NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
FACULTY OF COMMERCE
B.COMM (HONOURS DEGREE)
QUANTITATIVE ANALYSIS FOR BUSINESS [CIN 1106]

FIRST SEMESTER FINAL EXAMINATION- APRIL/MAY 2009

Duration **3 Hours**

Instructions to Candidates

1. Section A comprising parts a) through i) is compulsory. **Do not** start each part on a fresh page for section A. Choose and answer 5 questions out of 6 in section B, and **start each full question** on a fresh page for this section.
2. Write neatly and legibly.
3. Indicate questions answered at the bottom of the answer booklet.
4. Make sure your name and registration number on the attendance slip and the computer printout or attendance register are accurately captured.
5. Ensure that you sign the computer printout or attendance register as you hand in your answer booklet at the end of the examination.
6. Do not mutilate your answer booklet.

SECTION A –COMPULSORY: ANSWER ALL QUESTIONS (30 MARKS)

a) Given the Average Revenue Function:
AR = 60 –3Q, where Q is the quantity of units produced and sold, find:
i) the Total Revenue Function **[2 marks]**
ii) the Marginal Revenue Function **[2 marks]**

b) A cost function is:

$C = Q^2 - 30Q + 200$ where Q = quantity of units sold. Find the point of minimum cost. **[2 marks]**

c) Given that the marginal revenue function is f (x) = -6x + 60, and the marginal cost function is g (x) = 15, find the change in profit as we increase the number of units produced and sold from 3 to 5. **[3 marks]**

d) A manufacturer produces two products P and Q. Each unit of product P requires, in its production, 20 units of raw material A and 10 units of material B. Each unit of product Q requires 30 units of raw material A and 50 units of raw material B. There is a limited supply of only 1200 units of raw material A and 950 units of raw material B. Find, using the Gauss-Jordan method, the number of units of products P and Q, that will exhaust raw material A and raw material B.

(Section A continued on next page)

[6 marks]

e) Given:

$$\mathbf{A} = \begin{bmatrix} 2 & 7 \\ 3 & 0 \end{bmatrix}, \quad \mathbf{B} = \begin{bmatrix} 5 & 1 \\ 2 & 4 \end{bmatrix},$$ show that **AB** is generally not equal to **BA**,

that is, show that the **commutative law** for matrix multiplication breaks down. **[2 marks]**

f) Let **P** be the amount when an initial investment **Po** is made at interest rate **'i'** where interest is converted monthly over a period of one (1) year.

i) Give the expression for **P**. **[1 mark]**

ii) Give the rate of change of **P** with respect to **'i'.** **[2 marks]**

iii) What is the rate of change of **P** with respect to (i) when **Po** = $ 1000 and **i** = 6%. **[2 marks]**

g) Given that C is the cost function, and $C'(x)$ is Marginal Cost function, where $C'(x) = 30 - 0.02x$ [$C'(x)$ is the rate of change of Cost with respect to the number of units produced, x], find the total cost of producing 100 units, if $C(1) = 35$. **[4 marks]**

h) Using derivatives, show that Marginal Cost (MC) is equal to Average Cost(AC) when profit is maximum. **[2 marks]**

i) The demand for a product is given by $D(t) = 2000(8\text{-}4e^{-0.6t})$, where 't' is time, in months, that the product has been on the market. Determine the instantaneous rate of change of the function D(t) at time t = 5, and interpret your answer. **[2 marks]**

SECTION B: CHOOSE AND ANSWER FIVE(5) OUT OF SIX(6) QUESTIONS(70 MARKS)

QUESTION 1

You work for a company which makes two types of cotton cloth: denim and corduroy. Corduroy is a heavier grade of cotton and, as such, requires 7.5 kgs of raw cotton to produce one(1) metre, whereas denim requires five(5) kgs of raw cotton to produce one(1) metre. A metre of corduroy requires 3.2 hours of processing time, and a metre of denim requires 3.0 hours. Although the denim is practically unlimited, the maximum demand for corduroy is 510 metres per month. Your company has 6500 kgs of cotton and 3000 hours of processing time available each month. Your company makes revenue of $ 4.00 per metre for each type of cotton cloth. If the cost of making a metre of corduroy is $ 1.75 and for denim $ 0. 90, formulate the appropriate Linear Programming model and solve it using the SIMPLEX method. **Total[14 marks]**

QUESTION 2

The following Input-Output table assumes a two-industry economy of Zimbabwe comprising Ziscosteel and Wankie Colliery.

