CLEMSON UNIVERSITY

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Memorandum

To: Registrar's Office
Through: Dr. Karen High, Associate Dean, CoES
Through: Dr. J. Cole Smith, Chair Industrial Engineering Department
From: Dr. Burak Eksioglu, Industrial Engineering Undergraduate Coordinator
Date: April 13, 2016
Subject: Changes in DW for BSIE List of Elective Courses

Following the curriculum changes in the BSIE program the list of elective courses are updated. As such, we wish the DW for BSIE to accept the list of courses on the next page.

DEPARTMENT OF INDUSTRIAL ENGINEERING

College of Engineering and Science 110 Freeman Hall Clemson, SC 29634-0920

864.656.4716 Fax 864.656.0795 email *iedept@ces.clemson.edu*

Lab Science Requirement: 4 units required
BIOL 1030 and 1050
BIOL 1040 and 1060
BIOL 1100
BIOL 1200 and 1210
BIOL 1200 and 1220
BIOL 1200 and 1230
BIOL 1200 and 1240
CH 1020
GEOL 1010/1030

Ethics & Professional Practice Requirement (*1415 and later only*): 3 units
PHIL 1030
PHIL 3440
PHIL 3450
PHIL 3460
LAW 3220

Management Requirement: 3 units
MGT 2010
MGT 3070
MGT 4110
ELE 4000
ACCT 2010
ACCT 2020
ML 3010
AS 3090
MKT 4210

Engineering Requirement:
3 units required for 0910 – 1314 only
ME 2030
ME 3020
ME 3100
ME 4550 (Contact instructor about prerequisites)
CE 3410 (4 units)
All courses in the IE Technical Requirement list except IE 4000/4040
Note: *The ME and CE courses may have prerequisites and enrollment restrictions based on major.*

IE Technical Requirement: 9 units for 1415 and later; 6 units for 0910 - 1314
IE 4000 (6 units maximum for IE 4000 and IE 4040)
IE 4040 (6 units maximum for IE 4000 and IE 4040)
IE 4300
IE 4460
IE 4520
IE 4560
IE 4570
IE 4600
IE 4620
IE 4630
IE 4810
IE 4850
IE 4860
IE 4870
IE 4890
IE 4910
IE 4880 (1516 and earlier curricula only because it is required in 1617 and later)

Math / Science Requirement: 3 units for 1516 and earlier
BIOL 2010
BIOL 2030
BIOL 2040
BIOL 3150
CH 1020
CH 2010
CH 2230
ENSP 2000
GEOL 2700
GEOL 3000
PHYS 2220
PHYS 3210
PHYS 4170
PHYS 4320
MATH 2080 (4 units)
MATH 3190
MATH 3600
MATH 3650
MATH 4000
MATH 4020
MATH 4100
MATH 4190
MATH 4310
MATH 4340
MATH 4350
MATH 4530
MATH 4630
MICRO 2050
MATH 3110 (1516 and earlier curricula only because it is required in 1617 and later)

Humanities/Social Science Requirement (aka *HSS*):
15 credits total for 1516 and earlier and 12 credits total for 1617 and later.

Minor

Name: Nuclear Engineering and Radiological Sciences **Lead Dept:** Environmental Engr & Earth Sci

Change Minor

Effective Catalog Year: 2016-2017

☐

☑ **Change Minor Requirements:**

Current Catalog Description

A minor in Nuclear Engineering and Radiological Sciences (NERS) requires 15 credits: EES 3100, 4100, 4120, and ME 4260; and one course selected from: EES 4110, 4800, PHYS 4520, or another course approved by a NERS advisor.

Proposed Catalog Description

A minor in Nuclear Engineering and Radiological Sciences (NERS) requires 15 credits: EES 3100, 4100, 4120, and ME 4260; and one course selected from: EES 4110, 4140, 4800, ME 4280, or PHYS 4520.

Summary / Explanation

Two new courses related to the minor should be included as possible electives. The caveat of "or another course approved by a NERS advisor" should be removed.

Rationale for Change Minor

- ☐ Strengthen Program Requirement(s)
- ☐ Alignment of Student Learning Outcomes
- ☐ Alternative Delivery of Content
- ☐ Improve Time to Degree
- ☑ Evolution of the Discipline
- ☐ Changing Prerequisites
- ☐ Address DWF Rates
- ☐ General Education Modifications
- ☐ Other (Please specify.)

Form

User ID: lshulle **Name:** Lindsay Shuller-Nickles

Date: 05/06/2016 **Number:** 22191

Chair, Department Curriculum Committee — Date: 5/7/2016

David L. Freedman

Digitally signed by David L. Freedman
DN: cn=David L. Freedman, o=Clemson University, ou=Department of Environmental Engineering and Earth Sciences, email=dfreedm@clemson.edu, c=US
Date: 2016.05.06 17:51:47 -04'00'

Department Chair — Date: 5/6/2016

Chair, College Curriculum Committee — Date: 5/9/2016

College Dean — Date: 5/9/2016

Director, Calhoun Honors College — Date

Chair, Undergraduate Curriculum Committee — Date: 5/6/2016

Chair, Graduate Curriculum Committee — Date

Provost — Date: 6/20/16

President — Date

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CLEMSON UNIVERSITY

Dr. Lindsay C.
Shuller-Nickles,
Ph.D.
Assistant Professor
lshulle@clemson.edu
P: 864.656.1448

April 11, 2016

c/o: Brian Dominy
CoES Curriculum Committee Chair

Kevin Finneran
EEES Curriculum Committee Chair

cc: Timothy DeVol

ENVIRONMENTAL
ENGINEERING
AND
EARTH SCIENCES

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MEMO: Changes to the Nuclear Engineering and Radiological Sciences minor requirements

In efforts to improve transparency in our curricula the course requirements for the Nuclear Engineering and Radiological Sciences (NERS) minor should be modified to remove ", or any other course approved by a NERS advisor."

Three additional courses have come to the attention of the core NERS faculty and should be added to the elective course list: EES 4140 and ME 4280.

The catalog description should read:
Nuclear Engineering and Radiological Sciences (15 credits)
A minor in Nuclear Engineering and Radiological Sciences (NERS) requires 15 credits: EES 3100, 4100, 4120, and ME 4260; and one course selected from: EES 4110, 4140, 4800, ME 4280, or PHYS 4520.

If you have further questions, please contact Lindsay Shuller-Nickles (lshulle@clemson.edu or 513-607-8518).

Regards,

Lindsay Shuller-Nickles

Lindsay Shuller-Nickles
Environmental Engineering and Earth Sciences

CLEMSON
College of ENGINEERING AND SCIENCE

Courses that Satisfied the Former Humanities & Social Science Policy for Engineering Majors

Prior to 2010, all engineering students were required to take a 5th 3-credit Humanities or Social Sciences course, in addition to the 12 credits included in the university's General Education Requirements. (Those 12 credits consist of two Social Science courses and two Arts & Humanities courses from approved lists.) Although a 5th Humanities or Social Sciences course is no longer a requirement for all engineering majors, some programs have elected to either keep this requirement or to permit using a course from this list to satisfy a special departmental requirement. Therefore, the list of courses that satisfied the former Humanities & Social Science Policy for Engineering majors is maintained by the College and is shown below.

AAH 1000-4999
APEC 1000-2999
ANTH 1000-4999
ARAB 1000-4999
ART 1000-4999
ASL 1000-4999
CAAH 2010
CHIN 1000-4999
COMM 1000-4999 (except 1500, 2500)
DANC 1000-4999
EAS 1230
ECON 1000-4999
ENGL 2000-4999 (except 2170, 3040, 3100, 3120, 3140, 3150, 3160, 3330) (No ENGL 1XXX)
FR 1000-4999
GEOG 1000-4999
GER 1000-4999
GW 1000-4999

HIST 1000-4999
HON 1900, 1910, 1920, 2010, 2020, 2030, 2100, 2200, 2210, 2220
HUM 1000-4999
IS 2100
ITAL 1000-4999
JAPN 1000-4999
LANG 1000-4999
LAW 1000-4999
MUSC 1000-4999
PA 1000-4999
PAS 1000-4999
PHIL 1000-4999
PORT 1000-4999
POSC 1000-4999
PSYC 1000-4999
REL 1000-4999
RS 1000-4999
RUSS 1000-4999
SOC 1000-4999
SPAN 1000-4999
STS 1010, 1020, 3030
THEA 1000-4999
WS 1000-4999

SITE NAVIGATION

ABET Accreditation (accreditation.html)
CES Academic Advising (http://www.clemson.edu/ces/departments/ge/advising)
Employment (employment/index.html)
Engineering Honor Code (honor-code.html)
Humanities and Social Sciences Policy (humanities_policy.html)
FE Examination (fe_exam.html)
Honors & Awards (awards/index.html)
Links (links.html)
NAE Grand Challenge Scholars Program (grand-challenge-scholars-program.html)

Scholarships (scholarships/index.html)

Student Advisory Board (student-advisory-board/index.html)

Graduate Studies (../research/graduate-studies/index.html)

CES Global Engagement (../global-engagement/index.html)

Emphasis Areas and the Biomolecular Concentration

The Chemical Engineering curriculum includes Emphasis Areas to allow students flexibility in selecting courses and planning their future careers. Students in this curriculum must declare an area of interest and plan a sequence of Emphasis Area courses in the fall semester of the sophomore year. These initial plans can be modified later in consultation with an academic advisor. Before graduation each student in the regular Chemical Engineering curriculum must complete 9 credit hours of approved courses in one of the following Emphasis Areas:

- Applied Engineering, Mathematics, and Science
- Biomolecular Science and Engineering
- Business Management
- Energy Studies
- Environmental Engineering and Science
- Polymeric Materials

Alternatively, students in the Chemical Engineering curriculum may apply the 9-hours set aside for completion of an Emphasis Area toward the completion of any minor or second major offered by Clemson, except the Chemistry Minor and the Cluster Minor. (You can earn a minor in Chemistry if you wish, but you will also have to complete an Emphasis Area.) Minor requirements are set by the department granting the minor. Details of each minor are available in the Undergraduate Announcements. Students who enter the program having already earned a baccalaureate degree from an accredited institution may apply 9 approved hours of required junior or senior-level courses from the previous degree program to satisfy the Emphasis Area requirement.

Students also have the option of earning a Bachelor of Science degree in Chemical Engineering with a Biomolecular Concentration. The concentration is a modified version of the BSChE curriculum that devotes 22 credit hours of work to a stronger emphasis in biomolecular engineering and science.

REQUIREMENTS FOR EMPHASIS AREAS

Important note to students: It is **your responsibility** to insure that the Emphasis Area courses you select will be offered when you want to take them **and** that you will meet the prerequisites and other registration criteria stipulated by the offering department. Course schedules change frequently, and many of the Emphasis Area courses have prerequisites that are not part of the ChE curriculum. The Undergraduate Announcements lists prerequisites for every course offered by Clemson. For your convenience, a list of prerequisites for Emphasis Area courses is also provided below, following the course listings. This list is not guaranteed to be complete or up to date. In some cases a department may waive a prerequisite or accept a reasonable alternative for a well-qualified student. If you believe that you have reasonable alternatives to the listed prerequisites, then you should request a prerequisite waiver from the offering department. In other cases, even though you have the prerequisites, you may be unable to get into a course due to other registration restrictions such as space limitations, majors who are given priority, or the course is not offered on a regular schedule. **The department that offers a particular course is the only reliable source** that can tell you when a course will be offered and what requirements must be met prior to registration. Plan ahead and contact the offering department if there is any doubt about the availability of courses you select. It is highly advisable to plan ahead and coordinate the emphasis area prerequisites with your General Education requirements. For example, if you are considering the Business Management Emphasis Area, it would be advisable to take ECON 2110 for your Social Science requirement.

Note also that not all courses listed in the Emphasis Areas have 3 credits. Therefore, depending on the set of courses you select, you might need to complete more than 3 courses to satisfy the 9 credit hour minimum.

a) Applied Engineering, Mathematics, and Science Emphasis Area

Students must complete 1-3 engineering course(s), 0-2 mathematics course(s), and 0-1 science course from the lists below. Students who qualify for admission to the Combined BS/MS Program can also use graduate level courses that apply toward the MS degree in Chemical Engineering to satisfy requirements in this Emphasis Area. See the ChE Graduate Coordinator for details.

Options for Engineering Course(s):

CHE 4010 (Transport Phenomena)
CHE 4140 (Green Engineering)
CE 2010 (Statics)
IE 3600 (Industrial Applications of Probability and Statistics)
IE 3610 (Industrial Quality Control)
IE 4620 (Six Sigma Quality)
ME 2040 (Mechanics of Materials)

NOTE: Students who complete IE 3600, IE 3610, and IE 4620 will be granted a Six Sigma Certificate by the Industrial Engineering Department.

Options for Mathematics Course(s):

MATH 4340 (Advanced Engineering Mathematics)
MATH 4500 (Introduction to Mathematical Models)

Options for Science Course:

CH 3130 (Quantitative Analysis, 3150 or 3170 lab must be taken concurrently)
CH 4020 (Inorganic Chemistry)
CH 4110 (Instrumental Analysis)
CH 4130 (Chemistry of Aqueous Systems)
CH 4210 (Advanced Organic Chemistry)
CH 4270/4271 (Organic Spectroscopy)
CH 4350 (Atomic and Molecular Structure)
PHYS 2220 (Physics with Calculus III)
PHYS 4200 (Atmospheric Physics)
PHYS 4320 (Optics)
PHYS 4410 (Electromagnetics I)
PHYS 4450 (Solid State Physics)

b) Biomolecular Science and Engineering Emphasis Area

Students must complete 1-2 science course(s) and 1-2 engineering course(s) from the lists below.

Options for Science Courses:

BIOL 4340 (Biological Chemistry Laboratory Techniques)
BCHM 3050 (Biochemistry)
BCHM 4310 (Physical Approach to Biochemistry)
BCHM 4330 (General Biochemistry Lab)

BCHM 4060 (Physiological Chemistry)
BCHM 4360 (Nucleic Acid and Protein Biosynthesis)
CH 3600 (Biological Chemistry)
CH 4040 (Bioinorganic Chemistry)
CH 4140 (Bioanalytical Chemistry)
CH 4250 (Medicinal Chemistry)
GEN 3120 (Molecular Genetics)
GEN 4400 (Bioinformatics)
MICRO 3050 (General Microbiology)
MICRO 4070/4071 (Food and Dairy Microbiology)
MICRO 4130/4131 (Industrial Microbiology)
PHYS 4170 (Introduction to Biophysics)

Options for Engineering Courses:

BIOE 3020 (Biomaterials)
BIOE 4010 (Bioengineering Design Theory)
BIOE 4020 (Biocompatibility)
BIOE 4400 (Biopharmaceutical Engineering)
BIOE 4480 (Tissue Engineering)
BIOE 4490 (Drug Delivery)
BMOLE 4260 (Biosensors and Bioelectronics)
BMOLE 4270 (Membranes for Biotechnology and Biomedicine)
BE 4280 (Biochemical Engineering)

c) Business Management Emphasis Area

Students must take MGT 2010 (Principles of Management) plus two other courses from the list below.

