College of Engineering Committee on Academic Affairs  
Meeting Minutes 26 March 2015

Attendance:
Aero – Carl Hartsfield  
AVN – Not present (Seth Young)  
BME – Mark Ruegsegger - Chair  
CHE – Jeff Chalmers  
CIV – Not present (Frank Croft)  
CSE – Not present (Ken Supowit)  
ECE – George Valco  
ENG PHY – Robert Perry  
ENV – John Lenhart  
FAB – Ann Christy  
ISE – Carolyn Sommerich (ASAP Rep)  
MSE – Not present (Sheikh Akbar)  
ME – Rob Siston  
WLD – Dave Farson  
Graduate Student – Not present (Beenish Saba, Ankita Majumder)  
Undergraduate Student – Not present (Kareem Rasul, Amber Harriger)  

Non Voting:
Associate Dean for Undergraduate Education – Dave Tomasko  
KSA – Not present (Maria Conroy)  
Committee Secretary – Ed McCaul  
Advisor – Nikki Strader  

Guests – None

1. The minutes from the 19 February 2015 meeting were approved as corrected.

2. George Valco made a motion that the Engineering Sciences Minor be approved. Carl Hartsfield seconded the motion. The floor was opened for discussion. (Proposal is attached.)
   2.1. The committee was informed that the proposal includes a request for an exception for the 1000 level courses that are part of the minor. A few changes were made to the minor to include increasing the credit hours from 14 to 15 as well as requiring a two semester capstone sequence.
   2.2. The question was asked as to whether there has been any issues with non-engineering students taking an Engineering capstone course. The response was that non-engineering students take different courses than engineering students. The non-engineering students are assigned to a group of engineering students who are taking a capstone course and both groups meet together, different courses meeting at the same time and place.
   2.3. The question was asked as to whether the non-engineering students take the place of engineering students. The response was no, they are additional students.
2.4. The committee was informed that some MBA students take the capstone courses and are very helpful to the group they are assigned to.
2.5. There being no further discussion a vote was taken: 10 approved, 0 opposed, and 0 abstentions. The motion passed.

3. George Valco made a motion that the request to keep the Technological Studies Minor in limbo be approved. Carl Hartsfield seconded the motion. The floor was opened for discussion. (Proposal is attached.)
3.1. The committee was informed that the Technological Studies Minor was developed under quarters, but a semester version of the minor was never submitted. EEIC is not yet ready to offer the minor, but would like to keep it in limbo as some of their staff are interested in reviving it.
3.2. The question was asked as to what advantage EEIC gets by keeping the minor in limbo. The answer was that it may speed up approval to any changes to the minor as it would probably be reviewed by CAA’s Subcommittee D, which consists of the Chair of CAA and Randy Smith, instead of one of CAA’s regular subcommittees. In addition, keeping the minor in limbo would allow it to be maintained on SIS.
3.3. There being no further discussion a vote was taken: 10 approved, 0 opposed, and 0 abstentions. The motion passed.

4. George Valco informed the committee that the Humanitarian Minor has been sent back for correction and clarification.

5. George Valco informed the committee that Subcommittee A has provided feedback to EEIC on issues that need to be clarified in their departmental proposal. The subcommittee does not feel that it should give a recommendation to the full committee as to whether the proposal should be approved as it is a small subset of the full faculty. Instead, the subcommittee will be giving a recommendation that the proposal is ready to go forward to the full faculty for their vote. The comment was made that CCAA is required to vote on the proposal and present a recommendation to the full faculty. The comment was made that the proposal needs to be well vetted before it comes up for a vote.

6. Dave Farson made a motion that the proposed changes to ECE’s undergraduate curriculum be approved. George Valco seconded the motion. The floor was opened for discussion. (Proposal is attached.)
6.1. The committee was informed that the changes are to the sophomore and capstone sequence. ECE would like for the sophomore changes to be effective for the students entering in Autumn 2015 and the changes to the capstone sequence be effective for students graduating Autumn 2016 and on. The proposal contains a transition plan.
6.2. The comment was made that the changes were made based on ECE’s assessment process.
6.3. There being no further discussion a vote was taken: 10 approved, 0 opposed, and 0 abstentions. The motion passed.
7. Dave Farson made a motion that the MGEL Radar Track Proposal be approved. Jeff Chalmers seconded the motion. The floor was opened for discussion. (The proposal is attached.)

7.1. The committee was informed that this would be a new track for the program and that creation of it is in keeping with the original plan of the program.

7.2. The question was asked as to whether the program is already in effect. The response was yes.

7.3. The comment was made that page six has a lot of courses where the course number is identified as XXXX and by now those course numbers should be known. A friendly amendment was adopted that these courses should show their current number.

7.4. The comment was made that the proposed creation of an additional track would be easier to understand if the original approved proposal was included rather than just an excerpt from it. This was agreed to as a friendly amendment.

7.5. The comment was made that the ISE course shown in the excerpt has the wrong course number. Correction of this error was agreed to as a friendly amendment.

7.6. There being no further discussion a vote was taken: 10 approved, 0 opposed, and 0 abstentions. The motion with the friendly amendments passed. The committee secretary was asked to inform the proposer of the contingencies to approval of the proposal.

8. Carolyn Sommerich made a motion that the new course requests for CSE 1114, 2112, 5032, and 5043 be approved. George Valco seconded the motion. The floor was opened for discussion.

8.1. The committee was informed that 1114 and 2112 are courses that CSE will be offering for other units. ISE specifically asked CSE to create 2112 for their students.

8.2. The committee was informed that both 5032 and 5043 are designed to help graduate students who did not receive a BS degree in Computer Engineering information that they will need to succeed in CSE’s graduate program. The rationale for CSE to offered graduate level courses that are identical to existing undergraduate courses was discussed at the committee’s last meeting and it was decided then that this was a course structure issue that exists because of how our course numbering system is designed.

8.3. The question was asked as to whether 5032 and 5043 exclude students who have taken the undergraduate version. It was discovered that 5043 does not exclude the undergraduate version. Addition of the undergraduate version of 5043 to the exclusions clause was added as a contingency to the motion as a friendly amendment.

8.4. There being no further discussion a vote was taken: 10 approved, 0 opposed, and 0 abstentions. The motion with the friendly amendment passed. The committee secretary was asked to inform CSE of the contingency to approval of 5043.

9. Carolyn Sommerich made a motion that the new course requests for ISE 5043 and ECE 5043 be approved. Ann Christy seconded the motion. The floor was opened for discussion.

9.1. The committee was informed that the courses are crossed listed and would be taught by a faculty member who has a joint appointment in ISE and ECE.
9.2. The comment was made that the prerequisite of “biological sciences or math and physical sciences” should now be worded ‘biological, mathematical, and physical sciences” or BMPS. The committee was informed that the wording would be changed. 
9.3. There being no further discussion a vote was taken: 10 approved, 0 opposed, and 0 abstentions. The motion passed.

10. Carolyn Sommerich made a motion that the new course requests for ECE 2020, 2050, 2060, and 3900 be approved. George Valco seconded the proposal. The floor was opened for discussion.
10.1. The committee was informed that all of these courses are related to ECE’s undergraduate curriculum change, are contingent upon approval of that proposal, and are fully discussed in the proposal.
10.2. There being no further discussion a vote was taken: 10 approved, 0 opposed, and 0 abstentions. The motion passed.

11. Carolyn Sommerich made a motion that the course change requests for CSE 2231, ECE 4900, ECE 4900H, ECE 4901, ISE 6801, ME 4900, and ME 5682 be approved. George Valco seconded the motion. The floor was opened for discussion.
11.1. The committee was informed that the only change to CSE 2231 was to allow the Lima campus to offer the course.
11.2. The committee was informed that the three ECE courses are directly related to their proposed undergraduate curriculum proposal.
11.3. The committee was informed that the change to ISE 6801 was moving a course from being a prerequisite to an exclusion.
11.4. The committee was informed that the change to ME 4900 was adding ME 490x.01 as a prerequisite and for ME 5682 to change it so that it will be correctly listed with its ISE cross listed course.
11.5. The question was asked as to why ECE 4900 is entitled Capstone Design and not Capstone Design II when one of its prerequisites is ECE 3900, Capstone Design I. The response was that ECE plans on making that title change at a later date.
11.6. There being no further discussion a vote was taken: 10 approved, 0 opposed, and 0 abstentions. The motion passed.

12. The committee was informed that the committee secretary had approved ChBE 5772 as the change to the prerequisites made it easier for students to take the course.

13. The committee secretary asked George Valco which, if any, of ECE’s approved new courses or course changes should not be forwarded to OAA until after their undergraduate curriculum change is approved. The response was that only 4900, 4900H, and 4901 should be held.

14. EEIC’s Departmental Proposal was discussed.
14.1. Ann Christy informed the committee about the open house EEIC is holding next week so that engineering faculty can visit EEIC and learn more about the center while they are considering the request for EEIC to become a department.
14.2. All members present were given a copy of Frequently Asked Questions about EEIC’s departmental proposal and informed that the proposal is available at Carmen’s Wiki site. At that site anyone can make changes to the proposal that will be taken under consideration.

14.2.1. The question was asked as to how the committee will know that the proposal Subcommittee A brings to the full committee is the final proposal if anyone can make changes to it. The response was that the final proposal will be pdf protected and will be marked as CCAA Subcommittee A Version.

14.3. The question was asked as to whether there was a set mandatory period of time between the proposal being approved by CCAA and the full faculty voting on it. The response was that there is not.

14.4. Everyone was asked to please make the EEIC Departmental Proposal an agenda item on their department’s faculty meetings.

14.5. Ann Christy and others have been going to various departmental faculty meetings to discuss the proposal and are willing to talk with any group.

14.6. Everyone was asked to send to the committee secretary any comments they or their department may have on the proposal. George Valco requested that the committee secretary forward any comments received to him for consideration by Subcommittee A.

14.7. Rob Siston stated that MAE will have some comments soon.

14.8. The committee was reminded that there cannot be any changes to the document, if it gets approved by CCAA, between the time it leaves CCAA and comes up for a vote by the full faculty, although changes can be made at the college faculty meeting.

15. Being out of time the meeting was adjourned at 2:15.
March 11, 2015

To: CCAA

From: Lisa M. Abrams
   Associate Director
   Engineering Education Innovation Center

RE: Request to change Engineering Sciences Minor

I am requesting your approval of proposed changes and an exception to University policy to the Engineering Sciences Minor (ESM). The rationale for the change is to have ESM in full compliance with the new University policies on minors. This minor is designed for non-engineering students with an interest in learning more about technology’s role in today’s society; and who may be working with engineers in the future.

The requested exception to University policy is to allow four credit hours counted toward the minor to be at 1000-level

The exception request accounts for the ESM core curriculum component to be within our Fundamentals of Engineering course sequence. This sequence is an important first year sequence required for all engineers and should also be required for non-engineers pursuing the minor.

Changes to the curriculum sheet include updated statements reflecting the University overlap policies with respect to GE courses, between minors and with the major. A curriculum component was removed since the material was adequately covered in the first year course sequence. It is now required that ESM students take two semesters (rather than “at least one”) of the Capstone Collaboration course in order to fully benefit from the project experience.

We propose that students declaring the minor in Autumn 2015 will follow the new curriculum sheet. We will allow any student who has already declared the minor to complete the requirements from the current curriculum sheet. The current and proposed ESM Curriculum sheets are included.
Engineering Sciences Minor
Advising Sheet (Semesters)
The Ohio State University
College of Engineering
Approved by the Colleges of the Arts and Sciences
Revised January 2012, February 17, 2012, 16 April 2012

College of Engineering
Engineering Education Innovation Center (EEIC)
http://engineering.osu.edu/eeic/index.php
244 Hitchcock Hall; 2070 Neil Ave
Columbus, OH 43210-1278; 614-247-8953
Advisor: Robert J. Gustafson

This minor is designed for non-engineering students with an interest in learning more about technology’s important role in today’s society; and who may be working with engineers and technology based opportunities in the future. Specific learning goals include:

- Develop a basic understanding of the engineering design process
- Understand the capabilities and limitations of technologies and engineered systems
- Be able to make informed decisions about engineering activities and technologies
- Be able to work effectively as a member of a team including technology experts

The program advisor will work with you on selection of a suitable minor program to meet your specific career objectives. Upon completion of the minor, the advisor will approve and sign the Minor Program Form. You may then file the Minor Program Form with your college or school to receive a minor in Engineering Sciences.

**Key Curriculum Components**

- **Core - Introduction to Engineering** (4-8 credits)
- **Complementary Engineering Science** (2 credits minimum)
- **Computational Technology Competence** (2 credits minimum)
- **Technology and Society** (3 credits)
- **Capstone interdisciplinary teamwork experience** (3-6 credits)
- **Total Credits** (14 credit minimum)

**Note for students in the minor:**
You will be expected to complete a first calculus course (e.g., Math 1131 or 1151). This course will fulfill the math requirement of all courses for the minor. Other prerequisites will depend on courses selected.

**Core** of the Engineering Sciences Minor is the Introduction to Engineering course sequence:

ENGINEER 1181.01 or .02 and ENGINEER 1182.01 or .02 or .03 (Honors substitute permitted; 1281.01 or .02 or .03H and 1282.01 or .02 or .03H); 4-8 hours.

**ENGINEER 1181.xx - Fundamentals of Engineering I**
Engineering problem solving utilizing computational tools such as Excel and Matlab; hands-on experimentation; ethics; modeling; teamwork; written, oral and visual communications.

**ENGINEER 1182.xx - Fundamentals of Engineering II**
3-D visualization and sketching; introduction to CAD; engineering design-build; teamwork; written, oral and visual communications; and project management.

**Engineering Science Options:** 2 Credit Hours Minimum
AEROENG 2200, CIVILENG 2050, FABENG 2110, 3810, DESIGN 3105, ISE 2000, 2010, 2400, 2500, MATSCEN 2010, Other Engineering courses by permission of the Minor Coordinator

**Computation Technologies Options:** 2 Credit Hours Minimum
CSE 1111, 1112, 1113, 1211, 1221, 1222 or 1223, or 2221, ENGINEER 1281.01, 1281.02, or 1281.03

**Technology and Society Options:** 3 Credit Hours
Comparative Studies 2340, 2367.04, ENGINEER 2360.01, 2360.02, 2367, History 2701, Physics 2367, SOC 3302

**Capstone Experience:** 3-6 Credit Hours
ENGINEER 3081- Engineering Capstone Collaboration
Students contract to collaborate with an engineering capstone design team for at least one semester and contribute their disciplinary expertise.

