The University of Texas at Tyler
Department of Mechanical Engineering

MENG 5340 – Topics in Mechanical Engineering (Advanced Process Control)

Credits: 3 hours lecture, 0 hours laboratory per week

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

Text(s): NONE
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).
Wolfgang Altmann. *Practical Process Control for Engineers and Technicians*, edited by Steve McKay, Elsevier Science & Technology (2005). (ProQuest Ebook Central)
Su Whan Sung, Jietae Lee, and In-Beum Lee. *Process Identification and PID Control*, John Wiley & Sons, Incorporated (2009). (ProQuest Ebook Central)
Additional Material: Class Handouts
MATLAB, Simulink and Simscape by MathWorks, Inc. (available through virtual desktop – one.uttyler.edu)

Course Details: Recorded Lecture/Relevant Videos and Materials On Canvas

Class Meeting: Lecture: W 5:00 – 7:40 pm, HEC A217 & RBN 2007
Office: HEC A214
Office Hours: TTh 11:00 – 12:20 pm & W 2:30 to 3:50 pm or By appointment on Zoom or Phone.
E-mail: mbiswas@uttyler.edu
Phone: (903) 566-6115

Note: Use the above email only, which is used as official mode of campus communication. If you call, please leave a voicemail with name and contact if call is not answered. Please allow instructor at least 24-48 hours to respond to your email/phone.

Course Information

Catalog Description: Advanced studies in topics not covered in regularly scheduled graduate courses. May be repeated as content changes. A maximum of nine credit hours may be used for graduate credit on the degree plan.

Prerequisite(s): Dept Chair and/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 models and transfer functions of thermal processes.
2. Analyze and model dynamic thermal processes in time domain.
3. Utilize computational tools to design and analyze different types of control systems.
4. Able to read and interpret block diagrams, and process and instrumentation diagrams.
5. Relate the use of control systems to real-world problems in thermal fluid energy applications.

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 Thermal Processes
- Transfer Function and State-Space models
- Characteristic Dynamic Behavior and Analysis of Thermal Processes
- Advanced Control architectures including Feedback, Feedforward and Cascade Control
- Control System Design, Tuning and Analysis of Thermal Fluid Energy System
- Process and instrumentation diagram

Evaluation and grading activities

- Quiz: There will be 3 quizzes during the semester. Each open book, open computer 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: multiple 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 completed gets >90% depending on work shown. Otherwise, incomplete and unanswered problems are 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 20% deduction from the graded score. Live lecture classes are not mandatory, but strongly recommended. Participation is required on graded Discussions assignments.

- Project: students will work in an empirical process modeling and control design project of a topic approved by the instructor. The default project will be process modeling and feedback control (and advanced controls like feedforward) of thermal fluid energy system involving MIMO systems. Students are encouraged to discuss their work in groups, but each student needs to conduct the experimental data analysis for modeling and controller design and submit preliminary and final reports individually. Each report is 100 points. Students are expected to produce at a minimum conference paper quality report, a template of which will be provided. Each late submission is automatic 10% deduction. Late submissions of reports will be accepted until last class day of the semester.

Note: Instructions on the written and oral report format/style and grading rubric will be given separately on Canvas. Late submissions of assignments will result in 10-20% deduction from the graded score. All late assignments must be submitted on Canvas by last day of class (a Wednesday at 5 pm).

40%xQuiz + 20%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. However, no appeals can be made after the Monday following finals week.

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.
- Follow the UT Tyler Honor Code: I embrace honor and integrity. Therefore, I choose not to lie, cheat, or steal, nor to accept the actions of those who do.
- The Mechanical Engineering Student Handbook available electronically should be used to follow guidelines and will be used to assess Class Conduct & Participation grade.
- **The use of cellular phones during the class and lab is prohibited**.
- **No food or drink is allowed in the classroom or laboratories**.
- Student attitude: Given this is a professional, educational setting, it is recommended to dress and behave appropriately. A positive attitude/behavior is expected from the students in all classes (lectures and laboratories). Students disturbing directly or indirectly the class or other students will be asked to leave the classroom or laboratory with the consequences associated to an absence.