Options for Courses:

ACCT 2010 (Financial Accounting Concepts)
ELE 3010 (Introduction to Entrepreneurship)
ELE 4000 (Technology Entrepreneurship)
ELE 4010 (Executive Leadership and Entrepreneurship II)
ECON 3060 or MGT 3060 (Managerial Economics)
ECON 3100 (International Economy)
ECON 3210 or ELE 3210 (Economics of Innovation)
MKT 3140 (New Venture Creation I)
MGT 3150 or ELE 3150 (New Venture Creation II)
MGT 3900 (Operations Management)
MGT 4110 (Project Management)
MGT 4230 (International Business Management)

d) Energy Studies Emphasis Area

Students must complete 9 credit hours from the following options. You can get credit for both versions of ChE 445.

Options for Courses:

AGRB 4570 or ECON 4570 (Natural Resource Use, Technology, and Policy)
BE 4400/4401 or CE 4400/4401 (Renewable Energy Resource Engineering)
CE 4370 (Sustainable Energy)
CE 4430 (Water Resources Engineering)
CE 4910 (Energy Related)
CHE 4140 (Green Engineering)
CHE 4150 (Alternative Energy)
ECE 4200 (Renewable Energy Penetration on the Power Grid)
ECE 4570 or ME 4570 (Fundamentals of Wind Power)
ECE 4610 (Fundamentals of Solar Power)
ECE 4710 (Electric Vehicles and Energy Storage)
EES 3100 (Nuclear Engineering)
EES 4100 (Environmental Radiation Protection)
EES 4120 (Nuclear Fuel Cycle and Radioactive Waste Management)
GEOL 4090/4091 (Environmental and Exploration Geophysics)
ME 4200 (Energy Sources and Their Utilization)
ME 4220 (Design of Gas Turbines)
ME 4260 (Nuclear Energy)

e) Environmental Engineering and Science Emphasis Area

Students must complete 1 science or policy course and 2 engineering courses from the lists below. Students who qualify for admission to the Combined BS/MS Program can also use graduate level courses that apply toward the MS or MENGR degree in Environmental Engineering and Science to satisfy requirements in this Emphasis Area. See the EE&S Graduate Coordinator for details.

Options for Science/Policy Course:

CH 4130 (Chemistry of Aqueous Systems)
CH 4110 (Instrumental Analysis)
ENR 3120 (Environmental Risks and Society)
ENSP 4000 (Studies in Environmental Science)
PHYS 2450 (Physics of Global Climate Change)
PHYS 4200 (Atmospheric Physics)

Options for Engineering Courses:

CHE 4010 or BMOLE 4030 (Transport Phenomena)
CHE 4140 (Green Engineering)
CHE 4150 (Alternative Energy)
EES 4010 (Environmental Engineering)
EES 4020 (Water and Waste Treatment)
EES 4100 (Environmental Radiation Protection)
EES 4110 (Ionizing Radiation Detection and Measurement)
EES 4300 (Air Pollution Engineering)
EES 4800 (Environmental Risk Assessment)
EES 4850 (Hazardous Waste Management)
EES 4860 (Environmental Sustainability)
BE 4240 (Ecological Engineering)

BE 4400/4401 or CE 4400/4401 (Sustainable Energy Engineering)
ETOX 4210 (Chemical Source and Fate in the Environment)
ETOX 4460 (Soil and Water Quality Fundamentals)

f) Polymeric Materials Emphasis Area

Students must complete the required 9 hours by selecting courses from the following options.

Options for Courses:

BIOE 3020/3021 (Biomaterials)
CH 4510 (Frontiers in Polymer Chemistry)
CHE 4130 (Polymer Composite Engineering)
CHE 4450 (Special Topics, Polymer related)
MSE 4150 (Intro to Polymer Science and Engineering)
or CHE 4120 (Polymer Engineering)
MSE 4610/4611 (Polymer and Fiber Materials III)
PKSC 4160/4161 (Application of Polymers in Packaging)

g) Selected Minor in lieu of an Emphasis Area

Students may use the 9 hours devoted to the Emphasis Area requirement to select and complete any Minor, with the exception of the Chemistry Minor or the Cluster Minor. See the Undergraduate Announcements for requirements in the Minor of your choice.

Students who earn a second baccalaureate degree from Clemson or another accredited institution may apply 9 hours of required junior or senior-level courses from the other degree program to satisfy the Emphasis Area requirement.

Pre-requisites for Emphasis Area Courses

Warning: Pre-requisites listed below are not guaranteed to be correct. To be certain that you can get into a course, you must verify pre-requisites in the University Announcements and check course scheduling and enrollment restrictions with the department that offers the course.

a) Applied Engineering, Mathematics, and Science

Options for Engineering Course(s):

Course:	Pre-requisites:
CHE 4010	CHE 3300, MATH 2080
CHE 4140	CHE 2200, 2300
CE 2010	PHYS 1220, MATH 2060 (or concurrent enrollment)
IE 3600	MATH 2060
IE 3610	IE 3600
IE 4620	STAT 4110 or CHE 3070
ME 2040	MATH 2080, ME 2220, MSE 2100

Options for Mathematics Course(s):

Course:	Pre-requisites:
MATH 4340	MATH 2080
MATH 4500	MATH 3600 or 3650 and MATH 3020 or STAT 2300 or STAT 3090

Options for Science Course:

Course:	Pre-requisites:
CH 3130	CH 3150 or 3170 (Concurrent)
CH 4020	CH 3310, 3320
CH 4110	CH 3310, 3320
CH 4130	CH 1020 or 1060
CH 4210	CH 2240
CH 4270/1	One year each of organic & physical chemistry
CH 4350	CH 3320
PHYS 2220	PHYS 2210
PHYS 4200	MATH 1080, PHYS 2080 or 2210
PHYS 4320	PHYS 2210
PHYS 4410	PHYS 2210 and MATH 2080
PHYS 4450	PHYS 2210

Biomolecular Science and Engineering

Options for Science Course(s):

Course:	Pre-requisites:
BCHM 3050	BIOL 1030 or BIOL1100; Co-req CH 2230
BCHM 4060	BCHM 305 or CH2230
BCHM 4310	BCHM 3010 or consent of instructor; Co-req: CH3300 or CH3310
BCHM 4330	Concurrent enrollment in BCHM 4230 or 4310
BCHM 4360	BCHM 3010 and GEN 3020
BIOL 4340	BCHM 3050
CH 3600	CH 2230

CH 4040	BCHM 3010 or CH 2050
CH 4140	CH 3130, CH 4110
CH 4250	CH 2240
GEN 3020	BIOL 1100
GEN 4400	BCHM 3050 or GEN 3020
MICR 3050/1	BIOL1100/1110 or BIOL 1030/1040/1050/1060, CH 1010, 1020
MICR 4070/1	BCHM 3050 or CH 223, MICRO 305
PHYS 4170	MATH 2060, PHYS 2210, or consent of instructor

Options for Engineering Course(s):

Course:	Pre-requisites:
BIOE 3020/1	BIOE 2010, MSE 2100, CH 2230, CH 2270
BIOE 4010	BIOE 3020 or consent of instructor
BIOE 4020/1	BIOE 3020 and BIOL 4610 or consent of instructor
BIOE 4400	BCHM 3050
BIOE 4480	BIOE 3020, BIOL 3150, and BIOL4610
BIOE 4490	BIOE 3020
BMOLE 4030	CHE 3300, MATH 2080
BMOLE 4260	CHE 3300, and BIOCH 3010 or 3050, or consent of instructor
BMOLE 4270	CHE 3300 or equivalent or consent of instructor
CHE/BE 4280	Co-req CHE 3300 , CHE4500

Business Management

Course:	Pre-requisites:
MGT 2010	none
ACCT 2010	none
ELE 3010	MGT 2010
ELE 4000	Junior standing in engineering
ELE 4010	ELE 3010
ECON 3060	ECON 2110
ECON 3100	ECON 2110 and 2120
ECON 3210	ECON 3060 or 3140
MKT 3140	Junior standing
MGT 3150	ELE 3010
MGT 3900	STAT 3090 or equivalent and MGT 2180 or equivalent
MGT 4110	STAT 3090 or equivalent
MGT 4230	Junior Standing

Energy Studies

Course:	Pre-requisites:
AGRB/ECON 4570	MATH 1060, ECON 2110, and AGRB 3570 or ECON 3140
BE/CE 4400/1	Junior standing in engineering
CE 4370	CE 3310
CE 4430	CE 3410 (Fluid Mechanics)
CE 4910	Consent of instructor; priority to CE majors
CHE 4140	CHE 2110, MATH 1080

CHE 4150	CHE 2200, CHE 2300
ECE 4200	ECE 2070
ECE/ME 4570	ECE 2070
ECE 4610	ECE 3200
ECE 4710	ECE 3200
EES 3100	MATH 2080
EES 4100	PHYS 2210
EES 4120	EES 4100
GEOL 4090/4091	Junior standing
ME 4200	ME 3030, 3040 or consent of instructor: priority to ME majors
ME 4220	ME 3080 (Fluid Mechanics)
ME 4260	CHE 3210

Environmental Engineering and Science

Options for Science/Policy Course:

Course:	Pre-requisites:
CH 4130	CH 1020 or CH 1060
CH 4110	CH 3310, CH 3320
ENR 3120	Junior standing
ENSP 4000	ENSP 2000 or EES 2020 or consent of instructor
PHYS 2450	None
PHYS 4200	MATH 1080, PHYS 2080 or PHYS 2210

Options for Engineering Course(s):

Course:	Pre-requisites:
BE 4240	None
BE 4400/1	Junior standing in engineering
CHE 4010	CHE 3300, MATH 2080 (same for BMOLE 4030)
CHE 4140	CHE 2110, MATH 1080
CHE 4150	CHE 2200, CHE 2300
EES 4010	CHE 2300, MATH 2060
EES 4020	EES 2020 or 4010
EES 4100	PHYS 2210
EES 4110/1	EES 4100 or consent of instructor
EES 4300	EES 2020 or 4010
EES 4800	EES 2020 or 4010, MATH 2080
EES 4850	EES 2020 or 4010 and CH 2230
EES 4860	Junior standing in engineering
ETOX4210	CH 2230, CH 2270, and CH 3130
ETOX4460	CH 2240

Polymeric Materials

Course:	Pre-requisite:
BIOE 3020/1	BIOE 2010, MSE 2100, and CH 2230/2270

CH 4510	CH 2230, 2240, MSE 4150
CHE 4120	CH 2240, 3320
CHE 4130	CH 2240 and CHE 4120 or MSE 4150
CHE 4450	Consent of instructor
MSE 4150	CH 2240
MSE 4610/1	none
PKSC 4160/1	CH 2230, consent of instructor

Add Major

Major Name: Automotive Engineering
Degree: Certificate
Effective Catalog Year: 2016-2017
Curriculum Map: Curriculum Map for certificate in Automotive Engineering-20160505145420.docx
Description:
Additional Information: Automotive Engineering Cert-Prop-IH-rev-5-20160505145420.docx
Description:

Summary/Explanation

The proposed certificate in Automotive Engineering is being developed primarily for engineering and science undergraduates and possible local industry employees with engineering or science degrees. The Undergraduate Automotive Engineering Certificate Program will require four undergraduate courses in automotive engineering totaling 12 credit hours. The courses are being developed by the Department of Automotive Engineering faculty in consultation with industry and contain specific automotive content. Based on industry input solicited over the past several months, courses that reflect content in the fields of automotive product innovation, automotive systems integration, vehicle dynamics, and propulsion systems are currently envisioned. They are: Fall Semester: AuE 4030: Automotive Engineering Project Design Tools AuE 4010/6010: Vehicle Dynamics Lecture AuE 4011/6011: Vehicle Dynamics Laboratory Spring Semester: AuE 4020: Automobile Powertrain Systems Lecture AuE: 4021: Automobile Powertrain Systems Laboratory AuE 4040: Automotive Engineering Project Prototyping and Validation New courses and content will be developed on an as-needed basis. Pre-requisites for these courses will consist of courses already offered in the engineering and science programs in the College. The utilization of world-class and unique laboratories on the CU-ICAR campus will provide the students hands-on experience that will be hard to duplicate elsewhere. A carefully crafted set of laboratory experiences that reinforce concepts discussed in the classroom will be used to relate theoretical concepts to practice. The certificate is proposed to be initiated in Spring 2017.

Rationale for Add New Major

- ☐ **Strengthen Program Requirement(s)**
- ☐ **Alignment of Student Learning Outcomes**
- ☐ **Alternative Delivery of Content**
- ☐ **Improve Time to Degree**
- ☐ **Evolution of the Discipline**
- ☐ **Changing Prerequisites**
- ☐ **Address DWF Rates**
- ☐ **General Education Modifications**
- ☑ **Other (Please specify.)**

Offer undergrad students an opportunity to get expertise in automotive engineeringalong with their other engineering major, thereby improving the potential for employment in the automotive industry, one of South Carolina's largest economic sectors.

Form

User ID: pisup **Name:** Pierluigi Pisu
Date: 05/05/2016 **Number:** 22153

Chair, Department Curriculum Committee	5May2016 Date
Department Chair	5/4/16 Date
Chair, College Curriculum Committee	5/9/16 Date
College Dean	5/9/16 Date
Director, Calhoun Honors College	Date
Chair, Undergraduate Curriculum Committee	5/6/2016 Date
Chair, Graduate Curriculum Committee	Date
Provost	6/20/16 Date
President	Date

Curriculum Map for certificate in Automotive Engineering

Total Credit Hrs required: 12

Undergraduate students in engineering and science majors will be able to take the certificate in their senior year. The schedule for course offerings is as follows:

Fall Semester:

AuE 4030: Automotive Engineering Project Tools

AuE 4010/6010: Vehicle Dynamics Lecture

AuE 4011/6011: Vehicle Dynamics Laboratory

Spring Semester:

AuE 4020: Automobile Powertrain Systems Lecture

AuE: 4021: Automobile Powertrain Systems Laboratory

AuE 4040: Automotive Engineering Project Prototyping and Validation

College/Department: **College of Engineering and Science, Department of Automotive Engineering**

New Certificates: **Undergraduate Certificate in Automotive Engineering**

Implementation Date: **January 1, 2017**

CIP Code: 149999 **Automotive Engineering**

Methodology (traditional, online, blended): **Traditional and Blended**

Site of Delivery: **Main Campus, CU-ICAR**

Number of Credit Hours: **Undergraduate Certificate =12**

Contact Person: **Edward R. (Randy) Collins, Jr. (CES facilitator) and Zoran Filipi (AuE lead)**

1. Justification

The automotive sector of the world economy is enormous, and South Carolina particularly benefits from the economic impact of the automotive sector. Indeed, South Carolina's economic vitality is closely linked to companies like BMW, Michelin, Bosch, Proterra, and the multitude of Tier 1 and Tier 2 suppliers of the automotive industry. Most recently, Volvo has announced a large facility and expansion into the Lowcountry of South Carolina, which will further cement South Carolina as the nation's focal point for automotive and automotive-related industries and manufacturing. The growth of the automotive-related manufacturing industry is directly related to the availability of a highly trained workforce, including new college graduates and a significant portion of that workforce pool is engineering talent. It is safe to say that to ensure the success of this industry in South Carolina and beyond, Clemson University must do its share in producing highly trained and talented engineers and scientists.

