# 2015-2016 LONG SIGNATURE SHEET

Proposal Number: ETCM-03-03-16

Proposal Title: Creation of ENER Courses

Originating Department: Engineering Technology and Construction Management (ETCM)

TYPE OF PROPOSAL: UNDERGRADUATE_____ GRADUATE___X___ UNDERGRADUATE & GRADUATE____
(Separate proposals sent to UCCC and Grad. Council)

DATE RECEIVED	DATE CONSIDERED	DATE FORWARDED	ACTION	SIGNATURES
3/3/16	3/3/16	3/15/16	Approved	**DEPARTMENT CHAIR** *[signature]* [Anthony Brizendine:]
3/24/16	3/24/16	3/24/16	Approved	**COLLEGE CURRICULUM COMMITTEE CHAIR** *[signature]* [~~Tao Hong~~:] SRINIVAS PULUGURTHA
			Approved	**COLLEGE FACULTY CHAIR (if applicable)** [Bruce Gehrig:]
2016 Mar 29	2016 Mar 31	2016 Mar 31	Approved	**COLLEGE DEAN** *Ronald E. Smeleu* [Robert Johnson:]
			Approved	**GENERAL EDUCATION** (if applicable; for General Education courses) [print name here:]
			Approved	**HONORS COLLEGE** (if applicable; for Honors courses & programs) [print name here:]
			Approved	**UNDERGRADUATE COURSE & CURRICULUM COMMITTEE CHAIR** (for undergraduate content)
4/6/16	5/3/16	7/8/16	Approved	**GRADUATE COUNCIL CHAIR** (for graduate content) *[signature]* Rob Roy McGregor
				FACULTY GOVERNANCE ASSISTANT (Faculty Council approval on Consent Calendar)
				FACULTY EXECUTIVE COMMITTEE (if decision is appealed)
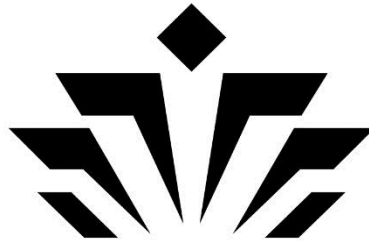
LONG FORM
COURSE AND CURRICULUM PROPOSAL

*To: College of Engineering Graduate Committee and UNC Charlotte Graduate Council

From: Deborah Sharer

Date: March 4, 2016

Re: Creation of ELET and ENER 5xxx Courses

Please find the attached proposal to modify the Master of Science in Construction and Facilities Management program.

COURSE AND CURRICULUM PROPOSAL

University of North Carolina at Charlotte

Revised Graduate

Course and Curriculum Proposal from: Department of Engineering Technology and Construction Management

TITLE: Creation of ELET and ENER 5xxx Courses

PROPOSAL SUMMARY.

The Department of Engineering Technology and Construction Management (ETCM) wishes to establish 5xxx graduate level courses to allow co-listing with undergraduate department courses. Specifically:
1. ENER 5123 will be created to allow co-listing with the currently existing ELET 4123.
2. ENER 5152 will be created to allow co-listing with the currently existing ELET 4152.
3. An ENER 5000 Special Topics course at the graduate level will be created to accompany ENER 4000 at the undergraduate level (submitted as a separate proposal).

A. JUSTIFICATION.
   1. The ETCM Department currently does not have the ability to co-list senior level undergraduate courses and graduate electives. These courses will allow the creation of these co-listings at the department level.

   2. The proposed courses do not have prerequisite/corequisite requirements.

   3. The UNC Charlotte course numbering guidelines have been followed for the proposed courses and are appropriate for graduate level coursework.

   4. These courses will expand the offerings of courses that may be of interest to students.

   5. The proposed courses have not been previously been offered as special topics courses.

B. IMPACT. The offering of this course will not impact current course offerings. It may facilitate the offering of multi-disciplinary courses within the department.

   1. The primary audience for the proposed courses is MSEEM students. The proposed courses are available to engineering graduate students.

   2. These courses will not impact current offerings but will expand offerings.
   a. ELET 5123 may be offered each fall in conjunction with the required ELET 4123 course. ELET 5152 and ENER 5000 will be offered on demand.
   b. There will be no impact on other courses.

c. The course cannot be offered with fewer students than defined using the college's current guidelines for enrollment.

d. Other courses will not be affected since:

   i. ELET 4123 is a program requirement and offered annually.

   ii. ENER 5152 and ENER 5000 will be offered when the corresponding courses (ELET 4152 and ENER 4000, respectively) are offered as major electives.

e. This will only affect the department level of the catalog through co-listing of limited senior level undergraduate and associated graduate courses.

III. RESOURCES REQUIRED TO SUPPORT PROPOSAL.

When added resources are not required, indicate "none". For items which require "none" explain how this determination was made.

A. PERSONNEL. No additional faculty, part-time teaching or student assistants will be required to deliver these courses. Qualified faculty members for each course are noted as follow:

   a. ENER 5123: Dr. Barry Sherlock, Dr. Deborah Sharer

   b. ENER 5152: Dr. Deborah Sharer, Dr. Barry Sherlock

   c. ENER 5000: ELET and/or MET faculty developing the elective.

