000005

CLEMSON
UNIVERSITY **Curriculum and Course Change System - Print Change/Delete Course Form**
XChange a Course - Abbrev & Number: PH SC-107
Corresponding Lab Course: PH SC-L-107
Corresponding Honors course: --
..Add Honors course: --
Corresponding Graduate course: --
..Add Graduate course: --
Course Title: INTRO TO EARTH SCI

Brief Statement of Change:
This course is now intended for the general student population rather
than for elementary education majors as stated in the catalogue
description.

| Last Term taught:1108 | **..Change Abbrev to:** |
| Effective Term:05/2012 | **..Change Number to:** |

..Change Catalog Title:	**..Change Transcript Title:**
from:	from: INTRO TO EARTH SCI
to:	to:

| .. | From: Fixed Credit: 4 (3,3) | To: Fixed Credit: (,) |
| **Change of Credit** | Variable Credit: -(-), (-) | Variable Credit: -(-),(-) |

.. Add cross-listing with the following child course(s):
.. Delete cross-listing with the following child course(s):
.. Reverse Parent/Child relationship with:

..Change Method of Instruction		**..Change Course Modifier**		**..Change General Education Designation**	
from:	to:	from:	to:	from:	to:
..A-Lecture Only	..	..Pass/Fail Only	..	English	
..B-Lab (w/fee)	..	XGraded	..	..Composition	..
..D-Seminar	..	..Variable Title	..	Oral	
E-Independent		..Creative Inquiry	..	..Communication	..
..Study	..	..Repeatable	..	..Mathematics	..
..F-Tutorial (w/fee)	..	maximum credits		Natural Science	
..G-Studio	..	from:		..w/Lab	..
..H-Field course	..	to:		..Math or Science	..
..I-Study Abroad	..			..A&H (Literature)	..
..L-Lab (no/fee)	..			A&H (Non-	
N/B-Lecture/Lab				..Literature)	..
X(w/fee)	..			..Social Science	..
N/L-Lecture/Lab(no				..CCA	..
..fee)	..			..STS	..

XChange Catalog Description:
from: Survey of topics in geology, meteorology, astronomy, and oceanography, emphasizing comprehension and practical application of earth science concepts to experiments and activities appropriate for the elementary school classroom. Enrollment priority will be given to Early Childhood and Elementary Education majors.
to: Survey of topics in geology, meteorology, astronomy, and oceanography, emphasizing comprehension and practical application of earth science concepts to experiments.

..Change Prerequisite(s):
from:
to:

Learning Objectives: • Construct ideas and connections between concepts to make sense of the ideas rather than simply memorizing isolated facts.
• Gain an appreciation for and understanding of the way science and scientists work.
• Provide an adequate foundation in science content that will enable students to understand scientific concepts and processes.
• Apply scientific concepts and process to daily life and career related situations.

Topical Outline: Hours Lecture
8 Earth in space
- Shape and size
- Motions
- Place and time
- The moon
2 Introduction to minerals
8 Rocks and Minerals
- Igneous rocks
- Sedimentary rocks
- Metamorphic rocks
- The rock cycle
8 Plate tectonic
- History of Earth
- Earth's Internal Structure
- Theory of plate tectonics

7 Building Earth's surface
- Earth's surface
- Diastrophism

- Earthquakes
6 Shaping Earth's surface
- Weathering
- Soils
- Erosion
3 Weather and climate
3 Earth's waters

Evaluation: The course grade will be determined based upon the total number of points earned during a semester. Each area of evaluative assessment will contribute as follows:
Lab Reports 20%
Weekly homework assignments 10%
Class participation 10%
Four Quizzes (4 @ 10%) 40%
Final Exam 20%

TOTAL 100%
Grades are assigned based upon your final percentage of points earned:
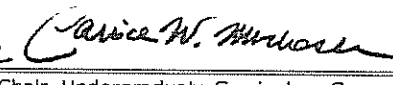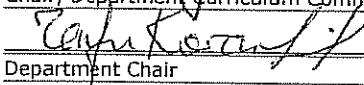90-100%: A 80-89.9%: B 70-79.9%: C 60-69.9%: D 59.9% and below: F

Learning Activities associated with General Education competencies (if applicable): The course is designed to fulfill the "natural science with lab" competancy.

Form Originator:MNAMMOU, Minory Nammouz**Date Form Created:** 1/11/2012
Form Last Updated by: , Date Form Last Updated: 2/8/2012
Form Number: 4771

Approval

Chair, Department Curriculum Committee	8 Feb 2012 Date	Chair, Undergraduate Curriculum Committee	3/2/2012 Date
Department Chair	2/8/12 Date	Chair, Graduate Curriculum Committee	Date
Chair, College Curriculum Committee	Date	Provost	3/25/12 Date
College Dean	2/9/12 Date	President	3/28/12 Date
Director, Calhoun Honors College	Date		

CLEMSON
UNIVERSITY Curriculum and Course Change System – Print Change/Delete Course Form

XChange a Course - Abbrev & Number: PH SC-108
Corresponding Lab Course: PH SC-L-108
Corresponding Honors course: --
..Add Honors course: --
Corresponding Graduate course: --
..Add Graduate course: --
Course Title: INTRO TO PHYS SCI

Brief Statement of Change:
This course is now intended for the general student population rather than for elementary education majors as stated in the catalogue description.