The automotive sector employs engineers and scientists of all types, including a significant number of mechanical, electrical, and industrial engineers plus computer scientists. Clemson has responded to the automotive industry by creating the CU-ICAR campus, hiring several endowed chairs and faculty, and creating MS and PhD programs in Automotive Engineering (AuE). These programs are producing highly sought after graduates for the US and beyond.

Discussions between senior leadership at Clemson and automotive industry partners such as BMW, Michelin, Honda, and Chrysler have demonstrated considerable enthusiasm for BS-level engineering students with strong exposure to automotive engineering and related topics since the vast majority of engineering jobs in that sector employ BS-level graduates. The creation of a BS degree in Automotive Engineering is considered too narrowly focused to serve our students or industrial constituents and would be prohibitively expensive. A certificate program, obtained in conjunction with an existing undergraduate degree program or after the completion of the degree, would provide the desired educational components that meet industry needs while being cost-effective for both the student and the university. While many universities in the US (including Clemson) and beyond have students participating in a plethora of automotive engineering competitions such as SAE Formula and Mini Baha etc., very few institutions offer a carefully structured automotive systems curriculum at the undergraduate level. This document proposes that Clemson's College of Engineering and Science (CES) develop and deploy an undergraduate certificate in Automotive Engineering. This certificate will be a one of a kind offering, commensurate with Clemson's reputation for providing unique and innovative experiences for it's students.

The proposed certificate program will utilize facilities and faculty on both the CU-ICAR campus as well as the main campus. Responsibility for the program will lie with the Automotive Engineering Department and faculty in other departments may participate in the delivery of courses and supervise students working on projects.

2. Curriculum Requirements

The proposed certificate in Automotive Engineering is being developed primarily for engineering and science undergraduates and possible local industry employees with engineering or science degrees. The courses in the certificate programs will consist of new courses that piggy-back off the extensive experience that faculty have gained in creating the very successful automotive graduate programs. Elements of the Deep Orange Program that has garnered world-wide attention will be incorporated. Similar to the process used in developing the graduate programs, industry will be consulted and play a key role in the development of the courses as well as the curricula for these programs. It is anticipated that an industry advisory board for the programs will be formed that can provide guidance and support as the programs are developed, and for their continuous improvement.

Initially the target audience for the program is Clemson undergraduate students and local industry employees. It is intended that in the long term, these courses may be made available on-line to a broader audience. Courses developed specifically for the certificate programs will likely also be able to be used within existing degree programs by undergraduate students participating in the certificate program to satisfy their technical elective requirements. Undergraduate students not participating in the certificate program will be allowed to take a subset of courses to satisfy their technical elective requirements.

Proposed Curricular Details: Undergraduate Certificate in Automotive Engineering (12 credits)

The Undergraduate Automotive Engineering Certificate Program will require four undergraduate courses in automotive engineering totaling 12 credit hours. The courses are being developed by the Department of Automotive Engineering faculty in consultation with industry and contain specific automotive content. Based on industry input solicited over the past several months, courses that reflect content in the fields of automotive product innovation, automotive systems integration, vehicle dynamics, and propulsion systems are currently envisioned. They are:

Fall Semester:
AuE 4030: Automotive Engineering Project Tools
AuE 4010/6010: Vehicle Dynamics Lecture
AuE 4011/6011: Vehicle Dynamics Laboratory

Spring Semester:
AuE 4020: Automobile Powertrain Systems Lecture
AuE: 4021: Automobile Powertrain Systems Laboratory
AuE 4040: Automotive Engineering Project Prototyping and Validation

New courses and content will be developed on an as-needed basis. Pre-requisites for these courses will consist of courses already offered in the engineering and science programs in the College.
The utilization of world-class and unique laboratories on the CU-ICAR campus will provide the students hands-on experience that will be hard to duplicate elsewhere. A carefully crafted set of laboratory experiences that reinforce concepts discussed in the classroom will be used to relate theoretical concepts to practice.

3. Assessment Plan, including Student Learning Outcomes

This program will be considered successful when the major constituents determine that the programs are sustainable as demonstrated by demand. One means for determining success is the willingness of industry to hire or promote graduates of this program. Clemson will consider these programs a success when there is a demand by students and industry for the certificate program.

Assessment

The Department Assessment Committee will be responsible for ensuring a proper assessment of the program including the development of metrics and targets as well as data collection. Assessment of the program will be conducted through external and internal means. The following approach to assessment will be used:

- The overall objectives of the programs will be assessed on a yearly basis by an automotive industry advisory board (comprised of representatives from the automotive industry and leadership of the College of Engineering and Science).
- Metrics will be developed and used for assessment in the following areas: (a) the number of students in the program and the enrollment trends (b) Student placement in the automotive industry including starting salaries, level of hiring, number of automotive employers etc. (c) Supervisor/employer assessment of the graduates of the program d) direct feedback from the graduates of the program, 1, 3, 5, and 10 years out and (d) peer survey/benchmarking of similar programs.
- Learning outcomes will be developed for each class and metrics formulated to assess the level of achievement for each student.
- Internal assessment of the quality of course delivery will be based on student evaluations of instructors delivering the courses, student comments, and faculty peer evaluations. Individual instructors will use student evaluations to improve the content and delivery of the subject matter.

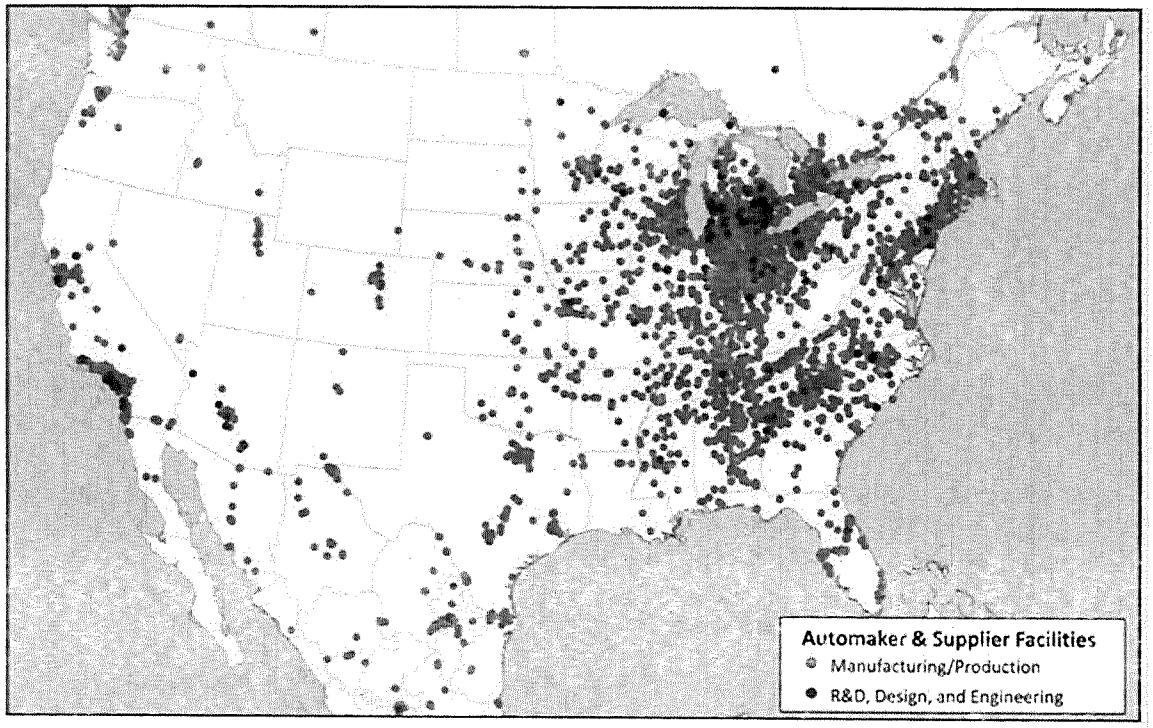
The assessment data and the advisory board recommendations will be used by the Department to continuously improve the quality of the program.

4. Supporting Data and Information

The Southeast is now the hub of automotive manufacturing in the US, and South Carolina is a key player in this shift. A 2011 study by USC's Moore School of Business [14] that was commissioned by the South Carolina Automotive Council of the South Carolina Manufacturing Alliance estimated the economic impact of the automotive industry to be approximately $27.1billion (2008). Further, the study reports that in 2008 there were 84,935 full-time equivalent jobs in the automotive industry in South Carolina, or 5.4 percent of the state employment base, the state was home to 12 original equipment manufacturers (OEM), 309 core manufacturing plants, and a larger supplier set that contained over 4,500 firms. There were over 120 Tier 1 and Tier 2 suppliers in just the ten-county upstate region of the Upstate. The numbers have certainly grown since the time that study was done. Today South Carolina is home to an extensive network of companies that supply the automotive industry. On a national scale, there are more than 1,000 automotive suppliers and assemblers in a 500 mile radius of Clemson University. The total employment in the automotive industry in South Carolina, as reported by the South Carolina Department of Commerce, was estimated to be about 235,000 in 2014.
The automotive industry of today is a high innovation workplace. Discussions with BMW in both Germany and Spartanburg as well as numerous other car manufacturers, indicate that they are looking for people who can bring innovative ideas to the table. The Deep Orange Program is frequently cited as producing these types of graduates. Understanding the customer, the automotive business, and the product is key. Similar discussions with suppliers reveal intense pressures being exerted on them by the OEMs for innovation and a similar search for talent. In response,

some suppliers are starting to create development centers along with their manufacturing facilities to cater to the demands of the OEMs, and this trend will only continue to grow. Many a study also points to the need for South Carolina to start to attract development centers in the state and the presence of an innovative, highly trained workforce is a key first step. Therefore Clemson University, taking the lead to develop such a program will have a unique position in the industry, provide exciting opportunities for it's graduates, enable economic development in the state, and once again lead the nation in providing relevant talent for the automotive industry.

Nationally, the following graphic shows a summary of the automotive industry in the US.



The U.S. automotive industry:

- Employs over 660,000 people (12/2012)[1]
- Produces over $522 Billion in shipments (2012)[2]
- Exports over $128 Billion in motor vehicles and parts (2012)[3]
- Supports $564 Billion in U.S. automotive sales (2012)[4]
- Supports $173 Billion in repairs and service revenue (2012)[4]
- Provides $92 Billion in state tax revenues (13% of total) in the U.S. (2010)[5]
  - $28.3 Billion in the 12 southern states, where auto contributes 16% of total tax revenues
- Provides $43 Billion in federal tax revenues (2010)[5]
- Has a jobs multiplier of 10—one of the highest of any industry[6]

Source: Center for Automotive Research

References:

1. D. P. Woodward, J. C. Von Nessen, V. Watson, "The Economic Impact of South Carolina's Automotive Cluster," Moore School of Business, January, 2011

Add 4000/6000 Course

000054

Course Attributes

Subject Abbreviation:	AUE-Automotive Engineering	**Catalog Title:**	Vehicle Dynamics ☐ **Additional Fee?**
Course Number:	4010 / 6010	**Transcript Title:**	Veh Dyn Perf Justification
Effective Term:	Fall 2016	**Cross-reference(s):**	
College:	Engineering and Science	**Grade Mode:**	Standard Letter
Department:	Campbell Grad Engr Program		

Form

User ID: sih **Name:** Imtiaz Haque
Date: 04/08/2016 **Number:** 16749

Hours

Fixed Credit Course

Credit Hrs	Contact Hrs
4	3

Variable Credit Course

Credit Hrs		Contact Hrs	
Min	**Max**	**Min**	**Max**

Rationale for Add Course

- ☐ **Strengthen Program Requirement(s)**
- ☐ **Alignment of Student Learning Outcomes**
- ☐ **Alternative Delivery of Content**
- ☐ **Improve Time to Degree**
- ☐ **Evolution of the Discipline**
- ☐ **Changing Prerequisites**
- ☐ **Address DWF Rates**
- ☐ **General Education Modifications**
- ☑ **Other (Please specify.)**

This course provides undergraduate students an opportunity to utilize the facilities of the CU-ICAR campus. It also provides undergraduate and first year graduate students interested in the field of vehicle engineering, an opportunity to take a class in vehicle dynamics. Plans to ffer a certificate in Automotive Engineering are currently before the board of trustees. If approved, this course will be an integral part of the certificate.

Schedule Types

- ☐ **Field Course**
- ☐ **Independent Study**
- ☐ **Internship**
- ☐ **Lab No Fee**
- ☐ **Lab With Fee**
- ◉ **Lecture**
- ☐ **Other**
- ☐ **Seminar**
- ☐ **Studio**
- ☐ **Tutorial**

Projected Enrollment

Year 1: 20
Year 2: 30
Year 3: 40
Year 4: 40

17

000055

Evaluation

4000

A	90	-	100
B	80	-	89
C	70	-	79
D	60	-	69
F	<		60

Homeworks 20%, Laboratories 20%, Tests 30%, Final Exam 30%

6000

A	90	-	100
B	80	-	89
C	70	-	79
F	<		70

Homeworks 15%, Laboratories 15%, Tests 30%, Paper Reviews, in-class Presentations 20%, Final Exam, 20%

Catalog Description

This course discusses fundamental concepts in the dynamic behaviour of ground vehicles, mainly two and four-wheeled vehicles. It stresses the application of dynamic systems modeling and analysis to understand ride performance, handling, and straight-line running. Practical considerations in vehicle design and its influence on vehicle performance are discussed.