**General Guidelines**
Required for graduation No
Credit hours required A minimum of 14
Filing the Minor Program form A Minor Program form must be filled out no later than the time the application for graduation is submitted to a college/school counselor. It will require the signature of the student and the student’s major program advisor.

**Changing the minor** Once the minor has been filed, any changes must be approved by the Chair of the Minor Oversight Committee. This form will be available on the CoE website

**Grades required** No grade below a C- will be permitted in courses comprising the minor. A minimum 2.00 cumulative point-hour ratio is required for the minor.
Course work graded Pass/Non-pass cannot count on the minor.

**Transfer credit hours allowed** No more than 6 hours of transfer credit may be applied to the minor.

**Overlap with the GEC** Permitted.

**Overlap Policy** The College of Engineering places no restrictions on the use of a course both in a minor and major program. However, students should consult their major program for any constraints that may be applied there.

**Exclusions to minor** Not open to Engineering majors.

**Additional Guidelines for ASC Students**
Overlap between minors Each minor completed must contain 12 unique hours.
Overlap with the major Not allowed and the minor must be in a different subject than the major
Engineering Sciences Minor
Advising Sheet
The Ohio State University College of Engineering

College of Engineering
Engineering Education Innovation Center (EEIC)
http://engineering.osu.edu/eeic/index.php
244 Hitchcock Hall; 2070 Neil Ave
Columbus, OH 43210-1278; 614-247-8953
Advisor: Dr. Lisa M. Abrams
Email: Abrams.34@osu.edu

This minor is designed for non-engineering students with an interest in learning more about technology’s important role in today’s society; and who may be working with engineers and technology based opportunities in the future. Specific learning goals include:

- Develop a basic understanding of the engineering design process
- Understand the capabilities and limitations of technologies and engineered systems
- Be able to make informed decisions about engineering activities and technologies
- Be able to work effectively as a member of a team including technology experts

The program advisor will work with you on selection of a suitable minor program to meet your specific career objectives. Upon completion of the minor, the advisor will approve and sign the Minor Program Form. You may then file the Minor Program Form with your college or school to receive a minor in Engineering Sciences.

Key Curriculum Components

- Core: 4 Credit Hours: The Engineering Sciences Minor contains the introduction to Engineering course sequence ENGR 1181.01 or .02 and ENGR 1182.01, .02 or .03 (Honors substitute permitted.)

  ENGR 1181.xx - Fundamentals of Engineering 1
  Engineering problem solving utilizing computational tools such as Excel and Matlab; hands-on experimentation; ethics; modeling; teamwork; written, oral and visual communications.

  ENGR 1182.xx - Fundamentals of Engineering 2
  3-D visualization and sketching; introduction to CAD; engineering design-build; teamwork; written, oral and visual communications; and project management.

- Engineering Science Options: 2-4 Credit Hours
  If no prior courses in Engineering, choose from: AVIATN 2000, BIOMED 2000, DESIGN 3105, ISE 2500, other Engineering courses by permission of the Minor Advisor.

  For students who have taken OSU Engineering courses, choose from: AEROENG 2200, CBE 2200, CIVILEN 2050, CSE 2221, ECE 2000, ENVENG 3200, FABENG 2100, ISE 2400, MATSCEN 2010, MECHEENG 2010, WELDENG 3001, other Engineering courses by permission of the Minor Advisor.

- Technology and Society Options: 3 Credit Hours
  COMPSTD 2340, 2367.04, ENGR 2361, 2362, 2367, HISTORY 2701, PHYSICS 2367, SOCIOl 3302

- Capstone Experience: 6 Credit Hours
  ENGR 5081.01 and ENGR 5081.02- Engineering Capstone Collaboration
  Students contract to collaborate with an engineering capstone design team for two semesters and contribute their disciplinary expertise.

General Guidelines

- Required for graduation: No
- Credit hours required: A minimum of 12
- Filing the Minor Program form: A Minor Program form must be filled out no later than the time the application for graduation is submitted to a college/school counselor. It will require the signature of the student and the student’s major program advisor
- Changing the minor: Once the minor has been filed, any changes must be approved by the Minor Advisor. This form is available on the College of Engineering website
- Grades required: No grade below a C- will be permitted in courses comprising the minor
- A minimum 2.00 cumulative point-hour ratio is required for the minor
- Course work graded Pass/Non-pass cannot count on the minor
- No more than 3 hours of course work graded Satisfactory/Unsatisfactory may count toward the minor
- No more than 3 hours of xx93 allowed
- Transfer credit hours allowed: No more than 6 hours of transfer credit may be applied to the minor
- Overlap with GE courses: No more than 6 hours can overlap
- Overlap between minors: Each minor completed must contain 12 unique hours
- Overlap with the major: Not allowed and the minor must be in a different subject than the major
- Exclusions to minor: Not open to Engineering majors
March 13, 2015

To: CCAA

From: Ann D. Christy
Interim Director
Engineering Education Innovation Center

RE: Request to postpone submittal of Technological Studies Minor proposal

I am requesting that the Technological Studies Minor be held in limbo for another year as we are not in a position to submit a proposal for the full minor. This minor is designed for non-engineering students with an interest in learning more about technology’s role in today’s society and who may be working with engineers in the future. Unlike our Engineering Sciences Minor (ESM), the Technological Studies Minor (TSM) does not require calculus as a pre-requisite to required courses in the minor. The TSM was designed under the university’s quarter-based curriculum, but not officially launched before we transitioned to semesters. Most of the required course modules have been built, and several faculty have expressed interest in developing the rest of the curriculum. The current TSM curriculum sheet is included.
This minor has the goal of allowing students to learn about technology and to become more technologically literate persons. Specific learning goals include:

- Better understand the role of technology (engineering) in society and the interactions of technology (engineering) with their major field
- Understand how to access and interpret reliable information to make informed decisions regarding technological issues
- Develop a basic understanding of the engineering design process

**Key Curriculum Components (minimum 20 credits)**

**Core** (9-10 Credit Hours)

Two options are available for the core element of the Technological Studies minor. For the first core option, two new courses are included specifically to introduce technological concepts for a non-engineering audience. Technical and practical aspects of several technology areas will be explored. A prerequisite of any one GEC Natural Science course is required. The second core option may appeal to those who have the higher mathematics prerequisite and want a quantitatively more rigorous approach.

**Option 1:**

**Option 2:**
ENG 181 (3) Introduction to Engineering I, and ENG 183 (3) Introduction to Engineering II
ISE 504 (3) Engineering Economic Analysis

**Computational Technology** (4-5 Credit Hours)

Competence Facility with computational technology is needed for technology considerations, therefore the curriculum requirement in this area is for both minors.

CSE 200, 201, 202, 203, 204 or Higher Level CSE Class Permitted

**Technology and Society** (5 Credit Hours)

Students also need to be able to place the technological development in a societal context as is the focus of the Technology and Society course requirement.

Comparative Studies 272, 597.01, ENG 360.02, 367, History 362, Physics 367, Soc 302

**Capstone Seminar** (2 Credit Hours)

A capstone seminar focusing on current technological topics of broad interest will complete the minor package.

**ENG 582 Technology Issues Seminar (New Course)**

The program advisor will work with you in selection of a suitable minor program to meet your specific career objectives. Upon completion of the minor, the advisor will approve and sign the Minor Program Form. You may then file the Minor Program Form with your college or school to receive a minor in Technological Studies.

**General Guidelines**

Required for graduation: No

Credit hours required: A minimum of 20

Transfer credit hours allowed: No more than 10 hours of transfer credit may be applied to the minor.

Overlap with the GEC: Permitted

Grades required: No grade below a C- will be permitted in courses comprising the minor. A minimum - 2.00 cumulative point-hour ratio is required for the minor.

Course work graded Pass/Non-Pass cannot count on the minor.

Filing the minor program form: A minor program form must be filled out no later than the time the application for graduation is submitted. It will require the signature of the student and the student’s major program advisor.

Exclusions to minor: Not open to Engineering majors.

**Additional Guidelines for ASC Students**

Overlap between minors: Each minor completed must contain 20 unique hours.

Changing the minor: Once a minor is on file in the college/school office, any changes must be discussed with the faculty advisor and/or the college/school counselor.

Overlap with the major: Not allowed and the minor must be in a different subject than the major.

**General Guidelines for Engineering Students**

Exclusions to minor: Not open to Engineering majors.

Changing a minor: Once the minor has been filed, any changes must be approved by the Chair of the Minors Oversight Committee. This form will be available on the CoE website.

Overlap Policy: Engineering places no restrictions on the use of a course both in a minor and major program. However, students should consult their major program for any constraints that may be applied there.
February 6, 2015

Vice Provost W. Randy Smith  
Council on Academic Affairs  
Office of Academic Affairs  
203 Bricker Hall  
190 North Oval Mall  
Columbus, OH 43210

Re: Proposal to update the curriculum for the BSECE program

Dear Vice Provost Smith:

The faculty of the Department of Electrical and Computer Engineering have proposed to change the ECE core courses required for the Bachelors of Science in Electrical Engineering degree programs, effective for students starting at The Ohio State University in Autumn of 2015. In brief, the proposed change adds 3 credit hours to the ECE core, balanced by a reduction of 3 credit hours in the Directed Elective category of the programs, so that the total hours to degree are not change. In addition, it is proposed that one part of the change, to the senior capstone design experience, go into effect for all students graduating Autumn 2016 or later.

The proposal, the current and proposed curriculum sheets (Appendices I and II), and syllabi for new courses and courses being changed for this proposal (Appendix III) are attached. In addition, since two of the current courses being changed are taken by students in the undergraduate programs offered by the Department of Computer Science and Engineering, their proposal for accommodating the changes in their program and reflecting their concurrence with these changes is attached in Appendix IV.

On 6 February 2015 the ECE faculty approved the proposed changes by a vote of 33 in favor and 0 opposed. A quorum of 29 was needed.

We are requesting approval of the proposed changes by of the Council on Academic Affairs.

Sincerely,

Joel T. Johnson  
Department Chair  
Electrical and Computer Engineering

cc: B.L. Anderson, Associate Chair  
G.J. Valco, Undergraduate Studies Committee Chair
Proposal to Modify the Programs of Study for the BS in Electrical and Computer Engineering (BSECE)

Executive Summary

The faculty of the Department of Electrical and Computer Engineering (ECE) are proposing parallel revisions to both the Electrical Engineering program of study and the Computer Engineering program of study that are sub-plans of the ECENG-BS plan and BSECE degree. There are three main proposed changes.

1. Revise the ECE sophomore sequence from two 4 cr-hr courses, ECE 2000 and 2100, to three 3 cr-hr courses, ECE 2020, 2050 and 2060. These changes will partition the course topics along coherent topical boundaries, and are expected to enhance the preparation of students for their junior level classes.

2. Include the ECE 3027 electronics laboratory course in the required core. This is expected to enhance the preparation of students in practical and implementation aspects of electronics, debugging and diagnostics, first for application in their capstone design experience, later in their careers.

3. Expand the capstone design experience from a one semester course, ECE 4900, to a session plus semester sequence, ECE 3900 and 4900. ECE 3900 will consist of the lecture content from the current ECE 4900, allowing the full semester of ECE 4900 to be devoted to the capstone design/build project.

These three changes increase the required ECE core by 3 cr-hr, but the total hours to degree will remain at 128. We propose to balance the increase in the core by a decrease in the number of electives that may be counted toward the degree, specifically the number of Directed Electives taken from units other than ECE for Electrical Engineering students or ECE and CSE for Computer Engineering students.

The proposed changes to the two programs are driven by our regular assessment processes applied to evaluation of the ECE undergraduate courses and curricula after the first three semesters.

We propose that the new program be required for students starting at The Ohio State University in Autumn semester 2015. Furthermore, we believe that the new capstone design sequence is valuable to current students and therefore propose it be required of all students graduating Autumn semester 2016 or later.

Primary contact: Dr. George J. Valco
ECE Undergraduate Studies Committee chair
Valco.1@osu.edu
614-292-5110

Secondary contact: Dr. Betty Lise Anderson
ECE Associate Chair for Instruction
Anderson.67@osu.edu
614-292-1323
Rationale for the Proposed Changes

ABET, Inc. is the accrediting body for the undergraduate programs offered by the ECE department. The ECE department has two ABET-accredited programs of study under the BSECE degree – an Electrical Engineering program of study and a Computer Engineering program of study. This proposal is for changes to the program curricular requirements for both programs of study. No changes are proposed to the goals of either program.

The proposed changes are a result of the regular assessment activity within the ECE department as part of our processes for continuous improvement of our undergraduate programs for maintaining accreditation. During spring semester of 2014 we conducted a review of all ECE required core courses and of the ECE technical electives offered during the first three semesters since the change to the semester calendar. The review was conducted in two rounds. The scope of the first round was the required core courses for both programs of study. The scope of the second round was the technical elective courses. In both rounds the reviews started with a study by the course supervisor of samples of student’s work and of other assessment data for the course, such as surveys of course goals and student learning outcomes, collected over the first three semesters. The course supervisor’s reports were subsequently reviewed by the curricular area committees responsible for each course. For the first round reviews of the required core courses the area committee reports were delivered to both the ECE Undergraduate Studies Committee (USC) and ECE Curriculum Committee (CC) for further action.

While the second round review of technical elective courses was being done the USC studied the recommendations from the area committee reports on the required core courses for issues that would be best addressed by changes to the structure of the curriculum rather than changes to individual courses. Since students majoring in Computer Science and Engineering (CSE) and Computer and Information Science (CIS) take one or both of the courses in the current sophomore sequence USC also solicited input from the CSE department on any feedback they might have from their assessments of their programs. Prof. Neelam Soundarajan from CSE provided input by email and also attended the 2 April 2014 USC meeting for discussion.

In addition to the proposed changes to the structure of the undergraduate curriculum that are the subject of this proposal, both rounds of the spring semester reviews resulted in many adjustments to individual ECE courses, which have already been submitted though the regular College of Engineering and University course change approval systems.

