The University of Texas at Tyler
Department of Mechanical Engineering

MENG 4330 – Process Control & Automation

Credits: 3 hours lecture, 0 hours laboratory per week

Instructor: M. A. R. Biswas, Assistant Professor of Mechanical Engineering

Text(s): None required.
Recommended: Chapter 8 Process control from Green, Don W., and Robert H. Perry. "Perry's chemical engineers' handbook." 8th Ed., McGraw-Hill Education (2007).
Dale E. Seborg, Thomas F. Edgar, Duncan A. Mellichamp, and Francis J. Doyle, *Process Dynamics and Control*, 3rd Ed., John Wiley and Sons, New York (2010).
Katsuhiko Ogata, System Dynamics, 4th Ed., Prentice Hall, 2003
Additional Material: Class Handouts and MATLAB by MathWorks, Inc.

Course Details: Online Videos and Material through Canvas

Office: Houston Engineering Center A214
Office Hours: By virtual appointment on Zoom or Phone.
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Course Information

Catalog Description: The use of controls in the process industry and in automation; measurement of variables, controller types, final elements, application of controllers, application of programmable logic controllers, ladder logic, general instrumentation design and practice.

Prerequisite(s): MENG 4312 (System Dynamics & Control), EENG 4308 (Automatic Control), or Instructor approved controls course

Required, Elective, Selected: Elective

Course Goals

Instructional Outcomes: By the end of this course students will be able to:

1. Ability to develop mathematical and transfer function models for dynamic processes.
2. Ability to analyze process stability and dynamic responses.
3. Ability to empirically determine process dynamics for step response data.
4. Implement and evaluate different types of PID feedback controllers.

5. Ability to read block diagrams and process and instrumentation diagrams.
6. Learn and develop feedforward control and cascade control architectures.

Relationship to Student Outcomes: This course supports the following Mechanical Engineering Program Student Outcomes, which state that our students will:

1. be able to apply science, mathematics, and modern engineering tools and techniques to identify, formulate, and solve engineering problems
2. be able to design selection of thermal/fluid, mechanical, and electro-mechanical components or systems, individually or on interdisciplinary teams, and effectively communicate those designs in both technical and non-technical forums

Topics Covered

- Mathematical modeling of different process dynamics
- Transfer Function and State-Space models
- Characteristic Dynamic Behavior of Processes for Empirical modeling
- Feedback, Cascade, Feedforward and Ratio Control
- Control System Design Analysis

Evaluation and grading activities

- Quiz: There will be three quizzes during the semester, the Review Quiz & Take Home Quiz. Each open book and open notes quiz will consist of 2-4 questions that cover selected topics to be taken within a fixed timeframe. Late or no submission of quiz will result in automatic grade of zero.

- Participation & Homework: 5 to 8 homework/participation assignments will be applied according to the topics covered on Canvas. Questions involving knowledge covered will be answered if the student proves attempt to come up with the answer. Solution to homework will not be given. However, students can work on the right solution by checking their work with the instructor. Each correct homework problem is 100%. Each completed, but incorrect problem is 80%. Incomplete or unanswered problem is 0%. Each HW counts for 10 pts. Late submissions of homework will be accepted until last class day of the semester and will result in 2 point deduction from the graded score. Live lecture Q&A classes are not mandatory, but strongly recommended. Participation is required on graded Discussions.

- Project: Students will work on default project to develop process dynamic model and analysis, and control design of a lab-scale electrochemical system. Students are encouraged to work in groups and submit preliminary and final reports. Students are expected to produce at a minimum conference-quality paper, a template of which will be provided. Late submissions will be accepted until last class day of the semester and will result in 10 point deduction from the graded score.

20%xQuiz + 40%xHW + 40%xProject = Total out of 100 pts.

Scale:		
	A	90 – 100
	B	80 – 89
	C	70 – 79
	D	60 – 69
	F	< 60

Grade appeal: grades can be appealed by meeting the instructor during office hours, but no later than a week after the grade has been given.

Note: your final semester grade is based on the 10-point scale. No curving or scaling will be applied even if you receive borderline grade such as 79.99.

Student Behavior

- Academic dishonesty, in the form of cheating, fabrication, falsification, multiple submissions, plagiarism, and complicity, will not be tolerated. Regulations about academic dishonesty are contained in *A Student Guide to Conduct and Discipline at UT Tyler*, which may be obtained from the Office of Student Affairs.
- The Mechanical Engineering Student Handbook available electronically should be used to follow guidelines and will be used to assess Class Conduct & Participation grade.
- Student attitude: A positive attitude/behavior is expected from the students in all interactions.

