Texas A&M University–Corpus Christi
College of Science and Technology
Engineering Technology

Course Number and Title: ENTTC 4446 Control Systems I

Weekly Schedule: 3 hours lecture and 3 hours laboratory

Prerequisites: ENTC 3444 Principles of Measurements and MATH 3315 Differential Equations

Course Description:
An introduction to control systems; open and feedback control; Laplace transform and frequency response; control valves; electric motors; P, PI, and PID modes of control; analog and digital controllers; process characteristics; analysis of control systems; gain and phase margin; stability; controller design methods.

Textbooks
1. Introduction to Control System Technology, 7th Edition, Robert Bateson, Prentice Hall, 2002.

2. MATLAB Student Version Release 12, The MathWorks, $99.00, Control Systems Toolbox, $29.00. http://www.mathworks.com/products/studentversion/- Optional.

3. Process Control Workshop Reference Manual, 37-001-2M5, Feedback—available in the lab.

Course Objectives
This course is designed to enable students to:
- Mathematically model a feedback control system.
- Derive the transfer function of a control system.
- Plot and interpret frequency responses.
- Contrast quick-opening, linear, and equal percentage control valves.
- Apply control valve sizing techniques to select the proper size for given specifications.
- Differentiate between induction, synchronous, and servo motors.
- Differentiate between the various configurations of DC motors.
- Analyze stepping motor configurations.
- Compare the characteristics and applications of the P, PI, PID modes of control.
- Analyze and design analog controller circuits.
- Analyze digital control algorithms.
- Examine the characteristics of a number of processes, such as integral, first-order lag, and second-order lag and analyze operations of such systems.
- Determine stability of control systems using Bode diagrams, Nyquist criterion, and the root locus method.

Assessment

	Points		If	Grade
Homework	05		90 ≤ Total < XX	A
Lab exercises/reports	05		80 ≤ Total < 90	B
Quiz	04		70 ≤ Total < 80	C
Midterm 1	15		60 ≤ total < 70	D
Midterm 2	15		xx < Total < 60	F
Draft of project research paper	02			
Project research paper	05			
Project progress report	02			
First project presentation	02			
Project report/presentation/demo	20			
Final	25			
Total	**100**			

Topics Covered

Block diagrams and transfer functions, open-loop control, closed-loop control, nonlinearites, benefits of automatic control, objectives of good control, block diagram simplification, analog and digital control, regulator and follow-up systems, process control, servomechanisms, sequential control, the evolution of control systems, Laplace transforms, inverse Laplace transforms, transfer functions, frequency response, Bode plots, relays, contactors and motor starters, solid-state switching devices, solenoid valves, cylinders, control valves, control valve control characteristics, valve sizing, induction motors, synchronous motors, servomotors, DC motors, stepping motors, ac adjustable-speed drives, dc motor amplifiers and drives, two-position control mode, floating control mode, proportional control mode, integral control mode, PI control mode, derivative control mode, PD control mode, PID control mode, analog controllers, digital controllers, integral or ramp process, first-order lag process, second-order lag process, dead-time process, first-order lag plus dead-time process, open loop Bode diagrams, closed-loop Bode diagrams, stability, gain and phase margins, Nyquist plots, root locus.

Laboratory Exercises/Experiments:

Lab 1 MATLAB Getting Started (Part I); Lab 2 MATLAB Getting Started (Part II)
Lab 3 Writing MATLAB programs and Use of Functions
Lab 4 Wireless Data Logging and Processing
Lab 5 Time domain response and unit-step response of Closed-loop Systems
Lab 6 Control System Analysis Using Simulink
Lab 7 Process System Componenents: Centrifugal Pump, Valves, and Flow Gauges
Lab 8 Calibration of System Components: Flow Meter, Servo valve, and Solenoid Valve
Lab 9 Interfaces: Circuit Breaker, Servo Valve, and I/V Converters
Lab 10 Interface Calibration and Controller Familiarization
Lab 11 Bode Plots, Nyquist Plot, and Root Locus
Lab 12 Controller Calibration; Lab 13 Float Level Transmitter

Prepared by: Ray Bachnak **Date:** _____