Prerequisite(s) Corequisite(s)

ME 3050 or equivalent Co-req. AuE 4011/6011

Required course for students in

None

Statement of need and justification based on assessment of student learning outcomes

Graduate students in the Automotive Engineering MS program have the possibility to specialize in the area of Vehicle Performance. There is no course currently being offered that provides instruction on the important topic of Vehicle Dynamics therefore leaving a big gap in their education. This course would fill that need. The AUE Department will work with the other departments to ensure incorporation of ABET accreditation standards and assessment criteria. For undergraduate students, this course provides a possible technical elective for students interested in Vehicles. Given the strong presence of the Automotive industry in South Carolina, a course such as this would create a lot of interest in the students. This course will also be part of an Automotive Engineering Certificate currently being presented for approval to the Board of Trustees.

Textbook(s)

• Gillespie, T. D., 1992, Fundamentals of Vehicle Dynamics, Society of Automotive Engineers, Inc. • Moore, H., 2014, Matlab for Engineers, Prentice Hall.

Learning Objectives

• Students will be able to demonstrate an understanding of systems concepts and how they pertain to the automobile. • Students will be able to apply Newton's Laws and other systems analysis tools to enhance understanding of vehicle performance. • Students will be able to demonstrate an understanding of automotive subsystems and their contributions to the dynamic performance of ground vehicles. • Students will be able to demonstrate an understanding of dynamic performance criteria and their application to design evaluation. • Students will be able to demonstrate an understanding of practical constraints in designing a vehicle to meet performance criteria. • Students will be able to apply modeling and analysis techniques to design evaluation

Topical Outline

1.Introduction 2. Dynamic performance criteria for ground vehicles 3. Automotive subsystem characteristics 4. Vehicle Ride Performance 5. Mechanics of Pneumatic Tires - construction, force generation, performance impact on ground vehicles 6. Introduction to aerodynamics 7. Acceleration Performance of ground vehicles 8. Braking Performance of ground vehicles 9. Lateral handling performance -Steady state and transient performance

Duplication (if applicable)

None. There is a course on the books in Mechanical Engineering, ME 4530/6530, that has not been taught for several years now. Professor Law, the only professor who ever taught it has retired. ME 4530/6530 is a 3 cr. lecture course. The proposed course is 4 cr. hrs. and has a laboratory associated with it. Discussions with the ME Department have been initiated to remove the ME class. The faculty are receptive to the proposal. Students from ME and other departments will be able to take this class to satisfy the tehnical elective requirements. The AUE Department will work with the other departments to ensure incorporation of ABET accreditation standards and assessment criteria.

Add course requirements for honors courses (if applicable)

none.

Add course requirements for 6000-level courses

Graduate students will be required to do work above and beyond that required of undergraduates. They will be required to demonstrate graduate level understanding of the material through: 1. Independent study of advanced topics. Topical areas could include: a. Subjective and objective

evaluation of vehicle performance b. Control of the vehicle by the human driver c. Advanced Model Development using simulation tools such as CarSim or SIMPACK 2. In-Class presentations of above topics 3. Paper Reviews: Assigned papers from vehicle dynamics literature to critically review and reproduce their results.

000056

Learning Activities associated with General Education competencies (if applicable)
None.

Syllabus

Upload File: AuE_4010_6010_Vehicle_Dynamics_Lecture-rev.4-20160408103301.docx

Description: Vehicle Dynamics

Chair, Department Curriculum Committee — Date

Department Chair — Date

Chair, College Curriculum Committee — 4/28/16 — Date

College Dean — Date

Director, Calhoun Honors College — Date

Chair, Undergraduate Curriculum Committee — 5/6/2016 — Date

Chair, Graduate Curriculum Committee — Date

Provost — 6/20/16 — Date

President — Date

000057

Add 4000/6000 Course

Course Attributes

Subject Abbreviation:	AUE-Automotive Engineering	**Catalog Title:**	Vehicle Dynamics Laboratory	☐ **Additional Fee?**
Course Number:	4011 / 6011	**Transcript Title:**	Veh Dyn Lab	Justification
Effective Term:	Fall 2016	**Cross-reference(s):**		
College:	Engineering and Science	**Grade Mode:**	Standard Letter	
Department:	Campbell Grad Engr Program			

Form

User ID: sih **Name:** Imtiaz Haque
Date: 04/08/2016 **Number:** 16775

Hours

Fixed Credit Course

Credit Hrs	Contact Hrs
0	3

Variable Credit Course

Credit Hrs		Contact Hrs	
Min	**Max**	**Min**	**Max**

Rationale for Add Course

- ☐ **Strengthen Program Requirement(s)**
- ☐ **Alignment of Student Learning Outcomes**
- ☐ **Alternative Delivery of Content**
- ☐ **Improve Time to Degree**
- ☐ **Evolution of the Discipline**
- ☐ **Changing Prerequisites**
- ☐ **Address DWF Rates**
- ☐ **General Education Modifications**
- ☑ **Other (Please specify.)**

Part of the course AuE 4010/6010

Schedule Types

- ○ **Field Course**
- ○ **Independent Study**
- ○ **Internship**
- ◉ **Lab No Fee**
- ○ **Lab With Fee**
- ○ **Lecture**
- ○ **Other**
- ○ **Seminar**
- ○ **Studio**
- ○ **Tutorial**

Projected Enrollment

Year 1: 20
Year 2: 30
Year 3: 40
Year 4: 40

Evaluation

4000

A	90	-	100
B	80	-	89
C	70	-	79
D	60	-	69
F	<		60

Laboratory Reports 50% Lab conduct and attendance 50%

6000

A	90	-	100
B	80	-	89
C	70	-	79
F	<		70

Laboratory Reports 40% Lab conduct and attendance 40% Team Leadership, in-class presentations, 20%

Catalog Description

Provost Date

0000958

President Date

000059

AuE 4011/6011 0(3): Vehicle Dynamics Laboratory Non-Credit Laboratory to accompany AuE 4010/6010.

☐ **Prerequisite(s)** ☑ **Corequisite(s)**
AuE 4010/6010

Required course for students in
None

Statement of need and justification based on assessment of student learning outcomes
Laboratory to accompany AuE 4010/6010. Students will obtain hands-on experience in vehicle dynamics

Textbook(s)
None. Instructor's notes will be used.

Learning Objectives
1. Students will be able to use data acquisition equipment and sensors to acquire data. 2. Students will be able to instrument a vehicle for testing. 3. Students will be able to demonstrate an understanding of vehicle testing methods and their relationship to metrics used to define vehicle performance. 4. Students will develop the ability to analyze vehicle testing data and relate the results to the design of the vehicle.

Topical Outline
1. Data Acquisition a. Data Sampling b. Analog to digital conversion c. Quantization Error d. Signal Clipping e. Signal Conditioning f. Frequency Transformation g. Frequency Analysis h. Aliasing i. Sensors 2. Vehicle instrumentation and data collection 3. 4-Post Shaker Vibration Testing (Ride Simulation and Fatigue Analysis): Data Aquisition and Analysis. a. Dune Buggy Road Load Data Acquisition and Fatigue Analysis 4. Traction and Braking testing (Chassis Dynamometer, CGEC): Data Acquisition and Analysis 5. Proving Ground Testing for vehicle handling performance (Michelin Proving Grounds): Subjective Evaluation of Vehicle performance. a. Skid Pad testing

Duplication (if applicable)
None.

Add course requirements for honors courses (if applicable)
None.

Add course requirements for 6000-level courses
Laboratories will be conducted in teams led by Graduate students. Graduate students will be expected to make in-class presentations.

Learning Activities associated with General Education competencies (if applicable)
none.

Syllabus
Upload File: AuE 4011-6011-ver1-20160408103858.docx

Description: Vehicle Dynamics Laboratory

Chair, Department Curriculum Committee — Date

Department Chair — Date

Chair, College Curriculum Committee — Date 4/28/16

College Dean — Date 4/28/16

Director, Calhoun Honors College — Date

Chair, Undergraduate Curriculum Committee — Date 5/6/2016

Chair, Graduate Curriculum Committee — Date

000060

Add Undergraduate Course

Course Attributes

Subject Abbreviation:	AUE-Automotive Engineering	**Catalog Title:**	Automobile Powertrain Systems ☐ **Additional Fee?**
Course Number:	4020	**Transcript Title:**	Automobile Powertrain SystemsJustification
Effective Term:	Spring 2017	**Cross-reference(s):**	
College:	Engineering and Science	**Grade Mode:**	Standard Letter
Department:	Campbell Grad Engr Program		

Form

User ID: rprucka **Name:** Robert Prucka
Date: 04/08/2016 **Number:** 18091

Hours

Fixed Credit Course

Credit Hrs	Contact Hrs
4	3

Variable Credit Course

Credit Hrs		Contact Hrs	
Min	**Max**	**Min**	**Max**

Rationale for Add Course

- ☐ **Strengthen Program Requirement(s)**
- ☐ **Alignment of Student Learning Outcomes**
- ☐ **Alternative Delivery of Content**
- ☐ **Improve Time to Degree**
- ☐ **Evolution of the Discipline**
- ☐ **Changing Prerequisites**
- ☐ **Address DWF Rates**
- ☐ **General Education Modifications**
- ☑ **Other (Please specify.)**

AuE Certificate

Schedule Types

- ○ **Field Course**
- ○ **Independent Study**
- ○ **Internship**
- ○ **Lab No Fee**
- ○ **Lab With Fee**
- ◉ **Lecture**
- ○ **Other**
- ○ **Seminar**
- ○ **Studio**
- ○ **Tutorial**

Projected Enrollment

Year 1: 20
Year 2: 30
Year 3: 40
Year 4: 40

Evaluation

Undergraduate

A	90	-	100
B	80	-	89
C	70	-	79
D	60	-	69
F	<		60

o Homework = 30% o Laboratories = 30% o Midterm Exam = 20% o Final Exam = 20%

Catalog Description

Addresses key aspects of automobile powertrain engineering, from government regulation to sub-system design. Powertrain operational requirements are discussed in the context vehicle-level performance, fuel economy, and emissions. The function, design, performance, and engineering requirements of engines, transmissions, electric motors and high voltage batteries are then described in detail.

☑ Prerequisite(s) ☑ Corequisite(s)

Prereq: ENGR 1410 and ME3030, or equivalent Coreq: AuE 4021

Required course for students in

AuE Certificate

Statement of need and justification based on assessment of student learning outcomes

Automotive powertrains are an important part of the automotive industry. Knowledge in this area is great for students that go into the auto industry or other energy related fields. This is a new course for the AuE Certificate program. The AuE department will work with appropriate

departments to incorporate ABET accreditation standards and assessment criteria for this course to ensure quality of coursework for students.

Textbook(s)

Guzzella, L., Sciarretta, A., "Vehicle Propulsion Systems, Introduction to Modeling and Optimization," 2nd Edition Springer-Verlag, 2007. ISBN 978-3-540-74691-1

Learning Objectives

After completing this course, individuals will be able to: • Comprehend vehicle models that estimate powertrain performance and efficiency requirements • Describe how customer preferences and government regulation influence powertrain design • Understand the influence of vehicle duty-cycle on powertrain design specifications • Identify engine type and displacement to meet vehicle-level requirements • Comprehend the influence of operating conditions on engine fuel efficiency • Differentiate the function and basic control of modern emissions control devices/systems • Estimate the influence of transmission design on fuel economy and vehicle performance • Generate approximate size requirements for high voltage battery systems • Size electric motors relative to powertrain requirements • Understand the functional requirements of powertrain thermal management systems • Recognize the influence on fuel economy and performance of various powertrain control methodologies

Topical Outline

• Powertrain operational requirements for vehicle performance, fuel economy and emissions (3 hours) • Performance evaluation and testing procedures (6 hours) • Customer preferences, societal issues and government regulation regarding powertrains (3 hours) • Internal combustion engine design, performance, and emissions (12 hours) • After-treatment system function, design, and control (3 hours) • Transmission design and function (3 hours) • Hybrid powertrain architecture and design (3 hours) • High voltage battery design, function and control (3 hours) • Motor/generator and power electronics performance and design (3 hours) • Thermal management of powertrain components (1.5 hour) • Supervisory control strategy concepts (e.g. torque control, system constraints, etc.) (1.5 hours) • Exams (3 hours)

Syllabus

Upload File: AuE_4020_Powertrain_Systems_Lecture-20160408113729.docx

Description: Automobile Powertrain Systems

24

10Apr16

Chair, Department Curriculum Committee — Date

11Apr16

Department Chair — Date

4/28/16

Chair, College Curriculum Committee — Date

4/28/16

College Dean — Date

Director, Calhoun Honors College — Date

5/6/2016

Chair, Undergraduate Curriculum Committee — Date

Chair, Graduate Curriculum Committee — Date

6/20/16

Provost — Date

President — Date

AuE 4020: Automobile Powertrain Systems, 4(3)

SEMESTER: TBD

SECTION: TBD

LOCATION: TBD

INSTRUCTOR: TBD

OFFICE: TBD

EMAIL: TBD

PROF. OFFICE HOURS: TBA

TEACHING ASSISTANT: TBD

TA OFFICE HOURS: TBA

COURSE DESCRIPTION:

Addresses key aspects of automobile powertrain engineering, from government regulation to sub-system design. Powertrain operational requirements are discussed in the context vehicle-level performance, fuel economy, and emissions. The function, design, performance, and engineering requirements of engines, transmissions, electric motors and high voltage batteries are then described in detail.

PREREQUISITE: ENGR 1410 and ME 3030, or equivalent

COREQUISTE: AuE 4021

REQUIRED TEXT:

Guzzella, L., Sciarretta, A., "Vehicle Propulsion Systems, Introduction to Modeling and Optimization," 2nd Edition Springer-Verlag, 2007. ISBN 978-3-540-74691-1

SUGGESTED TEXT (NOT REQUIRED):

Heywood, J., "Internal Combustion Engine Fundamentals," McGraw-Hill, New York, 1988.

LEARNING OUTCOMES:

After completing this course, individuals will be able to:

- Comprehend vehicle models that estimate powertrain performance and efficiency requirements
- Describe how customer preferences and government regulation influence powertrain design
- Understand the influence of vehicle duty-cycle on powertrain design specifications
- Identify engine type and displacement to meet vehicle-level requirements
- Comprehend the influence of operating conditions on engine fuel efficiency

- Differentiate the function and basic control of modern emissions control devices/systems
- Estimate the influence of transmission design on fuel economy and vehicle performance
- Generate approximate size requirements for high voltage battery systems
- Size electric motors relative to powertrain requirements
- Understand the functional requirements of powertrain thermal management systems
- Recognize the influence on fuel economy and performance of various powertrain control methodologies

TOPICAL OUTLINE:

- Powertrain operational requirements for vehicle performance, fuel economy and emissions (3 hours)
- Performance evaluation and testing procedures (6 hours)
- Customer preferences, societal issues and government regulation regarding powertrains (3 hours)
- Internal combustion engine design, performance, and emissions (12 hours)
- After-treatment system function, design, and control (3 hours)
- Transmission design and function (3 hours)
- Hybrid powertrain architecture and design (3 hours)
- High voltage battery design, function and control (3 hours)
- Motor/generator and power electronics performance and design (3 hours)
- Thermal management of powertrain components (1.5 hour)
- Supervisory control strategy concepts (e.g. torque control, system constraints, etc.) (1.5 hours)
- Exams (3 hours)

CLASS PROCEDURES, NOTES, PRE-REQUISITES, ATTENDANCE, ETC.:

- Late Instructor Policy: Students may leave after 15 minutes if the professor or a guest lecturer does not arrive in that time.