At the curriculum level the review resulted in three main recommendations: 1) revise the ECE sophomore sequence, 2) revise the ECE senior capstone design experience, and 3) require an electronics laboratory class. Those changes result in an increase in the number of credit hours in the required core. To accommodate that increase USC recommended that the number of Directed Elective hours be decreased, rather than increasing the total number of hours to degree or decreasing the number of required Technical Electives. The distinction between Technical Electives and Directed Electives is defined more fully on the advising sheets in Appendices I and II and on the ECE web pages: (https://ece.osu.edu/sites/ece.osu.edu/files/uploads/undergrads/dir électives ee.pdf or https://ece.osu.edu/sites/ece.osu.edu/files/uploads/undergrads/dir électives ce.pdf).
1. The current sophomore sequence (ECE 2000 and 2100) is the result of a redesign that was started before the University finalized the decision to move to the semester calendar. The sequence was piloted as a sequence of three quarter calendar course two years before the calendar change, and those three courses were used as part of the transition plan in the year before the change to the semester calendar. Those three courses were repackaged into a two semester course sequence at the calendar change. The current sequence, in which the first two-thirds of the first course covers digital logic, the last third of the first course and first third on the second course cover discrete time signals and systems, and the last two-thirds of the second course covers analog systems and circuits is too obviously a sequence of three quarter courses fit into a two semester format.

2. The discontinuity in the discrete systems content across the gap between semesters interferes with student learning, particularly when the gap spans the summer term.

3. The mixing of digital logic content and discrete time signals and systems content into a single grade for the first course, and of discrete time signals and systems content and analog systems and circuits content into a single grade for the second course allows a student’s strength in one area to cover for weakness in another. Having them as separate courses will require students to develop competence in each topic.

4. Reviews of several of the junior level ECE core courses identified the need for better preparation in topics such as $RC$, $RL$ and $RLC$ circuits. These are first introduced in the last two-thirds of the second course in the sophomore sequence, the analog systems and circuits portion. The laboratory learning related to these basic analog circuits also needs to be enhanced. It is more efficient to enhance the student’s preparation on those topics in the sophomore sequence than to add it to each of several junior level courses.

5. The review of ECE 4900, the capstone design course, indicated that students need additional preparation in trouble-shooting skills. This can be started in the sophomore sequence labs.

6. Assigning transfer credit for the sophomore sequence to students who started an ECE program elsewhere has been a problem since the current sophomore sequence is unique in its packaging of topics. We have tried several different approaches, including perpetuating versions of quarters-to-semesters transition courses as “transfer” courses, which had transfer students joining ECE 2000 two-thirds of the way through the semester, or ECE 2100 one-third of the way through. But the feedback on that was negative from both the transfer students and instructors. Such an approach was tolerable for the relatively brief quarters-to-semesters transition, but not as a permanent method, and we abandoned it after one year. As things stand now if a transfer student is missing the “wrong” parts of the current sophomore sequence they cannot be given transfer credit for the any of it and have to take the entire sophomore sequence.

7. The CSE department provided feedback that the last third of the first course and first third of the second course is problematic for their students. They suggested that while the material, as it is taught, may make sense to ECE students or provide them background which will be built on later, an alternative approach might be preferable for CSE students.
They requested we look for a version of the sequence meant for CSE students that omits the signal processing component while expanding the digital logic and/or analog circuit portions, and a version for CIS students that omits the signal processing component.

8. The department invested heavily in development of the new laboratories for the sophomore sequence. Continued use of that investment is made in the revised sophomore experience proposed here-in.

9. To address these various findings it is proposed that the sophomore sequence be broken into three courses, one focused on the digital logic content (ECE 2060), one focused on the discrete time signals and systems component (ECE 2050) and one focused on the analog systems and circuits component (ECE 2020). ECE 2060 and 2050 will still be taken in sequence, since the labs associated with ECE 2050 rely on the lab content from ECE 2060. But the prerequisites for ECE 2020 will allow it to be taken in either the first or second semester of the sophomore year. Its labs are being largely redesigned to enhance laboratory learning related to basic analog circuits and trouble-shooting skills.

**Capstone Design sequence**

1. On the quarter-calendar ECE 582 provided the lecture content on engineering design methodology and project management, while students performed their design projects in the subsequent course, ECE 682. When the ECE department was designing the semester programs we expected that the longer length of a semester would allow students to complete their design projects, even with lecture content on engineering design methodology and project management included in the first part of the semester. However, we have found that it is a challenge for students to complete the design/build experience in only one semester with the lecture content included.

2. In addition, while most ECE students take ECE 4900, the department also offers ECE 4901 and ECE 4900H options for special projects and honors thesis design projects. The review of those options did not find uniform evidence that students in those options were receiving the lecture content on engineering design methodology and project management.

3. It is proposed that the Capstone Design experience be expanded into a one and a half semester sequence. The first part will be a seven week session course (ECE 3900) that contains the lecture content on engineering design methodology and project management. It will be a 1 credit hour course. The second part will be the design, build, test and presentation phase. It will continue to use the ECE 4900 course number and be a 3 credit hour course.

**Required Electronics Laboratory**

1. The review of the capstone design course ECE 4900 identified that students need additional preparation in practical and implementation aspects of electronics, debugging and diagnostics.

2. A course change to increase laboratory course ECE 3027 from 0.5 credit hours to 1.0 credit hours has already been submitted. ECE 3027 is currently a technical elective. It is
proposed here that the course become required in both the Electrical Engineering and Computer Engineering programs of study.

While the recommendations for the capstone design sequence and electronics lab were fairly well defined at the end of May term 2014, several options for revision of the sophomore sequence needed to be evaluated further. An ad hoc subcommittee was appointed to flesh out the details of the recommended changes to the sophomore sequence over the summer of 2014.

The ad hoc subcommittee shared its results with USC at the beginning of Autumn semester 2014. All of the recommended changes were shared with the ECE faculty at a meeting on 2 September 2014. The consensus at that meeting was support for the recommended changes. A straw vote on a related change to the technical elective lab requirement for the Electrical Engineering program of study was also taken. The current program requires two technical elective lab courses. Since the proposed new program requires an additional lab in the core the straw vote was in favor of reducing the technical elective lab requirement from two to one. Reasons discussed included that requiring two labs reduced student’s flexibility to take other technical elective courses, and that students could still take additional labs if they desired. It was also pointed out that with ECE 3027 becoming a required lab other technical elective labs might have to be offered every semester to provide enough opportunities if two additional labs were required, which would strain resources.

Input from other constituents of the undergraduate programs was obtained during Autumn semester 2014. Prof. Neelam Soundarajan from CIS attended another USC meeting 8 September 2014, at which we presented our planned changes to the sophomore sequence. He took the plans back to the relevant committees in CSE, and later provided feedback by email. That feedback resulted in further changes to the proposed sophomore courses. Input from senior undergraduates enrolled in ECE capstone design was collected during two focus group meetings with sections of ECE 4900 on 11 September 2014. A teleconference was conducted with the ECE Industrial Advisory Board (IAB) on 24 October 2014.

The final proposal was presented to the ECE faculty for vote in February of 2015. The result of the vote is reported in the cover letter for this proposal.

**Summary of Autumn 2014 feedback from the CSE department**

- At the time of the meeting with Prof. Soundarajan on 8 September 2014 the proposal was for the new sophomore courses totaling 8 credit hours, the same as the current sophomore sequence. ECE 2060 and 2050 were to be 2.5 cr-hr, with 2.0 cr-hr of lecture and 0.5 cr-hr of lab, while ECE 2020 would be 3.0 cr-hr, with 2.5 cr-hr of lecture and 0.5 cr-hr of lab.
- The feedback from the CSE department was that their CSE majors would be required to take ECE 2060 and 2020, totaling 5.5 cr-hr, while their CIS majors would only take ECE 2060 at 2.5 cr-hr.
- The non-integer sums presented a problem, since CSE does not offer any 0.5 cr-hr courses to make up the difference.
- In response, we decided to increase ECE 2060 and 2050 each to 3.0 cr-hr, by leaving the labs at 0.5 cr-hr and increasing the lecture content. For ECE 2060 the lecture content was...
increased to provide a bit more robust coverage on some topics on the draft syllabus
previously shared with CSE and to go further into finite state machines.

- The CSE department concurred with this change, and their program change proposal to
accommodate the new ECE courses is included as Appendix IV of this proposal.

Summary of senior student input from the 11 September 2014 focus group meetings

- **Sophomore courses:** There was strong buy-in in both sessions for separating the sophomore
sequence into three courses.
- **Sophomore courses:** Students in the first session felt it was important that the new courses
not be a three-semester serial sequence, so that the ability to take technical elective courses is
not delayed.
- **Sophomore courses:** In both sessions students hoped that not all three courses would be
required as prerequisites for all of the junior-level core courses. (We responded that we
expected they would not, but the changes to junior level course perquisites will be made only
after approval of this proposal since they will not be needed until a couple of years after
students start in the new program.)
- **Sophomore courses:** Several students in the second session commented that they liked the
separation of topics into three courses for grade reasons, since it helps identify where
strengths are and where they have weaknesses they have to work on.
- **Sophomore courses:** In the second session students stated that with respect to taking ECE
2020 in the same semester as either 2060 or 2050 careful thought should be given to
scheduling the seven lab sessions of each class in such a way that the number of times
students have two labs in one week should be minimized.
- **Capstone Design:** In both sessions students expressed a desire for the 1 cr-hr course on
engineering design methodology and project management to be developed into an on-line
course. In the second session it was also suggested that it be offered in May term and in
summer.
- **Capstone Design:** In the first session concern was expressed that the prerequisites for the
first course in the capstone sequence not be the entire core, so that time to graduation is not
delayed. In the second session a student spoke in favor of prerequisites that permitted the
course to be taken earlier so that it would be of benefit for other class projects, not just for the
final capstone design experience.
- **Capstone Design:** In both sessions it was suggested that the first course in the capstone
sequence be combined with the technical writing course, ECE 3090.
- **Requiring Electronics Lab:** Strong buy-in expressed in second session for expanding ECE
3027 to a full semester 1 cr-hr course and requiring it for all students. Not as strongly
expressed in first session, but no dissent stated either.
- **Requiring Electronics Lab:** Students were shown a draft list of lab topics that might go
into the expanded course and made several suggestions for others. These were shared with
the course supervisor for developing the additional lab sessions.
- **Credit hour balancing:** Strong buy-in on reducing the number of hour of permitted
Directed Electives to balance the increase in the core hours. No suggestions made to take
hours from a different part of the curriculum or to increase total hours to degree.
- **Number of required technical elective labs:** In both sessions the initial comments were in
favor of continuing to require two technical elective labs. But after other students
commented that they liked the flexibility to take another lecture technical elective instead of
a lab, and that those so inclined could still take additional labs, the consensus seemed to shift. A show of hands was 2-to-1 in favor of only requiring one technical elective lab (combined sections tally).

Summary of input from the 24 October 2014 teleconference with the IAB

- Twelve members of the IAB were able to participate in the teleconference. Four were not, but one of those four sent comments by email. Participating from OSU were Profs. Joel Johnson (ECE chair), Betty Lise Anderson (ECE associate chair) and George Valco (ECE USC chair).
- **Sophomore courses:** The IAB unanimously supported the proposed changes to the sophomore sequence.
- **Capstone Design:** An IAB member who has taught capstone design commented that separating the lecture content will allow students to focus on their project in the following semester. Questions were asked on whether the two courses in the capstone sequence had to be taken in back-to-back semesters and on the possibility of scheduling conflict between the first course and ECE 3090, the technical writing course that is its pre- or co-requisite. The two capstone courses do not have to be taken in back-to-back semesters, allowing for students to do a co-op in their senior year. The seven-week session nature of both ECE 3090 and the first course in the capstone sequence allow students to do ECE 3090 in the first half of the semester and the first capstone course in the second half. And several sections of ECE 3090 are typically offered in the first session of the semester. The IAB unanimously supported the proposed changes.
- **Requiring Electronics Lab:** The IAB member who has taught capstone design commented that system integration and test is a challenge for his capstone students so this is a good idea. IAB supported this proposed change.
- **Credit hour balancing:** The issue was discussed but a vote was not taken. Questions of clarification and about impact on co-op students were asked and answered. An IAB member expressed favor for increased rigor.
- **Number of required technical elective labs:** General agreement expressed by IAB for only requiring one additional lab upon making the electronics lab required.

Curricular Changes

Advising sheets for the current (2013-2014) Electrical Engineering and Computer Engineering programs of study are shown in Appendix I. The new (2014-2015) advising sheets for both programs are shown in Appendix II. The syllabi of the new courses associated with the proposed changes are attached in Appendix III.

- The total hours to degree remains unchanged at 128 for both the Electrical Engineering and Computer Engineering programs of study.
- The General Education component and specifically required courses taken from other units are unchanged for both the Electrical Engineering and Computer Engineering programs of study.
• The ECE component of the required core is increased by 3 credit hours for both the Electrical Engineering and Computer Engineering programs of study.
  
  o One credit hour of the increase is associated with the revised sophomore experience, replacing ECE 2000 (4 cr-hr) and 2100 (4 cr-hr) with ECE 2060 (3 cr-hr), 2050 (3 cr-hr) and 2020 (3 cr-hr). Note that the tens digits in the course number (6, 5 and 2) are associated with the curricular sub-area within the ECE department, not with the order or level of the course. ECE 2060 will be prerequisite to ECE 2050 since the lab component of ECE 2050 relies on work done ECE 2060 lab. But neither ECE 2060 nor 2050 will be pre- or co-requisites for ECE 2020. Thus, although ECE 2020 is shown in second semester of sophomore year on the model advising sheet, students could move it earlier if they have room in their first semester schedule.
  
  o One credit hour of the increase is associated with requiring the ECE 3027 electronics laboratory course. ECE 3027 is currently a 0.5 cr-hr technical elective, but a course change proposal has already been submitted to increase it to 1.0 cr-hr. That change is not contingent on approval of this proposal.
  
  o One credit hour of the change is associated with the revised capstone design sequence. ECE 3900, Capstone Design I, is the new 1 cr-hr course consisting of the lecture content of current ECE 4900. The course number ECE 4900 will be re-used for the design/build phase of Capstone Design II, but the course change for it will be delayed until it is needed, as described in the transition plan section of this proposal.
  