Last Term taught:1105	**..Change Abbrev to:**
Effective Term:05/2012	**..Change Number to:**

..Change Catalog Title:	**..Change Transcript Title:**
from:	from: INTRO TO PHYS SCI
to:	to:

..	From: Fixed Credit: 4 (3,3)	To: Fixed Credit: (,)
Change of Credit	Variable Credit: -(-), (-)	Variable Credit: -(-),(-)

.. Add cross-listing with the following child course(s):

.. Delete cross-listing with the following child course(s):

.. Reverse Parent/Child relationship with:

..Change Method of Instruction		**..Change Course Modifier**		**..Change General Education Designation**	
from:	to:	from:	to:	from:	to:
..A-Lecture Only	..	..Pass/Fail Only	..	English	
..B-Lab (w/fee)	..	XGraded	..	..Composition	..
..D-Seminar	..	..Variable Title	..	Oral	
E-Independent		..Creative Inquiry	..	..Communication	..
..Study	..	..Repeatable	..	..Mathematics	..
..F-Tutorial (w/fee)	..	maximum credits		Natural Science	
..G-Studio	..	from:		..w/Lab	..
..H-Field course	..	to:		..Math or Science	..
..I-Study Abroad	..			..A&H (Literature)	..
..L-Lab (no/fee)	..			A&H (Non-	
N/B-Lecture/Lab				..Literature)	..
X(w/fee)	..			..Social Science	..
N/L-Lecture/Lab(no				..CCA	..
..fee)	..			..STS	..

XChange Catalog Description:
from: Survey of topics in chemistry and physics emphasizing comprehension and practical application of physical science concepts to experiments and activities appropriate for the elementary school classroom. Enrollment priority will be given to Early Childhood and Elementary Education majors.
to: Survey of topics in chemistry and physics emphasizing comprehension and practical application of physical science concepts to experiments.

..Change Prerequisite(s):
from:
to:

Learning Objectives: • Construct ideas and connections between concepts to make sense of the ideas rather than simply memorizing isolated facts.
• Gain an appreciation for and understanding of the way science and scientists work.
• Provide an adequate foundation in science content that will enable students to understand scientific concepts and processes.
• Apply scientific concepts and process to daily life and career related situations.

Topical Outline: Hours Lecture
2 What is Science?
8 Energy
- Work
- Motion
- Energy flow
8 Heat and temperature
- The kinetic molecular theory
- Temperature
9 Atoms and periodic properties
- Chemical bonds
- Composition of compounds

9 Chemical reactions
- Chemical equations
- Chemical formulas
- Types of chemical reactions

9 Water and solutions
- Household water

- Properties of water
- Solutions
- Acids bases and salts

Evaluation: The course grade will be determined based upon the total number of points student earn this semester. Each area of evaluative assessment will contribute as follows:
Lab Reports 20%
Weekly homework assignments 10%
Class participation 10%
Four Quizzes (4 @ 10%) 40%
Final Exam 20%

TOTAL 100%
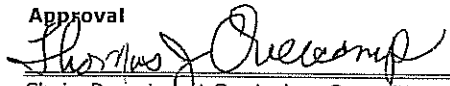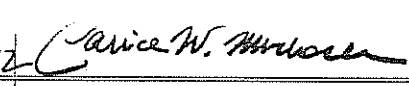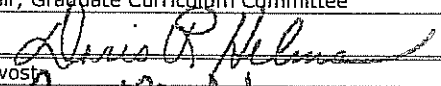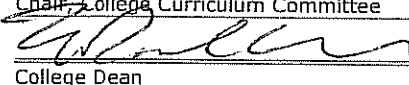Grades are assigned based upon your final percentage of points earned:
90-100%: A 80-89.9%: B 70-79.9%: C 60-69.9%: D 59.9% and below: F

Form Originator:MNAMMOU, Minory Nammouz**Date Form Created:** 1/11/2012
Form Last Updated by: , **Date Form Last Updated:** 2/8/2012
Form Number: 4772

Approval

(signature)	8 Feb 2012	_(signature)_	3/2/2012
Chair, Department Curriculum Committee	Date	Chair, Undergraduate Curriculum Committee	Date
(signature)	2/6/12		
Department Chair	Date	Chair, Graduate Curriculum Committee	Date
		(signature)	3/25/12
Chair, College Curriculum Committee	Date	Provost	Date
(signature)	2/9/12	_(signature)_	3/28/12
College Dean	Date	President	Date
Director, Calhoun Honors College	Date		

CLEMSON

UNIVERSITY **Curriculum and Course Change System – Print Change/Delete Course Form**

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X **Change a Course - Abbrev & Number:** I E- 482
Corresponding Lab Course: I E-L-482
Corresponding Honors course: --
.. Add Honors course: --
Corresponding Graduate course: I E- -682
.. Add Graduate course: --
Course Title: SYSTEMS MODELING

Brief Statement of Change:
MTH SC has an Operations Research / Management Science emphasis area which has
IE 482 listed. However, the prerequisites for IE 482 are very narrowly defined. Adding
these alternate prerequisites will more easily enable MTHSC students to register for
the course. Note that MTHSC 302 is specified since it is required for MTHSC degrees.

