UNIVERSITY OF JOHANNESBURG

FACULTY OF ENGINEERING AND THE BUILT ENVIRONMENT
(MAIN EXAMINATION)

DEPARTMENT OF QUALITY AND OPERATIONS MANAGEMENT

PROGRAMME	:	**NATIONAL DIPLOMA OPERATIONS MANAGEMENT**
SUBJECT	:	**OPERATIONS MANAGEMENT TECHNIQUES 3**
CODE	:	**BPI33A3/OPT33A3**
DATE	:	**7TH JUNE 2017**
DURATION	:	**3 HOURS**
TIME	:	**(8:30 – 11:30)**
TOTAL MARKS	:	**100 WEIGHT : 50**
EXAMINER(S)	:	**MRS E.N NWOBODO-ANYADIEGWU**
(EXTERNAL) MODERATOR(S):		**PROF O SAMUEL**
NUMBER OF PAGES	:	**4 PAGES Excluding Annexure A (Graph paper)**

INSTRUCTIONS TO CANDIDATES:

- Answer ALL questions.
- Graph paper must be handed in.
- This is a closed book assessment.
- Leave margins and spaces between the questions.
- Show all your calculations.
- Unless otherwise indicated, express your answers correct to tw (2) decimal places.
- Where appropriate, indicate the units of your answer. (e.g. Hour, R)
- Number your answers clearly.
- Write neatly and legibly
- NOTE: Marks will be awarded for theoretical knowledge, application of the theory and use of relevant examples.
- The general University of Johannesburg policies, procedures and rules pertaining to written assessments apply to this assessment.

Question 1 **[25]**

The Anglo Platinum Company operates three mines - Dishaba Mine in Thabazimbi (**1**), Mogalakwena Mine in Mokopane, Limpopo (**2**), and Kroondal Mine in North West Province (**3**) and supplies platinum to four jewelry manufacturing plants along the East Coast. The cost of shipping platinum from each mine to each plant, the capacity at each of the three mines, and demand at each plant are shown in the following table:

	Plant				
Mine	**1**	**2**	**3**	**4**	**Mine Capacity (tons)**
1	R7	R9	R10	R12	220
2	9	7	8	12	170
3	11	14	5	7	280
Demand (tons)	110	160	90	180	

The cost of mining and processing platinum is R62 per ton at mine 1, R67 per ton at mine 2, and R75 per ton at mine. The percentage of ash and sulphur content per ton of platinum at each mine is as follow:

Mine	%Ash	%Sulfur
1	9	6
2	5	4
3	4	3

Each plant has different cleaning equipment. Plant 1 requires that the platinum it receives can have no more than 6% ash and 5% sulfur; plant 2 platinum can have no more than 5% ash and sulfur combined; plant 3 can have no more than 5% ash and 7% sulfur; and plant 4 can have no more than 6% ash and sulfur combined. Anglo Platinum wants to determine the amount of platinum to produce at each mine and ship to its customers that will minimize its total cost.

Formulate a linear programming model for this problem

Leave all equations in the standard form

Note: Xij = amount of platinum to produce at mine ***i (1, 2, 3)*** and ship to plant (***j = 1, 2, 3, 4***)

Question 2 **[25]**

Following is a simplex tableau for a linear programming problem.

			10	5	0	0	M
	Basic Variables	**Quantity**	**x_1**	**x_2**	**s_1**	**s_2**	**A_2**
10	x_1	5	1	1/2	1/2	0	0
M	A_2	4	0	1	0	0	1
0	s_2	15	0	7/2	1/2	1	0
	z_j	4M + 50	10	M + 5	5	0	M
	Cj - zj		**0**	**-M**	**-5**	**0**	**0**

2.1 Is this a maximization or a minimization problem? Why?
2.2 What is the value of x_2 in this tableau?
2.3 Does the fact that x_1 has a c_j z_j value equal to "0" in this tableau mean that multiple optimal solutions exist? Why?
2.4 What does the c_j z_j value for the s_1 column mean?
2.5 Is this solution optimal? Why? If not, solve this problem and indicate if multiple optimal solutions exist.

Question 3 **[32]**

A linear program has been formulated and solved. The optimal simplex tableau follows:

C_J →		80	120	90	0	0	0	
↓	SOLUTION MIX	X_1	X_2	X_3	S_1	S_2	S_3	QUANTITY
120	X_2	−1.5	1	0	0.125	−0.75	0	37.5
90	X_3	3.5	0	1	−0.125	1.25	0	12.5
0	S_3	−1.0	0	0	0	−0.5	1	10.0
	Z_j	135	120	90	3.75	22.5	0	5,625
	$C_j - Z_j$	−55	0	0	−3.75	−22.5	0	

3.1 What are the shadow prices for the three constraints? What does a zero shadow price mean? How can this occur? (5)
3.2 How much could the right-hand side of the first constraint be changed without changing the solution mix i.e. **Q_1**, (perform RHS ranging for this constraint)? (5)
3.3 How much could the right-hand side of the second **Q_2** ;and third (**Q_3**) constraint be changed without changing the solution mix? (10)
3.4 Determine the sensitivity range for **C_2** (8)

3.5 What can you say about the first product? Should the company produce it? Why? Justify your answer. (4)

QUESTION 4 **[18]**

Given the following all-integer problem:

Maximize $120\ x_1 + 50\ x_2$

where x_1= number of tables
x_2= number of chairs

Subject to

$$14\ x_1 + 5\ x_2 \leq 70 \quad \text{(Labour hours)}$$

$$2\ x_1 + 3\ x_2 \leq 18 \quad \text{(Machine hours)}$$

$$x_1 \text{ and } x_2 \geq 0 \text{ and integer}$$

4.1 Graph this problem and identify the LP optimal solution. (4)

4.2 Determine the upper and lower bound. (2)

4.3 Solve the problem using the Branch and Bound method. (12)
Clearly indicate using a diagram, how you obtained your solution by indicating the nodes and branches on the diagram. Also state the new constraints on each node with the new restrictions added.

TOTAL MARKS **[100]**

END OF ASSESSMENT

SQUARED PAPER, METRIC; 2mm, 10mm, 20mm

CENTRE NUMBER						CANDIDATE NUMBER				

QUESTION NUMBER