• For the Electrical Engineering program of study the total number of elective hours is decreased from 31 to 28.
  
  o The required number of ECE Technical Elective hours in the Electrical Engineering program of study is unchanged, at 16. The number of required labs included in those 16 hours is reduced from two to one. With ECE 3027 becoming required the total number of labs the students are required to take is unchanged. The other structure associated with the ECE Technical Electives, as described on the advising sheets, is unchanged.
  
  o The number of Directed Electives that may count in the Elective category in the Electrical Engineering program of study is reduced from 15 to 12. Directed Electives are not required; they are an option. A student may choose to meet their Elective requirement entirely with ECE courses.

• For the Computer Engineering program of study the total number of elective hours is decreased from 20 to 17.
  
  o The required number of ECE or CSE Technical Elective hours in the Computer Engineering program of study is unchanged, at 9. The other structure associated with the ECE and CSE Technical Electives, as described on the advising sheets, is unchanged.
  
  o The number of Directed Electives that may count in the Elective category in the Computer Engineering program of study is reduced from 11 to 8. Directed Electives are not required, they are an option. A student may choose to meet their Elective requirement entirely with ECE courses.
Credit Hour Explanation for the Electrical Engineering Program of Study

<table>
<thead>
<tr>
<th>Program credit hour requirements</th>
<th>Number of credit hours in current program</th>
<th>Number of credit hours for proposed program</th>
<th>Change in credit hours</th>
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<td>Total minimum credit hours required for completion of program</td>
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Credit Hour Explanation for the Computer Engineering Program of Study

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<td>Total minimum credit hours required for completion of program</td>
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Transition Plan

It is proposed that the new curriculum be required for all ECE students who start at The Ohio State University Autumn 2015 or later. It is also proposed that the new curriculum be required for any student who started earlier, but who has not graduated by end of Autumn 2019 (five years for students starting Sp15).

The course change proposal to increase the ECE 3027 electronics laboratory course from 0.5 cr-hr to 1 cr-hr has already been submitted. It will count as a 1 cr-hr technical elective for students in the current programs, and as a required ECE core class for students in the proposed new programs. Therefore there are no transition issues associated with it.

Sophomore Sequence transition issues

New first-semester students starting Autumn 2015 without any AP credit and following the schedule on the curriculum sheet would first need ECE 2060 in Autumn semester 2016. But some of that cohort might have AP credit in the correct courses to take ECE 2060 earlier.

Similarly, new transfer students starting Autumn 2015 might have the prerequisites to start the sophomore courses earlier.
We plan to offer the current and new sophomore courses on the following schedule during the transition.

<p>| | |</p>
<table>
<thead>
<tr>
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<tr>
<td>Autumn 2015</td>
<td>ECE 2000 and 2100</td>
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<td>Spring 2016</td>
<td>ECE 2100 and 2060</td>
</tr>
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<td>Autumn 2016</td>
<td>ECE 2060, 2050, 2020, and 2104</td>
</tr>
<tr>
<td>Spring 2017</td>
<td>ECE 2060, 2050, and 2020</td>
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</table>

For any new transfer students in Autumn 2015 who still need the sophomore sequence and have the prerequisites to start taking it immediately we would accept ECE 2000 and 2100 in place of ECE 2020, 2050 and 2060 so as not to hold them back. This will leave them one credit hour short toward the ECE core of the new program. Such students in the Electrical Engineering program will be required to make up the shortfall with ECE Technical Elective. Those in the Computer Engineering program would be required to make up the shortfall with either ECE or CSE Technical Elective.

Current students who are behind on prerequisites or who otherwise do not start the sophomore sequence in Autumn 2015 will be able to use ECE 2020, 2050 and 2060 to fulfill the requirement. That will give them one credit hour extra toward the ECE core of the current program. That hour will count toward their Technical Elective requirement.

Current students and new transfer students who pass ECE 2000 but do not complete ECE 2100 the last time it is offered in Spring 2016 will be able to take ECE 2104 and ECE 2020 in Autumn 2016 to complete the sequence. ECE 2104 is one of several existing courses we previously used for transfer students who had taken courses similar to parts of ECE 2000 and 2100. When we stopped using that transfer credit approach and withdrew most of those courses from the catalog we specifically retained ECE 2104 to use as a transition course for this situation. It will only be offered one more time as shown, and then withdrawn. Any imbalances in ECE core credit hours that result will be handled with Technical Electives as described in the previous two paragraphs.

Any additional students who have credit for ECE 2000 but do not take either ECE 2100 or 2104 when they are last offered will need to take both ECE 2050 and 2020. There will be substantial repetition of topics in the first half of ECE 2050, but since they will have been away from that material for one year or more they are likely to need the refresher. Any imbalances in ECE core credit hours that result will be handled with Technical Electives as described in the previous three paragraphs.

**Capstone Design transition issues**

New first-semester students following the schedule on the curriculum sheet would not need ECE 3900 until Autumn semester 2018, and the updated version of ECE 4900 until Spring semester 2019. But prerequisites could be met earlier than what the sample schedule shows, particularly when AP credit and transfer students are also considered, so there might be demand for the courses earlier.

More importantly, we believe that the benefit of the new capstone sequence is valuable to current students, and do not want to wait until the 2018-2019 academic year to implement it. **We propose that the new capstone design sequence be required of all students graduating**
**Autumn semester 2016 or later.** That would require a first offering of ECE 3900 in Spring semester 2016, and first offering of the updated ECE 4900 in Autumn semester 2016. The new Capstone Design sequence will add 1 cr-hr to the ECE core for current students. That hour will count toward their Technical Elective requirement.

**Impact on Department**

The sophomore sequence is changing from two courses to three courses. ECE 2000 is currently taken by ECE, CSE and CIS majors. ECE 2060 will be taken by the same set of students. ECE 2100 is currently taken by ECE and CSE majors. ECE 2020 will be taken by the same set of students. From a faculty teaching load perspective those courses essentially balance. The new course ECE 2050 represents an increased teaching load, but it will only be taken by ECE majors and the increase is thus less than if CSE students were also taking it.

The proposed changes to the sophomore sequence also represent a change for laboratory resources. ECE 2000 and ECE 2100 are each 3 cr-hr of lecture and 1 cr-hr of lab. ECE 2020, 2050 and 2060 are each 2.5 cr-hr of lecture and 0.5 cr-hr of labs. ECE 2060 will mostly re-use labs from the digital logic portions of the ECE 2000 lab. ECE 2050 will mostly re-use a selection of the labs from the last third of ECE 2000 and from ECE 2100. The labs for ECE 2020 will be significantly changed from those used for ECE 2100, but will use the same major instruments. Although there is a net decrease in the total lab hours associated with this change, the new program will have three different laboratories in the same large space. Sequencing and interleaving the lab experiences for each of these courses, scheduling, and making sure the correct numbers of benches are set up for the experiments for the correct course each week will be more complicated.

Having ECE 3027 become a required core laboratory represents an increase in required laboratory resources, both for lab equipment and supplies and for teaching assistants. The increase from 0.5 cr-hr to 1.0 cr-hr will be piloted in the 2015-2016 academic year while the course still serves primarily as a technical elective for current students. In the 2016-2017 academic year it will also still primarily serve as a technical elective for current students, although some transfer students or students with significant AP credit may be taking it as a required core course. The demand for the course will increase significantly in the 2017-2018 academic year, when the first cohort of students in the new program reaches the junior year.

Introducing ECE 3900 to the capstone design sequence represents an increased teaching load. The possibility of offering it as an on-line course was raised during our planning of the revisions, and students also raised it in the focus group meetings. That may mitigate the lecture load. The grading load for assignments on engineering design methodology and project management will be shifted from ECE 4900 to ECE 3900, although there will be some additional assignments in ECE 3900 not present in ECE 4900, so some increase in grading load is expected.
Appendix I: Current BSECE Advising Sheets

The current BSECE Advising Sheets (2014-2015) for the Electrical Engineering program of study and for the Computer Engineering program of study are shown on the next two pages.
# 2014-2015

**Major:** Electrical and Computer Engineering  
**Program of Study:** Electrical Engineering  
**Degree:** Bachelor of Science in Electrical and Computer Engineering (BSECE)  
**Hrs.** 128

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- At least 16 hours of the Electives must be ECE Technical Electives.
  - Must take a concentration of 6 hours in one of the domains below.
  - Must take at least 3 hours in each of two other domains below.
  - Must include at least one 5000 level ECE Technical Elective.
  - At least two ECE Technical Elective courses must be labs.
- Up to 15 hours of the Electives may be Directed Electives from the ECE approved list. Directed Electives generally include: courses required for entry into other engineering majors; required and technical elective courses in other engineering majors; pre-med courses; business or entrepreneurship courses; math, statistics, physics and chemistry courses at higher level than required in the ECE core; and other physical science or biological science courses. For physical science or biological science courses a maximum of 7 hours numbered below 2000 may be counted as Directed Electives.

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**General Education (24 hrs)**

- One GE must be a US Social or Global Diversity Course.
- One GE must be an ETHICS course.
- English & Comm Skills (6 hr)
  - English 1110 xx 3
  - 2367 2nd Writing 3
- Social Sciences (6 hrs)
  - Only one course per Social Science group may count.
  - Grp 3
  - Grp 3
- Visual & Performing Arts 3
- Historical Study 3
- 2nd Hist. Study. or Culture & Ideas 3

### Directed Electives

- Total Directed Electives

### Other ECE Technical Electives

- Total Other ECE Electives
- Total ECE Domain Electives
- Total ECE Tech Electives

- Two Labs
- 5000-level

---

**Hours Req’d for Degree:**

**Earned Hours to Date:**

**Total Proposed Hours:**

**Final CPHR:**

**Final MGPA:**

**OK to Graduate?** Yes No

**Program Approved:**

---

**Revised 1/13/15 rjj**

**Page 13 of 37**
### Core (84 hrs)

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### Electives (20 hrs)

- At least 9 hours of the Technical Electives must be ECE or CSE courses selected from the lists below.
- Must include at least one 5000 level ECE or CSE Technical Elective.
- Up to 11 hours of the Electives may be Directed Electives from the ECE approved list. Directed Electives generally include courses required for entry into other engineering majors; required and technical elective courses in other engineering majors; pre-med courses, business or entrepreneurship courses; math, statistics, physics and chemistry courses at higher level than required in the ECE core; and other physical science or biological science courses. For physical science or biological science courses a maximum of 7 hours numbered below 2000 may be counted as Directed Electives.

#### VLSI (Very Large Scale Integrated Circuits) & Computer Aided Design
- ECE 5020 (3)
- Microprocessor Based Systems
  - ECE 5465 (3)
- Digital Design and Computer Architecture
  - ECE 5462 (3)
- Computer Networks
  - ECE 5101 (3) | CSE 3461 (3)
- Signals and Systems
  - ECE 3060 (3)
- Robotics and Control for Automation
  - ECE 3551 (3) | ECE 5463 (3) | ECE 5554 (3)
- Digital Signal Processing/Image Processing
  - ECE 5200 (3) | ECE 5256 (3) | ECE 5460 (3)
- Numerical Analysis
  - CSE 3561 (3)
- Database/Algorithms
  - CSE 3241 (3) | CSE 5242 (3)
- High Performance Computing
  - CSE 5441 (3)
Appendix II: Proposed BSECE Advising Sheets

The proposed BSECE Advising Sheets (2015-2016) for the Electrical Engineering program of study and for the Computer Engineering program of study are shown on the next two pages.
**Major: Electrical and Computer Engineering  Program of Study: Electrical Engineering**

**Degree: Bachelor of Science in Electrical and Computer Engineering (BSECE)**

Hrs. 128

### CORE (76 hrs)

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### ELECTIVES (28 hrs)

- At least 10 hours of the Electives must be ECE Technical Electives.
  - Must take a concentration of 6 hours in one of the domains below.
  - Must take at least 3 hours in each of two other domains below.
  - Must include at least one 3000-level ECE Technical Elective.
  - At least one ECE Technical Elective course must be a lab.

Up to 12 hours of the Electives may be Directed Electives from the ECE approved list. Directed Electives generally include: courses required for entry into other engineering majors; required and technical elective courses in other engineering majors; pre-med courses; business or entrepreneurship courses; math, statistics, physics and chemistry courses at a higher level than required in the ECE core, and other physical science or biological science courses. For physical science or biological science courses a maximum of 7 hours numbered below 2000 may be counted as Directed Electives.

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### DIRECTED ELECTIVES

- At least 10 hours of the Electives must be ECE Technical Electives.
- Must take a concentration of 6 hours in one of the domains below.
- Must take at least 3 hours in each of two other domains below.
- Must include at least one 3000-level ECE Technical Elective.
- At least one ECE Technical Elective course must be a lab.

Up to 12 hours of the Electives may be Directed Electives from the ECE approved list. Directed Electives generally include: courses required for entry into other engineering majors; required and technical elective courses in other engineering majors; pre-med courses; business or entrepreneurship courses; math, statistics, physics and chemistry courses at a higher level than required in the ECE core, and other physical science or biological science courses. For physical science or biological science courses a maximum of 7 hours numbered below 2000 may be counted as Directed Electives.

### OTHER ECE TECHNICAL ELECTIVES

- At least 10 hours of the Electives must be ECE Technical Electives.
- Must take a concentration of 6 hours in one of the domains below.
- Must take at least 3 hours in each of two other domains below.
- Must include at least one 3000-level ECE Technical Elective.
- At least one ECE Technical Elective course must be a lab.

Up to 12 hours of the Electives may be Directed Electives from the ECE approved list. Directed Electives generally include: courses required for entry into other engineering majors; required and technical elective courses in other engineering majors; pre-med courses; business or entrepreneurship courses; math, statistics, physics and chemistry courses at a higher level than required in the ECE core, and other physical science or biological science courses. For physical science or biological science courses a maximum of 7 hours numbered below 2000 may be counted as Directed Electives.

### Hours Req’d for Degree

- Transfer students: 30 OSU ECE hrs?
- Math & Sci. Science: 32 hrs?