Last Term taught: 1108	**.. Change Abbrev to:**	
Effective Term: 05/2012	**.. Change Number to:**	

.. Change Catalog Title: | **.. Change Transcript Title:**
from: | from: SYSTEMS MODELING
to: | to:

..
Change of Credit | From: Fixed Credit: 4 (3,2) | To: Fixed Credit: (,)
Variable Credit: - (-), (-) | Variable Credit: - (-),(-)

.. Add cross-listing with the following child course(s):
.. Delete cross-listing with the following child course(s):
.. Reverse Parent/Child relationship with:

.. Change Method of Instruction		**.. Change Course Modifier**		**.. Change General Education Designation**	
from:	to:	from:	to:	from:	to:
.. A-Lecture Only	..	.. Pass/Fail Only	..	.. English Composition	..
.. B-Lab (w/fee)	..	X Graded	..	.. Oral Communication	..
.. D-Seminar	..	.. Variable Title	..	.. Mathematics	..
.. E-Independent Study	..	.. Creative Inquiry	..	.. Natural Science w/Lab	..
.. F-Tutorial (w/fee)	..	.. Repeatable	..	.. Math or Science	..
.. G-Studio	..	maximum credits		.. A&H (Literature)	..
.. H-Field course	..	from:		.. A&H (Non-Literature)	..
.. I-Study Abroad	..	to:		.. Social Science	..
.. L-Lab (no/fee)	..			.. CCA	..
X N/B-Lecture/Lab(w/fee)	..			.. STS	..
.. N/L-Lecture/Lab(no fee)	..				

.. Change Catalog Description:
from:
to:

X **Change Prerequisite(s):**
from: IE 361 and IE 381
to: IE 361 and IE 381; or MTHSC 440 and MTHSC 441 and MTHSC 302

Learning Objectives:
Topical Outline:
Evaluation:

Form Originator: MKURZ, Mary Kurz **Date Form Created:** 1/4/2012
Form Last Updated by: MKURZ, Mary Kurz **Date Form Last Updated:** 1/4/2012
Form Number: 4762

Approval

	Date		Date
Chair, Department Curriculum Committee	1/4/12	Chair, Undergraduate Curriculum Committee	3/2/2012
Department Chair	1/4/12	Chair, Graduate Curriculum Committee	
Chair, College Curriculum Committee		Provost	3/25/12
College Dean	2/9/12	President	3/28/12
Director, Calhoun Honors College	Date		

CLEMSON
U N I V E R S I T Y **Curriculum and Course Change System – Print Change/Delete Course Form**

XChange a Course – Abbrev & Number: E C E-320
Corresponding Lab Course: --
Corresponding Honors course: --
XAdd Honors course: E C E-H-320
Corresponding Graduate course: --
..Add Graduate course: --
Course Title: ELECTRONICS I

Sent to Honors

Brief Statement of Change:
Add Honors section of ECE 320

Last Term taught:1108	..Change Abbrev to:
Effective Term:08/2012	..Change Number to:

..Change Catalog Title:	..Change Transcript Title:
from:	from: ELECTRONICS I
to:	to:

..	From: Fixed Credit: 3 (3,)	To: Fixed Credit: (,)
Change of Credit	Variable Credit: -(-), (-)	Variable Credit: -(-),(-)

.. Add cross-listing with the following child course(s):
.. Delete cross-listing with the following child course(s):
.. Reverse Parent/Child relationship with:

..Change Method of Instruction		..Change Course Modifier		..Change General Education Designation	
from:	to:	from:	to:	from:	to:
XA-Lecture Only	..	..Pass/Fail Only	..	..English Composition	..
..B-Lab (w/fee)	..	XGraded	..	..Oral Communication	..
..D-Seminar	..	..Variable Title	..	..Mathematics	..
..E-Independent Study	..	..Creative Inquiry	..	..Natural Science w/Lab	..
..F-Tutorial (w/fee)	..	..Repeatable	..	..Math or Science	..
..G-Studio	..	maximum credits		..A&H (Literature)	..
..H-Field course	..	from:		..A&H (Non-Literature)	..
..I-Study Abroad	..	to:		..Social Science	..
..L-Lab (no/fee)	..			..CCA	..
..N/B-Lecture/Lab(w/fee)	..			..STS	..
..N/L-Lecture/Lab(no fee)	..				

..Change Catalog Description:
from:
to:

..Change Prerequisite(s):
from:
to:

Learning Objectives: The goal of this course is to introduce the basic theory of semiconductor devices commonly used in electronic systems. Upon completion of this course, students should be familiar with the characteristics of diodes, bipolar junction transistors, and field-effect transistors. Students also should be able to analyze and design basic analog and digital circuits containing these devices.

