



# MANICALAND STATE UNIVERSITY OF APPLIED SCIENCES

**FACULTY OF AGRIBUSINESS AND COMMERCE**

**Agricultural Economics and Development**

**MATHEMATICS FOR AGRICULTURAL ECONOMICS**

**CODE: HACE 103**

**SESSIONAL EXAMINATIONS**

**SEPTEMBER 2020**

**DURATION: 3 HOURS**

**EXAMINER: MR N. CHIPUNZA**

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## ***INSTRUCTIONS***

- 1. Answer All questions in section A*
  - 2. Answer any Three (3) questions in section B.*
  - 3. Start a new question on a fresh page*
  - 4. Total marks 100*
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## SECTION A: [COMPULSORY]

### Question 1

Factorise where possible

a.  $2x^3 + x^2 - 2x - 1$  [3 marks]

b.  $2x^3 - 3x^2 - 3x + 2$  [3 marks]

### Question 2

Gode bakeries makes bread at a cost of \$20.00 per unit. In addition, the bakery has fixed costs of \$25000,000.00. Each loaf of bread is sold for \$85.00. How many units must be sold if the Gode is to have a profit of \$25,500.00? [4 marks]

### Question 3

For a firm with Total Cost given by

$$TC = 120 + 45q - q^2 + 0.4q^3$$

And faces a demand curve given by

$$p = 240 - 20q$$

Identify its

a. AC [2 marks]

b. FC [2 marks]

c. VC [2 marks]

d. AVC [1 mark]

e. AFC [1 mark]

f. Profit function. [2 marks]

### Question 4

Suppose the public demand for money is given by the formula

$$M = \alpha Y + \beta(r - \gamma)^{-\delta}$$

Where M is money supply, Y is national income, r is the interest, while  $\alpha$ ,  $\beta$ ,  $\gamma$  and

$\delta$  are positive parameters.

- a. Solve the equation for  $r$  [3 marks]  
b. For the USA, 1929-1952, the parameters were estimated to  $\alpha = 0.14, \beta = 76.03, \gamma = 2$  and  $\delta = 0.84$ . show that  $r$  is given by [5 marks]

$$r = 2 + \left( \frac{76.03}{M - 0.14Y} \right)^{\frac{25}{21}}$$

### Question 5

From the following information about the structural equations of a closed economy.

$$C = 50 + 0.8Y \text{ (consumption function)}$$

$$I = 20 - 5R \text{ (Investment function)}$$

$$L = 100 - R + 0.5Y \text{ (Money demand function)}$$

$$M = 200 \text{ (Money Supply function)}$$

- a. Derive the IS and LM curves. [4 marks]  
b. Solve for equilibrium income. [2 marks]  
c. Solve for interest rate. [2 marks]

### Question 6

Find the solutions to the following problem

$$50000x + 0.08y = 1,000,000$$

Max  $x^{0.5}y^{0.5}$  subject to

[4 marks]

## SECTION B [ANSWER ANY THREE (3) QUESTION]

### Question 7

- a) A Zimbabwean company, Museyamwa Printers, quotes the price of \$1,600.0 for printing 100 copies of a report and \$500.00 for printing 500 copies.

Assuming a linear relation, what would be the price of printing 300? [4 marks]

b) The total costs of producing  $x$  units of a commodity is

$$c(x) = 12x^3 - 100x^2 + 7500x, \quad x \geq 0$$

- i. Compute the marginal cost function  $c'(x)$  [4 marks]
- ii. For which value of  $x$  is the marginal cost the least? [4 marks]

c) if the total savings of a country is a function  $S(Y)$  of the national product  $Y$ , then  $S'(Y)$  is called the marginal propensity to save (MPS). Find the MPS for the following functions

- i.  $S(Y) = a + bY$  [4 marks]
- ii.  $S(Y) = 100 + 10Y + 2Y^2$  [4 marks]

### Question 8

Solve the utility maximization problem using the Lagrange method

$$\max u(x, y) = x^2 + y \quad \text{subject to} \quad x + 4y = 200$$

- a. Find the quantities demanded of the two goods? [10 marks]
- b. Suppose the income increases from 100 to 101. What is the exact increase in the optimal value of  $u(x, y)$ ? [5 marks]
- c. Compare with the values found in (a) and (b) for the Lagrange multiplier. [5 marks]

### Question 9

For what values of  $a$  is  $B$  symmetric [20 marks]

$$B = \begin{pmatrix} a & a^2 - 1 & -3 \\ a + 1 & 2 & a^2 + 4 \\ -3 & 4a & -1 \end{pmatrix}$$

### Question 10

The cost of producing  $x$  units of a commodity is given by

$$c(x) = 1200 + 300x + 6x^2$$

- a. Compute  $c(0)$ ,  $c(100)$ , and  $c(101) - c(100)$  [6 marks]  
b. Compute  $c(x + 1) - c(x)$ , and explain in words the meaning of the difference. [4 marks]

The cost of removing  $p\%$  of the impurities in a lake is given by

$$b(p) = \frac{10p}{105 - p}$$

- a. Find  $b(0)$ ,  $b(50)$  and  $b(100)$  [6 marks]  
b. What does  $b(50 + h) - b(50)$  mean? ( $h \geq 0$ ) [4 marks]

### Question 11

Use the Cramer's Rule to solve the following systems of equations for  $x$  and  $y$ . Test the answers by substitution.

- (a)  $3x + y = 8$                       (b)  $x + 3y = 1$                       (c)  $ax - by = 1$   
 $x - 2y = 5$                                $3x - 2y = 14$                                $bx + ay = 2$   
[Each question carries 4 marks]

- (d) Find the inverse of  $\begin{pmatrix} -2 & 3 & 2 \\ 6 & 0 & 3 \\ 4 & 1 & -1 \end{pmatrix}$  [8 marks]

**END OF EXAMINATION**