MINISTRY OF EDUCATION AND TRAINING
NATIONAL ECONOMICS UNIVERSITY

FALCULTY OF FUNDAMENTAL SCIENCES

MIDTERM TEST

Subject: Algebra and Calculus:

Applications in Economics and Business

Mode of study: Full time

Program:

Intake:

Allowed time: ***60 minutes***

Version: 01

Question 1: ***(4.0 points)*** Given a linear system

$$\begin{cases} x - y - 2z = -1 \\ 2x + 3y + z = -2 \\ 5x + 4y + 2z = 4 \end{cases}$$

a) Write the system in the matrix form Ax = b, for x = $\begin{bmatrix} x \\ y \\ z \end{bmatrix}$. Find the inverse of A if it exists.

b) Find the solution to the system.

Question 2: ***(2.0 points)*** Find the entries in the second column of the product $B^T A^T$ where

$$A = \begin{bmatrix} -2 & 1 & 3 \\ 4 & -3 & 2 \\ 3 & -1 & 8 \end{bmatrix} \qquad B = \begin{bmatrix} 3 & -2 & 4 \\ -1 & 3 & 2 \\ 4 & 5 & 1 \end{bmatrix}$$

Question 3: ***(4.0 points)*** Given a matrix

$$\mathrm{C} = \begin{bmatrix} 3 & 2 & -1 & -3 \\ -1 & 1 & 3 & 2 \\ 2 & -4 & 2 & m \\ 4 & 1 & 2 & -1 \end{bmatrix}$$

a) Find the determinant of the matrix C.

b) For what values of m, the matrix C is invertible? Then find the entry in the 4th row and the 1st column of C^{-1}.

Note: *No electronic devices, books or notes of any form are allowed.*

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Question 1: ***(2.0 points}*** If $F(x) = f(g(x))$ where $f(-2) = 8, f'(-2) = 4, g(5) = -2$ and $g'(5) = 6$. Find $F'(5)$.

Question 2: ***(2.0 points)*** A psychologist measures a child's capability to learn and remember by the function $f(x) = \frac{\ln(x+1)}{x+1}$ where x is the child's age in years, for $0 \leq x \leq 5$. At what age does a child have the greatest learning capacity?

Question 3: ***(2.0 points)*** Use implicit differentiation to find $\frac{dy}{dx}$ if $x^2 + 2y^3 = \frac{3}{xy}$.

Question 4: ***(2.0 points)*** Find intervals of increase and decrease for the function $f(x) = 3x\sqrt[3]{(5-x)^2}$. Determine whether each critical number corresponds to a relative maximum, a relative minimum, or neither.

Question 5: ***(2.0 points)*** Determine where the graph of the functions $f(x) = \frac{3x^2+5}{x^2+3}$ is concave upward and concave downward. Find the x coordinate of each point of inflection.

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