NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY

DEPARTMENT OF INDUSTRIAL AND MANUFACTURING ENGINEERING

OPERATIONS RESEARCH

TIE 6130

First Semester Supplementary Examination Paper

August 2015

This examination paper consists of 8 pages

Time Allowed: 3 hours

Total Marks: 100

Special Requirements:

Examiner's Name: Eng. William M. Goriwondo and Mr Nicholas Tayisepi

INSTRUCTIONS

1. Answer two (2) Questions from each Section. There are two sections.
2. Each question carries 25 marks
3. Use of calculators is permissible

MARK ALLOCATION

QUESTION	MARKS
1.	**25**
2.	**25**
3.	**25**
4.	**25**
5.	**25**
6.	**25**
TOTAL (Choose 2 questions from each section)	**100**

SECTION A

Question 1

a) Explain the Operations Research Techniques that you would use for the following application

i) Customer Segmentation [3]

ii) Fraud Prevention [3]

iii) Traffic Flow Optimisation [3]

iv) Resource Allocation [3]

b) A freight plane has three large compartments to carry cargo. Weight and volume limitations of these compartments are shown in Table Qu. 1a below :

Table Qu. 1a : Weight and Volume limitations

Compartment	**Weight (Tons)**	**Volume (m^3)**
Front	10	6800
Centre	16	8700
Rear	8	5300

There are four (4) cargoes waiting to be loaded in this plane. Properties of these cargoes are shown in Table Qu. 1b below.

Table Qu. 1b : Properties of Cargoes

Cargo	**Total Weight (Tons)**	**Total Volume (m3)**	**Profit (TL/ton)**
K1	18	8640	310
K2	15	9750	380
K3	23	13340	350
K4	12	4680	285

Furthermore, the weight of the cargo in the respective compartments must be the same proportion of that compartment's weight capacity to maintain the balance of the plane. Any proportion of these cargoes can be accepted.

i) Formulate a linear programming model to maximize the profit by choosing how many tons of which cargo to load on the plane under these circumstances. [8]

ii) Draw the Initial Simplex Tableau only and explain what it means. [5]

Question 2

(a) Explain how the transportation algorithm can be modified for profit maximization rather that the minimization of costs. [5]

(b) A company manufactures one product which is currently in short supply. The company's four (4) outlets A, B, C and D, already have requirements which in total exceed the combined capacity of its three production plants at X, Y and Z. The company needs to know how to allocate its production capacity to maximize profit. Distribution costs per unit from each production plant to each shop are given in Table Qu. 2 below.

Table Qu.2 : Distribution costs per unit

To **From**	**A**	**B**	**C**	**D**
X	22	24	22	30
Y	24	20	18	28
Z	26	20	26	24

Since the 4 shops are in different parts of the country, and as there are differing transportation costs between the production plants and the shops, along with slightly different production costs at each of the production plants, there is a pricing structure that enables different prices to be charged at the 4 shops. Currently the price per unit charged is $230 at A, $235 at B, $225 at C and $240 at D. The variable unit production costs are $150 at plants X and Z, and $155 at plant Y.

i. Set up a matrix showing the unit contribution to profit associated with each production plant/ shop allocation. [5]

ii. The demands at A, B, C and D are 850, 640, 380 and 230 respectively. The plant capacity at X is 625, at Y is 825 and at Z is 450. Use the transportation algorithm to determine the optimal allocation. [10]

iii. Determine the contribution to profit for the optimal allocation. [5]

Question 3

a) Describe the following two terms used in Decision Theory

i) State of Nature, [3]

ii) Alternative. [2]

b) The Gas Company of Zimbabwe has completed a study and is aware that there are gas reserves and they want to invest for the extraction of gas. Management of the company is considering whether or not to build a plant. Their decision is summarized in Table Qu. 3 below

Table Qu. 3 : Decision Table

Alternatives	**Favourable Market**	**Unfavourable Market**
Build a Large Plant	$250,000	-$150,000
Build a Small Plant	$70,000	-$10,000
Don't Build	$0	$0
Market Probabilities	0.4	0.6

i) Construct a Decision Tree, [7]

ii) Determine the best strategy, using the Expected Monetary Value (EMV). [4]

iii) What is the expected value of perfect information? [9]

SECTION A