The Open University of Sri Lanka
Faculty of Engineering Technology
Department of Textile and Apparel Technology

Study Programme	: Bachelor of Industrial Studies Honours
Name of the Examination	: Final Examination
Course Code and Title	**:TAZ5550/TAZ5544-Quantitative Techniques**
Academic Year	: 2020/21
Date	:6th February 2022
Time	:1400-1700 hrs
Duration	: 3 hours

General Instructions

1. Read all instructions carefully before answering the questions.

2. This question paper consists of **Eight (08)** questions in **Seven (07)** pages.

3.This question paper consists of three sections A, B, and C.

   Answer all questions in Section A and two (02) questions each from sections B and C.

4.Total questions to be answered are five (05). Do not answer more than that. Only first 05 questions are marked.

5. Answer for each question should commence from a new page.

6. Answers should be in clear hand writing.

7.You should clearly show the steps involved in solving problems

8.No marks are awarded for the mere answers without writing the necessary steps

SECTION A

This section carries 20 marks. Answer all the questions in this section.

(01)

(i) Give the values of the following logarithms without using a calculator.

   (a) $Log_4(1024)$ (b) $Log_{10}(0.0001)$ **(02 Marks)**

(ii) Rewrite the following equations in logarithm form   **(02 marks)**

   (a) $y = a^{2x}$ (b) $y = (4 + 2a)^x$

(iii) Find out the gradient of the graph $Y = (3x+4)(x+1)$, at $x=1$ **(02 Marks)**

(iv) Determine the second derivatives of the following functions with respect to x

   (a) $y = e^{2x+6}$ (b) $y = (3x+5)(x+2)$ **(02 Marks)**

(v) Determine the stationary points of the following function and find out whether they are

   minima or maxima or inflexion point

   $y = 3x^5 - 5x^3$ **(04 Marks)**

(vi) Give a example of Skew symmetric matrix of 3x3   **(02 Marks)**

(vii) Find the determinant of the matrix A, if   **(02 Marks)**

$$A = \begin{pmatrix} 1 & 0 & 3 \\ 2 & 1 & 4 \\ 1 & 2 & 1 \end{pmatrix}$$

(viii) Briefly describe what do you understand by the "Slack variables" used in "Simplex method"
in linear programming.   **(04 Marks)**

SECTION B

Maximum possible marks for this section is 40. Answer any two (02) questions from this section.

(02)

(a).Describe the importance of graphs in conveying information. (You may consider what you have learnt in the course as well your everyday life experiences.)

(05 Marks)

(b) Describe how linear equations are used in mathematical modelling.

(05 Marks)

...(c) It.cost the University Rs. 40,000/= a year to educate each Art student and Rs. 60,000/= a year to educate each Science student. The total budget the University has for educating the students is Rs.2,400,000/=. The university wishes to find the number of students that could be enrolled in each of the streams using the linear programming technique.

(i) To solve the problem by linear programming technique, write the budget constraints for number of art students and number of science students. (05 Marks)

(ii) Plot the graph and mark the feasibility region for solutions for this problem on the graph. (05 Marks)

(03) (a) Revenue can be expressed as a function of number of items sold (X) as follows.

R=10X ‑0.001 X²

The marginal revenue function is defined as $\frac{dR}{dX}$

(i)	Plot the function R verses X	(04 Marks)
(ii)	What us the meaning of the $\frac{dR}{dX}$?	(02 Marks)
(iii)	Calculate the marginal revenue R at X=2000	(02 Marks)

(b) The total production cost of on item produced by a company comprises of a fixed cost of Rs. 1,000/= per unit and a variable cost of Rs. 60/= per unit.

The price P of one unit and the number of units in demand Q are related as follows.

$$P = 100 - 0.01Q$$

(i) Write an equation for the total cost of production of the item.   (02 Marks)

(ii) Determine the 'marginal cost' of the item.   (02 Marks)

(The marginal cost is defined as $\frac{dC}{dQ}$)

where c is cost and Q is the number of units in demand.

