TO: The Faculty of the College of Engineering

FROM: The Faculty of Agricultural and Biological Engineering

RE: New Course ABE 31400

The faculty of the Department of Agricultural and Biological Engineering has approved the following new course. This action is now submitted to the Engineering Faculty with a recommendation for approval.

ABE 31400 **Design of Electronic Systems**
Sem. 2, Class 2. Lab 2. Cr. 3.
Requisites, Restrictions, and Attributes: MA 26200 or MA 26600

Description: Fundamental aspects of circuits, microprocessors, transducers, sensors, instrumentation, and data acquisition are presented, with particular emphasis on electronic systems used in agricultural, biological, and food applications. Laboratory exercises are used to apply the course material to constructing and testing circuits, microprocessor controlled systems, and the data collection and monitoring of systems.

Reason: The ability to incorporate microprocessors, data acquisition systems, electrical components, integrated circuits, and electrical test equipment is critical for agricultural and biological engineering students. Equipment throughout the entire food production chain (agricultural machines, environmental sensing, transportation and processing, quality monitoring, laboratory testing, etc.) rely heavily on the integration of electrical systems for the purposes of control, monitoring, data acquisition, and communication. This course will replace ECE 20100 in the current plan of study.

Bernard A. Engel, Professor and Head
Agricultural and Biological Engineering Department

APPROVED FOR THE FACULTY
OF THE SCHOOLS OF ENGINEERING
BY THE ENGINEERING
CURRICULUM COMMITTEE

ECC Minutes #13

Date 5/10/2013

Chairman ECC

EFD 52-13

Office of the Registrar
FORM 40 REV. 10/10

PURDUE UNIVERSITY
REQUEST FOR ADDITION, EXPIRATION,
OR REVISION OF AN UNDERGRADUATE COURSE
(10000-40000 LEVEL)

DEPARTMENT: Agricultural and Biological Engineering
EFFECTIVE SESSION: ~~Spring 2013~~ (201410)

INSTRUCTIONS: Please check the items below which describe the purpose of this request.

- [x] 1. New course with supporting documents
- [ ] 2. Add existing course offered at another campus
- [ ] 3. Expiration of a course
- [ ] 4. Change in course number
- [ ] 5. Change in course title
- [ ] 6. Change in course credit/type
- [ ] 7. Change in course attributes (department head signature only)
- [ ] 8. Change in instructional hours
- [ ] 9. Change in course description
- [ ] 10. Change in course requisites/restrictions
- [ ] 11. Change in semesters offered (department head signature only)
- [ ] 12. Transfer from one department to another

PROPOSED:		EXISTING:	
Subject Abbreviation	ABE	Subject Abbreviation	
Course Number	31400	Course Number	
Long Title	Design of Electronic Systems		
Short Title	Design Of Electronic Systems		

Abbreviated title will be entered by the Office of the Registrar if omitted. (30 CHARACTERS ONLY)

TERMS OFFERED
Check All That Apply:
[ ] Fall [x] Spring [ ] Summer

CAMPUS(ES) INVOLVED
[ ] Calumet [ ] N. Central
[ ] Cont Ed [ ] Tech Statewide
[ ] Ft. Wayne [x] W. Lafayette
[ ] Indianapolis

CREDIT TYPE
1. Fixed Credit: Cr. Hrs. 3
2. Variable Credit Range:
Minimum Cr Hrs
(Check One) To [ ] Or [ ]
Maximum Cr. Hrs
3. Equivalent Credit: Yes [ ] No [ ]

COURSE ATTRIBUTES: Check All That Apply

1. Pass/Not Pass Only	[ ]	6 Registration Approval Type	
2. Satisfactory/Unsatisfactory Only	[ ]	Department	[ ] Instructor [ ]
3. Repeatable	[ ]	7 Variable Title	[ ]
Maximum Repeatable Credit:	[ ]	8 Honors	[ ]
4. Credit by Examination	[ ]	9 Full Time Privilege	[ ]
5. Special Fees	[ ]	10 Off Campus Experience	[ ]

Schedule Type	Minutes Per Mtg	Meetings Per Week	Weeks Offered	% of Credit Allocated
Lecture	50	2		
Recitation				
Presentation				
Laboratory	~~100~~ 110	1		
Lab Prep				
Studio				
Distance				
Clinic				
Experiential				
Research				
Ind. Study				
Pract/Observ				

RECEIVED
JUN - 6 2013
OFFICE OF THE REGISTRAR

Cross-Listed Courses
RECEIVED
MAY 23 2013
OFFICE OF THE REGISTRAR

COURSE DESCRIPTION (INCLUDE REQUISITES/RESTRICTIONS):

Fundamental aspects of circuits, microprocessors, transducers, sensors, instrumentation, and data acquisition are presented, with particular emphasis on electronic systems used in agricultural, biological, and food applications. Laboratory exercises are used to apply the course material to constructing and testing circuits, microprocessor controlled systems, and the data collection and monitoring of systems.
Requisites, Restrictions, and Attributes: MA 26200 or MA 26600