Topical Outline: .
ECE H320
Device Materials-1.5 hrs
Semiconductor Diodes and models-3.0 hrs
Spice simulation and models -1.5 hrs
Diode Circuits-3.0 hrs
MOS devices and models-3.0 hrs
MOS circuits-6.0 hrs
BJT transistors and models-4.5 hrs
Spice simulation and models -1.5 hrs
Power Supplies-1.5 hrs
Amplifiers-6.0 hrs
MOSFET Digital circuits-3.0 hrs
Tests-3.0 hrs
Instructor choice-6.5 hrs
Total - 44 hours

ECE 320
Device Materials-1.5 hrs
Semiconductor Diodes and models-3.0 hrs
Spice simulation and models -1.5 hrs
Diode Circuits-3.0 hrs
MOS devices and models-4.5 hrs
MOS circuits-7.5 hrs
BJT transistors and models-4.5 hrs
Power Supplies-1.5 hrs
Amplifiers-7.5 hrs
MOSFET Digital circuits-1.5 hrs
Tests-4.5 hrs

Instructor choice-3.5 hrs
Total - 44 hours

Evaluation: Final averages will be calculated according to the following weights:
Test Average: 60%
Final Examination: 40%
The final examination is mandatory for all students. If the score on the final examination is higher than the lowest test score, the final examination score will be substituted for the lowest test score in computing the test average. The following scale will be used in assigning final letter grades:
Final average Letter grade
90.00 - 100 A
80.00 - 89.99 B
70.00 - 79.99 C
60.00 - 69.99 D
0 - 59.99 F
Individual test scores may be curved at the discretion of the instructor; however, final averages will not be curved or rounded. Points will be deducted from students' final averages if their honors project topics or reports are unacceptable or late.

Add course requirements for honors and/or 600-level courses (if applicable): Students must choose one of the following options for their honors project.
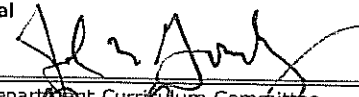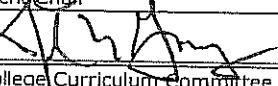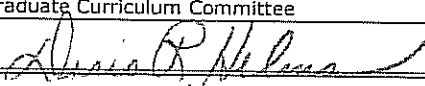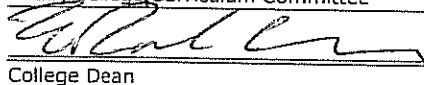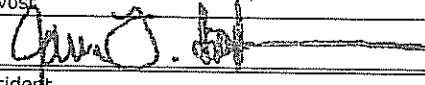1) Prepare a five-page report on some important aspect of the history of semiconductor devices or their applications. The paper must demonstrate that the student thoroughly understands at least one of the significant problems which influenced the development of one type of semiconductor diode or transistor.
2) Review five articles related to semiconductor devices published within the past ten years in scholarly technical journals, and write a one-page summary of each paper. The papers must be from leading technical journals or professional trade magazines (not consumer magazines) and must address one or more significant engineering problems involving semiconductor devices.
3) Perform a computer-based simulation of an engineering system or systems containing electronic devices, and prepare a five-page report summarizing the results. The system or systems simulated must be significantly more complex than those encountered in lab experiments in ECE 311.

Form Originator:EBRAD, Elizabeth Gibisch**Date Form Created:** 12/6/2011
Form Last Updated by: , **Date Form Last Updated:** 12/7/2011
Form Number: 4759

Approval

	Date		Date
Chair, Department Curriculum Committee	12/7/11	Chair, Undergraduate Curriculum Committee	3/2/2012
Department Chair	12/7/11	Chair, Graduate Curriculum Committee	
Chair, College Curriculum Committee	12/20/	Provost	3/25/12
College Dean	1/27/12	President	3/28/12
Director, Calhoun Honors College	Date		

ECE H320 Electronics I
Fall 2012 Syllabus

Class Meetings: Times: TBD
                       Classroom: TBD

Instructor: TBD
                     Office Hours: TBD

Text (required):   *Microelectronics: Circuit Analysis and Design,*
Fourth Edition, by D. A. Neamen, McGraw-Hill, 2010.

Prerequisites and Corequisites:

Students enrolled in ECE H320 are required to have completed the following courses with grades of C or better:

ECE 262
MTHSC 208
PHYS 221

Students enrolled in ECE H320 also must be enrolled in ECE 311 this semester.

Goals and Objectives:

The goal of this course is to introduce the basic theory of semiconductor devices commonly used in electronic systems. Upon completion of this course, students should be familiar with the characteristics of diodes, bipolar junction transistors, and field-effect transistors. Students also should be able to analyze and design basic analog and digital circuits containing these devices.

Topical Outline:

	CORE plus in depth topics (Faster paced) ECE H320	CORE only (Slower paced) ECE 320
Device Materials	1.5 hrs	1.5 hrs
Semiconductor Diodes and models	3.0 hrs	3.0 hrs
Spice simulation and models	1.5 hrs	1.5 hrs
Diode Circuits	3.0 hrs	3.0 hrs
MOS devices and models	3.0 hrs	4.5 hrs
MOS circuits	6.0 hrs	7.5 hrs
BJT transistors and models	4.5 hrs	4.5 hrs
Spice simulation and models	1.5 hrs	0.0 hrs
Power Supplies	1.5 hrs	1.5 hrs

Amplifiers	6.0 hrs	7.5 hrs	000013
MOSFET Digital circuits	3.0 hrs	1.5 hrs	
Tests	3.0 hrs	4.5 hrs	
Instructor choice	6.5 hrs	3.5 hrs	
	Total: 44 hrs	Total: 44 hrs	

Detailed Text Book Coverage by Chapter

ALL students cover the CORE material. The HONORS students will cover the additional topics and exercises listed under the column headed HONORS additional work.

