UNIVERSITY OF SWAZILAND

SUPPLEMENTARY EXAMINATION 2009

Dip.Comm II, IDE-Dip.Comm III

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) Use the Gauss-Jordan method to solve the linear system;

$$x + 2y + z = 1$$
$$x - y - z = 0$$
$$2x + y + z = 3.$$

[10 marks]

(b) A shop sells 700 CDs, 400 cassettes, and 200 CD players each week. The selling price of CDs is E4, cassettes E6, and CD players E150. The cost to the shop is E3.25 for a CD, E4.75 for a cassette, and E125 for a CD player. Find weekly profits using matrices. [10 marks]

QUESTION 2

2. (a) The demand functions for two products are;

$$p = 230 - 9x + y \text{ and } q = 130 + x - 4y,$$

where p and q are the respective prices and x and y are the respective amounts of each product sold. If the the joint cost function is;

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

then determine the prices and amounts that will maximize profit. What is the maximum profit? [10 marks]

(b) Use the method of Lagrange multipliers to optimize the function;

$$f(x,y) = 6x^2 + 12y^2,$$
subject to $x + y = 90$

[10 marks]

QUESTION 3

3. (a) For the function $f(x,y) = x^3 + y^3 - 6xy$, find all local extrema and classify them accordingly. [10 marks]

   (b) Let us consider a hypothetical economy with only two industries - electricity company E and water company W. Output for both companies is measured in dollars. The electric company uses both electricity and water (input) in the production of electricity (output), and the water company uses both electricity and water (input) in the production of water (output). Suppose that the production of each dollar's worth of electricity requires $0.30 worth of electricity and $0.10 worth of water, and the production of each dollar's worth of water requires $0.20 worth of electricity and $0.40 worth of water. Suppose that the electricity company produces $ 12 million worth of electricity and the water company produces $ 8 million worth of water (the final demand). How much electricity and water should be produced to meet this final demand? [10 marks]

QUESTION 4

4. Solve the following minimization Linear Programming problem by maximizing the Dual.

$$\text{minimize } C = 16x_1 + 45x_2$$
$$\text{subject to } 2x_1 + 5x_2 \geq 50$$
$$x_1 + 3x_2 \geq 27$$
$$x_1, x_2 \geq 0.$$

[20 marks]

5. (a) A company manufactures two products X and Y. Each product has to processed in three departments: welding, assembly and painting. Each unit of X spends 2 hours in the welding department, 3 hours in assembly and 1 hour in painting. The corresponding times for a unit of Y are 3,2 and 1 respectively. The man-hours available in a month are 1500 for the welding department, 1500 in assembly and 550 in painting. The contribution to profits and fixed overheads are E100 for product X and E120 for product Y. Formulate the appropriate linear programming problem and solve it graphically to obtain the optimal solution for the maximum contribution.   [12 marks]

(b) Consider a transportation problem in which the cost, supply and demand values are presented in the following table. The sources are the factories A, B and C and the destination are the warehouses 1, 2, 4 and 4.

	1	2	3	4	Supply
A	12	13	4	6	500
B	6	4	10	11	700
C	10	9	12	4	800
Demand	400	900	200	500	

i. Is this a balanced transportation problem ?   [2 marks]

ii. Find the initial basic feasible solution using the North-West Corner rule.   [6 marks]

QUESTION 6

6. (a) A debt of E4,000 is due in 12 months. The debtor pays E1500 after 4 months, followed by E1,200 after 8 months. If simple interest is charged at 12% p.a., determine how much is due at due date, assuming payments earn interest. [10 marks]

   (b) Mr Thunzi is due to retire at the age of 65. He will receive from his employer a terminal gift of E15000. He wishes to invest the whole amount and withdraw each year a fixed amount p that will allow his gift to last him 7 years, his life expectancy after retirement. How much will he receive each year if interest is at 5% p.a.? [10 marks]

QUESTION 7

7. Three accountants, Phindile, Rachel and Sibongile, are to be assigned to three projects, 1, 2 and 3. The assignment costs in units of E1000 are given in the table below.

		Project		
		1	2	3
	P	15	9	12
Accountant	R	7	5	10
	S	13	4	6

Solve the assignment problem to find the allocations that would minimize costs. [20 marks]