UNIVERSITY OF JOHANNESBURG

FACULTY OF ENGINEERING AND THE BUILT ENVIRONMENT
JUNE EXAMINATION

DEPARTMENT OF QUALITY AND OPERATIONS MANAGEMENT

PROGRAMME : **BACCALALAUREUS TECHNOLOGIAE OPERATIONS MANAGEMENT**

SUBJECT : **OPERATIONS MANAGEMENT TECHNIQUES IV**

CODE : **BPI44A4**

DATE :

DURATION : **3 HOURS**

TIME :

TOTAL MARKS : **100** **WEIGHT** : **50**

EXAMINER(S) : **MR J.F. AGWA-EJON**

EXTERNAL MODERATOR: **Dr BARNES SOOKDEO**

NUMBER OF PAGES : **PAGES (Including cover page)**

INSTRUCTIONS TO CANDIDATES:

- Answer ALL questions.
- Annexure A 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 two (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 [10]

Bokomo Foods Company manufactures cereals and other related products which were subjected to the competition board for price fixing. In order to reduce cost. The company decided to introduce vitamins in two of its main products. Two of the ingredients, oats and rice provide Vitamin A and B. The company wants to know how many ounces of oats and rice it should include in each box of cereal to meet the minimum ingredients of 48 million grams of vitamin A and 12 milligrams of Vitamin B while minimizing cost. An ounce of oats contribute 8 milligram of vitamin A and 1 milligram of Vitamin B, whereas and ounce of rice contributes 6 milligrams of A and 2 milligram of B. An ounce of oats cost R0.05, and ounce of rice cost R0.03.

a. Formulate a linear programming model for this problem. (4)
b. Use graphical method and corner points to calculate minimization costs. (6)

QUESTION 2 [10]

The owner of a machine shop is planning to expand by purchasing some new machines presses and lathes. The owner has estimated that each press purchased will increase profit by R100 per day and each lathe will increase profit by R150 daily. The number of machines the owner can purchase is limited by the cost of the machines and the available floor space in the shop. The machine purchase prices and space requirements are as follows.

Required floor		
Machine	**Space (ft^2)**	**Purchase price**
Press	15	R8,000
Lathe	30	R4,000

The owner has a budget of R40 000 for purchasing machines and 200 square feet of available floor space. The owner wants to know how many of each type of machine to purchase to maximize the daily increase in profit.

Maximize Z: $100X_1 + 150X_2$

Subject to: $8{,}000X_1 + 4{,}000X_2 \leq$ R40 000

$15X_1 + 30X_2 \leq 200\ ft^2$

$X_1, X_2 \geq 0$ and integer

(a) Draw a graph and determine the solution for this problem (10)

QUESTION 3 [20]

Danton a manufacturing companies that manufactures Circuit Breakers for Eskom, has four plants in South Africa in Vereeniging, Rustenburg, Nigel and Bloemfontein.

The company is able to produce the following numbers of Circuit Breakers per month:

Plant	*Production*
1. Vereeniging	5
2. Rustenburg	25
3. Nigel	20
4. Bloemfontein	25

Eskom purchase the following numbers of Circuit Breakers for their plants in three cities:

Firm:	Demand:
A. Bethlehem	10
B. Phalaborwa	20
C. Secunda	15

The transportation costs of Circuit Breakers (in hundreds of Ranks) from sources to destinations are shown in the following table. However, the Phalaborwa plant will not accept Circuit Breakers made in Rustenburg, and the Secunda plant will not accept Circuit Breakers from Bloemfontein; therefore, those routes are prohibited:

From	To (cost, in R100s)		
	A	B	C
1	R 7	R 8	R 5
2	6	10	6
3	10	4	5
4	3	9	11

a. Formulate this as a linear programming model (6)
b. Graphical illustration to show the supply and demand of Gold may be used. (4)
c. Determine the minimum costs. Use Graphical illustration to show the supply and demand of the items used. (5)

QUESTION 4 **[20]**

Vermeulen Trucking services in Boksburg transport powder soap from Unilever in big bags between Mozambique and South Africa. A standard shipment can be packaged in a class S bag, a class T bag, or a class H bag. A single class S bag yields a profit of R8; a class T bag, a profit of R6; and a class H bag, a profit of R14. Each complete package prepared requires a certain amount of packaging material and a certain amount of time as seen in the following table:

Class of Container	Packaging Material (Pounds)	Packing Time (Hours
S	2	2
T	1	6
H	3	4

Total amount of resource	120 pounds	240 hours available/week

Don Malaka, as head of the firm, must decide the optimal number of each class of container to pack each week. He is bound by the previously mentioned resource restrictions, but he also decides that he must keep his six full-time packers employed all 240 hours (6workers, 40 hours) each week. Formulate and solve this problem using simplex method.

QUESTION 5 **[20]**

The activities involve in building a small drinking place in Soweto in weeks (W) and the associated costs in Rands (R) are listed below;

Activity	Normal Time (W)	Crush Time (W)	Normal Cost (R)	Crush Cost (R)	Immediate Predecessors
A	3	1	1 000	1 600	-
B	2	1	2 000	2 700	-
C	3	3	500	500	-
D	7	3	1 300	1 600	A
E	6	1	850	1 000	B
F	2	1	4 000	5 200	C
G	4	2	1 500	2 000	D, E
H	8	5	4 500	3 000	D, E
I	6	4	2 000	1 600	F, G

2.1 Construct the network and determine the project completion time (06)

2.2 What will be the total cost of crushing this project to ten (10) weeks in the most economical way? (14)

QUESTION 6 **[20]**

The activities that are necessary to train a basketball team are listed in the following table below.

Activity	Duration	Immediate Predecessors
A	10	-
B	14	-
C	12	A
D	18	B,C

E	08	B,C
F	04	A
G	15	E
H	12	D,F
I	20	G,H

6.1 Construct a network for the training process . (06)

6.2 Identify the critical path using the letters in the networks. (02)

6.3 Calculate the total project duration. (02)

6.4 Determine the ES, EF, LS, LF, and Slake value for each activity in the project. (10)

TOTAL MARKS **[100]**