CORE	HONORS additional work (in-depth topics)
CH 1. Device materials	
CH 1. p-n junctions	Spice modeling, switching transient behavior, design ex
CH 1. diode models	Computer simulation and analysis theory
Appendix B	Spice simulator usage examples, B1, B2, B3
CH 2. diode circuits	Frequency response, diode design problem, spice simulation, des. ex 2.4, 2.1.4 detectors, 2.1.5 voltage doubler, 2.2.2 Zener res and % reg,, des ex 2.6, 2.5 photo diode, 2.6 DC supply
CH 3. mos devices & models (note: optional 3.6)	3.1.9 short channel effects, 3.1.1 non ideal, Design ex 3.5, spice simulation, sec 3.3 mosfet app, 3.5 multi stage, 3.7 des example
CH 4. mos circuits (4.9, 4.19 optional)	4.1.3 body effect,4.7 ssic, [4.7.1,4.7.3 opt], spice,ex 4.16, 4.8; multi stage amps, simulation probs 4.69 etc, design ex D.74 etc.
CH 5. BJT	Design example 5.10, sec 5.4.4, 5.5, design ap 6.6, spice analysis 5.74, Design and computer analysis problems 5.75 – 5.83
CH 2 Power supplies	Design example full wave, half wave, smoothing filters etc
CH 6 Amplifiers	Sect. 6.9, computer ex 6.16, sec 6.9.3,
CH 16 Mosfet digital	Include remainder of chapter 16.7 – 16.13
(16.1 – 16.6 only)	
CH 7 and/or CH8	(Instructor choice)

Grading:

Final averages will be calculated according to the following weights:

Test Average:	60%
Final Examination:	40%

The final examination is mandatory for all students. If the score on the final examination is higher than the lowest test score, the final examination score will be substituted for the lowest test score in computing the test average. The following scale will be used in assigning final letter grades:

Final average	Letter grade
90.00 - 100	A
80.00 - 89.99	B
70.00 - 79.99	C
60.00 - 69.99	D
0 - 59.99	F

Individual test scores may be curved at the discretion of the instructor; however, final averages will **not** be curved or rounded. **Points will be deducted from students' final averages if their honors project topics or reports are unacceptable or late.** Details of the honors project assignment are provided elsewhere in this syllabus.

Schedule:

Test 1:	TBD
Test 2:	TBD
Final Examination:	TBD

If class is canceled on a scheduled test date, the test will be given during the next class meeting following the cancellation.

Attendance Policy:

Students are required to be present for the final examination and both tests. Attendance at lectures is expected, although it is not required. Students are responsible for all material covered and all assignments given in every lecture. Some lectures may cover material not found in the textbook. It is the responsibility of each student to make up any deficiencies that result from missed classes. If the instructor does not arrive at the beginning of a class period and no advance arrangements have been made, students may leave after waiting fifteen minutes.

Homework Policy: Homework will be assigned but not collected or graded. Students are expected to complete all assignments.

Collaboration: All forms of collaboration during the tests and final examination are strictly prohibited. During these times, students may not communicate with anyone other than the person administering the test, and students may not use phones or any other communications devices. Students may not give or receive aid in any form during a test or examination.

Calculators: A scientific calculator will be needed for every test and the final examination.

Makeup Tests: **Makeup tests will not be given under any circumstances. A student who misses a test or the final examination for any reason will receive a grade of 0 for that test or examination.**

As noted above in the Grading section, if the score on the final examination is higher than the lowest test score, the final examination score will replace the lowest test score in computing the test average. The purpose of this policy is to accommodate students who must miss class when a test is given because of significant illness or other circumstances beyond their control.

Comportment: All students are expected to act in a professional manner and to pay attention to the instructor during lectures. Behavior judged by the instructor to be distracting, discourteous, or disruptive will not be tolerated. Prohibited behavior includes, but is not limited to, excessive talking, sleeping, working on homework, reading, and use of electronic devices (including laptop computers, cell phones, and personal music players). A student who fails to abide by these standards of conduct will be removed from the course and/or assigned a final grade of F.

Disabilities: Any student who needs accommodations for a disability should contact the Clemson University Office of Student Disability Services to obtain a signed letter documenting the disability. In order to obtain accommodations, the student must notify the instructor **at least one week** before any test for which accommodations are needed.

Changes to Syllabus:

The instructor reserves the right to make changes to this syllabus during the semester. Students will be given adequate notice in class of any changes.

ECE H320: Electronics I
Fall 2012 Honors Project

As a student enrolled in ECE H320 this semester, you are required to complete a special project to receive honors credit for the course. You may choose one of the following three options:

1)   Prepare a five-page report on some important aspect of the history of semiconductor devices or their applications. Your paper must demonstrate that you thoroughly understand at least one of the significant problems which influenced the development of one type of semiconductor diode or transistor.

2)   Review five articles related to semiconductor devices published within the past ten years in scholarly technical journals, and write a one-page summary of each paper. The papers must be from leading technical journals or professional trade magazines (not consumer magazines) and must address one or more significant engineering problems involving semiconductor devices.

3)   Perform a computer-based simulation of an engineering system or systems containing electronic devices, and prepare a five-page report summarizing the results. The system or systems simulated must be significantly more complex than those encountered in lab experiments in ECE 311.