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 Services
In accordance with federal law, a student requesting accommodation must provide documentation of his/her disability to the Disability Services counselor. If you have a disability, including a learning disability, for which you request an accommodation, please contact Ida MacDonald in the Disability Services office in UC 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.

Student Standards of Academic Conduct:

Disciplinary proceedings may be initiated against any student who engages in scholastic dishonesty, including, but not limited to, cheating, plagiarism, collusion, the submission for credit of any work or materials that are attributable in whole or in part to another person, taking an examination for another person, any act designed to give unfair advantage to a student or the attempt to commit such acts.

i. "Cheating" includes, but is not limited to:

- copying from another student's test paper;
- using, during a test, materials not authorized by the person giving the test;
- failure to comply with instructions given by the person administering the test;
- possession during a test of materials which are not authorized by the person giving the test, such as class notes or specifically designed "crib notes". The presence of textbooks constitutes a violation if they have been specifically prohibited by the person administering the test;
- using, buying, stealing, transporting, or soliciting in whole or part the contents of an unadministered test, test key, homework solution, or computer program;
- collaborating with or seeking aid from another student during a test or other assignment without authority;
- discussing the contents of an examination with another student who will take the examination;
- divulging the contents of an examination, for the purpose of preserving questions for use by another, when the instructors has designated that the examination is not to be removed from the examination room or not to be returned or to be kept by the student;
- substituting for another person, or permitting another person to substitute for oneself to take a course, a test, or any course-related assignment;
- paying or offering money or other valuable thing to, or coercing another person to obtain an unadministered test, test key, homework solution, or computer program or information about an unadministered test, test key, home solution or computer program;
- falsifying research data, laboratory reports, and/or other academic work offered for credit;
- taking, keeping, misplacing, or damaging the property of The University of Texas at Tyler, or of another, if the student knows or reasonably should know that an unfair academic advantage would be gained by such conduct; and
- misrepresenting facts, including providing false grades or resumes, for the purpose of obtaining an academic or financial benefit or injuring another student academically or financially.

ii. "Plagiarism" includes, but is not limited to, the appropriation, buying, receiving as a gift, or obtaining by any means another's work and the submission of it as one's own academic work offered for credit.

iii. "Collusion" includes, but is not limited to, the unauthorized collaboration with another person in preparing academic assignments offered for credit or collaboration with another person to commit a violation of any section of the rules on scholastic dishonesty.

iv. All written work that is submitted will be subject to review by plagiarism software.

UT Tyler Resources for Students

- UT Tyler Writing Center (903.565.5995), writingcenter@uttyler.edu
- UT Tyler Tutoring Center (903.565.5964), tutoring@uttyler.edu
- The Mathematics Learning Center, RBN 4021, this is the open access computer lab for math students, with tutors on duty to assist students who are enrolled in early-career courses.
- UT Tyler Counseling Center (903.566.7254)

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

Prepared By: M. A. R. Biswas Date: 1/14/2019

Week of		Major Items Due on Canvas	Video/Reading Assignment
Jan	16	Welcome and Intro	Review Syllabus
	23		Introduction to Process Control / Review Laplace Transform and Transfer Functions
	30		Dynamic modeling of thermal fluid energy systems
Feb	6		FODT/SODT/Higher order system characteristics
	13	Quiz 1	Empirical Model Development /System Identification
	20		Feedback Control
	27	Prelim Report	Control System Instrumentation
Mar	6		Closed Loop Control System Analysis
	13	Spring Break - No Class	
	20		PID Controller Design and Tuning
	27	Quiz 2	Feedforward and Ratio Control
Apr	3		Enhanced/Combined Control Strategies
	10		Programmable Logic Controllers and Ladder Logic
	17	Quiz 3	Work on Project
	24		Work on Project
May	1	Final Report	Work on Project