TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Applied & Health Sciences

DEPARTMENT OF MATHEMATICS & PHYSICS

UNIVERSITY EXAMINATION FOR THE
**BACHELOR OF SCIENCE IN ELECTRICAL & ELECTRONIC/CIVIL
ENGINEERING**

SMA 2472: OPERATIONS RESEARCH

SPECIAL/SUPPLEMENTARY EXAMINATION
SERIES: OCTOBER 2013
TIME: 2 HOURS

<u>**Instructions to Candidates:**</u>
You should have the following for this examination
- *Answer Booklet*

This paper consist of **FIVE** questions in **TWO** sections **A** & **B**
Answer question **ONE (COMPULSORY)** and any other **TWO** questions
Maximum marks for each part of a question are as shown
This paper consists of **THREE** printed pages

SECTION A (COMPULSORY)

Question One

a) Define the following terms:
   (i)   Operations research
   (ii)   Inventory
   (iii) Linear programming   **(3 marks)**

b) The pay off table below shows two states of nature S1 and S2 with probabilities 0.6 and 0.4 respectively and the alternative strategies A1 and A2.

	S1	S

	1	
A1	30	35
A2	20	30

Which strategy should the decision maker choose? (Show your working)   **(3 marks)**

c) A machine owner finds from his past records that the costs per year of maintaining a machine whose purchase price is $6,000 are as given below:

Year	1	2	3	4	5	6	7	8
Maintenance cost	1000	1200	1400	1800	2300	2800	3400	4000
Resale price	3000	1500	750	375	200	200	200	200

When is the machine due for replacement?   **(6 marks)**

d) A tourist car operator finds that during the past few months, the car's use has varied so much that the cost of maintaining it varied considerably. During the past 200 days the demand for the car fluctuated as follows:

Trips	0	1	2	3	4	5
Frequency	16	24	30	60	40	30

Monte-Carlo's simulation technique to simulate the average demand for a 10 week period.

(5 marks)

e) Use the simplex method to maximize:
$$z = x_1 + 4x_2$$
subject ot
$$x_1 + 2x_2 \le 8,000$$
$$6x_1 + 4x_2 \le 18,000$$
$$x_1, x_2 \ge 0$$

(6 marks)

f) At what average rate must a clerk at a supermarket work in order to insure a probability of 0.90 that customers will have to wait longer than 12 minutes? (It is assumed that there is only counter to which customers arrive in a poisson fashion at an average rate of 15 per hour. The length of service by the clerk has an exponential distribution)   **(7 marks)**

SECTION B (Answer any TWO questions from this section)

Question Two

(α) (β) (γ)

A plastic manufacturer can utilize 3 raw materials for only poly   , Gimp   and max   in varying proportions to produce three products A, B and C. (Using any one of the three, the three products can be manufactured) The firm wishes to produce at least 200 units of A, 300 units of B and 80 units of C. 1 kg

of α yields 4 units of A, 3 of B and 2 of C. 1 kg of β yields 5 units of A, 6 units of B and 1 unit of C while 1 kg of γ yields 1 unit of A, 3 units of B and 1 unit of C. If poly costs shs 20 per kg,

    a) Define the decision variables. **(3 marks)**
    b) Gimp shs 30 per kg and mas shs 50 per kg, find out:
        (i) The minimization function **(1 mark)**
        (ii) The constraints inequalities. **(3 marks)**

    c) Convert the problem into a maximization model **(4 marks)**
    d) Solve the problem **(11 marks)**

Question Three

a) The following table shows the jobs of a network along with their time estimates:

Job	$1 - 2$	$1 - 6$	$2 - 3$	$2 - 4$	$3 - 5$	$4 - 5$	$6 - 7$	$5 - 8$	$7 - 8$
To	1	2	2	3	7	5	5	3	8
Tm	7	5	14	5	10	5	8	3	17
Top	13	14	26	8	19	17	29	9	32

    (i) Draw the project network **(4 marks)**
    (ii) Calculate the total float **(9 marks)**
    (iii) Determine the critical path **(2 marks)**
    (iv) Compute the project length variance **(1 mark)**
    (v) Calculate the probability that the project is completed in 40 days **(4 marks)**

Question Four

a) The annual demand of an item is 3200 units. The unit cost is ksh 6 and inventory carrying charges 25% per annum. If the cost of one procurement is ksh 150, determine the:
    (i) Optimum lot size **(3 marks)**
    (ii) Number of orders per year **(2 marks)**
    (iii) Time between consecutive orders **(2 marks)**
    (iv) Optimal cost **(3 marks)**

b) A small ink manufacturer produces a certain type of ink at a total average cost of ksh 3 per bottle and sells it at a price of ksh 5 per bottle. The ink is produced over the weekend and is sold during the following week. According to past experience the weekly demand has never been less than 78 or greater than 80 bottles in his place:
    (i) Define the alternative courses of action **(1 mark)**
    (ii) Define the different states of nature **(1 mark)**
    (iii) Formulate the pay off table **(8 marks)**

Question Five

a) Suppose that the sales of a particular item per day is Poisson with mean 5
    (i) Prepare a probability distribution table **(9 marks)**
    (ii) Generate 20 days of sales by Monte Carlo method, working to two decimal places. **(3 marks)**

(iii) Find the average sales over the 20 days **(2 marks)**

b) A truck owner finds form his past records that the maintenance cost per year of a truck whose purchase price is 8 million are as given below:

Year	1	2	3	4	5	6	7	8
Maintenance cost (ksh) x 1000	1000	1300	17000	2200	2900	3800	4800	6000
Resale price (ksh x 1000)	4000	2000	1200	600	500	400	400	400

Determine the time at which it is profitable to replace the truck **(6 marks)**