- Class Attendance is not mandatory, but highly recommended. College work proceeds at such a pace that regular attendance is necessary for each student to obtain maximum benefits from instruction. Regular and punctual attendance at all class and laboratory sessions is a student obligation, and each student is responsible for all the work, including tests and written work, in all class and laboratory sessions.

- "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."

- Please refrain from cell phone and laptop communications during lectures

TESTS AND GRADING:

- Grading Distribution (100%)
    - Homework = 30%

- Laboratories = 30%
- Midterm Exam = 20%
- Final Exam = 20%

- Grading Scale
  - A = 90-100%
  - B = 80-89%
  - C = 70-79%
  - D = 60-69%
  - F = 69% or lower
- Assignments are due at the beginning of the class period
- No make-up exams will be provided
- Late assignments (homework and laboratory reports) will lose 10% per day late
- If cheating and/or plagiarism are monitored you will be severely penalized. Many of your assignments will be analyzed using 'Turnitin'. **You are free to discuss your assignments with classmates, but you must turn in your own work, written in your own words!**

ACADEMIC INTEGRITY:

AuE 4020: Please see the section on Undergraduate Academic Integrity in http://www.registrar.clemson.edu/publicat/catalog/2012/acadreg.pdf for a complete description of the applicable policies and procedures.

"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 course instructor, there is evidence that a student has committed an act of academic dishonesty, that person must make a formal written charge of academic dishonesty, including a description of the misconduct, to the Associate Dean of Undergraduate Studies. The reporting person may, at his or her discretion, inform each involved student privately of the nature of the alleged charge. In charges of plagiarism instructors may use, as an option, the Plagiarism Resolution Form available from the Office of Undergraduate Studies."

"Instructors suspecting a violation of the academic integrity policy should not assign a grade penalty until the process is complete. For suspected academic dishonesty outside the course setting, please consult with the Associate Dean of Undergraduate Studies".

000066

Add Undergraduate Course

Course Attributes

Subject Abbreviation:	AUE-Automotive Engineering	**Catalog Title:**	Automobile Powertrain Systems Laboratory
Course Number:	4021	**Transcript Title:**	Auto. Powertrain Sys. Lab.
Effective Term:	Spring 2017	**Cross-reference(s):**	
College:	Engineering and Science	**Grade Mode:**	Non-Gradeable
Department:	Campbell Grad Engr Program	☐ **Additional Fee?**	

Justification

Form

User ID: rprucka **Name:** Robert Prucka
Date: 04/08/2016 **Number:** 18096

Hours

Fixed Credit Course

Credit Hrs	Contact Hrs
0	3

Variable Credit Course

Credit Hrs		Contact Hrs	
Min	**Max**	**Min**	**Max**

Rationale for Add Course

- ☐ **Strengthen Program Requirement(s)**
- ☐ **Alignment of Student Learning Outcomes**
- ☐ **Alternative Delivery of Content**
- ☐ **Improve Time to Degree**
- ☐ **Evolution of the Discipline**
- ☐ **Changing Prerequisites**
- ☐ **Address DWF Rates**
- ☐ **General Education Modifications**
- ☑ **Other (Please specify.)**

AuE Certificate

Schedule Types

- ○ **Field Course**
- ○ **Independent Study**
- ○ **Internship**
- ○ **Lab No Fee**
- ◉ **Lab With Fee**
- ○ **Lecture**
- ○ **Other**
- ○ **Seminar**
- ○ **Studio**
- ○ **Tutorial**

Projected Enrollment

Year 1: 20
Year 2: 30
Year 3: 40
Year 4: 40

Evaluation

Undergraduate

A	90	-	100
B	80	-	89
C	70	-	79
D	60	-	69
F	<		60

Graded as part of AuE 4020 • Laboratory Reports – 80% • Laboratory Participation – 20%

Catalog Description

Non-credit laboratory to accompany AuE 4020. A hybrid electric vehicle will be evaluated in a chassis dynamometer facility. The vehicle is instrumented to analyze powertrain system and individual component performance. Students run industry standard drive cycles, record data, develop data processing routines and evaluate system performance.

☑ **Prerequisite(s)** ☑ **Corequisite(s)**

Prereq: None (same as AuE 4020) Coreq: AuE 4020

Required course for students in

AuE Certificate

Statement of need and justification based on assessment of student learning outcomes

Hands-on powertrain knowledge is critical for student development for careers in the auto industry. This is a new course for the AuE Certificate

program. The AuE department will work with appropriate departments to incorporate ABET accreditation standards and assessment criteria for this course to ensure quality of coursework for students.

000067

Textbook(s)

None

Learning Objectives

After completing this course, individuals will be able to: • Setup, run, and evaluate the validity of powertrain drive-cycle tests • Understand the acquisition and analysis of powertrain performance data • Evaluate and compare powertrain system designs and operating strategies for fuel efficiency and vehicle performance targets • Evaluate powertrain subsystems by quantifying efficiency and operating performance

Topical Outline

• Vehicle instrumentation and data acquisition setup (9 hours) • Drive-cycle system evaluation for fuel economy and operating characteristics/range (9 hours) • Transient and steady-state assessment of electric propulsion systems (9 hours) • Transmission shift schedule evaluation (3 hours) • Internal combustion engine specific assessment of calibration and efficiency (15 hours)

Syllabus

Upload File: AuE_4021_Powertrain_Systems_Lab-20160408113505.docx

Description: Automobile Powertrain Systems Laboratory

30

000068

10Apr16

Chair, Department Curriculum Committee — Date

Zoran Filipi — 11Apr16

Department Chair — Date

4/28/16

Chair, College Curriculum Committee — Date

4/28/16

College Dean — Date

Director, Calhoun Honors College — Date

5/6/2016

Chair, Undergraduate Curriculum Committee — Date

Chair, Graduate Curriculum Committee — Date

6/20/16

Provost — Date

President — Date

AuE 4021: Automobile Powertrain Systems Laboratory, 0(3)

SEMESTER: TBD

SECTION: TBD

LOCATION: TBD

INSTRUCTOR: TBD

OFFICE: TBD

EMAIL: TBD

PROF. OFFICE HOURS: TBD

TEACHING ASSISTANT: TBD

TA OFFICE HOURS: TBD

COURSE DESCRIPTION:

Non-credit laboratory to accompany AuE 4020. A hybrid electric vehicle will be evaluated in a chassis dynamometer facility. The vehicle is instrumented to analyze powertrain system and individual component performance. Students run industry standard drive cycles, record data, develop data processing routines and evaluate system performance.

PREREQUISITE: None (same as AuE 4020)

COREQUISTE: AuE 4020

SUGGESTED TEXT (NOT REQUIRED):

Heywood, J., "Internal Combustion Engine Fundamentals," McGraw-Hill, New York, 1988.

LEARNING OUTCOMES:

After completing this course, individuals will be able to:

- Setup, run, and evaluate the validity of powertrain drive-cycle tests
- Understand the acquisition and analysis of powertrain performance data
- Evaluate and compare powertrain system designs and operating strategies for fuel efficiency and vehicle performance targets
- Evaluate powertrain subsystems by quantifying efficiency and operating performance

LABORATORY OUTLINE:

- Vehicle instrumentation and data acquisition setup (9 hours)
- Drive-cycle system evaluation for fuel economy and operating characteristics/range (9 hours)
- Transient and steady-state assessment of electric propulsion systems (9 hours)
- Transmission shift schedule evaluation (3 hours)
- Internal combustion engine specific assessment of calibration and efficiency (15 hours)

EVALUATION SCHEME

- Laboratory Reports = 80%
- Laboratory Participation = 20%

CLASS PROCEDURES, NOTES, PRE-REQUISITES, ATTENDANCE, ETC.:

- Late Instructor Policy: Students may leave after 15 minutes if the professor or a guest lecturer does not arrive in that time.
- Class Attendance is not mandatory, but highly recommended. College work proceeds at such a pace that regular attendance is necessary for each student to obtain maximum benefits from instruction. Regular and punctual attendance at all class and laboratory sessions is a student obligation, and each student is responsible for all the work, including tests and written work, in all class and laboratory sessions.
- "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."
- Please refrain from cell phone and laptop communications during laboratories

TESTS AND GRADING:

- Graded as part of AuE 4020
- Assignments are due at the beginning of the class period
- Late assignments (homework and laboratory reports) will lose 10% per day late
- If cheating and/or plagiarism are monitored you will be severely penalized. Many of your assignments will be analyzed using 'Turnitin'. **You are free to discuss your assignments with classmates, but you must turn in your own work, written in your own words!**

ACADEMIC INTEGRITY:

AuE 4021: Please see the section on Undergraduate Academic Integrity in http://www.registrar.clemson.edu/publicat/catalog/2012/acadreg.pdf for a complete description of the applicable policies and procedures.

"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 course instructor, there is evidence that a student has committed an act of academic dishonesty, that person must make a formal written charge of academic dishonesty, including a description of the misconduct, to the Associate Dean of Undergraduate Studies. The reporting person may, at his or her discretion, inform each involved student privately of the nature of the alleged charge. In charges of plagiarism instructors may use, as an option, the Plagiarism Resolution Form available from the Office of Undergraduate Studies."

"Instructors suspecting a violation of the academic integrity policy should not assign a grade penalty until the process is complete. For suspected academic dishonesty outside the course setting, please consult with the Associate Dean of Undergraduate Studies".

Add Undergraduate Course

Course Attributes

Subject Abbreviation:	AUE-Automotive Engineering	**Catalog Title:**	Automotive Engineering Project Tools
Course Number:	4030	**Transcript Title:**	Auto. Eng. Project. Tools
Effective Term:	Fall 2016	**Cross-reference(s):**	
College:	Engineering and Science	**Grade Mode:**	Standard Letter
Department:	Campbell Grad Engr Program		

Additional Fee?

Justification
The course is to be offered as part of the certificate program in automotive engineering for undergraduates and industry.

Form

User ID: beshah **Name:** Beshah Ayalew
Date: 05/08/2016 **Number:** 16894

Hours

Fixed Credit Course

Credit Hrs	Contact Hrs
2	2

Variable Credit Course

Credit Hrs		Contact Hrs	
Min	**Max**	**Min**	**Max**

Rationale for Add Course

- **Strengthen Program Requirement(s)**
- **Alignment of Student Learning Outcomes**
- **Alternative Delivery of Content**
- **Improve Time to Degree**
- **Evolution of the Discipline**
- **Changing Prerequisites**
- **Address DWF Rates**
- **General Education Modifications**
- **Other (Please specify.)**

new course for certificate program

Schedule Types

- **Field Course**
- **Independent Study**
- **Internship**
- **Lab No Fee**
- **Lab With Fee**
- **Lecture**
- **Other**
- **Seminar**
- **Studio**
- **Tutorial**

Projected Enrollment

Year 1: 20
Year 2: 20
Year 3: 20
Year 4: 30

Evaluation

Undergraduate

A	90	-	100
B	80	-	89
C	70	-	79
D	60	-	69
F	<		60

40% Homework 40% Projects 20% Final Exam

Catalog Description

This is a team-based project course that covers state of the art analysis tools and methods for executing automotive system/ subsystem design and integration. Topics covered include automotive development processes, hands-on training on select design software covering different disciplines and team projects utilizing the same.

Prerequisite(s) Corequisite(s)

ENGR 1410 and ENGR 2080

Required course for students in

Automotive Engineering Certificate Program

Statement of need and justification based on assessment of student learning outcomes

New course for certificate program. The AuE department will work with appropriate departments to incorporate ABET accreditation standards and assessment criteria for this course to ensure quality of coursework for students.

Textbook(s)

none

Learning Objectives

1. Students will able to demonstrate familiarity with automotive development processes 2. Students will be able to demonstrate proficiency in state of the art software tools and methods for automotive system/subsystem design and integration 3. Students will be able to demonstrate practical hands-on

hardware/software integration of select automotive subsystems/systems 4. Students will be able to undertake complex automotive projects requiring team work

Topical Outline

1. Overview of Vehicle Development Processes a. V- model of product development (2 hrs) b. Product Strategy, Product Evolution Processes (2 hrs) 2. Software tools a. Building analysis models of automotive systems (mechanical, hydraulics, pneumatics, electrical, continuous, discrete, hybrid- state flow; solver selection); MATLAB/Simulink and overview of other similar software; application to projects (6 hrs) b. Multi-body dynamics simulation: MSC ADAMS, SIMPACK, CarSim etc (4hrs) c. Geometric design software: SOLIDWORKs, etc (2 hrs) d. Structural/Crashworthiness/analysis software: ANSYS, COMSOL, etc. (2hrs) e. CFD and Thermal Analysis Software (2hrs) 3. Hardware a. Automotive Electrical/Electronics Lab: sensors, actuators, networks (CAN, LIN, etc…) (4hrs) b. Tools for data acquisition, control prototyping, hardware-in-the-loop simulation (dSPACE, XPC Target, NI-Labview, etc) (6hrs) Example projects that apply the above tools concurrently throughout the course: 1. Analysis and Integration of new suspension designs 2. Integration of new braking system concepts 3. Integration of new powertrain subsystems 4. New chassis/component crashworthiness analysis Implementation of a model-based diagnostic algorithm for a safety function.

Syllabus

Upload File: AuE 4030- Aut. Eng. Proj. Tools-20160408101110.docx

Chair, Department Curriculum Committee	05/08/16 Date
Department Chair	5/8/16 Date
Chair, College Curriculum Committee	5/9/16 Date
College Dean	5/9/16 Date
Director, Calhoun Honors College	Date
Chair, Undergraduate Curriculum Committee	5/6/2016 Date
Chair, Graduate Curriculum Committee	Date
Provost	6/20/16 Date
President	Date

AuE 4030: Automotive Engineering Project Tools: (2 Cr hr/2 contact hr). This is a team-based project course that covers state of the art analysis tools and methods for executing automotive system/ subsystem design and integration. Topics covered include automotive development processes, hands-on training on select design software covering different disciplines and team projects utilizing the same.

