



UNIVERSITY
OF
JOHANNESBURG

**FACULTY OF ENGINEERING AND THE BUILT ENVIRONMENT
SUPPLEMENTARY EXAMINATION**

DEPARTMENT OF QUALITY AND OPERATIONS MANAGEMENT

PROGRAMME : **BACCALALAUREUS TECHNOLOGIAE
OPERATIONS MANAGEMENT**

SUBJECT : **OPERATIONS MANAGEMENT
TECHNIQUES IV**

CODE : **BPI44A4**

DATE : **28TH JULY 2016**

DURATION : **3 HOURS**

TIME : **(08:00 – 11:00)**

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

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

(EXTERNAL) MODERATOR(S): **MR G.S NHLABATHI**

NUMBER OF PAGES : **7 PAGES (including cover page and 2 graph papers)**

INSTRUCTIONS TO CANDIDATES:

- Answer ALL questions.
- Annexure A & B 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.

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- Use Table of Random Numbers and Formulae provided

QUESTION 1

[12]

Coricraft make wooden office desks for the government. The fixed monthly cost is R20 000, and variable cost is R20 per desk. The factory sells each leather chairs for R150.

- For a monthly volume of 1000 leather chairs, determine the total cost, total revenue and profit. (6)
- Determine the annual break-even volume for Coricraft. (3)
- If sales are down because more people are turning to competitive pricing far desks on the internet. Coricraft management wants to reduce the price to R85. If the other factors remain the same as in (a) and (b) above. What is the new break even volume? (3)

Hint use the following formulae:

$$TC = C_f + VC_v$$

$$TR = Vp$$

$$Z = Vp - C_f - VC_v$$

$$V = \frac{C_f}{p - C_v}$$

QUESTION 2

[18]

The Due Green Fertilizer Company produces fertilizers. The company fixed monthly cost is R25000 and its variable cost per round of fertilizers is R0.15. Due Green Fertilizer sells the fertilizers for R0.40 per pound.

- Determine the monthly break even volume for the company. Use formulae $V = \frac{C_f}{p - C_v}$ (2)
- Graphically illustrate the break-even volume for the Dunlop Company. (4)
- If the maximum operating capacity of Due Green Fertilizer is 120000 pounds of fertilizers per month, determine the break-even volume as a percentage of capacity. (3)
- If Due Green Fertilizer changes the price of its fertilizer from R0.40 per pound to R0.60 per pound, what effect will the change have on the break-even volume? (3)
- If Due Green Fertilizer changes its production process to add a weed killer to the fertilizers in order to increase its sales, the variable cost per pound will increase from R0.15 to R0.22. What effect will this change have on the break-even volume as in (d) above? (3)
- If Due Green Fertilizer increase its advertising expenditure by R14000 per year, what effect will the increase have on the break-even volume in (e)? (3)

QUESTION 3

[12]

Simphiwe Dandala is establishing an investment portfolio that will include the stock and bond funds. He has R720 000 to invest, and he does not want the portfolio to include more that 65% STOCKS. The average annual return for the sock fund he plans to invest in is 18%, whereas the average annual return for the bond is 6%. He further estimates that the most he could lose in the next year in the sock fund is 22%, whereas the most he could lose in the bond fund is 5%. To reduce his risk he wants to limit his potential maximum losses to R100 000.

- Formulate a linear programming model for this problem. (4)
- Solve the problem graphically and show feasible region. (4)
- Show and calculate all corner points. (4)

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QUESTION 4

[18]

Daphney Malaka makes pottery by hand in her basement. She has 20 hours available each week to make bowls and vases. A bowl requires 3 hours of labour and vase 2 hours of labour. It requires 2 pounds of special clay to make a bowl and 5 pounds to produce a vase. She is able to acquire 35 pounds of clay per week. Daphney sells her bowls for R50 and her vase at R40. She wants to know how many of each item to make each week to maximise revenue.

