UNIVERSITY OF SWAZILAND

SUPPLEMENTARY EXAMINATION 2010

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) Transform the following determinant to triangular form, and evaluate:

$$\begin{vmatrix} 1 & 2 & 3 \\ -3 & 1 & 5 \\ 2 & 4 & -1 \end{vmatrix}$$

[5 marks]

(b) Use the method of Lagrange multipliers to minimize the function $f(x, y) = 12x^2 + 6y^2$ subject to $x + y = 90$. [5 marks]

(c) A small company builds tool sheds. Each small shed requires 10 sheets of dry wall and 15 studs, while each large shed requires 15 sheets of dry wall and 45 studs. The company has available 60 sheets of dry wall and 135 studs. Also, the company make $E390$ profit on a small shed and $E520$ on a large shed.

Formulate the linear programming problem and use the graphical method to determine how many of each type of building the company should make to maximize its profit. [10 marks]

QUESTION 2

2. (a) Use Gaussian elimination to solve the linear system;

$$\begin{aligned} x_1 + 4x_2 + 3x_3 &= 1 \\ x_1 + 3x_2 + 3x_3 &= -1 \\ 2x_1 + 7x_2 + 7x_3 &= 2 \end{aligned}$$

[10 marks]

(b) A company manufactures x units of product A and y units of product B per month. In terms of the respective prices per unit p and q, the demand equations are

$$\begin{aligned} 2x + y + p &= 250 \\ x + y + q &= 153 \end{aligned}$$

and the cost function for the company is

$$C(x, y) = 5x + 3y + 5000$$

i. Determine the quantities and prices that maximize profit. [8 marks]

ii. What will the maximum monthly profit be? [2 marks]

QUESTION 3

3. (a) Find and classify all local extrema of the function
$f(x, y) = x^3 - 3xy + 3y^3$. [8 marks]

(b) An economy consists of agriculture, manufacturing, and labour industries. Each $E1$ of agriculture requires $50c$ in agriculture, $20c$ in manufacturing, and $E1$ in labour. Each $E1$ of manufacturing uses $80c$ in manufacturing and $40c$ labour, while $E1$ labour takes $25c$ agriculture and $10c$ manufacturing.

Find the production schedule for this economy if demand is for $E100$ agriculture, $E500$ manufacturing, and $E700$ labour. [12 marks]

QUESTION 4

4. (a) Solve the following linear programming problem using the simplex method.

$$\begin{aligned} \text{Maximize } P &= 30x_1 + 20x_2, \\ \text{Subject to } 2x_1 + x_2 &\leq 100, \\ x_1 + x_2 &\leq 80, \\ x_1, x_2 &\geq 0. \end{aligned}$$

[12 marks]

(b) The demand, supply and cost (in E) values of a certain transportation problem are shown in the following table. The sources are the warehouses A, B and C, and the destinations are the depots W, X, Y and Z.

From \ To	W	X	Y	Z	Supply
A	10	8	5	9	14
B	12	13	6	11	16
C	8	7	10	6	5
Demand	6	10	15	4	

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

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

QUESTION 5

5. A company has four jobs to be completed. Each machine must be assigned to complete one job. The time required to setup each machine for completing each job is shown in the table below. The company wants to minimize the total setup time needed to complete the four jobs. Use the Hungarian method to find the job allocations and the minimum setup time needed for processing of all four jobs. [20 marks]

Time (Hours)				
	Job1	Job2	Job3	Job4
Machine 1	14	5	8	7
Machine 2	2	12	6	5
Machine 3	7	8	3	9
Machine 4	2	4	6	10

QUESTION 6

6. A trucking company has a contract to move 115 truckloads of sand per week between three sand-washing plants W,X and Y, and three destinations, A,B and C. Cost and volume information is given below.

From \ To	Project A	Project B	Project C	Supply
Plant W	5	10	10	35
Plant X	20	30	20	40
Plant Y	5	8	12	40
Demand	45	50	20	

(a) Is this a balanced transportation problem ? [2 marks]

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

(c) Compute the optimal transportation cost. [12 marks]

QUESTION 7

7. (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]