Name:_____

IE 317 - Nonlinear Models in Optimization
Fall 2020
Midterm
21 November 2020

Question	1	2	3	4
Course Learning Outcome	1, 2	1, 2, 4	1, 2	1
Grade	/25	/25	/25	/25

Submit a single word or a pdf document that may include (1) scans of your hand-written answers, (2) computer-written answers, (3) MATLAB/Java codes. There will be NO Make-Up for the Midterm!

1) (25 pts) If a monopolist produces q units, she can charge $100 - 4q$ TL/unit. The fixed cost of production is 50 TL, and the variable per-unit cost is 4 TL.

   (1.1) (10 pts) Give a Nonlinear Programming (NLP) formulation for the profit maximization problem.

   (1.2) (8 pts) Graphically **and** analitically identify the q value which maximizes the profit.

   (1.3) (7 pts) What is the profitable range of production?

2) (25 pts) Consider the function $f(x) = x^3 + x^2 - 2x + 1$.

   (2.1) (10 pts) Find the stationary points of f and classify them as local min or local max.

   (2.2) (8 pts) Use bisection method to find the local minimum of f on the interval $[0, 2]$ (**Hint:** You may use the MATLAB codes in our lectures.).

   (2.3) (7 pts) Use bisection method to find the local maximum of f on the interval $[-2, 0]$ (**Hint:** You may use the MATLAB codes in our lectures.).

3) (25 pts) Linearize $x \cdot y^k$ for $k \in \mathbb{R}$, $x \geq 0$ is a continuous variable and $y \in \{0, 1\}$ is a binary variable.

4) (25 pts) Suppose $S_1, S_2 \subseteq \mathbb{R}^n$ are convex sets.
   Show that $S_1 \oplus S_2 = \{x_1 + x_2 \subseteq \mathbb{R}^n\colon\ x_1 \in S_1,\ x_2 \in S_2\}$ is a convex set.