Instructor: TBD, Room: TBD
TA: TBD
Course Office Hours: TBD
Prerequisites: ENGR 140 and ENGR 2080 or equivalent.
Industry participants must have taken an equivalent course to ENGR 1410 and ENGR 2080

Topical Outline (30hrs):

1. Overview of Vehicle Development Processes
    a. V- model of product development (2 hrs)
    b. Product Strategy, Product Evolution Processes (2 hrs)
2. Software tools
    a. Building analysis models of automotive systems (mechanical, hydraulics, pneumatics, electrical, continuous, discrete, hybrid- state flow; solver selection); MATLAB/Simulink and overview of other similar software; application to projects (6 hrs)
    b. Multi-body dynamics simulation: MSC ADAMS, SIMPACK, CarSim etc (4hrs)
    c. Geometric design software: SOLIDWORKs, etc (2 hrs)
    d. Structural/Crashworthiness/analysis software: ANSYS, COMSOL, etc. (2hrs)
    e. CFD and Thermal Analysis Software (2hrs)
3. Hardware
    a. Automotive Electrical/Electronics Lab; sensors, actuators, networks (CAN, LIN, etc...) (4hrs)
    b. Tools for data acquisition, control prototyping, hardware-in-the-loop simulation (dSPACE, XPC Target, NI-Labview, etc) (6hrs)

Example projects that apply the above tools concurrently throughout the course:

1. Analysis and Integration of new suspension designs
2. Integration of new braking system concepts
3. Integration of new powertrain subsystems
4. New chassis/component crashworthiness analysis
5. Implementation of a model-based diagnostic algorithm for a safety function.

Student Learning Outcomes:

1. Students will able to demonstrate familiarity with automotive development processes

2. Students will be able to demonstrate proficiency in state of the art software tools and methods for automotive system/subsystem design and integration
3. Students will be able to demonstrate practical hands-on hardware/software integration of select automotive subsystems/systems
4. Students will be able to undertake complex automotive projects requiring team work

Grading:

Homeworks 40%
Projects: 40%
Final Exam: 20%

Typical letter grades: A(90%+), B(80%-89%), C(70%-79%), D(60%-69%), F(<60%)

- Grading Complaints. All grading complaints must be resolved within 1 week after we return your graded work.
- Academic Integrity. Discussing homework problems with fellow students is encouraged, but what you submit must be your own individual work. We will deduct points for flagrant copying that is not justified with your own argument or steps. Make sure you are familiar with the CU Grad School's Academic Integrity Statement available at this URL:
- Violations of academic integrity will be dealt with according to the policies and procedures described in www.grad.clemson.edu/wiki/academic_reg. Please review those.

Here is also a statement from the Clemson University Provost on 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. In instances where academic standards may have been compromised, Clemson University has a responsibility to respond appropriately and expeditiously to charges of violations of academic integrity."

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."

Add Undergraduate Course

Course Attributes

Subject Abbreviation:	AUE-Automotive Engineering	**Catalog Title:**	Automotive Engineering Project Prototyping and Validation
Course Number:	4040	**Trauscript Title:**	Auto Eng Proj Prototyping
Effective Term:	Spring 2017	**Cross-reference(s):**	
College:	Engineering and Science	**Grade Mode:**	Standard Letter
Department:	Campbell Grad Engr Program	☐ **Additional Fee?**	

Justification

Form

User ID: rprucka **Name:** Robert Prucka
Date: 04/08/2016 **Number:** 17369

Hours

Fixed Credit Course

Credit Hrs	Contact Hrs
2	2

Variable Credit Course

Credit Hrs		Contact Hrs	
Min	**Max**	**Min**	**Max**

Rationale for Add Course

- ☐ **Strengthen Program Requirement(s)**
- ☐ **Alignment of Student Learning Outcomes**
- ☐ **Alternative Delivery of Content**
- ☐ **Improve Time to Degree**
- ☐ **Evolution of the Discipline**
- ☐ **Changing Prerequisites**
- ☐ **Address DWF Rates**
- ☐ **General Education Modifications**
- ☑ **Other (Please specify.)**

AuE Certificate

Schedule Types

- ○ **Field Course**
- ○ **Independent Study**
- ○ **Internship**
- ○ **Lab No Fee**
- ○ **Lab With Fee**
- ◉ **Lecture**
- ○ **Other**
- ○ **Seminar**
- ○ **Studio**
- ○ **Tutorial**

Projected Enrollment

Year 1: 20
Year 2: 20
Year 3: 20
Year 4: 30

Evaluation

Undergraduate

A	90	-	100
B	80	-	89
C	70	-	79
D	60	-	69
F	<		60

o Homework = 40% o Projects = 40% o Final Exam = 20%

Catalog Description

Project-based course where student teams develop and validate prototype automotive systems, sub-systems, or components. Lectures are provided for select topics related to product prototyping and validation. Topics covered include design for manufacturing, machining, 3D printing, welding, wiring, instrumentation, data acquisition, assembly, experimental design, data analysis and interpretation.

☑ Prerequisite(s) ☐ Corequisite(s)

AuE 4030

Required course for students in

Automotive Engineering Certificate Program

Statement of need and justification based on assessment of student learning outcomes

Experiential based learning is critical for automotive engineering. This is a new course for the AuE Certificate program. The AuE department will work with appropriate departments to incorporate ABET accreditation standards and assessment criteria for this course to ensure quality of coursework for students.

Textbook(s)
None

Learning Objectives
After completing this course, individuals will be able to: 1. Identify proper machining processes for a given manufacturing task 2. Perform wiring system design for automotive systems 3. Setup and utilize sensor and data acquisition systems 4. Analyze experimental data to generate product engineering insights

Topical Outline
1. Design for Manufacturing (2 hours) 2. Machining (e.g. mill, lathe, threading, etc.) (4 hours) 3. 3D Printing (2 hours) 4. Welding (e.g. TIG, MIG) (2 hours) 5. Wiring (e.g. DC low-voltage, grounding, relays) (4 hours) 6. Instrumentation (e.g. thermocouples, encoders, position, flow meters, strain measurement, etc.) (4 hours) 7. Data Acquisition (e.g. system configuration, wiring, sample rates, etc.) (4 hours) 8. Assembly (e.g. proper use of tools, torque specifications, etc.) (2 hours) 9. Experiment Design (2 hours) 10. Data Analysis (2 hours) 11. Interpretation of Test Data (2 hours)

Syllabus

Upload File: AuE 4040 Auto Eng Proj Prototyping and Validation-20160408113148.docx

Description: Auto Eng Project Prototyping and Validation

10Apr16

Chair, Department Curriculum Committee — Date

11Apr16

Department Chair — Date

4/28/16

Chair, College Curriculum Committee — Date

4/28/16

College Dean — Date

Director, Calhoun Honors College — Date

5/6/2016

Chair, Undergraduate Curriculum Committee — Date

Chair, Graduate Curriculum Committee — Date

6/20/16

Provost — Date

President — Date

AuE 4040: Automotive Engineering Project Prototyping and Validation 2(2)

SEMESTER: TBD

SECTION: TBD

LOCATION: TBD

INSTRUCTOR: TBD

OFFICE: TBD

EMAIL: TBD

PROF. OFFICE HOURS: TBD

TEACHING ASSISTANT: TBD

TA OFFICE HOURS: TBD

COURSE DESCRIPTION:

Project-based course where student teams develop and validate prototype automotive systems, sub-systems, or components. Lectures are provided for select topics related to product prototyping and validation. Topics covered include design for manufacturing, machining, 3D printing, welding, wiring, instrumentation, data acquisition, assembly, experimental design, data analysis and interpretation.

PREREQUISITE: AuE 4030

LEARNING OUTCOMES:

After completing this course, individuals will be able to:

1. Identify proper machining processes for a given manufacturing task
2. Perform wiring system design for automotive systems
3. Setup and utilize sensor and data acquisition systems
4. Analyze experimental data to generate product engineering insights

TOPICAL OUTLINE:

1. Design for Manufacturing (2 hours)
2. Machining (e.g. mill, lathe, threading, etc.) (4 hours)
3. 3D Printing (2 hours)
4. Welding (e.g. TIG, MIG) (2 hours)
5. Wiring (e.g. DC low-voltage, grounding, relays) (4 hours)
6. Instrumentation (e.g. thermocouples, encoders, position, flow meters, strain measurement, etc.) (4 hours)
7. Data Acquisition (e.g. system configuration, wiring, sample rates, etc.) (4 hours)
8. Assembly (e.g. proper use of tools, torque specifications, etc.) (2 hours)
9. Experiment Design (2 hours)
10. Data Analysis (2 hours)
11. Interpretation of Test Data (2 hours)

CLASS PROCEDURES, NOTES, PRE-REQUISITES, ATTENDANCE, ETC.:

- Late Instructor Policy: Students may leave after 15 minutes if the professor or a guest lecturer does not arrive in that time.
- Class Attendance is not mandatory, but highly recommended. College work proceeds at such a pace that regular attendance is necessary for each student to obtain maximum benefits from instruction. Regular and punctual attendance at all class and laboratory sessions is a student obligation, and each student is responsible for all the work, including tests and written work, in all class and laboratory sessions.
- "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."
- Please refrain from cell phone and laptop communications during lectures

TESTS AND GRADING:

- Grading Distribution (100%)
  - Homework = 40%
  - Projects = 40%
  - Final Exam = 20%
- Grading Scale
  - A = 90-100%
  - B = 80-89%
  - C = 70-79%
  - D = 60-69%
  - F = 69% or lower
- Assignments are due at the beginning of the class period
- No make-up exams will be provided
- Late assignments (homework and laboratory reports) will lose 10% per day late

- If cheating and/or plagiarism are monitored you will be severely penalized. Many of your assignments will be analyzed using 'Turnitin'. **You are free to discuss your assignments with classmates, but you must turn in your own work, written in your own words!**

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"When, in the opinion of a course instructor, there is evidence that a student has committed an act of academic dishonesty, that person must make a formal written charge of academic dishonesty, including a description of the misconduct, to the Associate Dean of Undergraduate Studies. The reporting person may, at his or her discretion, inform each involved student privately of the nature of the alleged charge. In charges of plagiarism instructors may use, as an option, the Plagiarism Resolution Form available from the Office of Undergraduate Studies."

"Instructors suspecting a violation of the academic integrity policy should not assign a grade penalty until the process is complete. For suspected academic dishonesty outside the course setting, please consult with the Associate Dean of Undergraduate Studies".

000082

Change Undergraduate Course

Change a Course

Subject:	ENGR-Engineering
Number:	1020
Effective Term:	Spring 2016
Title:	Engineering Discipl & Skills
Honors Course:	
☐ Add Honors Course:	
Last Term Course was taught:	201401

Brief Statement of Change Based on Assessment Results:
Changing pre-requisites to accommodate students who have math credit but not a high enough CMPT score

Rationale for Changing a Course

- ☐ **Strengthen Program Requirement(s)**
- ☐ **Alignment of Student Learning Outcomes**
- ☐ **Alternative Delivery of Content**
- ☐ **Improve Time to Degree**
- ☐ **Evolution of the Discipline**
- ☑ **Changing Prerequisites**
- ☐ **Address DWF Rates**
- ☐ **General Education Modifications**
- ☐ **Other (Please specify.)**

Honors

- ☐ **Honors Students Only?**
- ☑ **Honors sections allowed to be offered?**

☑ Change Prerequisite(s) / Corequisite(s)

From	Preq: Score of 65 or better on the Clemson Mathematics Placement Test (CMPT)
To	Preq: MATH 1050; or MATH 1040 or MATH 1060 with a C or better; or concurrent enrollment in MATH 1040 or MATH 1060; or a score of 65 or better on the Clemson Mathematics Placement Test (CMPT). Coreq: 1021

Learning Objectives

At the completion of this course, the student should be able to: 1. Identify fundamental dimensions, base units, and named derived dimensions and units 2. Apply laws governing dimensions, units, and equation development 3. Express observations in appropriate units and perform conversions between unit systems 4. Define, recall, and utilize basic mathematical and physical sciences principles, including but not limited to: amount, density, efficiency, electrical concepts, energy, force, mass, power, pressure, temperature and weight 5. Create "proper" plots of experimental and theoretical data 6. Determine graphical solutions to problems, with special emphasis on economic breakeven analysis 7. Identify a linear, power and exponential mathematical models from an equation form and a graphical sketch 8. Interpret mathematical models in terms of physical phenomena 9. Evaluate a logarithmic plot to determine an appropriate mathematical model to describe experimental data 10. Use Microsoft Excel to: a. enter data and text b. format information c. write basic mathematical formulas d. use absolute, relative, and mixed cell addressing e. utilize built-in functions, including mathematical, statistical, trigonometric and LOOKUP f. create conditional statements g. apply conditional formatting, data validation, sorting and filtering to a worksheet h. create proper plots of experimental and theoretical data i. model experimental data with a trendline j. create logarithmic plots

Topical Outline

The topical outline below includes the approximate number of class periods devoted to each module in brackets but is subject to change at the discretion of the instructor. Module 1: Foundational Engineering Concepts [1] - Fundamental Dimensions and Base Units - Basic Conversion Procedures Module 2: Problem Solving involving Conversions [3] - Equations involving Unit Conversions - Density - Force - Weight Module 3: Problem Solving involving Equations [3.5] - Derived Dimensions and Units - Equation Laws - Pressure (hydrostatic, total) - Temperature Equations Module 4: Problem Solving with Initial and Final Conditions [1.5] - Amount - Ideal Gas Module 5: Problem Solving with Conservation Laws [4] - Kinetic Energy - Potential Energy - Thermal Energy - Temperature Ratios - Work Module 6: Problem Solving with Rate and Loss [2.5] - Power - Efficiency Module 7: Problem Solving with Dynamic Systems [2] - Charge - Current Module 7: Problem Solving with Dynamic Systems (continued) - Resistance - Voltage Module 8: Foundational Engineering Concepts [2] - Basic Excel Workbook - Cell References - Built-in Excel Functions Module 9: Graphical Representation [3] - Proper Plots - Graphing in Excel - Trendlines in Excel Module 10: Automation of Problem Solving [2.5] - Conditionals in Excel Module 11: Interaction of Engineering Tools [3.5] - LOOKUP functions in Excel - Conditional Formatting in Excel - Data Validation - Sort and Filter Module 12: Graphical Interpretation [3] - Graphical Solutions - Breakeven Analysis Module 13: Model Interpretation [3] - Exponential Models - Linear Models - Power Law Models Module 14: Model Development [3] - Logarithmic Plots (log-log, semilog)

