

UNIVERSITY OF SWAZILAND

SUPPLEMENTARY EXAMINATION 2012/2013

IDE-Dip. Comm

TITLE OF PAPER : QUANTITATIVE TECHNIQUES

COURSE NUMBER : MS 202

TIME ALLOWED : THREE (3) HOURS

INSTRUCTIONS : 1. THIS PAPER CONSISTS OF
SEVEN QUESTIONS.
2. ANSWER ANY FIVE QUESTIONS.
3. NON PROGRAMMABLE
CALCULATORS MAY BE USED.

SPECIAL REQUIREMENTS : NONE

THIS EXAMINATION PAPER SHOULD NOT BE OPENED UNTIL
PERMISSION HAS BEEN GRANTED BY THE INVIGILATOR.

QUESTION 1

1. (a) A firm produces two types of calculators, x thousand of type A and y thousand of type B per year. The weekly demand and cost equations are:

$$p = 230 - 9x + y$$

$$q = 130 + x - 4y$$

$$C(x, y) = 200 + 80x + 30y$$

- i. Determine how many of each type of calculator should be produced per year to maximize profit? [5 marks]
 - ii. What is the maximum profit? [2 marks]
 - iii. Verify that this is indeed the maximum profit. [3 marks]
- (b) i. Find and classify all critical points of the function $f(x, y) = x^3 + y^3 - 6xy$. [10 marks]

QUESTION 2

2. (a) Solve the linear system

$$\begin{aligned}x + 2y + z &= 0 \\x - y - z &= -1 \\2x + y + z &= 2\end{aligned}$$

using Cramer's rule. [8 marks]

- (b) An economy is based on three industries: labour, transportation and food. Each \$1 in labour requires 40c in transportation and 20c in food, while each \$1 in transportation takes 50c in labour and 30c in transportation, and each \$1 in food production uses 50c in labour, 5c in transportation, and 35c in food.

Let the demand for the current production period be \$8,000 labour, \$12,000 transportation, and \$9,000 food.

Find the production schedule for the economy. [12 marks]

QUESTION 3

3. A company manufactures desks and chairs. Each desk requires 5 hours of carpentry and 1 hour of finishing. Similarly, a chair needs 1 hour of carpentry and 1 hour of finishing. During each production period, the carpentry and finishing departments can only work for up to 9 hours, 5 hours respectively. The company makes E2 profit per desk and E1 profit per chair.
- (a) The problem is to determine the number of desks and chairs that should be made in order to maximize profits. Formulate this as a linear programming problem. [8 marks]
- (b) Solve linear programming problem by the simplex method. [12 marks]

QUESTION 4

4. Two dietary drinks are used to supply protein and carbohydrates. The first drink provides 1 unit of protein and 3 units of carbohydrates in each litre. The second drink supplies 2 units of protein and 2 units of carbohydrates in each litre. An athlete requires 3 units of protein and 5 units of carbohydrates. The first drink costs E1 per litre and the second costs E3 per litre.
- (a) The problem is to find the amount of each drink the athlete should consume to minimize the cost and still meet the minimum dietary requirements. Formulate this as a linear programming problem. [8 marks]
- (b) Solve linear programming problem by maximizing the dual. [12 marks]

QUESTION 5

5. An wood processing company ships timber from 3 plantations, X , Y and Z , to its 3 factories, A , B and C . Table (1) shows the demand, availabilities and unit costs of transportation.

	A	B	C	Availability
X	8	6	9	40
Y	6	3	8	60
Z	10	7	9	140
Demand	180	40	20	

Table 1: Demand, supply and unit cost values

Starting with the north-west corner solution and using the stepping-stone method, determine the transportation pattern that minimises the total cost.

What is the minimum total transportation cost? [20 marks]

QUESTION 6

6. (a) A company wishes to assign its employees 1, 2, 3, 4 to 4 different projects. The assignment costs are given as follows:

Cost	A	B	C	D
1	21	20	39	36
2	25	22	24	25
3	36	22	36	26
4	34	21	25	39

Determine the optimal assignment schedule that minimizes the total cost.

[10 marks]

- (b) A company has 4 employees 1, 2, 3, 4 to assign to 4 projects A, B, C, D based on the following scores:

Score	A	B	C	D
1	90	65	95	40
2	70	60	80	75
3	85	40	80	60
4	55	80	65	55

Determine the optimal assignment schedule that maximizes the total score.

[10 marks]

QUESTION 7

7. (a) A debt of E1200 is to be paid off by payments of E500 in 45 days, E300 in 100 days and a final payment of E436.92. Interest is at 11% and the Merchant's rule was used to calculate the final payment. In how many days should the final payment be made? [6 marks]
- (b) A T.V set can be purchased using only one of two options. The first option is to pay E1100 cash. The second option requires a down payment of E450 followed by payments of E48 every month for 18 months. If interest charged is at rate 5% compounded monthly, are the two options equivalent? Justify your answer. [8 marks]
- (c) How much should you deposit in an account paying 6% compounded semi-annually in order to be able to withdraw E1000 every 6 months for the next 3 years? [6 marks]