*COURSE LEARNING OUTCOMES

Design integrated electronic systems for monitoring and controlling engineering systems. Utilize common test and development instruments while constructing and troubleshooting electronic systems (multi-meters, oscilloscopes, microprocessors, etc.). Demonstrate electrical system construction techniques including cable preparation, soldering, crimping, circuit board construction and others. Understand the function of common circuit components such as resistors, capacitors, inductors, diodes, transistors, op-amps, microprocessors, and integrated circuits. An ability to define and apply concepts of charge, current, voltage, power, energy, resistance, inductance, capacitance, amplification, and electrical system diagnostics. Analyze basic circuits using the principles of superposition, linearity, source transformations, Ohm's Law, Kirchoff's Voltage Law, and Kirchoff's Current Law, and Thevenin/Norton equivalent circuits. An ability to qualitatively predict and compute the step responses to first order (RL and RC) and second order (RLC) circuits. Design and use signal conditioning devices. Interface microcontrollers with a variety of sensors and actuators to accomplish tasks. Understand satellite based positioning systems and their common applications.

Calumet Department Head	Date	Calumet School Dean	Date
Fort Wayne Department Head	Date	Fort Wayne School Dean	Date
Indianapolis Department Head	Date	Indianapolis School Dean	Date
North Central Faculty Senate Chair	Date	Vice Chancellor for Academic Affairs	Date
West Lafayette Department Head: [signature]	5/17/13 Date	West Lafayette College/School Dean: [signature]	5-17-13 Date
West Lafayette Registrar: [signature]	6/11/13 Date		

OFFICE OF THE REGISTRAR

6/7/13

Office of the Registrar
FORM 40 REV. 10/10

PURDUE UNIVERSITY

REQUEST FOR ADDITION, EXPIRATION, OR REVISION OF AN UNDERGRADUATE COURSE
(10000-40000 LEVEL)

EFD S2-13

DEPARTMENT: Agricultural and Biological Engineering

EFFECTIVE SESSION: Spring 2013

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3. Equivalent Credit: Yes [ ] No [ ]

COURSE ATTRIBUTES: Check All That Apply

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3. Repeatable [ ]
   Maximum Repeatable Credit: [ ]
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5. Special Fees [ ]
6. Registration Approval Type
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Calumet Department Head	Date	Calumet School Dean	Date
Fort Wayne Department Head	Date	Fort Wayne School Dean	Date
Indianapolis Department Head	Date	Indianapolis School Dean	Date
North Central Faculty Senate Chair	Date	Vice Chancellor for Academic Affairs	Date
West Lafayette Department Head	Date	West Lafayette College/School Dean	Date

West Lafayette Registrar Date

OFFICE OF THE REGISTRAR

ABE 31400 Design of Electronic Systems

COURSE CONTACT INFORMATION:

Name: John Lumkes
Phone Number: 765-494-1173
E-mail Address: lumkes@purdue.edu
Campus Address: ABE 314

Catalog Description. Fundamental aspects of circuits, microprocessors, transducers, sensors, instrumentation, and data acquisition are presented, with particular emphasis on electronic systems used in agricultural, biological, and food applications. Laboratory exercises are used to apply the course material to constructing and testing circuits, microprocessor controlled systems, and the data collection and monitoring of systems.

Requisites, Restrictions, and Attributes: MA 26200 or MA 26600

COLLEGE (AGRICULTURE) LEARNING OUTCOMES ADDRESSED BY THIS COURSE

_____	Professional Preparation: Demonstrate proficiency in their chosen discipline that incorporates knowledge skills, technology, and professional conduct.
__X__	Scientific Principles: Demonstrate use of the scientific method to identify problems, formulate and test hypotheses, conduct experiments and analyze data, and derive conclusions.
__X__	Critical Thinking: Demonstrate critical thinking by using data and reasoning to develop sound responses to complex problems.
_____	Communication: Demonstrate the ability to write and speak with effectiveness while considering audience and purpose.
__X__	Teamwork: Demonstrate the ability to work effectively as part of a problem-solving team.
_____	Cultural Understanding: Demonstrate knowledge of a range of cultures and an understanding of human values and points of view of other than their own.
_____	Social Science Principles: Demonstrate ability to apply social, economic, political, and environmental principles to living in a global community.
_____	Civic Responsibility: Demonstrate awareness of civic responsibility to community and society at large.
__X__	Lifelong Learning: Demonstrate skills necessary for lifelong learning.

