MASENO UNIVERSITY

UNIVERSITY EXAMINATIONS 2015/2016

FOURTH YEAR FIRST SEMESTER EXAMINATION FOR THE DEGREE OF BACHELOR OF ARTS ECONOMICS WITH INFORMATION TECHNOLOGY

MAIN CAMPUS

AEC 409: OPERATIONS ANALYSIS I

Date: 8th January, 2016 Time: 8.30 - 10.30am

INSTRUCTIONS:

- Answer Question ONE and any other TWO Questions.

Q1. a) Kiboko group of companies has a sponsored a diet regime for a group of vulnerable children in Kamundu village. The nutritionist has adviced them that to maintain good health children must fulfil certain minimum daily requirements for several kind of nutrients. Suppose, that only three kinds of the nutrients are considered: Calcium, protein and vitamin A. Assume that the person diet is to consist of only two food items, I and II, whose price and nutrient contents are shown in the table below.

Table 1: Price and Nutrients Contents of Food

	Food I (per Kg)	Food II (per Kg)	
Price	Ksh. 0.60	Ksh. 1.00	Minimum Daily Requirement
Calcium	10	4	20
Protein	5	5	20
Vitamin A	2	6	12

Using the data on the table.

i) Formulate a nutrient minimization problem for the Kiboko Nutrition Programme. problem. [6 Marks]

ii) Compute the optimal feasible solution for the problem. [6 Marks]

iii) Describe three general formulations of linear programs. [6 Marks]

b) Given the following production problem with profit function and production constraints.

Maximize $\pi = 40x_1 + 30x_2$

Subject to

$x_1 \leq 16$ [Cutting Constraint]

$x_2 \leq 8$ [Mixing Constraint]

$x_1 + 2x_2 \leq 24$ [Packaging Constraint]

$x_1, x_2 \geq 0$

i) Formulate an extended problem with slacks. [6 Marks]

ii) Given the following output spaces for x_1, x_2 (0,0), (16,0), (16,4), (8,8) and (0,8) find out the solution spaces $(x_1, x_2, s_1, s_2, s_3)$ [6 Marks]

Q2. Consider the following linear program

$$\text{Maximize } \pi = 6x_1 + 2x_2 + 5x_3$$

Subject to
$$\begin{bmatrix} 2 & 3 & 1 \\ 1 & 0 & 2 \\ 1 & 2 & 5 \end{bmatrix} \leq \begin{bmatrix} 10 \\ 8 \\ 19 \end{bmatrix}$$

and $x_1, x_2, x_3 \geq 0$

i) Derive the best feasible solution using simplex method. [10 Marks]

ii) Using pivot method derive the best feasible solution that improves the profits in (i) above. [7 Marks]

iii) Highlight factors to be considered when setting up a pivot element. [3 Marks]

Q3. Describe duality theorems I and II . Using an example show that when $\bar{y}_i > 0 \Rightarrow \bar{s}_i = 0$; $\bar{x}_j > 0 \Rightarrow \bar{t}_j = 0$ and $\bar{s}_i > 0 \Rightarrow \bar{y}_i = 0$; $\bar{t}_j > 0 \Rightarrow \bar{x}_j = 0$ [20 Marks]

Q4. a) Discuss the basics of the following theorems.

i) Kuhn-Tucker Sufficiency Theorem [3 Marks]

ii) Arrow-Enthoven Sufficiency Theorem [3 Marks]

b) In normal analysis of the firm we tend to focus on profit maximization. But sales maximization becomes relevant when ownership and management of the firm are separate. Total revenue obtained is used as an indicator of market share and the manager is assumed successful if sales revenue goes up. This makes it necessary to consider sales maximization as an alternative to profit maximization where the profit level does not fall below a certain prescribed minimum say π_0, which is below the maximum profit associated with the MR=MC condition. If that is the case the management problem is to maximize $R = R(Q)$, subject to $\pi = R(Q) - C(Q) \geq \pi_0$ [10 Marks]

i) Set up the sales revenue maximization problem. [3 Marks]

ii) Form a Lagrangian function and set up Kuhn-Tucker conditions.