



THE CATHOLIC UNIVERSITY OF EASTERN AFRICA

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MAIN EXAMINATION

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MAY – AUGUST 2021

Ext 1022/23/25

FACULTY OF ARTS AND SOCIAL SCIENCES

DEPARTMENT OF ECONOMICS

REGULAR PROGRAMME

ECN 317: MATHEMATICS FOR ECONOMISTS II

Date: AUGUST 2021

Duration: 2 Hours

INSTRUCTIONS: Answer Question ONE and any other TWO Questions

Q1.

a) The Tusome Printing Company is facing a tight financial squeeze and is attempting to cut costs wherever possible. At present it has only one printing contract and, luckily, the book is selling well in both the hardcover and paperback editions. It has just received a request to print more copies of this book in either the hardcover or paperback form. Printing cost for hardcover books is Kshs. 700 per 100 while printing cost for paperback is only Kshs. 600 per 100. Although the company is attempting to economize, it does not wish to lay off any employees. Therefore, it feels obliged to run its two printing presses at least 90 and 70 hours per week, respectively. Press I can produce 100 hardcover books in 2 hours or 100 paperback books in 1 hour, while Press II can produce 100 hardcover books in 1 hour or 100 paperback books in 2 hours.

- i) Formulate this problem as a standard linear programming problem. (5 Marks)
  - ii) What should be the optimal production of hardcover books and paperback books? Use simplex method to solve. (8 Marks)
- b) Determine whether the following functions are linearly dependent. (4 Marks)

$$y_1 = 2x_1 + 3x_2$$

$$y_2 = 4x_1 + 12x_1x_2 + 9x_2$$

c) Highlight the Kuhn-tucker necessary conditions for a minimum and a maximum. **(6 Marks)**

d) The supply and demand function of cabbage is given as:

$$Qdt = 125 - 2P_t$$

$$Qst = -50 + 1.5P_{t-1}$$

Required:

- i) Determine the equilibrium price. **(2 Marks)**
- ii) Find general and particular solution. **(3 Marks)**
- iii) Is the price stable? **(2 Marks)**

**Q2.**

a) Solve the following system of equations using Gauss-Jordan: **(10 Marks)**

$$2X + 12Y - 2Z = 20$$

$$2X + 3Y + 3Z = 17$$

$$3X - 3Y - 2Z = -9$$

b) Differentiate between a homogeneous and a non-homogeneous difference equation. **(4 Marks)**

c) Solve the following difference equations.

i)  $Y_{t+1} = 0.2Y_t + 4$  **(3 Marks)**

ii)  $Y_{t+1} = 1.2Y_t, Y_0 = 5$  **(3 Marks)**

**Q3.**

a) With examples differentiate between first order linear differential function and second order third degree differential function. **(4 Marks)**

b) Determine if the following function is concave or convex.

$$Z = 2x - y - x^2 + 2xy - y^2 \quad \textbf{(4 Marks)}$$

c) Solve the following minimization problem and show all the necessary Kuhn-Tucker conditions.

**(12 Marks)**

Min:

$$C = (x - 4)^2 + (x_2 - 4)^2$$

st.

$$2x_1 + 3x_2 \geq 6$$

$$3x_1 - 2x_2 \geq -12$$

$$x_1, x_2 \geq 0$$

#### Q4.

a) Determine if the following functions are positive definite or negative definite using the Hessian determinants.

i)  $Z = 2XY - X^2 + 5Y^2$  (3 Marks)

ii)  $Z = 200 - 2x^2 - y^2 - 3w - xy - e^{x+y+w}$  (4 Marks)

b) Given demand and supply for the cobweb model as follows,

$$Q_{dt} = 22 - 3P_1, Q_{st} = -2 + P_{t-1}$$

Where,

$Q_{dt}$  is quantity demanded and  $Q_{st}$  is the quantity supplied.

i) Find the inter-temporal equilibrium prices. (3 Marks)

ii) Determine whether the equilibrium is stable. (4 Marks)

c) Solve for Y in the following differential equations.

i)  $\frac{dy}{dt} = \frac{t}{y}$  (3 Marks)

ii)  $\frac{dy}{dt} + 2ty = t$  (3 Marks)

#### Q5.

a) Determine if a Cobb-Douglas production function given as  $Q = AK^\beta L^\alpha$  is concave or convex given that  $\beta + \alpha \leq 1$ . (5 Marks)

b) Integrate the following functions:

i)  $\int (x+3)(x+1)^{\frac{1}{2}} dx$  (5 Marks)

ii)  $\int x^3 \cdot (\ln x^2) dx$  (5 Marks)

iii)  $\int 6x^2(x^3+2)^{99} dx$  (5 Marks)

**\*END\***

DET: MAY 2021