You might like to treat this assignment as a means of investigating an area of electronics technology in which you would like to work as an engineer. Your chosen project must be different from those of the other honors students in the course. Because electronic devices and systems are used in a wide variety of fields, the possible choices of areas of technology are vast. You may choose any field that interests you, as long as it is related in some way to electronic devices. I will be happy to provide suggestions.

You must inform me of your chosen project topic no later than (date to be determined) at 4:30 PM. **Two points will be deducted from your final course average for each day that your topic is late.**

Project reports must be typewritten and are due on or before (date to be determined) at 4:30 PM. **Two points will be deducted from your final course average for each day that your report is late. Failure to submit an acceptable report by (date to be determined) at 4:30 PM will result in a final course grade of F.**

The page requirements specified above do not include figures or lists of references. A list of references is required for options 1 and 2.

CLEMSON
U N I V E R S I T Y **Curriculum and Course Change System - Print New Course Form**

Course Abbreviation & Number:
X **New Undergraduate Course:** E C E- 101
.. **New Honors Course:** --
.. **New Graduate Course:** -

Effective Term: 05/2012
Catalog Title: Robots in Business and Society
Transcript Title: ROBOTS IN BUS & SOC

Fixed Credit Course: 3 (3,0)
Variable Credit Course: - (-), (-)

Method of Instruction	Course Modifier	General Education Designation
X A-Lecture Only	.. Pass/Fail Only	.. English Composition
.. B-Lab (w/fee)	X Graded	.. Oral Communication
.. D-Seminar	.. Variable Title	.. Mathematics
.. E-Independent Study	.. Creative Inquiry	.. Natural Science w/Lab
.. F-Tutorial (w/fee)	.. Repeatable	.. Math or Science
.. G-Studio	maximum credits:	.. A&H (Literature)
.. H-Field course		.. A&H (Non-Literature)
.. I-Study Abroad		.. Social Science
.. L-Lab (no/fee)		.. CCA
.. N/B-Lecture/Lab(w/fee)		X STS
.. N/L-Lecture/Lab(no fee)		

Add cross-listing with the following child course(s):

Catalog Description: Exploration of the significant role that robotics and automation play in society. Students will gain an appreciation of the ethics, economics, psychology, politics, and technologies that must be considered in the use of robots. Includes hands-on exercises using Legos to explore robot construction and intelligence. Open only to non-engineering majors.

Prerequisite(s): None.

Projected Enrollment:
Year 1 - 15 Year 2 - 20 Year 3 - 25 Year 4 - 25

Required course for students in:

Statement of need and justification based on assessment results of student learning outcomes: The course is proposed to address the already identified and documented need for General Education Competencies in Science, Technology and Society. The course will specifically address the requirements for students to "Demonstrate an understanding of issues created by the complex interactions among science, technology, and society". Robotics is a field of science that is rapidly transforming our lives. For example, remotely controlled military aircraft have already transformed the country's approach to foreign policy and we are on the verge of deploying robots that make life and death decisions on the battlefield without human intervention. As the government represents us and we are ultimately responsible for the policies, are we willing to delegate such decisions to automated equipment? An educated population and leadership must decide or it will happen by default. As a second example, robots have been proposed and are being heavily funded as the solution to taking care of the aging population, that is, robots must account for the shortfall in human caretakers. Is this how part of our population should be treated? An educated population and leadership must decide or it will happen by default. Students will first learn the complex technology and then the implications of using the technology. Robotics is a complex field that will greatly affect our society and thereby justified as a topic of study under the General Education Competencies in Science, Technology and Society.

The Electrical and Computer Engineering department continuously monitors and updates our undergraduate engineering curriculum in accordance with standard practices for ABET accreditation (the rigorous accreditation program for engineering programs nationwide). Procedures have been developed to measure a set of set outcomes. The specific outcome, students exhibit a "Outcome 1-h. a broad education necessary to understand impact of engineering solutions in global, economic, environmental, and societal context" will be evaluated in the proposed class using these same tools. The goal to evaluate the nonengineering students' performance using the same ABET assessment criterion will help to provide a consistent interpretation of program efficacy. Formative and summative assessments will be performed. The final report where the student must develop a robot solution, make a prototype to demonstrate the solution, and then synthesize a review of the technology and the potential societal impact will provide a significant artifact for the ePortfolio.

Textbook(s): Course notes and project manuals downloaded from course website.

Learning Objectives: Robotics and automation play a significant role in our lives from manufacturing to robotic surgery. The course will guide the student through the technologies that are used to build robots and the capabilities of robots in current applications. We will answer questions such as "How does the Roomba robot clean the floor in a house?" We will explore the economics of robots and their use as a tool to boost productivity. The lecture topics will be reinforced with hands-on laboratory exercises -- the students will use Legos Mindstorms to explore robot construction and intelligence. The future of robots as either an adversary to or equal partner with man has been portrayed in movies and books; we will analyze emerging trends to develop our own predictions for the future. The laboratories will culminate with a design project where students work with a group to build their own walking robot. In their future careers as business leaders, educators, physicians, etc. students will make decisions about robotics; the course will provide the tools they need to make good decisions.

