GRADUATE CERTIFICATE IN
AUTOMATION ENGINEERING AND PLC

OFFERED BY: Department of Electrical and Computer Engineering
Programs: M.S. in Chemical Engineering, M.S. in Electrical Engineering, M.S. in Mechanical Engineering

INTENDED AUDIENCE: _Main Campus Students _Distance (online) Students _X Both

PURPOSE:
Companies have requested that we have a graduate certificate in automation engineering, which is cross-disciplinary between chemical engineering, electrical engineering, and mechanical engineering. It will broaden the graduate certificate offerings of the campus and we expect that it will eventually increase the number of distance MS students. This certificate supports the ECE department goal of offering more certificates. All of these courses are offered as distance, also.

ADMISSION:
This graduate certificate program is open to all persons holding a B.S. degree in any field of engineering from an ABET accredited undergraduate program or a degree in a closely related technical field such as physics or mathematics. The minimum overall GPA in the B.S. degree program should be at least 2.5.

Once admitted to the program, the student must take four designated courses as given below. In order to receive a graduate certificate, the student must have an average graduate grade point average of 3.0 or better in the certificate courses taken.

Students admitted to the certificate program will have non-degree graduate status; however, if they complete the four-course sequence with a grade of B or better in each of the courses taken, they will be admitted to the M.S. program in chemical engineering, electrical engineering, or mechanical engineering if they apply. The certificate courses taken by students admitted to the M.S. program will count towards their master's degrees. Students who do not have all of the prerequisite courses necessary to take the courses in the certificate program will be allowed to take "bridge" courses at either the graduate or undergraduate level to prepare for the formal certificate courses.

Once admitted to the program, a student will be given three years to complete the program so long as he/she maintains a B average in the courses taken.

CONTRIBUTING FACULTY:
Doug Bristow
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CURRICULUM:
Students enrolled in this graduate certificate program will take two required courses and two elective courses. Alternative courses may be substituted with the departmental approval dependent on the availability of the courses listed below:

Required courses:
- Chem Eng 5190/Elec Eng 5350 – Plantwide Process Control
- Elec Eng 5340 – Advanced PLC

Choose two of the following:
- Chem Eng 5140 – Intermediate Chemical Process Safety
- Elec Eng 5345 – PLC Motion Control
- Elec Eng 5870/Mech Eng 5478 – Mechatronics
- Mech Eng 5449 – Robotic Manipulators and Mechanisms
- Mech Eng 5655 – Manufacturing Equipment Automation

**COURSE DESCRIPTIONS:**

**CHEM ENG 5140 Intermediate Chemical Process Safety** (online and on campus)
The identification and quantification of risks involved in the processing of hazardous and/or toxic materials are studied. Methods to design safety systems or alter the chemical process to reduce or eliminate the risks are covered. Prerequisite: Graduate Standing.

**CHEM ENG 5190 Plantwide Process Control** (online and on campus)
Synthesis of control schemes for continuous and batch chemical plants from concept to implementation. Multiloop control, RGA, SVD, constraint control, multivariable model predictive control, control sequence descriptions. Design project involving a moderately complicated multivariable control problem. Prerequisites: Chem Eng 4110 or Elec Eng 3320 or Elec Eng 3340 or graduate standing. (Co-listed with Elec Eng 5350).

**ELEC ENG 5340 Advanced PLC** (online and on campus)
Advanced programmable logic controller (PLC) programming, function block, structured text, function chart, sequencer. Factory communications, system simulation, human-machine interface (HMI) programming. Advanced PID control. Network security and reliability. Class-wide project. Prerequisite: Elec Eng 3340.

**ELEC ENG 5345 PLC Motion Control** (online and on campus)
Factory automation motion control integrated with programmable logic controllers, servo control, variable-speed drive control, PackML state model, sizing motors and drives, machine safety, and experience with commercial hardware/software. Laboratory exercises on small-scale standard applications such as coordinated motion of multiple axes and camming. Prerequisite: Elec Eng 3340.

**ELEC ENG 5350 Plantwide Process Control** (online and on campus)
Synthesis of control schemes for continuous and batch chemical plants from concept to implementation. Multiloop control, RGA, SVD, constraint control, multivariable model predictive control, control sequence descriptions. Design project involving a moderately complicated multivariable control problem. Prerequisites: Chem Eng 4110 or Elec Eng 3320 or Elec Eng 3340 or graduate standing. (Co-listed with Chem Eng 5190).

**ELEC ENG 5870 Mechatronics** (online and on campus)
This course will introduce students to the basics of mechatronics (i.e., the integration of mechanical, electrical, computer, and control systems). Students will learn the fundamentals of sensors and actuators for mechanical systems, computer interfacing, microcontrollers, real-time software, and control. Prerequisite: Mech Eng 4479 or equivalent. (Co-listed with Mech Eng 5478, Aero Eng 5478 and Comp Eng 5820).

MECH ENG 5449 Robotic Manipulators and Mechanisms (online and on campus)
Overview of industrial applications, manipulator systems and geometry. Manipulator kinematics; hand location, velocity and acceleration. Basic formulation of manipulator dynamics and control. Introduction to machine vision. Projects include robot programming, vision-aided inspection and guidance, and system integration. Prerequisites: Mech Eng 3313; Comp Sci 1970 or Comp Sci 1971 or Comp Sci 1972 or Comp Sci 1570. (Co-listed with Aero Eng 5449).

MECH ENG 5478 Mechatronics (online and on campus)
This course will introduce students to the basics of mechatronics (i.e., the integration of mechanical, electrical, computer, and control systems). Students will learn the fundamentals of sensors and actuators for mechanical systems, computer interfacing, microcontrollers, real-time software, and control. Prerequisite: Mech Eng 4479 or equivalent. (Co-listed with Aero Eng 5478, Elec Eng 5870 and Comp Eng 5820).

MECH ENG 5655 Manufacturing Equipment Automation (online and on campus)
Manufacturing automation at the equipment level. Topics include sensors, actuators, and computer interfacing for manufacturing equipment, dynamic modeling and control of manufacturing equipment, interpolation, coordinated motion control, kinematic and geometric error modeling, and runout. Prerequisites: Preceded or accompanied by Mech Eng 4479 or equivalent.