

MOMBASA POLYTECHNIC UNIVERSITY COLLEGE

DEPARTMENT OF MATHEMATICS AND PHYSICS

FOURTH YEAR SECOND SEMESTER EXAMINATION FOR THE DEGREE OF
BACHELOR OF SCIENCE IN ELECTRICAL AND ELECTRONICS ENGINEERING.

SMA 2472: OPERATIONS RESEARCH

DECEMBER : 2011

TIME: 2 HOURS

INSTRUCTIONS. Attempt Question One and any other Two Questions.

Question ONE (30 marks) compulsory.

a) Explain any four limitations of operations research. (4 marks)

b) Write the following linear programming problem in standard form, maximize

$$x_0 = 3x_1 + 2x_2 + 5x_3 \quad x_1 + 2x_2 + x_3 \leq 430$$

subject to

$$3x_1 + 2x_3 \leq 460$$

$$x_1 + 4x_2 \leq 420$$

hence using simplex method find the optimal solution. (6 marks)

c) A bicycle shop estimates the annual demand for its Hero brand of bicycles to be 384. The hold cost per bicycle is ksh 20 per year. The ordering cost is ksh 60 per product.

Determine (i) E.O.Q (3 marks)

(ii) The annual holding and ordering casts (2 marks)

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

d) Coastal electrical development ltd (ced) has identified the following activities / tasks in the regions electricity projects ced has also established the precedent relationship and duration of this activities. This information is in the following table.

Activity	A	B	C	D	E	F	G	H	I	J	K
Immediately preceded by	-	-	-	A	A	B,G	A,C	A,C	D	E,F,H	E,F,H
Duration (days)	8	5	3	5	6	6	3	10	8	12	11

i) Draw the network diagram for these projects. (5 marks)

- ii) Identify the critical path for these projects. (2 marks)
- iii) Find the duration to complete all the projects. (2 marks)
- e) An organization buys 400 units of an item in a year at a purchase cost of shs 5000 per unit and an ordering cost of shs 2000 per order placed, the carrying cost has been determined to be 20% of the cost of average stock. The organization has received a 2% discount offer for purchases of 100 or more units required. Determine the best inventory policy for the item. (4 marks)

Question TWO (20 marks)

- a) Explain what the following terms mean in network analysis.
- i) Project (1 mark)
 - ii) Activity (1 mark)
 - iii) Free float (1 mark)
 - iv) Independent float (1 mark)
 - v) Critical path (1 mark)

b) Using the simplex method find the optimal basic feasible solution and hence the optimal value of x_0 for a linear programming problem to, maximize

$$x_0 = 3x_1 + 5x_2 - 2x_3$$

$$x_1 + 2x_2 + 2x_3 \leq 10, \quad 2x_1 + 4x_2 + 3x_3 \leq 15 \quad x_1 \geq 0 \quad x_2 \geq 0 \quad x_3 \geq 0$$

subject to and , , . (6 marks)

c) Bandari development co. ltd is using network planning for one of their building project; the network consists of 10 activities A to J whose duration depends on the number of craftsmen available. Those required for each activity are given in the table below.

Activity	Preceded by	Duration in weeks	No. of craftsmen
A	-	6	0
B	-	8	3
C	-	9	0
D	A	5	1
E	A,B	4	0
F	C,E	3	2
G	C,E	2	1
H	C	4	1
I	D,F,G	7	1
J	H	3	1

- i) Draw the network for the project and determine the critical path. (5 marks)
- ii) Given that 3 craftsmen only are available thought the project, schedule the activities so that the earliest project completion date is achieved. (Splitting of activities is allowed) (4 marks)

Question THREE (20 marks)

a) Briefly explain any five roles of Operations research in business and industries. (5 marks)

b) Jericho Ltd manufactures B2b on a special lathe for use in a continuous assembly. The assemblies that use B2b are manufactured at a lower rate, this allows time for doing odd jobs on the special lathe when it is not being used for B2b parts. When parts are being run deliveries are made to the assembly area, otherwise the assembly department draws parts from the inventory. The following data is given for B2b parts:

production rate = 4000 pieces a day.

Assembly requirement = 2000 pieces a day.

Inventory holding cost = kshs 20 per unit per year

Unit variable production cost =kshs 2000

Set up cost = kshs 110,000 per set up

Acquisition lead time = 10 working days (1 year = 250 working days)

i) calculate the production EBQ. (2 marks)

ii) determine the length of a production run (1 mark)

iii) determine the length of break between production runs. (2 marks)

iv) what is the TC associated with the inventory policy formulated in i), ii) and iii) above. (2 marks)

v) determine assembly departments reorder level. (1 mark)

vi) suppose it turns out that actual holding cost is kshs 16 per unit/ year and set up cost is kshs 180,000 per set up and yet the policy above is implemented for one year. Determine the cost of prediction error. (3 marks)

c) Determine the range of optimality, $\frac{c_1}{c_2}$ for a maximization function $z = 5x_1 + 4x_2$ with a solution at the intersecting point of $6x_1 + 4x_2 \leq 24$, and $x_1 + 2x_2 \leq 6$. (4 marks)

Question FOUR (20 marks)

a) Explain what the following phrases mean in operations research;

i) Non degenerate solution.

ii) Feasible solution.

iii) Constrains

iv) Slack variables (4 marks)

b) A paint manufacturer produces both interior and exterior paints from two raw materials, M and N. the following table provides the basic data of the company.

	Tons of raw material per ton of paint		
	Exterior paints.	Interior paints	maximum daily
Row material for M	6	4	24
Row material for N	1	2	6
Profit per ton (M ksh)	5	4	

A market survey restricts the maximum daily demand of interior paints to 2 tons, the daily demand for interior paint cannot exceed that of exterior paint by more than 1 ton. The manufacturer wants to determine the optimum product mix, by graphical method maximize the total daily profit. (7 marks)

c) Using the Queuing theory advice a company that as a certain type of machines breaking down at an average rate of 5 times a month. The breakdowns are in accordance of poisson's process. Cost of idle machine hour comes to kshs 150 per hour. Two repairmen V and W have been interviewed: V charges kshs 80 per hour and services broken down machines at the rate of 7 per month whereas W charges kshs 100 per hour and services the same at a rate of 9 per month, which repairman's services should be hired and why. (9 marks)

Question FIVE (20 marks)

a) The manager of an oil refinery must decide on the optimal mix of 2 possible blending process of which the inputs and outputs per production run are as follows

	in		out	
Process	Crude A	Crude B	Gasoline X	Gasoline Y
1	5	3	5	8
2	4	5	4	4

The maximum amount available of crude A and B are 200 units and 150 units respectively. Market requirements show that at least 100 units of gasoline X and 80 units of Y must be produced. The profit per production run from process 1 and 2 are 3 and 4 Mkshs respectively. Form a linear optimization model and use the graphical method to determine the maximum profit in Mkshs. (10 marks)

b) Given the following information

- Arrival and services follow poisson process.
- Customers arrive at a rate of 8 per hour.
- Service rate is 10 customers per hour.
- i) What is the average time of customers waiting for service? (2 Marks)
- ii) What is the average time for a customer must wait in the queue? (2 Marks)
- iii) What is the average time for a customer to be in the system? (1 Mark)

c) A certain production produces on average 7 % defective items, and they occur randomly. Items are packaged for sale in lots of five. The production manager wants to know what percentage of the lots contains no defectives, using the Monte Carlo simulation advice. (Stimulate at least 10 lots of 5 item using 2 digit tables) (5 marks)

