# MAASAI MARA UNIVERSITY

## REGULAR UNIVERSITY EXAMINATIONS
## 2018/2019 ACADEMIC YEAR

## SCHOOL OF BUSINESS AND ECONOMICS
## BACHELOR OF ARTS IN ECONOMICS
## THIRD YEAR SECOND SEMESTER

## COURSE CODE: ECO 3107
## COURSE TITLE: OPERATIONS RESEARCH

**DATE: 16. 4. 2019** **TIME: 8.30AM – 10.30AM**

**INSTRUCTIONS TO CANDIDATES**

Answer Question **ONE** and any other **THREE** questions

**QUESTION ONE** **(25 MARKS)**

Clearly defining your variables and coefficients, develop a general formulation of **a**)linear programming problem using the summation approach **(5marks)**

**b**)A toy manufacturing company uses three types of machines in the manufacture ofthree types of children toys. Toy 1 requires 4 hours on machine A, one hour on machine B and three hours on machine C

Toy 2 requires six hours on machine A one and half hours on machine B and onehour on machine C
Toy 3 requires three hours on machine A three hours on machine B,
There is an excess of 24 hours of machine A time 12 hours of machine B time and 12hours machine C time. Toy one produces Ksh. 0.50 profit per unit, toy two producesKsh. 6.00 profit per unit and toy three produces Ksh. 5.00 profit per unit.
Required:
Formulate the linear programming model. **( 5marks)**

**c**)Given a linear programming problem as below:

Maximize $Z=20x_1 + 10x_2$Subject to

$$x_{1+} 2x_2 \leq 40$$

$3x_1+ x_2 \leq 30$
$4x_1+ 3x_2 \leq 60$
$x_{1,}x_2 \geq 0$
Using the graphical approach, determine

**i**) The feasible solution region **(2 marks)**

**ii**) The optimal solution **(3 marks)**

**d**)Given

Minimize$Z=3x_1 + 2x_2 + 5x_3$
Subject to $x_1 + 2x_2 + x_3 \leq 430$
$3x_1 + 2x_3 \leq 460$
$x_1 + 4x_2 + x_3 \leq 420$
$x_{1,}x_2, x_3 \geq 0$
Using the simplex method of LPP determine the optimal solution to this problem.

**(10 marks)**

**QUESTION TWO(15MARKS)**

**a**)Clearly defining your variables and coefficients, develop a tabular formulation of a general transportation problem. **(5 marks)**

**b**)A firm has two factories 1 and 2 and three retail stores A, B and C. the number of units available at factories 1 and 2 are 20 and 300 respectively and the demand at retail store are 100, 150 and 250 respectively. Rather than shipping directly from sources to destinations it is decided to investigate the possibility of trans-shipment. Given the transportation costs in Kenya shillings per unit for each movement as per the four diagrams below;

| **FACTORY** | **RETAIL STORES** | | |
|---|---|---|---|
| | A | B | C |
| 1 | 7 | 8 | 9 |
| 2 | 5 | 4 | 3 |

| **FROM FACTORY** | **TO FACTORY** | |
|---|---|---|
| | 1 | 2 |
| 1 | 0 | 6 |
| 2 | 6 | 0 |

| **RETAIL STORE** | **RETAIL STORES** | | |
|---|---|---|---|
| | A | B | C |
| A | 1 | 5 | 1 |
| B | 1 | 0 | 4 |
| C | 7 | 6 | 0 |

| **FROM RETAIL STORE** | **TO FACTORY** | |
|---|---|---|
| | 1 | 2 |
| A | 7 | 2 |
| B | 1 | 5 |
| C | 8 | 9 |

Find the optimal shipping schedule for the trans-shipment (**10Marks)**

**QUESTION THREE(15 marks)**

**a**) Given an LP relaxation problem as follows.

Max $z = 8x_1 + 6x_2 + 7x_3 + 50x_4 + 2x_5$

Subject to $3x_1 + 2x_2 + 7x_4 + 3x_5 \leq 100$

$4x_1 + 5x_2 + 6x_4 + 8x_5 + 4x_5 \leq 250$

$2x_1 + 3x_2 + 4x_3 + x_4 + x_5 \leq 60$

$X_j \geq 0$

J = 1,2,3,4,5

Required: determine

**i**)Pure integer programming problem **(2 marks)**

**ii**)Mixed IPP **(2 marks)**

**iii**)Zero – one problem IPP **(2 marks)**

**b**)Given the following

Max $z = 8x_2 + x_2$

Subject to $x_1 + 3x_{2\leq} 9$

$9x_1 + 7x_{2\leq} 56$

$X_1, X_2 \geq 0$

$X_1, X_2$ integer

Required:

**i**) using brute force approach determine the optional solution to the integer programming problem **(6marks)**

**ii**)determine the cost of indivisibility **(3 marks)**

**QUESTION FOUR** **(15 MARKS)**

A four- ton vessel is loaded with one or more of three items (item I = 1,2,3) with unit weight of each item (wi) in tons and the unit revenue (Ri) in thousands of Kenya shillings as per the table below

| **Item (i)** | **Weight (wi)** | **Revenue (Ri)** |
|---|---|---|
| 1 | 3 | 70 |
| 2 | 1 | 20 |
| 3 | 2 | 40 |

Determine how the vessel should be loaded to minimize revenue **(15 marks)**

**QUESTION FIVE (15 MARKS)**

**a)** With the help of well labeled diagram and clearly defining your variables, develop an inventory production (continuous replenishment) Model with uniform demand and utilization rate and where production rate is greater than utilization rate **(10Marks)**

**b)** Given company X that produces product Y, the company produces the required materials for product Y internally, call it material Z. The annual production rate and utilization rate of Z is 200,000 and 150,000units respectively. The company ordering cost per order and holding cost per unit is Ksh.100 and Ksh.200 respectively.

Determine the economic order quantity if it is given that the company works 250 days annually and production and consumption rates of material Z are uniform throughout all the working days. **(5 Marks)**

**//END**