- Formulate an integer programming model for this problem. (4)
- Draw graph. (4)
- Show the normal solution and the integer solution. (4)
- Follow x_1 to calculate profit using branch and bound method. (6)

QUESTION 5

[20]

Cj			6	20	12	0	0
	Basic variables	Quantity	X1	X2	X3	S1	S2
6	X1	20	1	1	0	0	0
12	X3	10	0	1/3	1	0	1/6
0	S1	10	0	1/3	0	1	1/6
	Zj	240	6	10	12	0	2
	Cj – Zj		0	10	0	0	-2

- Is this a maximization or a minimization problem? Why?
- Is the solution in this tableau optimal? Why?
- What does X_3 equal in this tableau? S_2 ?
- What is the value of X_1 and X_2 ?
- Write out the original objective function for the linear programming model, using only decision variables.
- How many constraints are in the linear programming model?
- What does the $c_j - z_j$ value of "2" in the " S_2 " column mean?
- What is the meaning of a shadow price?
- Which row in the simplex table indicate the shadow prices for the variables?
- Explain briefly why it would have been difficult to solve this problem graphically.

QUESTION 6

[15]

The interstate Truck Rental firm has accumulated extra trucks at three of its leasing outlets as shown in the following table

Leasing Outlet	Extra Trucks
1. Atlas Road	70
2. St Helena	115
3. Grasskop	60
Total	245

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The firm also has four outlets with shortages of rental Trucks as follows;

Leasing Outlet	Truck Shortages
A. Nelspruit	80
B. Caroline	50
C. Linfield	90
D. Pietersburg	<u>25</u>
Total	245

The firm wants to transfer trucks from these outlets with extras to those with shortages at the minimum total cost. The following cost of transportation these trucks from city to city have been determined.

	TO (Cost)			
From	A	B	C	D
1	R70	R80	R45	R90
2	120	40	30	75
3	110	60	70	80

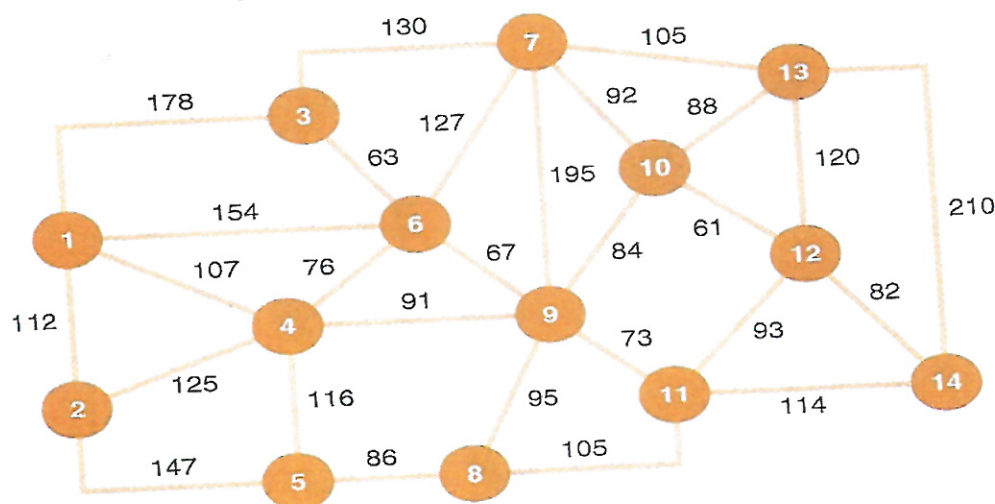
- Formulate this as a linear programming model (5)
- Determine the minimum costs (5)
- Use graphical illustration to show of transportation cost these trucks from city to city. (5)

QUESTION 7

[5]

University of Johannesburg have decided to restrict the side walk throughout the east side of its campus square to provide wheelchair access. However, upgrading sidewalks is a very expensive undertaking, so for the first phase of this project, university administrators at APK wants to make sure they connect all buildings with wheelchair access with the minimum number of refurbished sidewalk possible.

The following is a network of the existing sidewalk of the east side of campus square, with the feet between each building shown on the branches.



Determine the minimal spanning tree network that will connect all the buildings on campus with wheelchair access sidewalks and indicate the number of feet of sidewalk.