(iii) Express the revenue as a function of Q.   (02 Marks)

(Revenue R is given by R = PQ)

(iv) Calculate the marginal revenue function at Q = 50   (04 Marks)

(The marginal revenue is given by $\frac{dR}{dQ}$)

(v) Express the total profit as a function of Q.   (02 Marks)

(04) (a) Define following matrices of order 3x3

(i) Square Matrices

(ii) Diagonal Matrices   (04 Marks)

(b) If $A=\begin{pmatrix} 1 & -3 & 2 \\ 2 & 1 & -3 \\ 4 & -3 & -1 \end{pmatrix}$ $B=\begin{pmatrix} 1 & 4 & 1 & 0 \\ 2 & 1 & 1 & 1 \\ 1 & -2 & 1 & 2 \end{pmatrix}$ $C=\begin{pmatrix} 2 & 1 & -1 & -2 \\ 3 & -2 & -1 & -1 \\ 2 & -5 & -1 & 0 \end{pmatrix}$

Show that AB = AC. Thus AB = AC does not necessarily imply B=C   (08 Marks)

(c) If $A = B = \begin{pmatrix} 1 & -2 & 3 \\ 2 & 3 & -1 \\ -3 & 1 & 2 \end{pmatrix}$ and $B = \begin{pmatrix} 1 & 0 & 2 \\ 0 & 1 & 2 \\ 1 & 2 & 0 \end{pmatrix}$

Determine AB and BA and show that AB $\neq$ BA

(08 Marks)

(05) (a) Determine the inverse of the below given matrix

(10 Marks)

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

(b) Hence solve following sets of equations.

$4X - 5Y + Z = 2$

$3X + Y - 2Z = 9$

$X + 4Y + Z = 5$

(10 Marks)

SECTION C

Maximum possible marks for this section is 40. Answer any two (02) questions from this section.

(06)

(a) Explain "Linear Programming" in your own words. And briefly describe the main steps in the formulation of linear programming. **(04 marks)**

(b) A Manufacturing company can produce three types of cloths, say A, B and C. Three

Kinds of wool are required for it, namly,red wool, green wool and blue wool. One unit length of type A cloth needs 2 m of red wool and 3 m blue wool . One unit length of type B needs 3m of red wool, 2m of green wool and 2m of blue wool and One unit length of type C cloth needs 5 m of green wool and 4m of blue wool.

The firm has a stock of only 800 m of red wool, 1000 m of green wool and 1500 m of blue wool. The profit obtained from 1 unit length of Type A cloth is Rs 3,of type B cloth is Rs 5 and that of type C cloth is Rs 4.

Formulate the problem as linear programming model in order to get the maximum profit

(16 marks)

(07) A furniture factory making chairs and tables Both products are processed in three machines M₁ M₂ and M₃ Profit contribution from chair is Rs 200 per chair and Rs 300 per table

The times required in hours for each product for each machine and total time available for each machine are given in the table below.

Machine	Chair	Table	Available time (Hrs)
M₁	3	3	36
M₂	5	2	50
M₃	2	6	60

Formulate this problem as a linear programming model.

(a) What are the variables in this problem?   **(02 marks)**

(b) What is the objective of this problem?   **(02 marks)**

(c) What are the constraints of the problem?   **(04 marks)**

(d) Solve the **formatted programme graphically** to determine how the factory should schedule production in order to maximize the profit..   **(12 marks)**

(08) A company produces two different products X and Y. The machine availability for these products for next month is estimated to be 1400 hours.

The time required to produce product X is 1 hour and for product Y is 2 hours.

The product X need 2 m of raw material and 1m for product Y.

There are 1600 m of raw materials are available for above period.

The contribution of the profit of product X is Rs 4 per unit and Rs 5 for per unit for product Y.

(a) Determine using the **Simplex Method**, how many units of each product should be produced in order to get the maximum profit?

(b) What is the maximum profit?   **(20 marks)**