DEPARTMENTAL/PROGRAM LEARNING OUTCOMES ADDRESSED BY THIS COURSE

__X__	an ability to apply knowledge of mathematics, science, and engineering
__X__	ability to design and conduct experiments, as well as to analyze and interpret data.
__X__	an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
_____	an ability to function on multidisciplinary teams
__X__	an ability to identify, formulate, and solve engineering problems

_____ an understanding of professional and ethical responsibility

_____ an ability to communicate effectively

_____ the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context

__X__ a recognition of the need for, and an ability to engage in life-long learning

_____ a knowledge of contemporary issues

__X__ an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Course outline of Topics/Syllabus

Course Topics/Practices:

- Linear circuitry analysis
- Microcontrollers
- Data acquisition and analysis
- Statistical analysis
- AC/DC power and conversion
- Data Communications
- Sensors and transducers
- Computer components
- Actuation and Control
- GPS and Data Logging

Lab Topics/Practices:

- Circuit construction and troubleshooting
- Equipment for electronic systems construction, testing, and troubleshooting
- Instrumentation and sensors
- Microprocessor programming and applications
- Integrated circuits in electronic systems

Reading List/Textbook

Online tutorials (ex. http://arduino.cc/en/Tutorial/HomePage and bookboon.com—Wasif Naeem, Concepts in Electrical Circuits, ISBN: 978-87-7681-499-1)

http://sourceforge.net/projects/simulide/ (Open source Arduino and circuit simulator)

http://www.adafruit.com/products/170 (example of the type of kit each student will buy)

Example syllabus

ABE 314 – Design of Electronic Systems

Spring 2014
Instructor: Dr. John Lumkes (lumkes@purdue.edu)
Office: ABE 314
Telephone: 49-41173 (office)
Office Hours: Immediately after each lecture and by appointment
Teaching Assistant: TBD
Class Schedule:
Lecture - T Th
Lab - Th

Textbook and/or other recommended material

Course Pack for lecture material; electrical systems hardware kit for each student

Course Learning Objectives:

Successful completion of the course will enable the students to:

- Design integrated electronic systems for monitoring and controlling engineering systems
- Utilize common test and development instruments while constructing and troubleshooting electronic systems (multi-meters, oscilloscopes, microprocessors, etc.).
- Demonstrate electrical system construction techniques including cable preparation, soldering, crimping, circuit board construction and others.
- Understand the function of common circuit components such as resistors, capacitors, inductors, diodes, transistors, op-amps, microprocessors, and integrated circuits.
- An ability to define and apply concepts of charge, current, voltage, power, energy, resistance, inductance, capacitance, amplification, and electrical system diagnostics.
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- Design and use signal conditioning devices.
- Interface microcontrollers with a variety of sensors and actuators to accomplish tasks.
- Understand satellite based positioning systems and their common applications.

Grading Procedure

A midterm exam and a final exam will be administered. Your grade for the course will be comprised of the following:

Lab exercises	50 %
Midterm Exam	20 %
Final Exam	30 %

The final grades for the course will be based solely on your performance in this class. The following performances will guarantee such grades:

Grade	GPA Value	Numerical Range
A	4.0	93-100
A-	3.7	90.0 - 92.9
B+	3.3	87.0 - 89.9
B	3.0	83.0 - 86.9
B-	2.7	80.0 - 82.9
C+	2.3	77.0 - 79.9
C	2.0	73.0 – 76.9
C-	1.7	70.0 – 72.9
D+	1.3	67.0 – 69.9
D	1.0	63.0 – 66.9
D-	0.7	60.0 – 62.9
F	0.0	< 60.0

Weekly Syllabus for Lecture and Lab

Week	Lecture Topic	Laboratory
1	Intro to electrical laws and concepts (charge, voltage, current etc...)	Lab safety, introduction to lab instruments, and "Blinking Light" code introduction
2	Circuit Analysis/Measurement, Circuit components	Using the Arduino as a measure tool; Matlab introduction
3	Circuit Analysis, terminology, Kirchhoff's laws, Ohm's laws	Current and voltage measuring of series and parallel circuits
4	Op amps, signal conditioning	Op amps and strain gauges
5	Superposition, linearity, source transformations, Thevenin/Norton equivalence	RC filters and oscilloscopes
6	1st order RL and RC circuits, 2nd order RLC circuits	Buttons/switches, pull up and pull down resistors

7	Transistors, relays, Switches, Power Supplies	Transistors and switching times compared to relays, oscilloscope
8	Filters types and design	Analog, PWM and Input from potentiometer, LED and solenoids
9	Computer Components and functions, machine view/machine vision	Simulink and State Flow
10	Actuators and controls (PLC)	Digital lock lab using State flow
11	Speed sensors and pickups, CANBUS, electric motors	PWM and Actuators
12	Sensors and gauges, temperature sensors, strain, pressure, flow, force gauges	Separate lab week for ENREs, MSEs and BEs
13	AC/DC power and conversion, Statistics, Data Acquisition	Continuation of week 12
14	Microcontrollers, Data communications	Continuation of week 12
15	Further applications....	