UNIVERSITY OF SWAZILAND

SUPPLEMENTARY EXAMINATIONS 2008

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
SPECIAL REQUIREMENTS	:	NONE

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

QUESTION 1

1. (a) Use the method of Lagrange multipliers to optimize

$$f(x, y) = xy$$

subject to $x + y = 16$. [8 marks]

(b) The demand functions for two products are

$$p = 12 - 2x \qquad \text{and} \qquad q = 20 - y$$

where p and q are the respective prices for each product, and x and y are the respective amounts of each sold.

Suppose the joint cost function of these products is

$$C(x, y) = x^2 + 2xy + 2y^2$$

Find the revenue function and the profit function. Determine the prices and amounts that will maximize profit. What is the maximum profit? [12 marks]

QUESTION 2

2. (a) Find the sum of the series $2 + 5 + 8 + \ldots + 1001$. [6 marks]

(b) 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. [7 marks]

(c) A debt of E2000 is to be paid off by payments of E500 in two months, E200 in four months and a final payment of E1435. Interest at 12% under the merchant's rule was used to calculate the final payment. In how many months should the final payment be made? [7 marks]

QUESTION 3

3. (a) A farmer deposits E2000 followed by additional deposits of E300 each year for 8 years. What amount will the investment be if interest is computed at 15% compounded annually? [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 4

4. A manufacturer of lightweight mountain tents makes a standard model and an expedition model for national distribution. Each standard tent requires 1 labour hour from the cutting department and 3 labour hours from the assembly department. Each expedition tent requires 2 labour hours from the cutting department and 4 labour hours from the assembly department. The maximum labour hours available per day in the cutting department and the assembly department are 32 and 84 respectively. If the company makes a profit of E50 on each standard tent and E80 on each expedition tent, use the graphical method to determine how many tents of each type should be manufactured each day to maximize the total daily profit? [20 marks]

QUESTION 5

5. Solve the following minimization Linear Programming problem by maximizing the Dual. [20 marks]

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

QUESTION 6

6. (a) Let the interrelationship between the production of two industries R and S in a given year is given by the data in Table 1.

	R	S	C	Total
R	30	40	60	130
S	20	10	40	70

Table 1: Data for Industries R and S.

If the forecast external demand in two years is $\begin{bmatrix} 80 \\ 40 \end{bmatrix}$, what should the total output X be? [10 marks]

(b) Show that

$$\begin{bmatrix} 3 & -2 & -1 \\ -4 & 1 & -1 \\ 2 & 0 & 1 \end{bmatrix}^{-1} = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 5 & 7 \\ -2 & -4 & -5 \end{bmatrix}$$ [10 marks]

QUESTION 7

7. (a) Solve the following system of equations using the Gauss-Jordan method.

$$\begin{aligned} 2x_1 + 4x_2 + 6x_3 &= 18 \\ 4x_1 + 5x_2 + 6x_3 &= 24 \\ 3x_1 + x_2 - 2x_3 &= 4 \end{aligned}$$

[10 marks]

(b) Consider a transportation problem in which the cost, supply and demand values are presented in the following table.

		Destination				
		1	2	3	4	Supply
Source	1	10	0	20	11	15
	2	12	7	9	20	25
	3	0	14	16	18	5
Demand		5	15	15	10	

Obtain an initial feasible solution using the north-west corner rule. [10 marks]