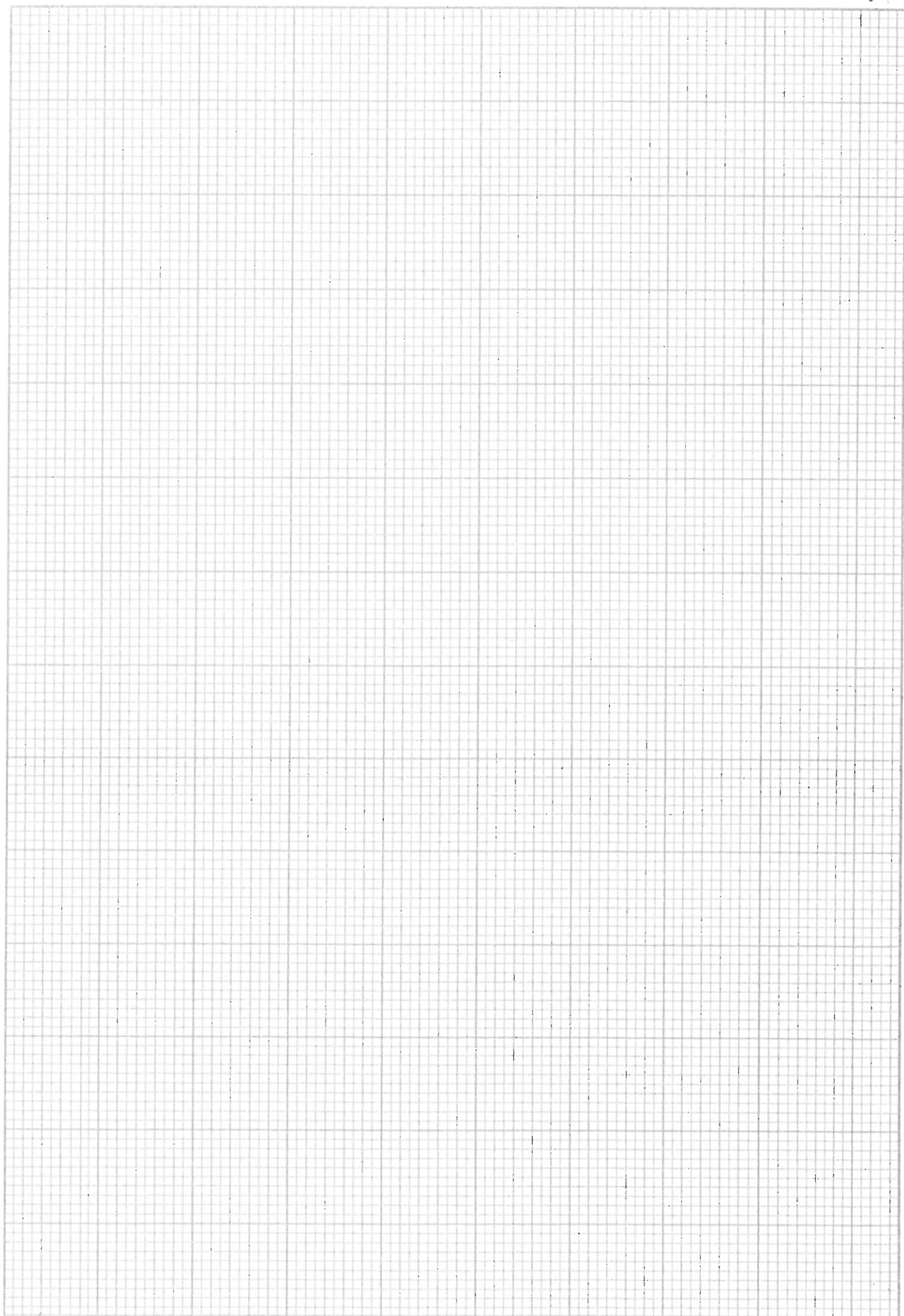
END OF ASSESSMENT

GOOD LUCK

100 MARKS

QUESTION
NUMBER

[illegible]



QUESTION
NUMBER

CENTRE NUMBER						CANDIDATE NUMBER				

