# MASENO UNIVERSITY

## UNIVERSITY EXAMINATIONS 2016/2017

FOURTH YEAR FIRST SEMESTER EXAMINATION FOR DEGREE OF BACHELOR OF SCIENCE (MATHEMATICS AND ECONOMICS & BACHELOR OF ARTS (ECONOMICS) WITH INFORMATION TECHNOLOGY

## MAIN & CITY CAMPUSES

## AEC 409: OPERATIONS ANALYSIS I

Date: 30th November, 2016

Time: 8.30 - 11.30am

INSTRUCTIONS:
- Answer Question ONE and any other TWO

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ISO 9001:2008 CERTIFIED

Q1. a) Easy Go Coaches is a leading bus company which produces two services luxury and executive rides. They have three departments ticketing, passenger loading and luggage loading. The equipment in each department can be usedfor 8 hrs per day. The process of producing the services can be summarized as follows: i) Product I (luxury service) the passengers areticketed and luggage loaded in the buses. For every 1 bus the company uses 1/2 hr of ticketing capacity and 1/3 hrof luggage loading capacity. For product II (Executive service) the passengers are first loaded in the bus and then theirluggage loaded in the bus. Each bus of executive service uses 1hr of passenger loading capacity and 2/3 of luggage loading capacity. Finally, products 1 and 2 can be sold at prices Ksh. 8,000 and Ksh. 6,000 per bus respectively, but after deducting variable cost incurred, they yield on a net basis of Ksh. 4000 and Ksh. 3000 per ton. The problem is what output combination should the Easy Go Coached choose in order to maximize the total profit?

i) Set up the linear program problem for Easy Go Coaches.    [2 Marks]

ii) Compute the basic feasible solutions for the problem.    [ 6 Marks]

b) Suppose the Board of Directors have realised that most of their bus seats in both executive and luxury services are not filled most of the time.

i)    Set up the transformed linear program problem.    [2 Marks]

ii)    Construct the simplex tableau and find asolution for the condition Product I and Product II production are zero.    [3 Marks]

iii)    Suppose now the managers want to improve on the profits. Use the pivot method to exhaust possibilities for further profits using product I and II as the basis of your argument.    [8 Marks]

Q2. Consider the following linear program

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

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

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 whensetting upa pivot element.   [3 Marks]

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

Q4. a) Discuss the basicsof 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 marketshare and the manager isassumed successfulif 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 $\pi_0$, 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) From a Lagrangian function and set up Kuhn-Tucker conditions.

                                          [3 Marks]

iii) Show the sales maximizing output rule.     [3 Marks]

b) Suppose now the firm have revenue and cost functions.

$$R = 32Q - Q^2 \text{ and } C = Q^2 + 8Q + 4 \text{ and Let } \pi_0 = 18$$

Derive the marginalelements usingKuhn-Tucker conditions.   [ 5 Marks]

Q5. a) Describe three key models of info-gap theory      [6 Marks]

    b) Use resource allocation example to discuss the following tenets of info gap decision theory,

      i) Robustness      [7 Marks]

      ii) Opportuness      [7 Marks]