**Final CPHR: **
**Final MGPA: **
**OK to Graduate? **
**Yes**

Program Approved

Advisors Signature

Date
**Major:** Electrical and Computer Engineering  
**Program of Study:** Computer Engineering  
**Degree:** Bachelor of Science in Electrical and Computer Engineering (BSECE)  
**Hrs.:** 128

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**ELECTIVES (17 hrs)**

- At least 9 hours of the Technical Electives must be ECE or CSE courses selected from the lists below.
- Must include at least one 5000 level ECE or CSE Technical Elective.
- Up to 8 hours of the Electives may be Directed Electives from the ECE approved list. Directed Electives generally include: courses required for entry into other engineering majors; required and technical elective courses in other engineering majors; premajors courses, business or entrepreneurship courses; math, statistics, physics and chemistry courses at a level higher than required in the ECE core; and other physical science or biological science courses. For physical science or biological science courses a minimum of 7 hours numbered below 2000 may be counted as Directed Electives.

**CSE DIRECTED ELECTIVES**

- VLSI (Very Large Scale Integrated Circuits) & Computer Aided Design
  - ECE 5020 (3)

**Other ECE Tech Electives**

- Total Other ECE TE: __________
- Total Short List TE: __________
- Total ECE & CSE Elec.: __________

**Non-CSE Directed Electives**

- Total Non-CSE DE: __________

**General Education (24 hrs)**

- One GE must be a US Social or Global Diversity Course.
- One GE must be an ETHICS course.
- English & Comm Skills (6 hr)
  - English 1110 xx: 3
  - 2367 2nd writing: 3
- Social Sciences (6 hrs)
  - Only one course per Social Science group may count
  - Grp: 3
- Literature: 3
- Visual & Performing Arts: 3
- Historical Study: 3
- 2nd Hst. Stdy. or Culture & Ideas: 3

**CSE TECHNICAL EMPLOYMENT ELECTIVES**

- 5000-level: __________

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**ECE TECHNICAL EMPLOYMENT ELECTIVES**

- Transfer students: 30 OSU ECE hrs?  
- Math & B. Science: 32 hrs?  
- OK to Graduate? Yes No  
- Program Approved:  

Revised 1/15/15: QIV

Page 17 of 37
Appendix III: Syllabi of new courses

The syllabi of the following courses are given in this appendix:

- ECE 2020 new course request
- ECE 2050 new course request
- ECE 2060 new course request
- ECE 3027 This course syllabus is for the 1.0 cr-hr version. The course change request from 0.5 cr-hr to 1.0 cr-hr has already been submitted since the course is already used as a technical elective and increasing it to 1.0 cr-hr is not contingent on approval of this proposal.
- ECE 3900 new course request
- ECE 4900 The new syllabus is included here for completeness, but this course change should not be implemented until Autumn 2016 as described in the Transition Plan section of this proposal.

Note: The terms “approved” or “proposed” in the titles refer to the internal status in the tool used for creating the syllabi at the time these files were saved, and not to status at the University level. (We would update the status to show “official” in the title after they are approval by OAA.)
ECE 2020 (Approved): Introduction to Analog Systems and Circuits

Course Description
Circuit theory and applications of passive components and Op amps. Introduction to analog systems using differential equations and Laplace transforms.

Prior Course Number: 2100
Transcript Abbreviation: Anlg Sys & Circuit
Grading Plan: Letter Grade
Course Deliveries: Classroom, Greater or equal to 50% at a distance
Course Levels: Undergrad
Student Ranks: Sophomore
Course Offerings: Autumn, Spring
Flex Scheduled Course: Never
Course Frequency: Every Year
Course Length: 14 Week
Credits: 3.0
Repeatable: No
Time Distribution: 2.5 hr Lec, 1.5 hr Lab
Expected out-of-class hours per week: 5.0
Graded Component: Lecture
Credit by Examination: No
Admission Condition: No
Off Campus: Never
Campus Locations: Columbus, Lima, Marion
Prerequisites and Co-requisites: Prereq: Math 1152 (152) or 1161.01 or 1172 or 1181H or 161, and Physics 1250 or 1260 or 131, and CSE 1222 or 2221 or 202 or 205 or 221 or EnGraph 167 or Engr 1281.01H or 1281.02H; and Engr 1182.01 or 1182.02 or 1182.03 or 1282.01H or 1282.02H or 1282.03H or Engineer 183 or 193H, or Engr 1186 (Engineer 186) and 1187 (187) and concur: 1188 (185) concurrent, or 1187 and 1188 and concur: 1186; and CPHR 2.00 or above.
Exclusions: Not open to students with credit for 2100, 2100.02, 2100.06, 2100.07, 2100.08, 2105, 2106, 2110, 2127, 2137, 2300, 205, 209, 292, 294.03, or 301.
Cross-Listings:

Course Rationale: Restructuring of Sophomore Sequence.

The course is required for this unit's degrees, majors, and/or minors: Yes
The course is a GEC: No
The course is an elective (for this or other units) or is a service course for other units: Yes

Subject/CIP Code: 14.1001
Subsidy Level: Baccalaureate Course

Programs

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CpE</td>
<td>Computer Engineering</td>
</tr>
<tr>
<td>EE</td>
<td>Electrical Engineering</td>
</tr>
</tbody>
</table>

General Information
Course consists of seven 3 hour labs rather than 14 1.5 hour labs. Course will meet 3x / week for 45 minutes a session.

Course Goals

- Master circuit concepts such as voltage, current, charge, resistors, inductors, capacitors, etc.
- Master how to analyze, design and implement circuits using Ohm's Law, Kirchhoff's laws and superposition
- Be competent in Phasor Domain sinusoidal techniques
- Be competent in analyzing, designing and implementing steady state and transient behavior of RC, RL, RLC circuits
- Be competent in Laplace Transform techniques
- Be competent in analyzing, designing and implementing simple active filters based on ideal Op amps
- Be familiar with how to use modern computer tools for analog simulation
- Be competent in how to use laboratory instruments and laboratory methodology
- Be competent with methodology for critical troubleshooting skills
- Be competent in reporting standards

Course Topics

<table>
<thead>
<tr>
<th>Topic</th>
<th>Lec</th>
<th>Rec</th>
<th>Lab</th>
<th>Cli</th>
<th>IS</th>
<th>Sem</th>
<th>FE</th>
<th>Wor</th>
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<tr>
<td>Fundamentals of electric circuits: Charge, Voltage, Kirchhoff's Laws, power and sign conventions, Ohm's law, practical circuit elements</td>
<td>2.5</td>
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<tr>
<td>Circuit Analysis Techniques: Node Voltage / Mesh analysis, superposition, Thevenin and Norton equivalents</td>
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<tr>
<td>Ideal op amp, feedback, active filters, cascaded active filters</td>
<td>2.5</td>
<td>3.0</td>
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<tr>
<td>RC and RL first-order circuits, natural and total response, RC Op amp circuits</td>
<td>2.5</td>
<td>3.0</td>
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<tr>
<td>Initial and Final Conditions, Series and Parallel RLC, General solution of second-order circuits</td>
<td>2.5</td>
<td>3.0</td>
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<td>Laplace transforms, properties, pole zero diagrams and inverse Laplace transform</td>
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<tr>
<td>System transfer function scaling, impulse response, step response, sinusoidal response, s-Domain circuit analysis</td>
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<tr>
<td>Sinusoidal signals, Phasor domain analysis, impedance transformations</td>
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<td>RC, RL, RLC frequency response vs transient response</td>
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<td>Bode Plots, Passive and Active Filters</td>
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<tr>
<td>Periodic Waveforms, Average and Complex Power, Maximum power Transfer</td>
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<td>Multisim circuit analysis</td>
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<tr>
<td>Introduction to Lab Equipment, troubleshooting skills</td>
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Representative Assignments

Homework, lab reports

Grades

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<th>Aspect</th>
<th>Percent</th>
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<tbody>
<tr>
<td>Homework</td>
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Representative Textbooks and Other Course Materials

<table>
<thead>
<tr>
<th>Title</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circuits, 2nd ed, 978-1-934891-19-3, NTS Press</td>
<td>Ulaby and Mahabirz</td>
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</table>

ABET-EAC Criterion 3 Outcomes

<table>
<thead>
<tr>
<th>Course Contribution</th>
<th>College Outcome</th>
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<tbody>
<tr>
<td>***</td>
<td>a An ability to apply knowledge of mathematics, science, and engineering.</td>
</tr>
<tr>
<td>***</td>
<td>b An ability to design and conduct experiments, as well as to analyze and interpret data.</td>
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<tr>
<td>*</td>
<td>c An ability to design a system, component, or process to meet desired needs.</td>
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<tr>
<td>**</td>
<td>d An ability to function on multi-disciplinary teams.</td>
</tr>
<tr>
<td>***</td>
<td>e An ability to identify, formulate, and solve engineering problems.</td>
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<td></td>
<td>f An understanding of professional and ethical responsibility.</td>
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<td></td>
<td>g An ability to communicate effectively.</td>
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<td></td>
<td>h The broad education necessary to understand the impact of engineering solutions in a global and societal context.</td>
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<tr>
<td></td>
<td>i A recognition of the need for, and an ability to engage in life-long learning.</td>
</tr>
<tr>
<td>***</td>
<td>j A knowledge of contemporary issues.</td>
</tr>
<tr>
<td></td>
<td>k An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.</td>
</tr>
</tbody>
</table>

Additional Notes or Comments
Initial Design 8/29/14

Prepared by: Ryan McPherson
ECE 2050 (Approved): Introduction to Discrete Time Signals & Systems

Course Description
Introduction to sampled time signals and linear time invariant sampled time systems.

Prior Course Number: 2000, 2100, 292
Transcript Abbreviation: Intr Disc Sig&Sys
Grading Plan: Letter Grade
Course Deliveries: Classroom
Course Levels: Undergrad
Student Ranks: Sophomore
Course Offerings: Autumn, Spring
Flex Scheduled Course: Never
Course Frequency: Every Year
Course Length: 14 Week
Credits: 3.0
Repeatable: No
Time Distribution: 2.5 hr Lec, 1.5 hr Lab
Expected out-of-class hours per week: 5.0
Graded Component: Lecture
Credit by Examination: No
Admission Condition: No
Off Campus: Never
Campus Locations: Columbus, Lima, Marion
Prerequisites and Co-requisites: Prereq: 2060 or 2000. Prereq or concur: Math 2568.
Exclusions: Not open to students with credit for 2100, 2100.01, 2100.04, 2110, 2104, 291, 294.02 or 351
Cross-Listings:

Course Rationale: Part of splitting of ECE 2000 and ECE 2100 into 3 courses to better represent topics taught.

The course is required for this unit's degrees, majors, and/or minors: Yes
The course is a GEC: No
The course is an elective (for this or other units) or is a service course for other units: No

Subject/CIP Code: 14.1001
Subsidy Level: Baccalaureate Course

Programs

<table>
<thead>
<tr>
<th>Abbreviation</th>
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<tr>
<td>CpE</td>
<td>Computer Engineering</td>
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<tr>
<td>EE</td>
<td>Electrical Engineering</td>
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</tbody>
</table>

General Information
There are actually seven 3 hour labs instead of fourteen 1.5 hour labs.
Lectures will meet three times per week for 45 minutes a session.

Course Goals
Be competent with the fundamentals of discrete time linear time invariant (LTI) systems
Be competent in using laboratory instruments, methodology and reporting standards
Be competent in working in teams for laboratory experiments
Be competent in performing z-transforms and inverse z-transforms
Be competent in analyzing, designing and synthesizing discrete time LTI systems, including finite impulse response (FIR) and infinite impulse response (IIR) filters
Be familiar with sampling, analog to digital and digital to analog conversions
Be familiar with how to implement designs in hardware using modern techniques such as FPGAs and microcontrollers
Be exposed to troubleshooting and debugging practices

### Course Topics

<table>
<thead>
<tr>
<th>Topic</th>
<th>Lec</th>
<th>Rec</th>
<th>Lab</th>
<th>Cli</th>
<th>IS</th>
<th>Sem</th>
<th>FE</th>
<th>Wor</th>
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<tbody>
<tr>
<td>Introduction to continuous &amp; discrete signals, sampling &amp; aliasing, quantization</td>
<td>2.0</td>
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<tr>
<td>Review of complex numbers</td>
<td>1.0</td>
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<tr>
<td>Discrete time signals and special functions</td>
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<tr>
<td>Discrete time systems descriptions &amp; properties: LTI systems, impulse response, FIR/IIR conditions, convolution, difference equations, zero-state and zero-input, flow diagrams</td>
<td>6.0</td>
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<tr>
<td>Z-transform techniques: two-sided vs one-sided z-transform, region of convergence (ROC), rational z-transforms, LTI systems in z-domain, power series and partial fraction expansion, transient and steady-state, stability</td>
<td>7.0</td>
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<tr>
<td>Steady-state frequency response of discrete time LTI systems: spectrum, Fourier series, discrete time Fourier transform &amp; relationship to z-transform, frequency response from poles &amp; zeros in transfer function</td>
<td>7.0</td>
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<tr>
<td>Frequency response of LTI systems and LTI frequency selective filters</td>
<td>7.0</td>
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<tr>
<td>Instrumentation and CAD tool review: oscilloscope, Matlab, microcontroller and FPGA programming</td>
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<td>9.0</td>
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<tr>
<td>FPGA implementation of discrete time filters (FIR, IIR)</td>
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<tr>
<td>Microcontroller implementation of discrete time filters (FIR, IIR)</td>
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<td>6.0</td>
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</table>

### Representative Assignments

Homework
Midterm Exam 1
Midterm Exam 2
Lab Reports
Final Exam

### Grades

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Percent</th>
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<tbody>
<tr>
<td>Homework</td>
<td>15%</td>
</tr>
<tr>
<td>Midterm Exam 1</td>
<td>20%</td>
</tr>
<tr>
<td>Midterm Exam 2</td>
<td>20%</td>
</tr>
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</table>
Representative Textbooks and Other Course Materials

<table>
<thead>
<tr>
<th>Title</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Digital Signal Processing, 4th Ed</em></td>
<td>John G. Proakis &amp; Dimitris G. Manolakis</td>
</tr>
</tbody>
</table>

ABET-EAC Criterion 3 Outcomes

<table>
<thead>
<tr>
<th>Course Contribution</th>
<th>College Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>aspect</strong></td>
<td>a. An ability to apply knowledge of mathematics, science, and engineering.</td>
</tr>
<tr>
<td><strong>aspect</strong></td>
<td>b. An ability to design and conduct experiments, as well as to analyze and interpret data.</td>
</tr>
<tr>
<td>*</td>
<td>c. An ability to design a system, component, or process to meet desired needs.</td>
</tr>
<tr>
<td>**</td>
<td>d. An ability to function on multi-disciplinary teams.</td>
</tr>
<tr>
<td><strong>aspect</strong></td>
<td>e. An ability to identify, formulate, and solve engineering problems.</td>
</tr>
<tr>
<td><strong>aspect</strong></td>
<td>f. An understanding of professional and ethical responsibility.</td>
</tr>
<tr>
<td><strong>aspect</strong></td>
<td>g. An ability to communicate effectively.</td>
</tr>
<tr>
<td><strong>aspect</strong></td>
<td>h. The broad education necessary to understand the impact of engineering solutions in a global and societal context.</td>
</tr>
<tr>
<td><strong>aspect</strong></td>
<td>i. A recognition of the need for, and an ability to engage in life-long learning.</td>
</tr>
<tr>
<td><strong>aspect</strong></td>
<td>j. A knowledge of contemporary issues.</td>
</tr>
<tr>
<td><strong>aspect</strong></td>
<td>k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.</td>
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</tbody>
</table>

Additional Notes or Comments
Created summer and autumn 2014 for UG program revision – sophomore sequence update.

