

**BOWEN UNIVERSITY**  
**COLLEGE OF MANAGEMENT AND SOCIAL SCIENCES**  
**ECONOMICS PROGRAMME**  
**B.Sc. DEGREE EXAMINATION 2021/2022 ACADEMIC SESSION**  
**FIRST SEMESTER EXAMINATION**

Course Title: Mathematical Techniques for Economists I

Course credit: 3

Course code: ECN 203

Time Allowed: 2 hours 30 mins

Date: March 2022

Instruction: Provide your answers clearly and show your workings step by step.

Section A: You are required to attempt all questions in this section. Each question awards 2 marks

1. The point at which the domain of a function has the derivative equal to zero or undefined is called the .....
2. The determinant used to test for functional dependence in both linear and non-linear equations is .....
3. Find the  $Z_x$  and  $Z_y$  when  $z = x^3 - 9xy + 2y^4$ .
4. Transpose the matrix and indicate the new order
  - a.  $\begin{bmatrix} 13 & 5 & 9 \\ 2 & 6 & 4 \end{bmatrix}$
5. a. What is a Square matrix?
6. A zero matrix is also known as .....
7. Consider the cost function  $C(q) = 3q^2 + 2q + 5$ , what is the marginal cost?
8. Is the cost function in question 7 a concave or convex?

9. If  $A = \begin{bmatrix} 1 & 3 & 4 \\ -2 & 4 & 8 \\ 3 & -2 & -1 \end{bmatrix}$  and  $B = \begin{bmatrix} 4 & 1 & 0 \\ 1 & 3 & 5 \\ 0 & 1 & 6 \end{bmatrix}$  Find  $A + B$ .

10.  $A = \begin{bmatrix} 1 & 2 & 3 \\ 0 & 1 & 4 \end{bmatrix}$   $B = \begin{bmatrix} -1 & 2 \\ 2 & 3 \\ 5 & 0 \end{bmatrix}$  Find  $C$  when  $C = AB$

11. A firm faces a demand curve  $Q = 36 - 2P$ . Find an expression for the TR and MR.

12. Given  $a_{11} = 4$ ,  $a_{32} = 5$ ,  $a_{13} = 10$ ,  $a_{23} = 6$  and  $a_{31} = -10$ , fill in the missing values in the matrix below

$$A = \begin{bmatrix} - & 8 & - \\ 7 & 10 & - \\ - & - & 9 \end{bmatrix}$$

13. Express this system of linear equation in matrix box

$$9X_1 + 3X_2 + 8X_3 = 45$$

$$4X_1 + X_2 + 3X_3 = 29$$

$$5X_1 + 2X_2 + X_3 = 50$$

14. What is a monotonic function?
15. If  $z = 6w^3 + 9wy + 5x^3 - 9wx - 2y^2$ , find  $zx$ ,  $zy$  and  $zw$ .

**SECTION B: Answer question one and any other one in this section**

1. a. Assume that a firm producing a single product in two distinct markets has the demand functions and a joint cost function:

$$Q_1 = 24 - 0.2P_1$$

$$Q_2 = 10 - 0.05P_2$$

$$TC = 35 + 40Q \text{ where } Q = Q_1 + Q_2$$

- i. What is the profit-maximising level of output and price in the market with discrimination? (8 marks)
- ii. What is the profit-maximising level of output and price in the market without discrimination? (8 marks)
- iii. What is the profit differential in the two markets? (4 marks)

2. a. Test for the functional dependence in each of the following by means of the Jacobian.

i.  $y_1 = 4x_1 - x_2$   
 $y_2 = 16x_1^2 + 8x_1x_2 + x_2^2$  (4 marks)

ii.  $y_1 = 4x_1^2 + 3x_2 + 9$   
 $y_2 = 16x_1^4 + 24x_1^2x_2 + 9x_2^2 + 12$  (4 marks)

- b. Find the first derivative, second derivative and cross partial derivative if

i.  $z = 3x^2 + 12xy + 5y^2$  (6 marks)

ii.  $z = 7x^3y^4$  (6 marks)

3. Given the total revenue and total cost functions for different firms, you are required to maximize profit for the firms.

i.  $TR = 1400Q - 6Q^2$ ,  
 $TC = 1500 + 80Q$  (10 marks)

ii.  $TR = 4000Q - 33Q^2$ ,  
 $TC = 2Q^3 - 3Q^2 + 400Q + 5000$  (10 marks)

4. Solve for the unknowns in the system of linear equations using either Cramer's rule or matrix inversion.

$$2x_1 + 4x_2 - 3x_3 = 12$$

$$3x_1 - 5x_2 + 2x_3 = 13$$

$$-x_1 + 3x_2 + 2x_3 = 17$$

(20 marks)