University policies

Students Rights and Responsibilities

To know and understand the policies that affect your rights and responsibilities as a student at UT Tyler, please follow this link:
http://www.uttyler.edu/ohr/hop/hopseries500.php

Grade Replacement/Forgiveness

If you are repeating this course for a grade replacement, you must file an intent to receive grade forgiveness with the registrar by the 12th day of class. Failure to do so will result in both the original and repeated grade being used to calculate your overall grade point average. Undergraduates will receive grade forgiveness (grade replacement) for only three course repeats; graduates, for two course repeats during his/her career at UT Tyler.

State-Mandated Course Drop Policy

Texas law prohibits a student who began college for the first time in Fall 2007 or thereafter from dropping more than six courses during their entire undergraduate career. This includes courses dropped at another 2-year or 4-year Texas public college or university. For purposes of this rule, a dropped course is any course that is dropped after the census date (See Schedule of Classes for the specific date).
Exceptions to the 6-drop rule may be found in the catalog. Petitions for exemptions must be submitted to the Registrar's Office and must be accompanied by documentation of the extenuating circumstance. Please contact the Registrar's Office if you have any questions.

Disability/Accessibility Services

In accordance with Section 504 of the Rehabilitation Act, Americans with Disabilities Act (ADA) and the ADA Amendments Act (ADAAA) the University of Texas at Tyler offers accommodations to students with learning, physical and/or psychological disabilities. If you have a disability, including non-visible a diagnosis such as a learning disorder, chronic illness, TBI, PTSD, ADHD, or you have a history of

modifications or accommodations in a previous educational environment, you are encouraged to visit https://hood.accessiblelearning.com/UTTyler and fill out the New Student application. The Student Accessibility and Resources (SAR) office will contact you when your application has been submitted and an appointment with Cynthia Lowery, Assistant Director Student Services/ADA Coordinator. For more information, including filling out an application for services, please visit the SAR webpage at http://www.uttyler.edu/disabilityservices, the SAR office located in the University Center, # 3150 or call 903.566.7079

Student Absence due to Religious Observance
Students who anticipate being absent from class due to a religious observance are requested to inform the instructor of such absences at least two weeks ahead of time.

Student Absence for University-Sponsored Events and Activities
If you intend to be absent for a university-sponsored event or activity, you (or the event sponsor) must notify the instructor at least two weeks prior to the date of the planned absence. At that time the instructor will set a date and time when make-up assignments will be completed.

Social Security and FERPA Statement:
It is the policy of The University of Texas at Tyler to protect the confidential nature of social security numbers. The University has changed its computer programming so that all students have an identification number. The electronic transmission of grades (e.g., via e-mail) risks violation of the Family Educational Rights and Privacy Act; grades will not be transmitted electronically.

Emergency Exits and Evacuation:
Everyone is required to exit the building when a fire alarm goes off. Follow your instructor's directions regarding the appropriate exit. If you require assistance during an evacuation, inform your instructor in the first week of class. Do not re-enter the building unless given permission by HCC Police, Fire department, or Fire Prevention Services.

NOTE: The syllabus is subject to change during the course of semester as deemed necessary.

Prepared By: M. A. Rafe Biswas Date: 1/18/2018

Week of		Due on Canvas	Video/Reading Assignment
Jan	16		Review Syllabus/ Laplace Transform and Transfer Functions
	22	Review Quiz on Thursday	Introduction to Process Control
	29	Welcome and Intro	Dynamic modeling of thermal fluid energy systems
Feb	5	HW # 1	FODT/SODT/Higher order system characteristics
	12		Empirical Model Development /System Identification
	19	HW # 2	Feedback Control
	26	Literature Review	Control System Instrumentation
Mar	5	HW # 3	Closed Loop Control System Analysis
	12	Spring Break - No Class	
	19		PID Controller Design and Tuning
	26		Feedforward and Ratio Control
Apr	2		Enhanced/Combined Control Strategies
	9	HW # 4/Prelim Report due Thursday	Programmable Logic Controllers and Ladder Logic
	16	THQ	Work on Project
	26	HW # 5	Work on Project
May	1	Final Report due Thursday	