	2,3	5	3	850	1000

c. Determine the optimum strategies and the value of the game from the following 2x5 pay off matrix game for x and y (6 marks)

Y

$$x\begin{pmatrix} 6 & 3 & -1 & 0 & -3 \\ 3 & 2 & -4 & 2 & -1 \end{pmatrix}$$

QUESTION FIVE (20 MARKS)

a. Briefly explain the Monte- Carlo techniques (4 marks)

b. MRM Ltd made the following estimates for a component they use;

Annual usage 1125

Ordering costs ksh 50 per order

Carrying costs per year ksh 5 per component.

based on these estimate, an EOQ of 150 and expected total stock costs of 750 were calculated as follows.

$$EOQ = \frac{\sqrt{2x50x1125}}{5} = 150$$

Expected total stock costs=ordering cost p.a + Holding cost p.a

$$= \left(\frac{1125}{150}\right)50 + \frac{5x150}{2} = 750$$

During the year the EOQ of 150 was used for reordering but the actual usage of components turned to be 20% higher at 1350.

i. Calculate the actual total stock costs (2 marks)

ii. Calculate what the total stock costs would be if a current EOQ was used (2 marks)

iii. Find out how sensitive total total costs are to errors in the usage estimates. (2 marks)

c. Draw an activity on node diagram for the following project hence calculate the EST/LST and LFT values for each box (10 marks)

Activity	Preceding activity	Duration(days)
1	-	4
2	1	7
3	1	5
4	1	6
5	2	2
6	3	3
7	5	5

8	2,6	11
9	7,8	7
10	3	4
11	4	3
12	9,10,11	4

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