000083

Evaluation

Undergraduate

A	90	-	100
B	80	-	89
C	70	-	79
D	60	-	69
F	<		60

Assignments = 5% Exam 1 = 15% Exam 2 = 25% Exam 3 = 15% Final Exam = 40%

Syllabus

Upload File: ENGR 1020 Syllabus-20160405123100.pdf

Description: ENGR 1020 Syllabus Spring 2016

Form

User ID: jminor **Name:** John Minor

Date: 04/05/2016 **Number:** 21210

000084

Chair, Department Curriculum Committee — Date 4/5/16

Department Chair — Date 4/5/16

Chair, College Curriculum Committee — Date 4/28/16

College Dean — Date 4/28/16

Director, Calhoun Honors College — Date

Chair, Undergraduate Curriculum Committee — Date 5/6/2016

Chair, Graduate Curriculum Committee — Date

Provost — Date 6/20/16

President — Date

Change Undergraduate Course

Change a Course

Subject:	ENGR-Engineering
Number:	1050
Effective Term:	Spring 2016
Title:	Engr Discipline & Skills I
Honors Course:	
☐ Add Honors Course:	
Last Term Course was taught:	201601

Brief Statement of Change Based on Assessment Results:
Matching pre-requisites for ENGR 1020

Rationale for Changing a Course

- ☐ **Strengthen Program Requirement(s)**
- ☐ **Alignment of Student Learning Outcomes**
- ☐ **Alternative Delivery of Content**
- ☐ **Improve Time to Degree**
- ☐ **Evolution of the Discipline**
- ☑ **Changing Prerequisites**
- ☐ **Address DWF Rates**
- ☐ **General Education Modifications**
- ☐ **Other (Please specify.)**

Honors

- ☐ **Honors Students Only?**
- ☑ **Honors sections allowed to be offered?**

☑ Change Prerequisite(s) / Corequisite(s)

From	Preq: MATH 1050; or MATH 1060 or MATH 1070 with a C or better; or a score of 65 or higher on the Clemson Mathematics Placement Test (CMPT)
To	Preq: MATH 1050; or MATH 1040 or MATH 1060 with a C or better; or concurrent enrollment in MATH 1040 or MATH 1060; or a score of 65 or better on the Clemson Mathematics Placement Test (CMPT)

Learning Objectives

At the completion of this course, the student should be able to: 1. Identify fundamental dimensions, base units, and named derived dimensions and units 2. Apply laws governing dimensions, units, and equation development 3. Express observations in appropriate units and perform conversions between unit systems 4. Define, recall, and utilize basic mathematical and physical sciences principles, including but not limited to: amount, density, efficiency, electrical concepts, energy, force, mass, power, pressure, temperature and weight

Topical Outline

The topical outline below includes the approximate number of class periods devoted to each module in brackets but is subject to change at the discretion of the instructor. Module 1: Foundational Engineering Concepts [1] - Fundamental Dimensions and Base Units - Basic Conversion Procedures Module 2: Problem Solving involving Conversions [3] - Equations involving Unit Conversions - Density - Force - Weight Module 3: Problem Solving involving Equations [3.5] - Derived Dimensions and Units - Equation Laws - Pressure (hydrostatic, total) - Temperature Equations Module 4: Problem Solving with Initial and Final Conditions [1.5] - Amount - Ideal Gas Module 5: Problem Solving with Conservation Laws [4] - Kinetic Energy - Potential Energy - Thermal Energy - Temperature Ratios - Work Module 6: Problem Solving with Rate and Loss [2.5] - Power - Efficiency Module 7: Problem Solving with Dynamic Systems [2] - Charge - Current Module 7: Problem Solving with Dynamic Systems (continued) - Resistance - Voltage

Evaluation

Undergraduate

A	90	-	100
B	80	-	89
C	70	-	79
D	60	-	69
F	<		60

Assignments 5% Midterm Exam 40% Final Exam 55%

Syllabus

Upload File: ENGR 1050 Syllabus-20160405142822.pdf

Description: ENGR 1050 Syllabus Spring 2016

Form

User ID: jminor **Name:** John Minor
Date: 04/05/2016 **Number:** 21230

Chair, Department Curriculum Committee — Date 4/5/16

Department Chair — Date 4/5/16

Chair, College Curriculum Committee — Date 4/28/16

College Dean — Date 4/28/16

Director, Calhoun Honors College — Date

Chair, Undergraduate Curriculum Committee — Date 5/6/2016

Chair, Graduate Curriculum Committee — Date

Provost — Date 6/20/16

President — Date

Change Undergraduate Course

Change a Course

Subject:	ENGR-Engineering
Number:	1070
Effective Term:	Spring 2016
Title:	Programming & Prob Solving I
Honors Course:	
☐ Add Honors Course:	
Last Term Course was taught:	201601

Brief Statement of Change Based on Assessment Results:
Add ENGR 1020 to pre-requisites

Rationale for Changing a Course

- ☐ **Strengthen Program Requirement(s)**
- ☐ **Alignment of Student Learning Outcomes**
- ☐ **Alternative Delivery of Content**
- ☐ **Improve Time to Degree**
- ☐ **Evolution of the Discipline**
- ☑ **Changing Prerequisites**
- ☐ **Address DWF Rates**
- ☐ **General Education Modifications**
- ☐ **Other (Please specify.)**

☑ Change Prerequisite(s) / Corequisite(s)

From	Preq or concurrent enrollment: ENGR 1060 with a C or better.
To	Preq: ENGR 1060 or ENGR 1020 with a C or better; or concurrent enrollment in ENGR 1060

Learning Objectives

At the completion of this course, the student should be able to: 1. Create, save and execute a program 2. Use MATLAB to: a. enter data in the form of scalars, vectors, and matrices; b. enter text in the form of character strings; and c. enter mixed data in the form of cell arrays d. write basic mathematical formulas e. utilize built-in functions, including mathematical, statistical, trigonometric f. create conditional statements g. apply error and warning statements 3. Allow MATLAB to exchange data with...: a. a user, through input/menu and formatted output (fprintf/sprintf) statements b. another MATLAB program, using user-defined functions c. a text file, using save / load d. an Excel workbook, using xlsread / xlswrite

Topical Outline

The topical outline below includes the approximate number of class periods devoted to each module in brackets. Module 1: Foundational Engineering Concepts – Data Structures [1] - Scalars - Vectors - Matrices Module 2: Foundational Engineering Concepts – Basic Programs & More Data Structures [2] - MATLAB interface - Assignment operator - Dot operator - Create, run and save a program Module 3: Foundational Engineering Concepts – Data Structures [1] - Character Strings - Cell Arrays Module 4: Interaction of Engineering Tools – User [1] - input - menu - fprintf - sprint Module 5: Interaction of Engineering Tools – other programs [1] - User-defined functions Module 6: Interaction of Engineering Tools –MAT files and Excel [1] - load - save - xlsread - xlswrite Module 7: Automation of Problem Solving – Conditionals [2] - Relational operators - Logical operators - Conditional statements Module 8: Interaction of Engineering Tools – Data Validation [1] - Errors - Warnings

Evaluation

Undergraduate

A	90	-	100
B	80	-	89
C	70	-	79
D	60	-	69
F	<		60

Assignments 5% Midterm Exam 40% Final Exam 55%

Syllabus

Upload File: ENGR 1070 Syllabus-20160405144922.pdf

Description: ENGR 1070 Syllabus Spring 2016

Form

User ID:	jminor	**Name:**	John Minor
Date:	04/05/2016	**Number:**	21233

Chair, Department Curriculum Committee	Date 4/5/16
Department Chair	Date 4/5/16
Chair, College Curriculum Committee	Date 4/28/16
College Dean	Date 4/28/16
Director, Calhoun Honors College	Date
Chair, Undergraduate Curriculum Committee	Date 5/6/2016
Chair, Graduate Curriculum Committee	Date
Provost	Date 6/20/16
President	Date

Change Undergraduate Course

000089

Change a Course

Subject: ENGR-Engineering

Number: 1080

Effective Term: Spring 2016

Title: Programming & Prob Solving II

Honors Course:

☐ Add Honors Course:

Last Term Course was taught: 201508

Brief Statement of Change Based on Assessment Results:
Changing pre-requisites to include ENGR 1020 as part of offering both full term and half term courses.

Rationale for Changing a Course

- ☐ **Strengthen Program Requirement(s)**
- ☐ **Alignment of Student Learning Outcomes**
- ☐ **Alternative Delivery of Content**
- ☐ **Improve Time to Degree**
- ☐ **Evolution of the Discipline**
- ☑ **Changing Prerequisites**
- ☐ **Address DWF Rates**
- ☐ **General Education Modifications**
- ☐ **Other (Please specify.)**

☑ Change Prerequisite(s) / Corequisite(s)

From Preq: ENGR 1060 and ENGR 1070 each with a C or better.

To Preq: ENGR 1060 and ENGR 1070 each with a C or better; or ENGR 1020 and ENGR 1070 each with a C or better.

Learning Objectives

At the completion of this course, the student should be able to: 1. Use MATLAB to: a. create proper plots of experimental and theoretical data b. model experimental data with a trendline 2. Compose, interpret, and utilize definite and indefinite looping structures 3. Analyze and interpret data to formulate a solution to an engineering problem, utilizing code containing: a. input from a user, text file, or Excel workbook; b. formatted output to the Command Window, a text file, or Excel workbook; c. conditional statements, including error and warning messages; d. graphs; e. mathematical modeling; and f. looping structures.

Topical Outline

The topical outline below includes the approximate number of class periods devoted to each module in brackets. Module 1: Graphical Representation [4] - Graphing in MATLAB - Trendlines in MATLAB Module 2: Automation of Problem Solving [2] - Indefinite Loops (WHILE) Module 3: Automation of Problem Solving [2] - Definite Loops (FOR) Module 4: Advanced Problem Solving [3] - Combining: * input from a user, text file, or Excel workbook; * formatted output to the Command Window, a text file, or Excel workbook; * conditional statements, including error and warning messages; * proper plot rules and creation of graphs in MATLAB; * mathematical modeling, including trendline generation for experimental data; and * definite and indefinite looping structures

Evaluation

Undergraduate

A	90	-	100
B	80	-	89
C	70	-	79
D	60	-	69
F	<		60

Assignments 5% Midterm Exam 40% Final Exam 55%

Syllabus

Upload File: ENGR 1080 Syllabus-20160406073338.pdf

Description: ENGR 1080 Syllabus Spring 2016

000090

Form

User ID:	jminor	**Name:**	John Minor
Date:	04/06/2016	**Number:**	21269

000091

Chair, Department Curriculum Committee	4/6/2016 Date
Department Chair	4/6/16 Date
Chair, College Curriculum Committee	4/28/16 Date
College Dean	4/28/16 Date
Director, Calhoun Honors College	Date
Chair, Undergraduate Curriculum Committee	5/6/2016 Date
Chair, Graduate Curriculum Committee	Date
Provost	6/20/16 Date
President	Date

Change Undergraduate Course

Change a Course

Subject: ENSP-Environ Sci and Policy

Number: 4000

Effective Term: Fall 2016

Title: Studies In Environmental

Honors Course: Abbr Num

☐ Add Honors Course: Abbr Num

Last Term Course was taught: 201508

Brief Statement of Change Based on Assessment Results:

ENSP 4000 is a multidisciplinary course, with students from different programs across the curriculum enrolling either to fulfill a requirement or to elect a science and policy course. Students from the ENR programs, Chemical Engineering, and, recently, Biosystems Engineering have become regular enrollees, along with Environmental Engineering, Geology, and Hydrogeology majors. The change will save the time and effort it takes to enroll students via the course (prerequisite) override system.

Rationale for Changing a Course

- ☐ Strengthen Program Requirement(s)
- ☐ Alignment of Student Learning Outcomes
- ☐ Alternative Delivery of Content
- ☐ Improve Time to Degree
- ☐ Evolution of the Discipline
- ☑ Changing Prerequisites
- ☐ Address DWF Rates
- ☐ General Education Modifications
- ☐ Other (Please specify.)

Honors

- ☐ Honors Students Only?
- ☐ Honors sections allowed to be offered?

☐ Change Subject

To

☐ Change Number

To

☐ Change Catalog Title

From

To

☐ Change College

From Engineering and Science

To

☐ Change Transcript Title

From Studies In Environmental

To

☐ Change Grade Mode

From

To

☐ Change Course Attributes

From

To

☐ Change Schedule Type

From	To
◯ Field Course	◯ Field Course
◯ Independent Study	◯ Independent Study
◯ Internship	◯ Internship
◯ Lab No Fee	◯ Lab No Fee

◯ Lab With Fee	◯ Lab With Fee
◯ Lecture	◯ Lecture
◯ Other	◯ Other
◯ Seminar	◯ Seminar
◯ Studio	◯ Studio
◯ Tutorial	◯ Tutorial

☐ Change Course Modifier

From	To
☐ Variable Title	☐ Variable Title
☐ Creative Inquiry	☐ Creative Inquiry
☐ Repeatable	☐ Repeatable
Max Credits:	Max Credits:

☐ Change General Education Designation

From	To
☐ English Composition	☐ English Composition
☐ Oral Communication	☐ Oral Communication
☐ Mathematics	☐ Mathematics
☐ Natural Sci w/Lab	☐ Natural Sci w/Lab
☐ Math or Science	☐ Math or Science
☐ A&H (Literature)	☐ A&H (Literature)
☐ A&H (Non-Lit)	☐ A&H (Non-Lit)
☐ Social Science	☐ Social Science
☐ CCA	☐ CCA
☐ STS	☐ STS

☐ Change in Additional Fee

◯ Add ◉ Delete

Justification

☐ Change of Credit

From

Fixed Credit Course

Credit Hrs	Contact Hrs
3	3

Variable Credit Course

Credit Hrs		Contact Hrs	
Min	Max	Min	Max

To

Fixed Credit Course

Credit Hrs	Contact Hrs

Variable Credit Course

Credit Hrs		Contact Hrs	
Min	Max	Min	Max

☐ Change a Cross Reference

☐ Change Catalog Description

☐ Add cross reference with course(s):

☐ Delete cross reference with course(s):

From

To

☑ Change Prerequisite(s) / Corequisite(s)

From: Either EES 2010 or ENSP 2000

To: Any one of the following courses: AGRB 3570; BE 2120; CHE 2100; EES 2010; ENSP 2000; WFB 4300

☐ Change In Student Learning Objectives

Learning Objectives

Topical Outline

Duplication (if applicable)

Add course requirements for honors courses (if applicable)

Learning Activities associated with General Education competencies (if applicable)

Evaluation

Undergraduate

A	90	-	100
B	80	-	89
C	70	-	79
D	60	-	69
F	<		60

Weighted percentages of assignments (quizzes

Syllabus

Upload File: 0815 ENSP 4000-001 Syllabus(2)-20160418164616.pdf

Upload File: Choose File | no file selected

Description: Syllabus, ENSP 4000 Fal

Form

User ID:	mtmpsn	Name:	Margaret Thompson
Date:	04/18/2016	Number:	21689

4/27/16
Chair, Department Curriculum Committee Date

David L. Freedman 4/27/16
Department Chair Date

4/28/16
Chair, College Curriculum Committee Date

4/28/16
College Dean Date

Director, Calhoun Honors College Date

John D. Griffin 5/6/2016
Chair, Undergraduate Curriculum Committee Date

Chair, Graduate Curriculum Committee Date

Robert T. Jones 6/20/16
Provost Date

President Date

97

Change Major

Major Name: Computer Engineering
Degree: Bachelor of Science
Effective Catalog Year: 2016-2017

- ☐ **Change Major Name to:** CPEN
- ☐ **Change Degree to:** Bachelor of Science
- ☑ **Change Curriculum Requirements**
- ☐ **Change General Education Requirements**
- ☐ **Add, Change, or Delete Concentration(s)**
- ☐ **Add, Change, or Delete Emphasis Area(s)**

Curriculum Map: CpE Curriculum Map-20160509084412.pdf
Description: Added footnote 1 for Degree Works coding.
Additional Information:
Description:

Summary/Explanation

The only change is the addition of the following footnote: "This course must be passed with a C or better either to transfer into ECE from General Engineering or to satisfy later course prerequisites". This is a clarification, for the purposes of Degree Works coding, of an existing requirement in ECE.