Topical Outline: 7 - hrs Living and Working with Robots
9 - hrs Building and Controlling Robots
8 - hrs Artificial Intelligence
5 - hrs Economics of Robots
6 - hrs Ethical Issues
8 - hrs Our Future with Robots
2 - hrs Midterm and Final exam

Evaluation: 20% Final design competition and presentation,
35% Midterm test
35% Final exam
10% Attendance

Standard grading scale applies; ≥ 90 = A, 90-80 = B, 80 - 70 = C, 70 - 60=D, <60 =F

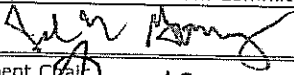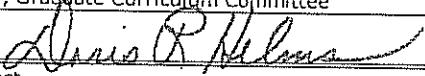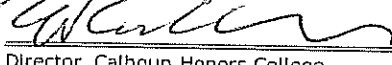**Learning Activities associated with General Education competencies (if applicable):** A Science, Technology and Society (STS) designation is sought for the course. Students will explore the significant role that robotics and automation play in society. They will gain an appreciation of the ethics, economics, psychology, politics, and technologies that must be considered in the use of robots. The course structure includes hands-on exercises that teach the fundamentals of robotics such as robot motion, robot intelligence, and sensing. Using this core, students will understand the underlying capabilities and limitations of modern robot systems such as unmanned combat aircraft (drones). The course will then tie the technology to the uses of the technology and highlight the decisions that the students will face as future business, political, or education leaders and as citizens and consumers.

Form Originator: EBRAD,Elizabeth Gibisch **Date Form Created:** 2/2/2012
Form Last Updated by: , **Date Form Last Updated:** 2/7/2012
Form Number: 4858

Approval

	Date		Date
Chair, Department Curriculum Committee		Chair, Undergraduate Curriculum Committee	3/2/2012
Department Chair	2/7/12	Chair, Graduate Curriculum Committee	
Chair, College Curriculum Committee	2/7/12	Provost	3/25/12
College Dean		President	3/28/12
Director, Calhoun Honors College	2/9/2012		

Semester: Summer I or Summer II
Section Number: Section 1
Credits: 3 (3,0)
Meeting Time and Days: TBD
Location: TBD

Prerequisites: None (Open only to non-engineering majors)

Course Overview and Goals

Robotics and automation play a significant role in our lives from manufacturing to robotic surgery. The course will guide the student through the technologies that are used to build robots and the capabilities of robots in current applications. We will answer questions such as "How does the Roomba robot clean the floor in a house?" We will explore the economics of robots and their use as a tool to boost productivity. The lecture topics will be reinforced with hands-on projects -- the students will use Legos Mindstorms to explore robot construction and intelligence. The future of robots as either an adversary to or equal partner with man has been portrayed in movies and books; we will analyze emerging trends to develop our own predictions for the future. The projects will culminate with a design project where students work with a group to build their own walking robot. In their future careers as business leaders, educators, physicians, etc. students will make decisions about robotics; the course will provide the tools they need to make good decisions.

Instructor Information:

Timothy Burg	Darren Dawson
Office: 307 Fluor Daniel (EIB)	Office: 105 Riggs
Phone: 656-1368	Phone: 656-5924
e-mail: tburg@clemson.edu	e-mail: ddawson@clemson.edu
Office Hours: TBD	Office Hours: TBD

Attendance Policy: Students are expected to attend all lectures. However, you should not attend class if you are sick with a contagious disease, e.g. the flu; you should avoid infecting the class during your illness. Physical attendance in class is expected but the following provision is made in the case of illness: **if you miss class you should review the presentation and accompanying reading assignment and write a 1 page summary of the presentation.** If your instructor has not arrived within 15 minutes after the starting time for the class you may leave.

Disability Access Statement from the Office of Student Disability Services: "It is University policy to provide, on a flexible and individualized basis, reasonable accommodations to students who have disabilities. Students are encouraged to contact Student Disability Services to discuss their individual needs for accommodation."

Topical Outline: 45 Hours with the following application topics:

1. *7 hrs* **Living and Working with Robots.** The course is motivated by the pervasive use of robots (and automation) and the impact on our lives. The use of robots has evolved from "hidden" uses in factories, space and underwater exploration, and laboratories to more direct consumer contact in applications such as surgery (many local hospitals have a Da Vinci surgical robot), housekeeping (the $200 Roomba robot is available at Target stores), lawnmowers (anyone with $3000 can buy the Husqvarna autonomous, solar-powered lawnmower), entertainment (toy robots), companionship (Genibo QD is an autonomous pet robot that displays emotion, mood, intelligence, character, and intimacy through artificial intelligence), transportation (the 2011 Ford Focus is essentially and autonomous robot in the parallel-parking mode), and military (we receive almost nightly updates of drone attacks in Afghanistan with total deaths near 3000 persons). Complicating the practical, ethical and economic analysis of robots, our perception of robots is shaped by their portrayal as either extreme friends or foes in movies and books.
   - Project 1: Introduction to the Lego Mindstorms NXT 2.0 kit. This project will explain how to connect to a laptop computer to the Lego Mindstorms NXT 2.0 via USB cable and Bluetooth.
2. *9 hrs* **Building and Controlling Robots** - All robots can be described as a collection of common components such as electronic sensors, cameras, computers, software, mechanics, and a power source. The organization of these components, the robot design, allow robots to see and feel the world (senses), make decisions (intelligence), and respond (motions and speech). The basic operation and output information from sensors such as accelerometers, gyroscopes, torque, force, color, digital compass, infrared emitter/detector, and sonar

will be described. The common actuators used to move a robot, electric motors, muscle wires, and air and hydraulic cylinders, will be examined. The underlying tools of kinematics, dynamics, motion planning, and coordination will be overviewed.