Prepared by: Bradley Clymer
ECE 2060 (Approved): Introduction to Digital Logic

Course Description
Introduction to the theory and practice of combinational and clocked sequential networks.

Transcript Abbreviation: Int Digital Logic
Grading Plan: Letter Grade
Course Deliveries: Classroom, Greater or equal to 50% at a distance
Course Levels: Undergrad
Student Ranks: Sophomore
Course Offerings: Autumn, Spring
Flex Scheduled Course: Never
Course Length: 14 Week
Credits: 3.0
Repeatable: No
Time Distribution: 2.5 hr Lec, 1.5 hr Lab
Expected out-of-class hours per week: 5.0
Graded Component: Lecture
Credit by Examination: No
Admission Condition: No
Off Campus: Never
Campus Locations: Columbus

Prerequisites and Co-requisites: Prereq: Math 1152 (152) or 1161.01 or 1161.02 or 1172 or 1181H or 161, and Physics 1250 or 1260 or 131, and CSE 1222 or 2221 or 202 or 205 or 221 or EnGraph 167 or Engr 1281.01H or 1281.02H or 1222 or Engineer 192.01H or 192.02H; and Engr 1182.01 or 1182.02 or 1182.03 or 1282.01H or 1282.02H or 1282.03H or Engineer 183 or 193H, or Engr 1186 (Engineer 186) and 1187 (187) and concur: 1188 (185) concurrent, or 1187 and 1188 and concur: 1186, or major in CIS or CIS-PRE; and CPHR 2.00 or above.
Cross-Listings:

Course Rationale: Restructuring of Sophomore sequence. Splitting ECE2000 and ECE2100 into 3 courses.

The course is required for this unit's degrees, majors, and/or minors: Yes
The course is a GEC: No
The course is an elective (for this or other units) or is a service course for other units: Yes

Subject/CIP Code: 14.1001
Subsidy Level: Baccalaureate Course

Programs

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>CpE</td>
<td>Computer Engineering</td>
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<tr>
<td>EE</td>
<td>Electrical Engineering</td>
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</table>

General Information

There are actually seven 3 hour labs rather than fourteen 1.5 hour labs. Lectures will meet three times per week for 45 minutes a session.
**Course Goals**

- Master the number representations used in today's digital systems and their arithmetic properties and conversion techniques
- Master analyzing and synthesizing networks of combinatorial, digital logic elements
- Be competent to analyze, design and synthesize digital clocked sequential circuits
- Be familiar with modern computer tools for digital design, verification and simulation
- Be familiar with how to implement their design schematics to hardware using modern FPGAs
- Be competent in working in teams for lab experiments
- Be familiar with digital circuit design methods
- Be competent in reporting standards
- Exposure to methodology for critical troubleshooting skills

**Course Topics**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Lec</th>
<th>Rec</th>
<th>Lab</th>
<th>Cli</th>
<th>IS</th>
<th>Sem</th>
<th>FE</th>
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<tbody>
<tr>
<td>Number systems and conversion</td>
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<tr>
<td>Boolean algebra</td>
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<td>Karnaugh maps</td>
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<td>Multi-level gate circuits</td>
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<td>Multiplexers, decoders and PLDs</td>
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<tr>
<td>Latches and flip-flops</td>
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<tr>
<td>Registers and counters</td>
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<td>Timing (delays, timing diagrams)</td>
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<td>Analysis of clocked sequential circuits (general models for</td>
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<td>sequential circuits, timing charts, state tables, graphs)</td>
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<td>Design of clocked sequential circuits</td>
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<td>Finite state machines, flow diagrams, mapping to flip-flop</td>
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<td>circuits with logic gates.</td>
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<tr>
<td>Introduction to lab Equipment: Signal Generator and Oscilloscope,</td>
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<td>how to measure digital signals using the oscilloscope and the</td>
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<td>motivation for using digital signals</td>
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<td>Introduction to Quartus and the DE2 Board: HDL files, basic RTL</td>
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<td>6.0</td>
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<tr>
<td>components for simulation. Quartuss on-chip debugging tools, Signal</td>
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<tr>
<td>Tap II and the In-System Memory Content Editor.</td>
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<tr>
<td>Using the CODEC: Students are shown how to use the DE2s audio CODEC</td>
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<td>3.0</td>
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<td>chip to perform conversions between analog and digital signals.</td>
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<tr>
<td>Introduction to the Synthesizer: build a synthesizer, Students</td>
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<td>3.0</td>
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<tr>
<td>also learn how to use Matlab to create memory contents for ROM</td>
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<td>look-up tables. Finally students are introduced to bit shifting as</td>
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<td>a means of scaling signed and unsigned numbers.</td>
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<tr>
<td>Electronic Keyboard: Students build a circuit that takes signals</td>
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<td>3.0</td>
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<td>from PS2 keyboard and converts them into musical tones by applying</td>
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<td>the concepts and skills they have learned in the previous 5 labs.</td>
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<tr>
<td>Demo Player Feature for an Electronic Keyboard: Students add an</td>
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<td>3.0</td>
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<tr>
<td>auto play feature to the electronic keyboard that automatically</td>
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<td>plays a short tune. Emphasizes the use of sequential components,</td>
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<tr>
<td>testing of large Quartus project.</td>
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Representative Assignments

<table>
<thead>
<tr>
<th>Assignment</th>
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<tbody>
<tr>
<td>Homework</td>
</tr>
<tr>
<td>Midterm Exams</td>
</tr>
<tr>
<td>Final Exam</td>
</tr>
<tr>
<td>Lab Reports</td>
</tr>
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</table>

Grades

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Percent</th>
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<tbody>
<tr>
<td>Homework</td>
<td>15%</td>
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<tr>
<td>Midterm Exam 1</td>
<td>20%</td>
</tr>
<tr>
<td>Midterm Exam 2</td>
<td>20%</td>
</tr>
<tr>
<td>Final Exam</td>
<td>25%</td>
</tr>
<tr>
<td>Lab Reports</td>
<td>20%</td>
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Representative Textbooks and Other Course Materials

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<th>Title</th>
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ABET-EAC Criterion 3 Outcomes

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<td>*** e</td>
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<td>g</td>
<td>An ability to communicate effectively.</td>
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<td>h</td>
<td>The broad education necessary to understand the impact of engineering solutions in a global and societal context.</td>
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<td>*** k</td>
<td>An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.</td>
</tr>
</tbody>
</table>

Additional Notes or Comments

Initial Design: 9/10/14 Khan
Updated from 2.5 to 3 hr course 10/9/14

Prepared by: Ryan McPherson
ECE 3027 (Proposed): Electronics Laboratory

Course Description
Electronic amplification, signal processing, timing, and power regulation circuits. Experiments with electronics evaluation modules and use of an analog system lab kit for electronics testing.

Prior Course Number: 327
Transcript Abbreviation: Electronics Lab
Grading Plan: Letter Grade
Course Deliveries: Classroom
Course Levels: Undergrad
Student Ranks: Junior, Senior
Course Offerings: Autumn, Spring
Flex Scheduled Course: Never
Course Frequency: Every Year
Course Length: 14 Week
Credits: 1.0
Repeatable: No
Time Distribution: 3.0 hr Lab
Expected out-of-class hours per week: 0.0
Graded Component: Laboratory
Credit by Examination: No
Admission Condition: No
Off Campus: Never
Campus Locations: Columbus
Prerequisites and Co-requisites: Prereq: 2020 or 2100 or 292 or 294 (Spring 2011) or 209, and enrollment in ECE or EngPhysics major. Prereq or concur: 3020 (323).
Exclusions: Not open to students with credit for 327.
Cross-Listings:

Course Rationale: Existing lab course, increased from session to full semester. Part of a program change proposal, to become required for major rather than elective.

The course is required for this unit's degrees, majors, and/or minors: Yes
The course is a GEC: No
The course is an elective (for this or other units) or is a service course for other units: Yes

Subject/CIP Code: 14.1001
Subsidy Level: Baccalaureate Course

Programs

<table>
<thead>
<tr>
<th>Abbreviation</th>
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</tr>
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<tbody>
<tr>
<td>CpE</td>
<td>Computer Engineering</td>
</tr>
<tr>
<td>EE</td>
<td>Electrical Engineering</td>
</tr>
</tbody>
</table>

General Information

This electronics lab course uses educational kits as being developed in the ongoing growth of the maker movement. Students are assigned in groups of two and have an overall lab kit assigned to them for the entire semester. In the course topics below, student groups are able to pick up where they left off from the previous lab with their specific kit, allowing for flexibility in the depth into which they can explore the topics. The lab manual and added material contains more content than can be explored in one semester.
Course Goals

Use knowledge of circuits and electronics to design electronic circuits, and to measure and document performance of electronic circuits

Provide the student the experience of designing, constructing, testing, and debugging electronic circuits

Course Topics

<table>
<thead>
<tr>
<th>Topic</th>
<th>Lec</th>
<th>Rec</th>
<th>Lab</th>
<th>Cli</th>
<th>IS</th>
<th>Sem</th>
<th>FE</th>
<th>Wor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overview of the TI Analog System Lab Kit Pro and lab procedures. Op Amp Circuits - verify correct operation by reducing offset voltage with unity gain configuration, and use this to estimate open loop gain.</td>
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<td>3.0</td>
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<tr>
<td>Op Amp Circuits: Inverting and non-inverting configurations.</td>
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<td>3.0</td>
</tr>
<tr>
<td>Op amp based Schmitt trigger, oscillators, and monostable multivibrator. Dual supply vs. single supply designs. Oscillator driving light emitting diode circuits.</td>
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<tr>
<td>Op amp integrators and differentiators - dual vs. single supply. Slew rate effects, settling time, and ringing behaviors.</td>
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<tr>
<td>Transistor amplifiers and inverters - single supply vs dual supply designs. N type vs P type transistor amplifier configurations.</td>
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<tr>
<td>Op amps combined with transistor buffer amplifiers for driving higher current loads such as light emission, sound, and other power considerations, such as regulation.</td>
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<tr>
<td>Measurements of TI Analog System Lab Kit's built-in low dropout regulator and DC-DC switching regulator.</td>
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<tr>
<td>Discrete low dropout regulator design and measurement. Op Amp selection with respect to stability and settling time.</td>
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<tr>
<td>Discrete form of switching regulator - LCR plus transistor switch.</td>
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<tr>
<td>Analog multipliers vs. multiplying Digital to Analog Converters (DAC). Programmable oscillator with analog multiplier vs. DAC.</td>
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<tr>
<td>Programmable filter with analog multiplier vs DAC. Controlling DAC with TI Launchpad Microcontroller.</td>
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<tr>
<td>Analog to Digital Converter in TI Launchpad Microcontroller.</td>
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</tbody>
</table>

Representative Assignments

Laboratory Reports
Quizzes

Grades

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Percent</th>
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</thead>
<tbody>
<tr>
<td>Laboratory Reports</td>
<td>70%</td>
</tr>
<tr>
<td>Quizzes</td>
<td>30%</td>
</tr>
</tbody>
</table>
Representative Textbooks and Other Course Materials

<table>
<thead>
<tr>
<th>Title</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laboratory Notes</td>
<td>Elec. and Comp. Engr. Dept.</td>
</tr>
</tbody>
</table>

ABET-EAC Criterion 3 Outcomes

<table>
<thead>
<tr>
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</tr>
</thead>
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<td>*</td>
<td>a. An ability to apply knowledge of mathematics, science, and engineering.</td>
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<td>**</td>
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<td></td>
<td>d. An ability to function on multi-disciplinary teams.</td>
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<td>h. The broad education necessary to understand the impact of engineering solutions in a global and societal context.</td>
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<td></td>
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<td>j. A knowledge of contemporary issues.</td>
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<tr>
<td>**</td>
<td>k. An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.</td>
</tr>
</tbody>
</table>

Additional Notes or Comments
converted prereq and exclusions to standard form.
Added "or 292 or 294 (Spring 2011) " to prereqs 4/11/12
Increased to full semester 1 credit hour for ECE program change 10/10/2014

Prepared by: George Valco
ECE 3900 (Proposed): Capstone Design I

Course Description
Fundamentals of the engineering design process. Design principles and methodology. Project management during design.

Transcript Abbreviation: Capstone Design I
Grading Plan: Letter Grade
Course Deliveries: Classroom, Greater or equal to 50% at a distance
Course Levels: Undergrad
Student Ranks: Senior
Course Offerings: Autumn, Spring
Flex Scheduled Course: Never
Course Frequency: Every Year
Course Length: 7 Week
Credits: 1.0
Repeatable: No
Time Distribution: 2.0 hr Lec
Expected out-of-class hours per week: 4.0
Graded Component: Lecture
Credit by Examination: No
Admission Condition: No
Off Campus: Never
Campus Locations: Columbus
Prerequisites and Co-requisites: Prereq: Sr standing and enrollment in the ECE major. Prereq or concur: 3090.
Exclusions: Not open to students with credit for 4900 (682), 4900H (683H), 4901 (683), or 582, or Engr 4901 or 4903.
Cross-Listings:

Course Rationale: Split lecture content out of 4900 into previous semester to allow more time for capstone design project completion in 4900.