	User		**Total Output**
	Ziscosteel	Wankie Colliery	
Producer			
Ziscosteel	40	30	200
Wankie Colliery	20	90	300

If demand for the output of Ziscosteel is predicted to increase by 25% while demand for output of Wankie Colliery decreases by one third, use the fact that total output for the ***ith*** industry is given by:

$\mathrm{X}_i = \sum_{j=1}^{n} b_{ij} + d_i$, and determine the total output required by each industry, respectively, to satisfy both inter-industry demand and final consumer demand.

Total[14 marks]

QUESTION 3

In 1995 an organization decided to restructure its business by making more use of part-time staff in certain areas: cleaning, catering and secretarial. Over the last few years the Finance Director has expressed concern about the way the costs associated with these groups of staff appear to have increased. In her view this may have been caused by lack of central management responsibility in negotiating suitable pay scales with part-time staff. You have been asked to investigate and have collected the data shown in the table below when these services were converted to a part-time staff basis, and for 2001, which is the last year available**(Continued on next page).**

Hourly rates and hours worked: Part-time staff

	1995		2001	
	Hourly Pay rate($)	**Total hours**	**Hourly Pay rate**	**Total Hours**
Cleaning	30000,00	4000	40900,00	5500
Catering	30500,00	2000	40000,00	2100
Secretarial	60500,00	6000	60750,00	7000

Required to:
Calculate Laspeyres and Paasche Price Indeces using 1995 as the base year, and advise.

Total[14 marks]

QUESTION 4

a) You have a savings plan whereby $ 1000 is placed in an account at the end of each year at the annual rate of 5%. The value of your investment at the end of year 10 is $1000 + 1000(1.05) + 1000(1.05)^2 + 1000(1.05)^3 + 1000(1.05)^4 + 1000(1.05)^5 + 1000(1.05)^6 + 1000(1.05)^7 + 1000(1.05)^8 + 1000(1.05)^9$.

Using the sum of a Geometric Progression, find the Future Value of the annuity of $ 1000 above.

[6 marks]

b) A regular amount 'a' is deposited into a fund earning compound interest 'i' at the end of each interest period, for 'n' periods. The growth of the fund is a Geometric Progression as follows:

Future Value = $\$ a + a(1+i) + a(1+ i)^2 + a(1+ i)^3 + a(1+ i)^4 + \ldots + (1+ i)^{n-1}$. Using the sum of a Geometric Progression, show that the future value of the annuity of 'a' is given by: F.V. =

$$a\frac{[(1+i)^n - 1]}{i}$$

[8 marks]

Total[14 marks]

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QUESTION 5

The following table is a balanced transportation problem for Fox worth Corporation, an American Company which manufactures Air-conditioners, and distributes them according to demand, at various demand destinations. The relevant transportation costs are shown below:

To Destinations / From Origins	D1: Chicago	D2: Houston	D3: Atlanta	Origin Availability
O1:	90	80	100	
O2:	20	40	50	1900
O3:	40	90	60	1600
Destination Demand		2000	1800	4500

You are required to:

a) Compute the total transportation cost using the Northwest corner method, and give the initial basic feasible solution. **[3 marks]**

b) Compute the total transportation cost using the Matrix-Minima method, and give the initial basic feasible solution for this method. **[3 marks]**

c) Compute the optimal solution, using the STEPPING-STONE ALGORITHM. **[8 marks]**

Total[14 marks]

<u>QUESTION 6</u>

A Company sells soft drinks and snacks through vending machines located in different public buildings. Presently the company has 5 soft drink and 7 snack-vending machines in different locations throughout the municipal air terminal. The daily revenue, in dollars, received from these machines is given by:

$$f(x,y) = 20\sqrt{x} + 3y^2 + 15xy + e^{\frac{x^2}{y^2}} .$$

a) How much additional revenue will be generated if one additional soft-drink vending machine is installed, but snack-vending machines are held constant at 7? **[7 marks]**

b) How much additional revenue will be generated if the number of snack-vending machines is increased from 7 to 8 while the number of soft-drink machines is held constant at 5? **[7 marks]**

Total[14 marks]

END OF EXAMINATION