ME 533 Nonlinear Dynamics Analysis

Homework 1

All problems are from the textbook from the textbook "Applied Nonlinear Control" by Slotine and Li, Prentice Hall, 1991.

Problem 1
(Problem 2.1 from textbook)
Draw the phase portrait and discuss the properties of the linear, unity feedback control system of open-loop transfer function

$$G(p) = \frac{10}{p(1+0.1p)}$$

Problem 2
(Problem 2.3 from textbook)
Consider the nonlinear system

$$\dot{x} = y + x(x^2 + y^2 - 1)\sin(\frac{1}{x^2 + y^2 - 1})$$

$$\dot{y} = -x + y(x^2 + y^2 - 1)\sin(\frac{1}{x^2 + y^2 - 1})$$

Without solving the system explicitly, show that the system has infinite number of limit cycles. Determine the stability of these limit cycles (Hint: use polar coordinates)

Problem 3
(Problem 2.4 from textbook)
The system shown in the below figure represents a satellite control system with rate feedback provided by a gyroscope. Draw the system's phase portrait and determine the system's stability.