The course is required for this unit's degrees, majors, and/or minors: Yes
The course is a GEC: No
The course is an elective (for this or other units) or is a service course for other units: No

Subject/CIP Code: 14.1001
Subsidy Level: Baccalaureate Course

Programs

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Course Goals

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<tbody>
<tr>
<td>Be competent with the principles and issues of engineering design</td>
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<tr>
<td>Be familiar with principles and tools for management of a design project</td>
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<tr>
<td>Demonstrate competence in technical writing skills</td>
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</table>
Course Topics

<table>
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<tr>
<th>Topic</th>
<th>Lec</th>
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<th>IS</th>
<th>Sem</th>
<th>FE</th>
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</thead>
<tbody>
<tr>
<td>Engineering design methodology</td>
<td>5.0</td>
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<td>Project management (Gantt charts, task breakdowns, budgets, etc)</td>
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<td>Engineering standards</td>
<td>1.0</td>
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<td>Test and validation plan development</td>
<td>1.0</td>
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<td>Debugging, failure and risk analysis and management</td>
<td>1.0</td>
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<td>Resources for design and implementation of projects</td>
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<tr>
<td>Group dynamics and effective professional teams</td>
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Representative Assignments

Problem statements, analysis of specifications and requirements, design concepts, test plans, task lists, Gantt chart and scheduling, and budget exercises.

Quizzes covering lecture material.

Case studies and critiques.

Grades

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Percent</th>
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<tbody>
<tr>
<td>Homeworks</td>
<td>40%</td>
</tr>
<tr>
<td>Quizzes</td>
<td>30%</td>
</tr>
<tr>
<td>Final project</td>
<td>30%</td>
</tr>
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<table>
<thead>
<tr>
<th>Title</th>
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<tbody>
<tr>
<td>Design for Electrical and Computer Engineers: Theory, Concepts and Practice</td>
<td>Ralph M. Ford and Chris S. Coulston</td>
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</tbody>
</table>

**Prepared by:** George Valco
ECE 4900 (Proposed): Capstone Design II

Course Description
Application of design principles and methodology to conceptual and detailed technical design, implementation, and testing of a capstone project.

Prior Course Number: 682
Transcript Abbreviation: Capstone Design II
Grading Plan: Letter Grade
Course Deliveries: Classroom
Course Levels: Undergrad
Student Ranks: Senior
Course Offerings: Autumn, Spring
Flex Scheduled Course: Never
Course Frequency: Every Year
Course Length: 14 Week
Credits: 3.0
Repeatable: No
Time Distribution: 3.0 hr Rec, 3.0 hr Lab
Expected out-of-class hours per week: 3.0
Graded Component: Laboratory
Credit by Examination: No
Admission Condition: No
Off Campus: Never
Campus Locations: Columbus
Prerequisites and Co-requisites: Prereq: Option 1: 2560 (265), 3010 (312), 3020 (323), 3027 (327), 3030 (432), 3040 (341), 3050 (352), 3090 (582), and 3900 and Sr standing, and enrollment in Electrical Engineering Program of Study (EES subplan) of the ECE major. Prereq or concur: 3080 (481). Option 2: 3020 (323), 3027 (327), 3090 (582), 3561 (561), 3567 (567), 3900, CSE 2231 (321), and 2451, and Sr standing, and enrollment in Computer Engineering Program of Study (CES subplan). Prereq or concur: 3080 (481) and 5362 (662).
Exclusions: Not open to students with credit for 4900H (683H), 4901 (683), or 682, or Engr 4903.
Cross-Listings:

Course Rationale: Existing course being revised to allow focus on design, implementation and testing aspects of capstone project with new course 3900 taken prior term.

The course is required for this unit's degrees, majors, and/or minors: Yes
The course is a GEC: No
The course is an elective (for this or other units) or is a service course for other units: No

Subject/CIP Code: 14.1001
Subsidy Level: Baccalaureate Course

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</tbody>
</table>

General Information
The scheduled recitation time will be used for team presentations for progress reports and final project reporting; and for team meetings both with the instructor and amongst team members.

Course Goals

- Demonstrate competence applying engineering design methods
- Demonstrate competence in the management of a project
- Demonstrate competence in a team-based environment
- Demonstrate mastery in technical writing and presentation skills
- Design, build, demonstrate, and report on a major project, integrating material learned
- Be exposed to relevant engineering standards
- Demonstrate familiarity in considering multiple realistic constraints (e.g. economic, environmental, sustainability, manufacturability, ethical, health and safety, social and political issues) while carrying out their design

Course Topics

<table>
<thead>
<tr>
<th>Topic</th>
<th>Lec</th>
<th>Rec</th>
<th>Lab</th>
<th>Cli</th>
<th>IS</th>
<th>Sem</th>
<th>FE</th>
<th>Wor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Senior project design</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project execution, test, and analysis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Documentation of project</td>
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</table>

Representative Assignments

- Project proposal document, with problem definition statement, requirements and systems specifications, project implementation and test plan, Gantt charts and budget estimates.
- Working prototype.
- Final presentation.
- Final report.

Grades

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design proposal/ planning presentation</td>
<td>15%</td>
</tr>
<tr>
<td>Design proposal/planning report</td>
<td>20%</td>
</tr>
<tr>
<td>Regular progress/status reports</td>
<td>15%</td>
</tr>
<tr>
<td>Preliminary and final demonstrations</td>
<td>15%</td>
</tr>
<tr>
<td>Final presentation</td>
<td>15%</td>
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<tr>
<td>Final report</td>
<td>20%</td>
</tr>
<tr>
<td>+/- one letter grade from team grade based on individual and teamwork assessment</td>
<td>0%</td>
</tr>
</tbody>
</table>

Representative Textbooks and Other Course Materials

<table>
<thead>
<tr>
<th>Title</th>
<th>Author</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design for Electrical and Computer Engineers: Theory, Concepts and Practice</td>
<td>Ralph M. Ford and Chris S. Coulston</td>
</tr>
</tbody>
</table>

ABET-EAC Criterion 3 Outcomes
<table>
<thead>
<tr>
<th>Course Contribution</th>
<th>College Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>***</td>
<td>a An ability to apply knowledge of mathematics, science, and engineering.</td>
</tr>
<tr>
<td>**</td>
<td>b An ability to design and conduct experiments, as well as to analyze and interpret data.</td>
</tr>
<tr>
<td>***</td>
<td>c An ability to design a system, component, or process to meet desired needs.</td>
</tr>
<tr>
<td>***</td>
<td>d An ability to function on multi-disciplinary teams.</td>
</tr>
<tr>
<td>***</td>
<td>e An ability to identify, formulate, and solve engineering problems.</td>
</tr>
<tr>
<td>*</td>
<td>f An understanding of professional and ethical responsibility.</td>
</tr>
<tr>
<td>***</td>
<td>g An ability to communicate effectively.</td>
</tr>
<tr>
<td>**</td>
<td>h The broad education necessary to understand the impact of engineering solutions in a global and societal context.</td>
</tr>
<tr>
<td>**</td>
<td>i A recognition of the need for, and an ability to engage in life-long learning.</td>
</tr>
<tr>
<td>*</td>
<td>j A knowledge of contemporary issues.</td>
</tr>
<tr>
<td>***</td>
<td>k An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.</td>
</tr>
</tbody>
</table>

**Additional Notes or Comments**

Added quarter equivalents of prereqs. Add 4901 to exclusions. Update press and exclusions to university format.
update prereqs to 3561 instead of 3567 for CpE 4/23/12

corrected prereq to show 5362 only required of CES subplan. 4/27/12

changed text to Ford and Coulston 3/27/13

Added ENGR 4903 to exclusions.

Update course goals, lectures, grading, and Criterion 3 outcomes 5/8/14

Correct ABET outcome f to two stars 7/2/14

Update course for program change splitting lecture content into ECE 3900 10/7/14

**Prepared by: George Valco**
Appendix IV: CSE Concurrence

The letter of concurrence from the Department of Computer Science and Engineering, which also describes the changes to the BS-CSE program needed to accommodate the changes to the sophomore sequence of courses, is provided on the next two pages.
February 13, 2015

Prof. Mark Ruegsegger
Chair
CCAA

Re: Proposed changes in ECE courses included in the BS-CSE program

Dear Mark:

Students in the BS-CSE program are currently required to take ECE 2000, 2100 (4 credit hours each). Based on feedback we received from students at our last Undergraduate Forum, reiterated by student representatives on our Undergraduate Studies Committee which I chair, we suggested to the ECE faculty that they consider certain changes in these courses. Mainly, while our students seemed to understand and appreciate the material in the first two-thirds of ECE 2000 and the last two-thirds of ECE 2100, they had difficulties with the last third of ECE 2000 and the first third of 2100. Moreover, the topics that our students had difficulties with were also ones that were not directly related to CSE. As it turns out, the ECE faculty were already considering changes in these courses based on feedback from their own students.

After extensive discussions, some of which our faculty participated in, ECE faculty have proposed reorganizing these courses into three new courses, ECE 2020, 2050, and 2060 (3 credit hours each). The net result, from the point of view of CSE students, is that the contents of ECE 2020 and 2060 are ideally suited for BS-CSE majors; the contents of ECE 2050 may be of interest to a small number of BS-CSE majors who have a special interest in certain specialized applications.

Hence the CSE Undergraduate Studies Committee proposed that BS-CSE majors be required to take ECE 2020 and 2060 in place of ECE 2000 and 2100; and that the freed up 2 credit hours be added to the technical elective hours of the program. Thus, there will be no change in the total number of credit hours required for the degree. This change will go into effect for students who join in Au 2015 and beyond. Current students who have already completed both ECE 2000 and 2100 will follow their original program; students who have completed ECE 2000 may, if they so choose, take ECE 2100 by Sp 2016 (after which it will no longer be offered); or take ECE 2020 with 1 credit hour being added to their technical electives; students who have not yet taken neither will be advised to take ECE 2020 and 2060 although they may also choose one of the other alternatives described above. These changes were discussed and recommended by the committee to the CSE faculty for its approval in late Au 2014. The CSE faculty electronically approved the changes in early December 2014.
These changes will ensure that the ECE courses that our student take are better suited to the BS-CSE program and we urge approval of the proposed change simultaneously with the approval of the changes in the ECE program. We also sincerely thank our ECE colleagues for being so willing to listen to the concerns expressed by our students and to revise their courses to make them more suitable for the BS-BS-CSE program.

One final note: As you may recall, we have another degree, BS-CIS, through the College of Arts and Sciences. Students in that program are currently required to take ECE 2000. With the proposed changes in the ECE courses, those students will be required to take ECE 2060, with the 1 freed up credit hour being added to their technical electives. We are sending a request to the ASC (NMS) Curriculum Committee requesting approval of that change.

Sincerely,

Neelam Soundarajan
Chair, Undergraduate Studies Committee
Computer Science and Engineering

cc: Xiaodong Zhang, Chair, CSE Department
    George Valco, Chair, ECE Undergraduate Studies Committee
Executive Summary

March 4, 2015

The Master of Global Engineering Leadership Graduate Studies Committee (MGELGSC) unanimously approved the proposal to add Radar Systems as a new technical track offering by the Electrical and Computer Engineering department. The Radar Systems technical track will consist of four, three credit hour courses for a total of twelve credit hours. This meets the program requirements that each technical track consist of 11-13 credit hours.

For questions contact either:

Bob Mick
Director of Professional Programs
Mick.15@osu.edu
614-292-0393

Dr. Avraham Benatar
MGEL Faculty Director
Benatar.1@osu.edu
614-292-1390

Master Global Engineering Leadership Graduate Studies Committee Members

Dr. Avraham Benatar
Dr. Trevor Brown
Dr. Yann Guezennece
Bob Mick
Dr. Rajiv Ramnath
Dr. Beth-Anne Schuelke-Leech
Materials Joining Track Coordinator
John Glenn School of Public Affairs
Automotive Systems Engineering Track Coordinator
College of Engineering
Enterprise Services & Architecture Track Coordinator
John Glenn School of Public Affairs
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III. Structure and Curriculum
IV. Administration and Support
V. Appendices
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   b) Letter of Support ECE Department Chair
   c) Letter of Support Air Force Research Laboratory
   d) MGEL proposal; Curriculum, pages 5-8
Master Global Engineering Leadership (MGEL)
New Technical Track Proposal:
Radar Systems

Providing Radar Systems Expertise for Engineering Professionals

Rationale:
The Master Global Engineering Leadership (MGEL) technical track in Radar Systems will provide post graduate training in radar systems engineering to enhance the global engineering leadership training of participants. Students in the track are expected to be drawn from:

- Engineers in business and industry
- Public or private sector employment
- Mid-career retraining
- PhD training
- Those who want either or both a broad understanding and technical depth

The department of Electrical and Computer Engineering (ECE) has a long history in teaching and research in and around the subject of radar systems. The state of Ohio has a considerable investment in sensors generally and radar specifically representing a 2.5 billion dollar industry. Extensive radar systems activity at Wright Patterson Air Force Base and the need for training a large personnel base in the area further motivate this proposal.

An MGEL track with specialization in radar systems is consistent with the College’s land grant mission for engineers who want to be able to respond to rapidly changing technical and global conditions and to accelerate their careers in industry or the public sector. The radar systems track will prepare professionals in radar systems engineering, equipping them to play key roles in innovative and challenging technical projects within their organizations. The courses offered are designed to enable students to be equipped with all the necessary knowledge to enable them to play a leading role in research and development in industrial and government institutes. Graduates will be equipped to advance to technical leadership positions through the effective application of their technology, analytical and radar system design skills.

Admission Requirements:
Beyond the standard MGEL admission requirements, student in the track are required to have completed their undergraduate training in electrical and computer engineering, or to have past experience with radar systems development.

Structure and Curriculum:
The MGEL Radar Systems technical track will consists of four courses at three credit hours each for a total of twelve credit hours. This meets the program requirement that each technical track consist of 11-13 credit hours and enabling MGEL students to meet the required number of credit hours to graduate from the degree program.
Engineers who complete the MGEL track in Radar Systems will:

- be current in the latest radar systems engineering knowledge and related advances
- be equipped with the technical tools to tackle advanced radar problems
- be able to apply knowledge more effectively toward new innovations and directions
- be able to recognize and address the impact and importance of global radar developments
- know how to communicate technical material to both technical and nontechnical audiences
- be able to lead technical teams and projects

Courses

5010: Wireless Propagation and Remote Sensing: (3) cr hrs Practical methods for predicting tropospheric, ground wave, and ionospheric propagation, including refraction, reflection, and extinction effects. Study of remote sensing systems and their applications. Prereq: 3010 (312), or Grad standing in Engineering, Biological Sciences, or Math and Physical Sciences.

