THE MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

(A Constituent College of JKUAT)

Faculty of Applied & Health Sciences

DEPARTMENT OF MATHEMATICS & PHYSICS

UNIVERSITY EXAMINATION FOR BACHELOR OF SCIENCE IN ELECTRICAL
& ELECTRONICS ENGINEERING

SMA 2472: OPERATIONS RESEARCH

SPECIAL/SUPPLEMENTARY EXAMINATION
SERIES: FEBRUARY/MARCH 2012
TIME: 2HOURS

Instructions to Candidates:
You should have the following for this examination
  - *Answer booklet*
This paper consists of **FIVE** questions
Answer Question **ONE** (**Compulsory**) from **SECTION A** and any other **TWO** questions from **SECTION B**
Maximum marks for each part of a question are clearly shown
This paper consists of **FOUR** printed pages

SECTION A (Compulsory)

a) State any **FOUR** purposes of an inventory. (4 marks)

b) A computer company purchases 5000 hard drivers per year for use cost in its computers. Each order costs Kshs. 70. The inventory holding cost is 25% of the unit price. The supplier has provided the following price list.

Order quantity	Price per unit (p)
1 – 49	50
150 – 249	45
250 and above	42.50

Assuming instantaneous delivery find:

(i)   Optimal order delivery

(ii)   Optimal total annual cost   (4 marks)

c) A small manufacturing firm produces two types of gargets A and B which are first processed in a foundary then sent to machine shop for finishing. The number of man-hours required in each shop for the production of each unit of A and B and the number of man-hours the firm has available per week are as tabulated below.

	Foundry	Machine shop
Gadget A	10	5
Gadget B	6	4
Firms capacity per week	100	600

The profile on the sale of A is shs.30 per unit as compared with shs.20 per unit for B. How many of each type A and B should be produced per week in order to maximize the profit, solve graphically.
(10 marks)

d) Suppose a grocer is faced with a problem of how many fruits to stock to meet the next day's demand. All fruits left at the end of the day are worthless (over ripe). Each fruit is sold at shs. 8 and is purchased for shs. 5 hence each fruit sold bring a profit of shs 3 but if not sold at the end of the day then it must be discarded resulting in a loss of shs. 5. The historical record of the fruits demanded is as follows:

Number of fruits demanded	No. of days requisted	Probability of event
0-12	0	0.00
13	5	0.05
14	10	0.10
15	20	0.20
16	30	0.30
17	25	0.25
18	10	0.10
Over 18	0	0.00
Total	100	1.00

What should be the optimal decision of the grocer and how much does the grocer expect on the best day.

SECTION B (Attempt any TWO questions)

Question TWO (20 marks)

a) Explain what the following terms mean in network analysis
      (i)   Dummy activity   (1 mark)
      (ii)   Activity floats   (1 mark)
      (iii)   Total float   (1 mark)
      (iv)   Event   (1 mark)

b) Suppose that the weekly demand of electric devices has the following probability distribution

Number demanded	Probability	Random numbers assigned
0	0.10	00 to 09
1	0.40	10 to 49
2	0.30	50 to 79
3	0.20	80 to 99
Total	1.00	

Distribution delivery times pattern of was as follows:

2	0.20	00 to 19
3	0.60	20 to 79
4	0.20	80 to 99
Total	1.00	

Inventory carrying cost is kshs 5 per unit/week, order placing is kshs 10 per occurrence and loss in net revenue (sale price less cost of goods) is kshs 50 per unit for shortage.

Estimate average weekly cost of the inventory system, with a policy of using reorder quantities of 4 and reorder points of 5 units. Using the technique of Monte carlo simulation for 20 weeks period taking 8 units as the opening balance of inventory advice   (12 marks)

c) Using decision theory advise a businessman who wants to decide whether to stock commodity X or Y from rival companies, he can stock neither but not both. If he stocks X and if it is a success, he feels that he can make kshs 2000 but it it fails he losses kshs 5000. If one stocks Y and succeeds he makes kshs 4000 but if it fails you lose kshs 3000. Which commodity should he stock if one has the following probability distribution in view?

Probability of	Stock of commodity X	Stock of Commodity Y
Success	0.80	0.60
Failure	0.20	0.40

Question THREE (20 marks)

a) Briefly state any FIVE steps generally that one is involved in during applications of operations research methods.   (5 marks)

b) A distributor of sports equipment has been using EOQ policies for its order items. The carrying cost for one of its item has been 20% of its cost and the corresponding WOQ = 100. If the carrying increases to 30% of its cost, find the new EOQ.   (5 marks)

c) If a chemical manufacturer uses two chemicals A and B in varying proportion to produce 3 products P1, P2 and P3. The manufacturer has an order to supply 150 units of P1, 200 units of P2 and 60 units of P3. Each tone of chemical A produces 3 units of P1, 5 units of P2 and units of P3. While I tonne of B produces 5 units of P1, 5 units of P2 and 1 unit of P3. The cost of chemical A and B per tone is Ksh 400 and Ksh 500 respectively. Determine by simplex method the tones of A and B to be purchases in order to minimize to cost and also meet production targets.
                    (10 marks)

Question FOUR (20 marks)

Consider a project with the following data.

DATA	Time (Wks)			COST K£	
Activity	Proceeded by	Normal T	Crash T	Normal Cost	Crash cost
A	-	6	3	10000	14000
B	-	4	3	5000	8000
C	A	3	2	4000	5000
D	B	8	6	9000	12000
E	C	7	4	7000	8000

There is a site overhead cost of Kshs. 900 per week.

    (i)   Determine the projects normal time, critical path and the TC in normal time   (5 marks)

    (ii)   Determine the shortest possible duration of the project and its associated total cost

        (6 marks)

    (iii)   Perform time-cost analysis on the crashing process   (6 marks)

    (iv)   Represent the TC, time and duration on a graph   (3 marks)

Question FIVE (20 marks)

a) At a certain petrol pump customers arrive in a poison process with an average time of 5 minutes between arrivals. The time intervals between services at the pump follow exponential distribution and as such as mean time taken to service a unit is 2 minutes on the basis of this information.

    (i)   What would be the expected average queue length?   (2 marks)

    (ii)   What would be the average number of customers in the queuing system?   (1 mark)

    (iii)   How long on an average a customer waits in the queue?   (2 marks)

    (iv)   How much time average does a customer wait spend in the system   (2 marks)

    (v)   By how much should the flow of customers be increased to justify the opening of a second service point, if the management is willing to open provided customers wait for 5 minutes for service   (2 marks)

b) The Royal food store has an annual demand of 10,000 cases of food. A case of food cost the store shs. 5. The ordering cost is shs 25 per order. The carrying/holding cost is 20% of the cost of case of food. Determine:

    (i)   EOQ   (3 marks)

    (ii)   The number of orders per year   (2 marks)

    (iii)   Annual total cost   (2 marks)

$$x_0 = 2x_1 + 5x_2$$

c) Given a linear programming problem maximize   , subject to

    $3x_1 + 2x \leq 6$

    $2x_1 + 9x_2 \leq 8$

    $x_1 \geq 0, x_2$

        Unconstrained. Obtain the corresponding canonical form.   (4 marks)