EE-490
SENIOR ELECTRICAL ENGINEERING DESIGN PROJECT

DEPARTMENT	Electrical & Computer Engineering
COORDINATOR	Mark G. Thompson, Professor of Electrical Engineering
CATALOG DESCRIPTION	Students will design, implement, document, and present a device or system as a significant capstone project. The project will emphasize electrical engineering, but will be multidisciplinary.
PREREQUISITES	EE-210, Circuits I EE-211, Circuits I Laboratory EE-240, Electromagnetic Fields & Applications EE-310, Circuits II EE-320, Electronics I EE-321, Electronics I Laboratory EE-332, Signals & Systems CE-210, Digitals I CE-320, Microcomputers I
CLASS/LAB SCHEDULE	One 120-minute class period and two 120-minute laboratory sessions per week. (2-4-4)
TEXTBOOK	Project Dependent
REFERENCE	Project Dependent
CREDITS	4 credits

COURSE LEARNING OUTCOMES

Each student who receives credit for EE-490 will have demonstrated the ability to do all of the tasks listed below:

1. Write an appropriate engineering proposal.
2. Marshal relevant facts from disparate sources including libraries and the Internet.
3. Synthesize marshaled relevant facts and experience into a design in a cooperative and symbiotic fashion.
4. Allocate and schedule time, effort, and team members so as to accomplish the design within the existing limitations.
5. Iterate the design as new information or problems are encountered or found.
6. Write a comprehensive report.
7. Participate in the presentation and demonstration of the design project.

TOPICS

1. Presentation by the faculty of alternative projects and the forming of groups (2 classes)
2. Presentation by the faculty of topics of general interest (such as soldering techniques, resources available at Kettering University, and discussion of different kinds of components) and topics directed to, and tailored to the class project. The latter is expected to include a list of relevant Internet sites. (2 classes)
3. Most of the remaining class periods will be used for faculty monitoring of the progress of groups and assistance as appropriate. Groups are expected to work outside of the scheduled class period.
4. At the end of the semester, each group shall make a presentation that includes the design, the performance, and a demonstration of the end result. A final, written report from each group is also due at the end of the semester.

This syllabus was last reviewed by Mark G. Thompson in December 2008.

Common Statement on Students with Documented Disabilities

The University will make reasonable accommodations for persons with documented disabilities. Students need to register with the Wellness Center every term they are enrolled in classes. To be assured of having services when they are needed, students should contact the Wellness Center during the first week of each term. Note that it is the student's responsibility to arrange accommodations with each professor. For more information on "Disability Services," refer to the *Student Life* section of the current Undergraduate Catalog. Undergraduate catalogs are located at http://www.ketering.edu/undergraduate . This information is also noted in the Student Handbook.

Common Statement on Ethics in the University and Academic Integrity

Kettering University values academic honesty and integrity. Cheating, collusion, misconduct, fabrication, and plagiarism are serious offenses. Each student has a responsibility to understand, accept, and comply with the University's standards of academic conduct as set forth in our statement, "Ethics in the University," and "Academic Integrity" as well as policies established by individual professors. For more information, refer to the *Student Life* section of the current Undergraduate Catalog. Undergraduate catalogs are located at http://www.ketering.edu/undergraduate . This information is also noted in the Student Handbook.

EE-490, Senior Electrical Engineering Design Project
Fall, 2014

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Project: **LED Lighting Fixture Development for Horticulture Applications - Driver and Control Electronics**

Catalog Data: EE-490, Senior Electrical Engineering Design Project 2 0 4 4
Prerequisite: CE-210, EE-210, EE-230, EE-240, EE-310, EE-320, CE-320
Students will design, implement, document, and present a device or system as a significant capstone project. The project will emphasize electrical engineering, but will be multidisciplinary.

Textbook: None

References: See updated posts on course Blackboard

Project Description Outline:

The EE-490 project for this term involves the development of an LED lighting fixture for horticultural applications including the power electronic driver module and microelectronic system controller.

The EE490 course description includes the statement: *Students will design, implement, document, and present a device or system as a significant capstone project. The project will emphasize electrical engineering, but will be multidisciplinary.*

To keep things in perspective, consider that one branch of electrical engineering deals with the generation, transmission, and utilization of electric energy. Other branches of electrical engineering deal with control and the design of electronic circuits (both digital and analog; microelectronic and power electronic). Yet another area of electrical engineering deals with so-called physical electronics, that is, the semiconductor materials and processes that make up the devices and circuits used by electrical engineers. This particular EE490 project blends all of these areas into a compact yet significant multidisciplinary project that addresses a significant global societal issue … the development of energy efficient, low maintenance, reliable, and tunable LED lighting fixtures optimized to enhance plant growth. The EE490 course objectives are intended to give EE senior students a broad perspective and an opportunity to develop and practice engineering design skills including analytical reasoning, computer simulation, teamwork utilization, project management, financial and economic considerations, system fabrication, system test and verification, and robust design for reliability.

In this project, each design team of 3 students will design, implement, document, and present an LED "Grow Light" to meet specific operational specifications in accordance with EE490 course objectives. Furthermore, each team will have the opportunity to practice entrepreneurial and intrapreneurial skills in accordance with Kettering University initiatives by proposing and implementing unique special features that could potentially enhance the functionality and marketability of the LED grow light.

The overall project outline will be broken into 3 broad stages:
Stage 1: Initial development of basic system control features (60%)

In this stage, student teams will design and assemble an LED grow light from a hardware kit provided. The kit includes a heat sink fixture support and fan (and associated hardware), a dc power supply, an assortment of 3 W LED's (Red and Blue), and 2 commercial LED driver modules. To perform system control functions, an Arduino Uno microcontroller along with a small protoshield board are included. Basic functionality in this stage includes On/Off Switch, 2-channel analog input potentiometer dimming, fan control, delay and ramp up to set power spectral density level.

Stage 2: Design and implementation of LED driver modules to replace the commercial units provided in the initial development (20%)

A power electronic driver module for an LED light fixture is basically a DC/DC converter (a switched-mode power supply) operating in a constant current source mode. It typically employs temperature compensation so that the module can drive a string or strings of power LED's at a non-fluctuating set current level appropriate to the

application. Each student team will design and implement their own LED driver modules to replace the functionality of the commercial drivers supplied in the basic kit.

Stage 3: Entrepreneurial/Intrapreneurial concepts development (20%)

Each team will propose up to four unique (and significant) enhancements to the basic functionality set in the initial development. All proposed enhancements will be pre-approved by the instructor.