Rationale for Change Major

- ☐ **Strengthen Program Requirement(s)**
- ☐ **Alignment of Student Learning Outcomes**
- ☐ **Alternative Delivery of Content**
- ☐ **Improve Time to Degree**
- ☐ **Evolution of the Discipline**
- ☐ **Changing Prerequisites**
- ☐ **Address DWF Rates**
- ☐ **General Education Modifications**
- ☑ **Other (Please specify.)**

1

Form

User ID: cstrimp **Name:** Courtney Honeycutt
Date: 05/09/2016 **Number:** 22269

Carl Baum — 5/9/16
Chair, Department Curriculum Committee — Date

Carl Baum for Dan Nordeen — 5/9/16
Department Chair — Date

Karen A Whitney — 5/9/16
Chair, College Curriculum Committee — Date

[redacted] Karen A Whitney — 5/9/16
College Dean — Date

Director, Calhoun Honors College — Date

John D. Griffin — 5/6/2016
Chair, Undergraduate Curriculum Committee — Date

Chair, Graduate Curriculum Committee — Date

Robert H Jones — 6/20/16
Provost — Date

President — Date

COMPUTER ENGINEERING

Bachelor of Science

Computer engineers have excellent career opportunities in the design and application of hardware and software components for a variety of computer applications. These include mainframe, desktop, and embedded microprocessor platforms, as well as the networking of various types of computers and peripherals.

Based on a strong foundation in mathematics, computer science, and the physical sciences, the Computer Engineering program includes engineering science and design in circuits, electronics, computer organizations and design, peripheral interfacing, and software engineering. Emphasis is placed on hands-on experience with networked computer systems, micro-, mini-, and mainframe computers, and the solution of a wide range of practical problems using engineering principles. In addition to these technical skills, students learn to communicate effectively and to develop interpersonal, teamwork, and management skills, all of which contribute to success in a professional engineering career. The program is also an excellent preparation for graduate study.

Information on the program and its objectives is available at *www.clemson.edu/ces/departments/ece/*.

Freshman Year

First Semester

4 - CH 1010 General Chemistry
3 - ENGL 1030 Accelerated Composition
1 - ENGR 1050 Engineering Disciplines and Skills I
1 - ENGR 1060 Engineering Disciplines and Skills II
4 - MATH 1060 Calculus of One Variable I[1]
3 - Arts and Humanities Requirement[2] *or*
3 - Social Science Requirement[2]

16

Second Semester

1 - ENGR 1070 Programming and Problem Solving I
1 - ENGR 1080 Programming and Problem Solving II
1 - ENGR 1090 Programming and Problem Solving Applications
4 - MATH 1080 Calculus of One Variable II[1]
3 - PHYS 1220 Physics with Calculus I[1]
6 - Arts and Humanities Requirement[2] *or*
6 - Social Science Requirement[2]

16

Sophomore Year

First Semester

3 - CPSC 1110 Elementary Computer Programming in C/C++[1]
2 - ECE 2010 Logic and Computing Devices[1]
3 - ECE 2020 Electric Circuits I[1]
1 - ECE 2090 Logic and Computing Devices Lab.[1]
1 - ECE 2110 Electrical Engineering Lab. I[1]
4 - MATH 2060 Calculus of Several Variables[1]
3 - PHYS 2210 Physics with Calculus II[1]

17

Second Semester

1 - ECE 2120 Electrical Engineering Lab. II[1]
3 - ECE 2220 Systems Programming Concepts for Computer Engineering[1]
3 - ECE 2620 Electric Circuits II[1]
3 - ECE 2720 Computer Organization[1]
1 - ECE 2730 Computer Organization Laboratory[1]
4 - MATH 2080 Intro. to Ordinary Diff. Equations[1]

15

Junior Year

First Semester

3 - ECE 2230 Computer Systems Engineering[1]
1 - ECE 3110 Electrical Engineering Lab. III[1]
3 - ECE 3200 Electronics I[1]
3 - ECE 3300 Signals, Systems, and Transforms[1]
3 - ECE 3710 Microcontroller Interfacing[1]
1 - ECE 3720 Microcontroller Interfacing Lab.[1]
3 - MATH 3110 Linear Algebra[1]

17

Second Semester

3 - ECE 3170 Random Signal Analysis[1]
3 - ECE (CPSC) 3220 Intro. to Operating Systems[1]
3 - ECE 3270 Digital Computer Design
3 - ECE 3520 Programming Systems[1]
3 - MATH 4190 Discrete Math. Structures I

15

Senior Year

First Semester

3 - COMM 1500 Intro. to Human Comm. *or*
3 - COMM 2500 Public Speaking
3 - ECE 4090 Continuous and Discrete Sys. Design[1]
2 - ECE 4950 Integrated System Design I[1]
3 - ENGL 3140 Technical Writing
6 - Computer Engineering Technical Requirement[3]

17

Second Semester

2 - ECE 4960 Integrated System Design II
3 - Arts and Humanities Requirement[2] *or*
3 - Social Science Requirement[2]
6 - Computer Engineering Technical Requirement[3]
3 - Special Requirement[4]

14

127 Total Semester Hours

[1]The course must be passed with a C or better either to transfer into ECE from General Engineering or to satisfy later course prerequisites.

[2]See General Education section of the *Undergraduate Announcements*. Six of these credit hours must also satisfy General Education Cross-Cultural Awareness and Science and Technology in Society Requirements.

[3]Select from department-approved list.

[4]Three additional credits of university or college approved Arts and Humanities or Social Science courses; or ELE 3010 or 4010; or any additional three-credit, 4000-level course from the departmental Computer Engineering Technical Requirement list or Electrical Engineering Technical Requirement list; or one additional course selected from MATH 4120, 4340, 4350, 4400, 4410, or 4530.

Notes:

1. A student is allowed to enroll in ECE courses (excluding ECE 2070, 2080, 3080) only when all prerequisites have been passed with a grade of C or better.
2. All Computer Engineering students must have a cumulative engineering grade-point average of 2.0 to enroll in any 3000- or 4000-level ECE courses.
3. No student may exceed a maximum of two attempts, excluding a W, to complete successfully any ECE course.

99

Change Major

Major Name: Electrical Engineering
Degree: Bachelor of Science
Effective Catalog Year: 2016-2017

- ☐ **Change Major Name to:** ELEN
- ☐ **Change Degree to:** Bachelor of Science
- ☑ **Change Curriculum Requirements**
- ☐ **Change General Education Requirements**
- ☐ **Add, Change, or Delete Concentration(s)**
- ☐ **Add, Change, or Delete Emphasis Area(s)**

Curriculum Map: EE Curriculum Map-20160509084153.pdf

Description: Added footnote 1 for Degree Works coding.

Additional Information:

Description:

Summary/Explanation

The only change is the addition of the following footnote: "This course must be passed with a C or better either to transfer into ECE from General Engineering or to satisfy later course prerequisites". This is a clarification, for the purposes of Degree Works coding, of an existing requirement in ECE.

Rationale for Change Major

- ☐ **Strengthen Program Requirement(s)**
- ☐ **Alignment of Student Learning Outcomes**
- ☐ **Alternative Delivery of Content**
- ☐ **Improve Time to Degree**
- ☐ **Evolution of the Discipline**
- ☐ **Changing Prerequisites**
- ☐ **Address DWF Rates**
- ☐ **General Education Modifications**
- ☑ **Other (Please specify.)**

1

Form

User ID: cstrimp **Name:** Courtney Honeycutt
Date: 05/09/2016 **Number:** 22251

Carl Bare 5/9/16
Chair, Department Curriculum Committee Date

Carl Bare for Dan Moreland 5/9/16
Department Chair Date

Chair, College Curriculum Committee 5/9/16
Date

College Dean Date

Director, Calhoun Honors College Date

John D. Griffin 5/6/2016
Chair, Undergraduate Curriculum Committee Date

Chair, Graduate Curriculum Committee Date

Robert H Jones 6/20/16
Provost Date

President Date

ELECTRICAL ENGINEERING

Bachelor of Science

Electrical engineers are in high demand for a wide range of influential positions. Professional duties range from analytical problem solving to the design of components and systems. The scope of employment requires a unique breadth and depth of knowledge and technical skills, which are reflected in the Electrical Engineering program. This program also offers an excellent preparation for graduate education. Detailed information can be found at *www.clemson.edu/ces/departments/ece/*.

Building on a foundation of mathematical and physical sciences, students progress into the application of these in the engineering science areas of circuits, electronics, communications, controls, power, and electromagnetics. In these subjects, students also begin to apply the concepts and techniques learned to the design of circuits and systems. Senior technical design courses offer the opportunity to further develop expertise in a selected area.

In addition to these technical skills, students learn to communicate effectively, both orally and with the written word. Because engineers work for the benefit of society, the curriculum includes a strong component of humanities and social science courses. Also, many project design assignments enable the development of interpersonal, teamwork, and management skills, which are necessary for success in a professional engineering career.

Freshman Year

First Semester

4 - CH 1010 General Chemistry
3 - ENGL 1030 Accelerated Composition
1 - ENGR 1050 Engineering Disciplines and Skills I
1 - ENGR 1060 Engineering Disciplines and Skills II
4 - MATH 1060 Calculus of One Variable I[1]
3 - Arts and Humanities Requirement[2] *or*
3 - Social Science Requirement[2]

16

Second Semester

4 - CH 1020 General Chemistry
1 - ENGR 1070 Programming and Problem Solving I
1 - ENGR 1080 Programming and Problem Solving II
1 - ENGR 1090 Programming and Problem Solving Applications
4 - MATH 1080 Calculus of One Variable II[1]
3 - PHYS 1220 Physics with Calculus I[1]
3 - Arts and Humanities Requirement[2] *or*
3 - Social Science Requirement[2]

17

Sophomore Year

First Semester

3 - CPSC 1110 Elementary Computer Programming in C/C++[1]
2 - ECE 2010 Logic and Computing Devices[1]
3 - ECE 2020 Electric Circuits I[1]
1 - ECE 2090 Logic and Computing Devices Lab.[1]
1 - ECE 2110 Electrical Engineering Lab. I[1]
4 - MATH 2060 Calculus of Several Variables[1]
3 - PHYS 2210 Physics with Calculus II[1]

17

Second Semester

1 - ECE 2120 Electrical Engineering Lab. II[1]
3 - ECE 2620 Electric Circuits II[1]
3 - ECE 2720 Computer Organization[1]
1 - ECE 2730 Computer Organization Laboratory[1]
4 - MATH 2080 Intro. to Ordinary Diff. Equations[1]
3 - Arts and Humanities Requirement[2] *or*
3 - Social Science Requirement[2]

15

Junior Year

First Semester

1 - ECE 3110 Electrical Engineering Lab. III[1]
3 - ECE 3200 Electronics I[1]
3 - ECE 3300 Signals, Systems, and Transforms[1]
3 - ECE 3600 Electric Power Engineering[1]
3 - ECE 3800 Electromagnetics[1]
3 - Advanced Mathematics Requirement[3]

16

Second Semester

1 - ECE 3120 Electrical Engineering Lab. IV[1]
3 - ECE 3170 Random Signal Analysis[1]
3 - ECE 3210 Electronics II[1]
3 - ECE 3710 Microcontroller Interfacing[1]
1 - ECE 3720 Microcontroller Interfacing Lab.[1]
3 - ECE 3810 Fields, Waves, and Circuits[1]
3 - ENGL 3140 Technical Writing

17

Senior Year

First Semester

3 - COMM 1500 Intro. to Human Comm. *or*
3 - COMM 2500 Public Speaking
3 - ECE 4090 Continuous and Discrete Syst. Des.[1]
3 - ECE 4270 Communications Systems
2 - ECE 4950 Integrated Systems Design I[1]
3 - Electrical Engineering Technical Requirement[4]

14

Second Semester

2 - ECE 4960 Integrated System Design II
3 - Arts and Humanities Requirement *or*
3 - Social Science Requirement
6 - Electrical Engineering Technical Requirement[4]
3 - Special Requirement[5]

14

126 Total Semester Hours

[1] The course must be passed with a C or better either to transfer into ECE from General Engineering or to satisfy later course prerequisites.

[2] See General Education section of the *Undergraduate Announcements*. Six of these credit hours must also satisfy General Education Cross-Cultural Awareness and Science and Technology in Society Requirements.

[3] MATH 4190, 4340, 4350, 4530, or 4540

[4] Select from department-approved list.

[5] Three additional credits of university or college approved Arts and Humanities or Social Science courses; or ELE 3010 or 4010; or any additional three-credit, 4000-level course from the departmental Computer Engineering Technical Requirement list or Electrical Engineering Technical Requirement list; or one additional course selected from MATH 3110, 4120, 4190, 4340, 4350, 4400, 4410, 4530, or 4540.

Notes:

1. A student is allowed to enroll in ECE courses (excluding ECE 2070, 2080, 3080) only when all prerequisites have been passed with a grade of C or better.
2. All Electrical Engineering students must have a cumulative engineering grade-point average of 2.0 to enroll in any 3000- or 4000-level ECE courses.
3. No student may exceed a maximum of two attempts, excluding a *W*, to complete successfully any ECE course.