NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY

DEPARTMENT OF INDUSTRIAL AND MANUFACTURING ENGINEERING

Bachelor of Engineering (Hons) Degree Industrial and Manufacturing Engineering

OPERATIONS RESEARCH

TIE 5208

Second Semester Main Examination Paper

APRIL/MAY 2015

This examination paper consists of 6 pages

Time Allowed:	3 hours
Total Marks:	100
Special Requirements:	NIL
Examiner's Name:	Eng. William M. Goriwondo

INSTRUCTIONS

1. Answer any five (5) Questions.
2. Each question carries 20 marks.
3. Use of calculators is permissible.

Question 1

a) Explain why most Operations Research tools are not being used by Decision Makers in Zimbabwe and how these challenges can be overcome? [6]

b) The main production line in your organization is producing below its rated capacity and this has been happening for two weeks. You are tasked to investigate this problem and suggest a solution.

   i. Explain what techniques you would use to complete the first phase of Operations Research Problem Solving. i.e Problem Recognition and Definition. [4]

   ii. If you decide to use the Inter-disciplinary approach, who would you include in your team and why? [4]

   iii. What are the advantages and disadvantages of the Inter-disciplinary approach? [6]

Question 2

a) Explain using a real life example, the difference between Modelling and Simulation? [4]

b) Discuss how neural networks are used as an Operations Research Method. [5]

c) Identify the most suitable Operations Research Technique for problems in the areas.

   i. Capital Budgeting, [2]

   ii. Fraud Prevention, [2]

   iii. Inventory Planning. [2]

d) Discuss the key considerations that are required for using Modeling in problem solving. [5]

Question 3

a) An organisation makes two types of study desks namely, Standard and Deluxe. The cost of labour and materials for the two types is shown in Table Qu.3 below.

Table Qu.3

	Labour	**Materials**
Standard	$30	$25
Deluxe	$40	$50

The total spent on labour must not exceed $1,150 and the total spent on materials must not be more than $1,250. The profit on a standard desk is $70 and the profit on a deluxe desk is $100.

How many desks of each type should be made to maximise the profit? [10]

b) Use the Simplex Method to solve the following problem. [10]

Maximise $-x_1 + 3x_2 - 3x_3$

Subject to $3x_1 - x_2 - 2x_3 \leq 7$

$-2x_1 - 4x_2 + 4x_3 \leq 3$

$x_1 - 2x_3 \leq 4$

$-2x_1 + 2x_2 + x_3 \leq 8$

$3x_1 \leq 5$

$x_1, x_2, x_3 \geq 0$

Question 4

Your company is considering whether it should tender for two contracts (MS1 and MS2) on offer from a Government Department for the supply of certain components. The company has three options

- Tender for MS1 only; or
- Tender for MS2 only; or
- Tender for both MS1 and MS2

If tenders are to be submitted, the company will incur additional costs. These costs will have to be entirely recouped from the contract price. The risk, of course, is that if a tender is unsuccessful the company will have made a loss.

The cost of tendering for contract MS1 only is $50,000. The component supply cost if the tender is successful would be $18,000.

The cost of tendering for contract MS2 only is $14,000. The component supply cost if the tender is successful would be $12,000.

The cost of tendering for both contract MS1 and MS2 is $55,000. The component supply cost if the tender is successful would be $248,000.

For each contract, possible tender prices have been determined. In addition, subjective assessments have been made of the probability of getting the contract with a particular tender price as shown in Table Qu.4 below. Note here that the company can only submit one tender and cannot, for example, submit to tenders (at different prices) for the same contract.

Table Qu.4

Option	**Possible Tender Prices ($)**	**Probability of getting contract**
MS1 only	130,000	0.20
	115,000	0.85
MS2 only	70,000	0.15
	65,000	0.80
	60,000	0.95
MS1 and MS2	190,000	0.05
	140,000	0.65

i. Develop a Decision Tree for this problem. [10]

ii. What do you suggest the company should do and why? [4]

iii. What are the downside and the upside of your suggested course of action [6]

Question 5

a) Describe the interaction between the major constituents of the Project Triangle in Project Management. [6]

b) A project consists of 8 activities. The activity completion times and the precedence relationships are shown in Table Qu.5 below.

Table Qu.5

Activity	Completion Time (Days)	Immediate Predecessor activities
A	5	-
B	7	-
C	6	-
D	3	A
E	4	B,C
F	2	C
G	6	A,D
H	5	E,F

i. Draw the network diagram [8]

ii. Identify the critical path and the project duration. [4]

iii. If activity E is delayed by 3 days, how is the project affected. [2]

Question 6

Hwange Thermal Power station uses coal as one of its major raw material. It is located within the source of this major raw material.

a) Explain how a stock control system you would recommend for Hwange Thermal Power station works and why you chose that particular one? [8]

b) Categorise and discuss all the costs associated with stock at Hwange Thermal Power Station. [12]

Question 7

You are the Manager responsible for allocating duties to employees in your section. After assessing the marks obtained in some examinations, you decide to use these marks to assign your employees to tasks based on their performance. The marks scored by your employees are shown in Table Qu.7 below.

Table Qu.7

	Quality Management	Processes	Computer Control	Computer Aided Design (CAD)
Lawrence	80	50	40	30
Mbongeni	40	75	50	60
Nothando	80	80	60	50
Oscar	70	60	50	70

If each employee is to be assigned a single task, show how you would allocate these tasks to your employees. [20]

END OF EXAMINATION