



CHITEPO SCHOOL OF LAW AND BUSINESS SCIENCES

DEPARTMENT OF ECONOMICS AND FINANCE

BACHELOR OF COMMERCE DEGREE

LEVEL 1 SEMESTER 1

EXAMINATION QUESTION PAPER

MODULE CODE

HEF114

MODULE NARRATION

**MATHEMATICAL METHODS FOR
ECONOMICS AND FINANCE 1**

DATE

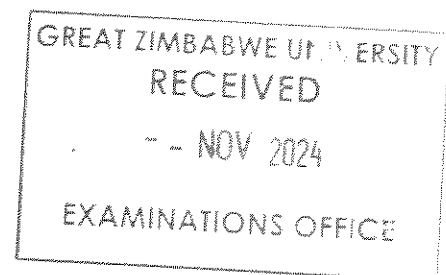
2024

DURATION

3 HOURS

INSTRUCTIONS TO CANDIDATES:

1. Answer any four questions
2. All questions carry equal marks
3. Start each answer on a fresh page
4. Show all workings, where applicable



QUESTION 1

(a) If $x = \frac{3}{7}$ and $y = \frac{1}{14}$, find the simplest form of the fractions below:

(i) $\frac{x-y}{x+y}$ [3 marks]

(ii) $\frac{13(2x-3y)}{2x+1}$ [3 marks]

(b) Simplify $\frac{x-y}{x+y} + \frac{x}{x-y} + \frac{3xy}{x^2-y^2}$ [3 marks]

(c) Sketch the graph of $y = 3 - |x|$ [4 marks]

(d) Explain, using examples and/or illustrations, the following terms used in functions:

(i) Predicted variable [3 marks]

(ii) Exogenous variable [3 marks]

(iii) Domain [3 marks]

(iv) Range [3 marks]

QUESTION 2

(a) The population of a village was 753 in 1990. If the population grows according to the equation $P = 753e^{0.03t}$ where P is the number of persons in the population at time t.

(i) Graph the population equation for $t = 0$ to $t = 30$ [3 marks]

(ii) From the graph, estimate the population in 2000 and in 2010 [3 marks]

(iii) In what year will the population reach 1750 persons? [4 marks]

(b) Find the derivatives of the following functions:

(i) $f(x) = x^{-0.33}$ [2 marks]

(ii) $f(p) = Ap^{\alpha} + B$ [3 marks]

(i) $g(t) = t^n(a\sqrt{t} + b)$ [5 marks]

(ii) $y = \left(\frac{x-1}{x+3}\right)^{1/3}$ [5 marks]

[Total 25 marks]

QUESTION 3

(a) Suppose a firm has a market demand function given by $q = 100 - \frac{1}{3}p$ and a cost function given by $C = q^2 + 3q + 600$.

(i) Find this firm's marginal revenue (MR) and marginal cost (MC). [4 marks]

- (ii) Assume that the firm is operating under monopoly, determine the profit-maximising price and quantity of the firm. [5 marks]
- (iii) Now, assume that the firm is operating under perfect competition, determine the profit-maximising price and quantity of the firm. [5 marks]
- (iv) Based on your answers, which market structure is more favourable for consumers and why? [3 marks]
- (b) Suppose that the demand for screws is $q^d = p^{-2}e^{-2p}$. Find the price elasticity of demand if $p = 0.5$. [4 marks]
- (c) Suppose that the demand for wheat is $q^d = 20e^{-0.5p}$, while the supply of wheat is $q^s = 5e^{0.2p}$. Find the price elasticity of the supply of wheat at the equilibrium price and quantity of wheat. [4 marks]
- [Total 25 marks]**

QUESTION 4

- (a) A firm faces the demand schedule $p = 184 - 4q$ and the TC function $TC = q^3 - 21q^2 + 160q + 40$.
What output will maximize profit? What will be the maximum profit be? [6 marks]
- (b) Suppose that a firm operates with the total cost function $TC = 50 + 0.4q^2$ and is a monopoly facing the demand schedule $p = 360 - 2.1q$.
Analyze the comparative static effect of a change in the lump sum tax T on the firm's output and profit maximizing price. [6 marks]
- (c) A monopolist faces a demand function $P = 152.5 - 3Q$ and has costs given as $TVC = \frac{1}{2}Q^3 - 15Q^2 + 175Q$ and $TFC = 300$
- (i) Derive the firm's net profit function [3 marks]
- (ii) Find the output, Q , at which profit is minimised and maximised. [4 marks]
- (iii) Confirm the condition $MC = MR$ for maximum profit. [3 marks]
- (iv) Sketch the total cost, total revenue and total profit on one diagram, and MR, MC on a diagram vertically below it. [3 marks]
- [Total 25 marks]**

QUESTION 5

- (a) For the demand schedule $p = (60 - 0.1q)^{0.5}$ find the value of q that maximizes total revenue. [5 marks]
- (b) A firm's production function is given by:
 $Q(L) = 12L^2 - \frac{1}{20}L^3$, where L denotes the number of workers, with $L \in [0, 200]$.
- (i) Determine the size of workforce that maximises output $Q(L)$ [3 marks]
- (ii) Determine the size of the workforce that maximises output per worker $\frac{Q(L)}{L}$ [3 marks]
- (iii) Show that $Q'(L^{**}) = Q(L^{**})/L^{**}$ and give an economic interpretation of this. [3 marks]
- (c) A monopoly faces the following TR and TC schedules:
 $TR = 300q - 2q^2$ and $TC = 12q^3 - 44q^2 + 60q + 30$
What output should it sell to maximize profit? [4 marks]
- (d) In a basic Keynesian macroeconomic model, it is assumed that $Y = C + I$, where $I = 250$ and $C = 0.75Y$:
- (i) What is the equilibrium level of Y ? [3 marks]
- (ii) What increase in I would be needed to cause Y to increase to 1,200? [4 marks]

[Total 25 marks]

END OF EXAMINATION