- *Project 2*: Motors This project is an introduction to the use of the Lego Mindstorms NXT motors.
- *Project 3*: Ultrasonic Sensor This project will introduce you to the Mindstorms ultrasonic sensor. The ultrasonic sensor can be used to determine the distance from the robot to an object. Sensor will be used to create a control system to have the robot follow a wall.

3. *8 hrs* **Artificial Intelligence** - Computers are well suited to performing monotonous calculations efficiently and reliably. This allows artificial machines to perform jobs for which humans are ill-suited. For more complex problems, computers have trouble understanding specific situations, and adapting to new situations that a human could readily understand. Artificial intelligence involves borrowing characteristics from human intelligence, and applying them to the computer.

- *Project 4*: Touch Sensor This project will introduce students to Mindstorms sensors, using the touch sensor as an example. The touch sensor is the simplest of the sensors included in the Mindstorms kit. It simply returns a value true or false indicating whether it is being pressed or not. This project will cover how to use the touch sensor in a program.
- *Project 5*: Color & Light Sensors Robot is programmed to drive around in a figure eight pattern with the aid of a sensor.

4. *5 hrs* **Economics of Robots** – The basis for making good economic decisions regarding robots will be discussed. It seems intuitive that choosing a robot that can perform a task faster, better, and more reliably than a human counterpart is an easy economic choice. However, many hidden and complex benefits and costs confound such decisions. As an example, it has not been clear if robotic surgery is cost effective. A recent study shows that in terms of direct costs, surgery with the daVinci robot costs about $3000 more per operation than having a surgeon perform the same operation. Surprisingly, when the total cost to the hospital is considered, the savings through avoided complications and associated blood transfusions translate into a $700 savings per operation. Traditional hand-harvesting of grapes cost $494 an acre in 2006, compared with $282 an acre in 2008 after automation. In some cases the additional cost of a robot may yield an increase in quality.

5. *6 hrs* **Ethical Issues** – One definition of a robot is "a mechanical device for performing a task which might otherwise be done by a human", deciding whether to replace a human with a robot has direct and far reaching effects. The economics of robots often suggest a business advantage for replacing workers with robots. This choice raises questions about the commitment of a company to employees and the overall effects on society. The other side of this question is that robots can replace workers in dangerous or repetitive task but at a higher cost, how does a company choose between higher cost and human health.

The use of robots as surrogates in military encounters raises many ethical questions. Robots may make decisions devoid of favorable human qualities such as compassion, what are the risks of empowering robots? Who is ultimately held responsible for the actions of a robot? Are robots counterproductive to the larger goal of peace, with lower casualties and lower political risk does engaging in war become the most convenient method of conflict resolution? We will explore the pros and cons to the exponentially-advancing robot technology.

6. *8 hrs* **Our Future with Robots** – The future of robotics including nanorobots, humanoid robots, snake-like robots, flexible robots, self-replicating robots, courier robots, autonomous vehicles, self-reconfiguring modular robots, human enhancement technologies, and robot swarms.

- Design Project: After gaining a firm understanding of the fundamentals of design and the use of the Mindstorms, the student teams will complete a design challenge by designing, building, and programming their own robot. Final report will include an analysis of the ethical and social impacts of deploying their device.

7. *2 hrs* Midterm and Final exam

Course Materials: Course notes and project manuals downloaded from course website.

Grading: Standard grading scale applies; ≥ 90 = A, 90-80 = B, 80 - 70 =C, 70 - 60=D, <60 =F
20% Final Design report
20% Project Reports(equally weighted)
30% Midterm test
30% Final exam

Academic Integrity: "As members of the Clemson University community, we have inherited Thomas Green Clemson's vision of this institution as a 'high seminary of learning.' Fundamental to this vision is a mutual commitment

to truthfulness, honor, and responsibility, without which we cannot earn the trust and respect of others. Furthermore, we recognize that academic dishonesty detracts from the value of a Clemson degree. Therefore, we shall not tolerate lying, cheating, or stealing in any form."

"When, in the opinion of a faculty member, there is evidence that a student has committed an act of academic dishonesty, the faculty member shall make a formal written charge of academic dishonesty, including a description of the misconduct, to the Associate Dean for Curriculum in the Office of Undergraduate Studies. At the same time, the faculty member may, but is not required to, inform each involved student privately of the nature of the alleged charge."

References:
http://www.societyofrobots.com/sensors.shtml
http://www.freakonomics.com/2010/07/20/is-robotic-surgery-cheaper/
http://ethics.calpoly.edu/ONR_report.pdf "Autonomous Military Robotics: Risk, Ethics, and Design."
http://ideasforprogress.wordpress.com/2011/05/14/new-paradigm-shift-in-economics/
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http://www.tenspider-tech.net/robotics-automation/index.html