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 by the Engineering Curriculum Committee

ECC Minutes 413  
Date 5/10/2013  
Chairman ECC
PURDUE UNIVERSITY
REQUEST FOR ADDITION, EXPIRATION, OR REVISION OF AN UNDERGRADUATE COURSE
(10000-40000 LEVEL)

DEPARTMENT: Agricultural and Biological Engineering
EFFECTIVE SESSION: Spring 2013 (20140)

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

☐ 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

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

EXISTING:
Subject Abbreviation: Subject Abbreviation
Course Number: Course Number

TERMS OFFERED:
Check All That Apply:
☐ Fall ☐ Spring ☐ Summer

CAMPUS(ES) INVOLVED:
☐ Columb. ☐ Cont Ed ☐ Ft. Wayne
☐ Tech Bluffdale ☐ W. Lafayette

CREDIT TYPE:
1. Fixed Credit: 3
2. Variable Credit: Minimum Credit: 0
Maximum Credit: 4

SCHEDULE TYPE:
Lecture: 100
Presentation: 0
Laboratory: 0
Study: 0
Distance: 0
Clinical: 0
Environmental: 0
Research: 0
Inst. Study: 0
Field/Shop: 0

RECEIVED
JUN - 6 2013
OFFICE OF THE REGISTRAR

OFFICE OF THE REGISTRAR
MAY 2 3 2013

COURSE DESCRIPTION (INCLUDE PRIORITIES/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. Utilizes common test and development instruments while constructing and troubleshooting electronic systems (multi-meters, oscilloscopes, microprocessors, etc.). Demonstrates electrical system construction techniques including cable preparation, soldering, crimping, circuit board construction and others. Understands 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 change, current, voltage, power, energy, resistance, inductance, capacitance, amplification, and electrical system design. 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.
**PURDUE UNIVERSITY**
REQUEST FOR ADDITION, EXPIRATION, OR REVISON OF AN UNDERGRADUATE COURSE (10000-40000 LEVEL)

**DEPARTMENT:** Agricultural and Biological Engineering  
**EFFECTIVE SESSION:** Spring, 2013  
**INSTRUCTIONS:** Please check the items below which describe the purpose of this request.

- [ ] New course with supporting documents
- [ ] Add existing course offered at another campus
- [ ] Expiration of a course
- [ ] Change in course number
- [ ] Change in course title
- [ ] Change in course credit/credit
- [ ] Change in course attributes (department head signature only)
- [ ] Change in instructional hours
- [ ] Change in course description
- [ ] Change in course requisites/restrictions
- [ ] Change in semesters offered (department head signature only)
- [ ] Transfer from one department to another

**PROPOSED:**
- Subject Abbreviation: ABE
- Course Number: 31400
- Long Title: Design of Electronic Systems

**EXISTING:**
- Subject Abbreviation
- Course Number
- Long Title

**TERMS OFFERED:**
- Check All That Apply: [ ] Fall  [x] Spring  [ ] Summer
- CAMPUS(ES) INVOLVED:
  - [ ] Calumet
  - [ ] Cont.Ed
  - [ ] R. Wayne
  - [ ] Indianapolis
  - [ ] N. Central
  - [ ] Tech Statewide
  - [ ] W. Lafayette

**CREDIT TYPE:**
- 1. Fixed Credit: Cr. Hrs. 3
- 2. Variable Credit Range: [ ] Minimum Cr. Hrs. (Check One) To [ ] Or [ ] Maximum Cr. Hrs.
- 3. Credit by Examination: [ ] Yes [ ] No
- 4. Maximum Repeatable Credit: [ ] To [ ] Or [ ]

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

**Schedule Type**
- Lecture: 50
- Recitation: 2
- Presentation: 1
- Laboratory: 110
- Clinic: 1
- Research: 1
- Prac/Observ: 1

**Weeks Offered**
- [ ] Online
- [ ] Hrs.
- [ ] % of Credit Allocated

**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.

**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 determine 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, special transformations, Ohm’s Law, Kirchoff’s Voltage Law, and Kirchoff’s Current Law, and Thevenin/Norton equivalent circuits. An ability to qualitatively 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.