5011: Antennas: (3) cr hrs Electromagnetic radiation; fundamental antenna parameters; dipole, loops, patches, broadband and other antennas; array theory; ground plane effects; horn and reflector antennas; pattern synthesis; antenna measurements. Prereq: 3010 (312), or Grad standing in Engineering, Biological Sciences, or Math and Physical Sciences.

5013: An Introduction to Radar Systems: (3) cr hrs Introduces the fundamentals of radar such as the main concepts and techniques used in modern radar systems. The class is a survey course exposing students to a wide range of radar applications and design issues. Prereq: 3050 (352), and 3010 (312) or 3010.01, and Stat 3470 (427); or Grad standing in Engr.

5206: Medical Imaging and Processing: (3) cr hrs Introduction to medical imaging techniques (CT, MRI, PET, ultrasound), including data collection, image reconstruction, physics of tissue interactions, and digital processing of medical images. Prereq: 3050 (352). Prereq or concur: 3090 or 582, or Grad standing in ECE, BiomedE, or Biophys.

Faculty Teaching Technical Track Courses

Dr. Chris Baker - An Introduction to Radar Systems
Dr. John Volakis - Antennas
Dr. Brad Clymer – Medical Imaging and Processing
Dr. Fernando Teixeira – Wireless Propagation and Remote Sensing
Delivery:
All courses will be offered 100% online but will also be taught simultaneously with (at least for initial offerings) on-campus sections. Online processes will be developed in conjunction with ODEE instructional designers, including options for remote presentation of projects required in the courses. All of these courses are already taught using electronic presentation materials, and ECE 5206 offerings already include videotaping of lectures.

Program Administration and Support:
Prof. Chris Baker will serve as the track coordinator, and will serve as the lead POC for college MGEL personnel. Administrative issues related specifically to track courses will be addressed by existing ECE support staff. Additional funds as required (expected to be minimal given existing distance learning equipment already available) will be identified from ECE department sources.

Commitment and Letters of Support:
ECE GSC
ECE Chair
AFRL
Bob Mick
Director of Professional Programs
The College of Engineering
165 Hitchcock Hall
2070 Neil Avenue
Columbus, OH 43210

Cc: Prof. Joel T. Johnson
Chair, Department of Electrical and Computer Engineering
205 Dreese Labs
2015 Neil Avenue
Columbus, OH 43210

October 27, 2014

Dear Bob,

The Graduate Studies Committee has reviewed the Proposal for a Radar Systems Track within the Masters of Global Engineering Leadership (MGEL) program, submitted by Prof. Chris Baker.

After careful examination of the documentation submitted to the Committee, and thorough evaluation of the admission requirements and the proposed curriculum, the Committee has expressed its full, unanimous and enthusiastic support to the proposed track. In particular, the Committee recognizes the strategic importance of a Radar Systems Track within the MGEL, in the light of longstanding synergetic collaborations between the Department of Electrical and Computer Engineering (especially, the ElectroScience Lab) and various industrial partners and governmental institutions (particularly, the Air Force Research Laboratories at Wright-Patterson AFB.) The Committee also praises the specific selection of the courses within the track, which provide both breath and depth in the curriculum, as well as the choice of Prof. Baker as Track Coordinator.

Please, do not hesitate to contact me, should additional information become necessary.

Sincerely,

Andrea Serrani
Professor and Graduate Studies Chair
November 5th, 2014

Bob Mick
Director of Professional Programs
The College of Engineering
165 Hitchcock Hall
2070 Neil Avenue
Columbus, OH 43210

Dear Bob,

I am writing to express my support for the proposed Radar Systems Track within the Masters of Global Engineering Leadership (MGEL) program. The Department of Electrical and Computer Engineering has identified graduate level distance learning as a high priority strategic initiative, and the Radar Systems Track represents an important step toward our goals. We believe the track will experience strong support due to the Department’s international reputation in radar systems and our strong partnerships with industry and government in this area.

Please feel free to contact me if you require any additional information.

Sincerely,

Joel T. Johnson
Professor and Department Chair
Electrical and Computer Engineering
Dear OSU Masters in Global Engineering Leadership Program:

I am writing to express my personal support for the creation of a Radar Systems track in the Masters of Global Engineering Leadership (MGEL) program as proposed by the Department of Electrical and Computer Engineering. I first learned of the prospects for this program during discussions with Professor John Volakis and was immediately interested as it provides an opportunity to ensure/enhance the competency of our workforce in this area of critical interest to the Air Force Research Laboratory (AFRL) well into the future.

Obtaining qualified personnel who are well trained in radar systems engineering is a significant challenge and there are few/no universities that offer a tailored curriculum to teach the necessary background/skills/expertise required to contribute to this relevant area. I have long been interested in establishing a radar systems focused masters level training program to meet these needs and a program at The Ohio State University that provides distance education to our personnel located in Dayton, and at other AFRL locations is of great interest. Since many of our personnel perform both technical and project management functions, the MGEL is particularly attractive as it provides a combination of leadership and engineering education.

I expect that a good number of AFRL personnel would jump at the opportunity to participate in this program offered at one of the nation's premier institutions. Knowing the quality of education delivered at The Ohio State University by professors/researcher prominent in this field, I will definitely recommend it to my colleagues.

Please feel free to contact me if you have questions about these recommendations.

Sincerely,

Stephen W. Schneider, Ph.D., ST  
Chief Scientist (Act’g), Sensors Directorate  
Air Force Research Laboratory

office 937/528-8831  
cell 937/212-2788
Education Innovation Center (EEIC) in the College to develop and test new ways to use the technologies (see Appendix D, letter of support from the EEIC Director). The John Glenn School will take advantage of the College of Engineering’s experience and infrastructure in distance education to teach their courses in the MGEL degree program. Similarly, faculty and instructors from The Fisher College of Business will also use distance education technologies to teach the business courses. This teaching methodology will allow working students the flexibility to undertake the degree at their own pace (within limits described in Appendix C) and location. Web conferencing capabilities through Carmen Connect, one-day on-campus sessions for orientation and graduation will help to provide experiences essential to the quality of the education and the development of professional networks. Appendix D includes a letter of support from the John Glenn School of Public Affairs as well as a letter of concurrence from The Fisher College of Business allowing their faculty and instructors to teach the business courses. If the John Glenn School of Public Affairs makes the decision to withdraw from the program or to not allow their faculty to teach in the MGEL program, the CoE is prepared to quickly hire lecturers/instructors with graduate standing in the Graduate School to teach the core courses. This should guarantee the continuity of the program.

The proposed MGEL program will also expand the visibility and reputation of the State of Ohio and The Ohio State University in the field of post-graduate training in the professional practice of engineering and in online education. The program will draw a cadre of professional resources to the college that will enhance engineering education across the board. The program will integrate existing knowledge and resources across university departments, colleges, centers and schools and leverage these resources with industry connections.

\[d\) Vision\]

The OSU MGEL degree program will provide outstanding educational opportunities for technical leaders in engineering fields. It will prepare graduates to respond to the challenges of the 21\textsuperscript{st} century by providing the highest quality course content in technical areas and by helping graduates develop the professional and critical skills they will need to respond to this changing international environment.

\[II. \] Proposed Curriculum

The proposed curriculum will result in a tagged Master’s degree as described in The Ohio State University Graduate Handbook (Semester version, XIV.1, pg. 48). It will be delivered in distance education methods while including opportunities for group interactions through web conferencing to help students apply the content to team solutions of engineering problems as well as to provide networking opportunities. In addition to being the most appropriate pedagogical model, providing the MGEL curriculum in this format will increase the pool of potential students and offer better service and more flexibility for these students as well.
The minimum of 33 semester credit hour program is designed for completion in one year (two semesters) if taken full time. Students have the flexibility of taking the curriculum on a part time basis over a period of two to three years (a maximum of four years unless the Graduate Studies Committee (formed specifically for this program) grants an extension (see Appendix C). The degree program consists of a set of common core classes, a variety of technical tracks from which students may choose and an integrative project, including course work on project management. Students may also earn up to 3 hours of credit for previous course completed elsewhere. Previous course work (see section II-d for more details) can be used to replace a technical track course or professional (core) course.

The curriculum includes three components (see Figure 1) (see Appendix A for sample curricula):

a) **The Core (17-18 hours):** This integrated core includes business, public administration and engineering courses including topics such as engineering leadership, innovation, intrapreneurship/entrepreneurship, project management and teambuilding, accounting, legal issues, engineering ethics and professionalism. These courses draw on OSU’s significant strengths in the John Glenn School of Public Affairs as well as the OSU College of Engineering.

The overall structure is illustrated in Figure 1. The courses and special experiences to be offered in the core include:

- John Glenn School of Public Affairs
  - PUBAFRS 6050 Management in Public Agencies\(^3\) (4 credits)
  - PUBAFRS 5750H The Business-Government Relationship\(^4\) (3 credits)
- OSU College of Engineering in collaboration with Fisher College of Business faculty and instructors
  - ENGR xxxx Leadership and Team Effectiveness\(^5\) (3 credits)
  - ENGR xxxx Accounting/Finance for Engineers (3 credits)
  - ENGR xxxx Technology Strategy & Innovation Management (3 credits)
- OSU College of Engineering
  - ENGR xxxx Engineering Ethics and Professionalism (1 credit)
  - ISE 5810 Lean Sigma Foundations (4 credits)
  - Special events and on-campus experiences, including orientation and graduation ceremonies

The syllabi for all new courses can be found in Appendix H.

Note that ENGR xxxx Engineering Ethics and Professionalism has an entire section (Section 13) devoted to global issues. The syllabus for ENGR xxxx Technology Strategy & Innovation Management is highlighted where global issues are explicitly covered.

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\(^3\) Students may elect either this course or the Leadership and Team Effectiveness course in Engineering.

\(^4\) Possible one week intensive course in Washington, DC as a substitute [http://www.washcampus.edu/](http://www.washcampus.edu/)

\(^5\) Students may elect either this course or the Management in Public Agencies course in the Glenn School depending on whether they are focused on the public or private sector.
b) **Technical Tracks (11-13 hours):** In addition to the required core, each student will choose a technical track to guide his or her choice of in-depth technical elective courses. These technical tracks will be identified on the student’s transcript to make them more marketable within their industry or public sector. Each student will have an advisor within the track who will act as the student’s faculty mentor. Most tracks will be interdisciplinary and will include emerging areas such as automotive systems, energy and sustainability, information systems, advanced materials and systems engineering/project management. Three technical tracks have been approved for the first year of the program (see Figure 1); however, additional tracks will be added in future years. The tracks are made up of technical and multi-disciplinary courses. The technical courses utilize advanced principles and the newest developments together with the skills provided in the core to take trained engineers to a new level of understanding and practice of their profession. Together with the integrative project, the track courses prepare professionals for life-long learning in a changing technological world. (Currently approved tracks are detailed in Appendix B. The process for adding new tracks, evaluating existing tracks and removing existing tracks is given in Appendix C. It will also be possible for students to create individualized tracks under the guidance of their faculty advisors and with the approval of the MGEL Graduate Studies Committee, as discussed in Appendix C.)

![Diagram of Masters of Global Engineering Leadership: Core and Technical Tracks](image)

Figure 1: Masters of Global Engineering Leadership: Core and Technical Tracks

A complete list of faculty involved in the teaching of all the above courses can be found in Appendix I. This list includes department, rank as well as email information.

c) **Integrative project (5 hours):** The integrative project develops solutions for real-world challenges, applies principles learned through the core and track courses and introduces project development, project management and project assessment. The project serves to knit together the professional core and the advanced technical tracks. Each technical track will have an integrative project class and ISE 5810 will act as the project management class that will provide the basis for students to pursue these projects. The first year, the integrative project will use existing course numbers for Group Studies at the graduate level (e.g., ECE 8194, CSE 8194, etc.). In the future, if needed, course numbers specific to the MGEL program will be created.
Summary of MGEL
- Minimum of 33 graduate credit hours (semester hours)
- Full time or part time
- All courses taught in distance education format. One day on-campus sessions for orientation and graduation with the cohort they enter the program.
- Faculty mentorship

d) Curricular Options: Several additional options will be available to students.

MGEL Certificates of Specialization: Certificates of specialization (hereafter referred to as certificates) can provide milestones to help motivate students through the degree program. In addition, some certificates have specific academic or industry requirements and are widely recognized as valuable in themselves. Faculty may propose programs that award certificates to students upon completion of specific sets of courses. Such certificate programs must be in accordance with academic and industry standards. Each MGEL certificate proposal must be reviewed and approved by the MGEL Graduate Studies Committee. Appendix C provides the process by which certificates may be proposed within this program.

International Experiences: Students will have the opportunity to undertake an international experience during their degree program (at extra cost). These opportunities will take advantage of the College of Engineering’s connections with research and industrial labs around the world. If students elect to take an international experience they may receive (i) course credit (up to 6 credits) and replace technical track courses or professional (core) courses or (ii) a Certificate. The amount of credit will vary depending on the specific experience selected. Students will receive course credit if they chose to take pre-approved (by MGEL-GSC) course(s) at international institutions.

For example, programs at OSU’s Center for Automotive Research provide the opportunity for students in related tracks to experience global viewpoints from renowned faculty from Europe and Asia. Currently, the international partners are: Swiss Federal Technical University, ETH-Z, Zürich, Switzerland (Certificate in Advanced Propulsion Systems); Forschungsinstitut für Kraftfahrwesen und Fahrzeugmotoren Stuttgart, in cooperation with the University of Stuttgart (Certificate in Powertrain Modeling and Control); Korea Advanced Institute of Science and Technology (KAIST) (Certificate in Automotive Noise, Vibration, and Harshness). In some cases students will experience this international component through distance education facilities (e.g. lectures by and discussions with faculty in foreign institutions), but there will also be on-site opportunities available at several foreign universities and firms. These foreign site opportunities will be optional at extra cost and will work through the appropriate University offices when formal agreements are necessary.