**Signature:**

**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

X 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.

X 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.

X Cultural Understanding: Demonstrate knowledge of a range of cultures and an understanding of human values and points of view of other than their own.

X Social Science Principles: Demonstrate ability to apply social, economic, political, and environmental principles to living in a global community.

X 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

X 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
a recognition of the need for, and an ability to engage in life-long learning
a knowledge of contemporary issues
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


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.
- 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.

**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:
<table>
<thead>
<tr>
<th>Grade</th>
<th>GPA Value</th>
<th>Numerical Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>4.0</td>
<td>93-100</td>
</tr>
<tr>
<td>A-</td>
<td>3.7</td>
<td>90.0 - 92.9</td>
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<tr>
<td>B+</td>
<td>3.3</td>
<td>87.0 - 89.9</td>
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<tr>
<td>B</td>
<td>3.0</td>
<td>83.0 - 86.9</td>
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<tr>
<td>B-</td>
<td>2.7</td>
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<td>0.7</td>
<td>60.0 - 62.9</td>
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<tr>
<td>F</td>
<td>0.0</td>
<td>&lt; 60.0</td>
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**Weekly Syllabus for Lecture and Lab**

<table>
<thead>
<tr>
<th>Week</th>
<th>Lecture Topic</th>
<th>Laboratory</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Intro to electrical laws and concepts (charge, voltage, current etc...)</td>
<td>Lab safety, introduction to lab instruments, and &quot;Blinking Light&quot; code introduction</td>
</tr>
<tr>
<td>2</td>
<td>Circuit Analysis/Measurement, Circuit components</td>
<td>Using the Arduino as a measure tool; Matlab introduction</td>
</tr>
<tr>
<td>3</td>
<td>Circuit Analysis, terminology, Kirchhoff's laws, Ohm's laws</td>
<td>Current and voltage measuring of series and parallel circuits</td>
</tr>
<tr>
<td>4</td>
<td>Op amps, signal conditioning</td>
<td>Op amps and strain gauges</td>
</tr>
<tr>
<td>5</td>
<td>Superposition, linearity, source transformations, Thevenin/Norton equivalence</td>
<td>RC filters and oscilloscopes</td>
</tr>
<tr>
<td>6</td>
<td>1st order RL and RC circuits, 2nd order RLC circuits</td>
<td>Buttons/switches, pull up and pull down resistors</td>
</tr>
<tr>
<td>7</td>
<td>Transistors, relays, Switches, Power Supplies</td>
<td>Transistors and switching times compared to relays, oscilloscope</td>
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<td>---------------------------------------------------------------</td>
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<tr>
<td>8</td>
<td>Filters types and design</td>
<td>Analog, PWM and Input from potentiometer, LED and solenoids</td>
</tr>
<tr>
<td>9</td>
<td>Computer Components and functions, machine view/machine vision</td>
<td>Simulink and State Flow</td>
</tr>
<tr>
<td>10</td>
<td>Actuators and controls (PLC)</td>
<td>Digital lock lab using State flow</td>
</tr>
<tr>
<td>11</td>
<td>Speed sensors and pickups, CANBUS, electric motors</td>
<td>PWM and Actuators</td>
</tr>
<tr>
<td>12</td>
<td>Sensors and gauges, temperature sensors, strain, pressure, flow, force gauges</td>
<td>Separate lab week for ENREs, MSEs and BEs</td>
</tr>
<tr>
<td>13</td>
<td>AC/DC power and conversion, Statistics, Data Acquisition</td>
<td>Continuation of week 12</td>
</tr>
<tr>
<td>14</td>
<td>Microcontrollers, Data communications</td>
<td>Continuation of week 12</td>
</tr>
<tr>
<td>15</td>
<td>Further applications....</td>
<td></td>
</tr>
</tbody>
</table>