B. PHYSICAL FACILITY. Current space is adequate for all proposed courses.

C. EQUIPMENT AND SUPPLIES: No new equipment or supplies are required for any proposed course.

D. COMPUTER. Current computer and software is adequate for all proposed courses.

E. AUDIO-VISUAL. No additional audiovisual resources are required to implement these proposed changes

F. OTHER RESOURCES. No other resources are required to implement these proposed changes.

G. SOURCE OF FUNDING. No new/additional resources are required.

IV. CONSULTATION WITH THE LIBRARY AND OTHER DEPARTMENTS OR UNITS

A. LIBRARY CONSULTATION. Indicate written consultation with the Library Reference Staff at the departmental level to ensure that library holdings are adequate to support the proposal prior to its leaving the department. (Attach copy of *Consultation on Library Holdings*). This is attached as Appendix 1.

B. CONSULTATION WITH OTHER DEPARTMENTS OR UNITS. Each course in this proposal is an ETCM Department course offering. The curriculum committee approval is the consultation necessary for this proposal.

      C. HONORS **C**OUNCIL **C**ONSULTATION. N/A

V. INITIATION, **A**TTACHMENTS AND **C**ONSIDERATION OF THE **P**ROPOSAL

      A. ORIGINATING **U**NIT. Briefly summarize action on the proposal in the originating unit including information on voting and dissenting opinions.

     The proposal was unanimously approved by the ETCM faculty on March 3, 2016.

      B. CREDIT **H**OUR. **(Mandatory if new and/or revised course in proposal)**
        Review statement and check box once completed:
        ☒ The appropriate faculty committee has reviewed the course outline/syllabus and has determined that the assignments are sufficient to meet the University definition of a credit hour.

      C. ATTACHMENTS.

        1. CONSULTATION: Consultation with other departments or units was unnecessary.

        2. COURSE OUTLINE/SYLLABUS: For undergraduate courses attach course outline(s) including basic topics to be covered and suggested textbooks and reference materials with dates of publication. For Graduate Courses attach a course syllabus. Please see Boiler Plate for Syllabi for New/Revised Graduate Courses.

     Outlines/syllabi for proposed courses are attached as Appendix 2.

        3. PROPOSED CATALOG COPY: Copy should be provided for all courses in the proposal. Include current subject prefixes and course numbers, full titles, credit hours, prerequisites and/or corequisites, concise descriptions, and an indication of when the courses are to be offered as to semesters and day/evening/weekend. Copy and paste the current catalog copy and use the Microsoft Word "track changes" feature (or use red text with "~~strikethrough~~" formatting for text to be deleted, and adding blue text with "underline" formatting for text to be added).

          a. For a new course or revisions to an existing course, check all the statements that apply:
        __X__ This course will be cross listed with another course.
        _____ There are prerequisites for this course.
        _____ There are corequisites for this course.
        __X__ This course is repeatable for credit. (ENER5000 only)
        _____ This course will increase/decrease the number of credits hours currently offered by its program.
        _____This proposal results in the deletion of an existing course(s) from the degree program and/or catalog.

For all items checked above, applicable statements and content must be reflected in the proposed catalog copy.

    b. If overall proposal is for a new degree program that requires approval from General Administration, please contact the facultygovernance@uncc.edu for consultation on catalog copy.

Proposed catalog copy is attached as Appendix 3.

4. ACADEMIC PLAN OF STUDY (**UNDERGRADUATE ONLY**): Does the proposed change impact an [existing Academic Plan of Study](#)?
☐ Yes. If yes, please provide updated Academic Plan of Study in template format.
☒ No.

5. STUDENT LEARNING OUTCOMES ([UNDERGRADUATE](#) & [GRADUATE](#)): Does this course or curricular change require a change in Student Learning Outcomes (SLOs) or assessment for the degree program?
☐ Yes. If yes, please provide updated SLOs in template format.
☒ No.

6. TEXTBOOK COSTS: It is the policy of the Board of Governors to reduce textbook costs for students whenever possible. Have electronic textbooks, textbook rentals, or the buyback program been considered and adopted?
☒ Yes. Briefly explain below.
☐ No. Briefly explain below.

Each course in the college is scrutinized with the object of keeping textbook costs down. The courses defined in this proposal will be no exception to this practice.

IMPORTANT NOTE: A Microsoft Word version of the final course and curriculum proposal should be sent to facultygovernance@uncc.edu upon approval by the Undergraduate Course and Curriculum Committee and/or Graduate Council chair.

Appendix 1: Library Consultation

UNC CHARLOTTE
J. Murrey Atkins Library

Consultation on Library Holdings

To: Deborah Sharer

From: Jeff McAdams

Date: 02/02/16

Subject: ENER4000/5000, ELET4123/5123, ELET4152/5152

Summary of Librarian's Evaluation of Holdings:

Evaluator: Jeff McAdams   Date: 02/02/16

Check One:
1. Holdings are superior   _____
2. Holdings are adequate   __x__
3. Holdings are adequate only if Dept. purchases additional items.   _____
4. Holdings are inadequate   _____

Comments:
Library holdings should be adequate to support student research for this course (see list of items held by subject heading below). Students will have access to relevant databases including *Compendex, Inspec, Science Direct, Web of Science, IEEE Xplore, ASTM Digital Library, CRC Engineering Handbooks*, and many others.

LC Subject Heading	Books	Journals
Signal processing Digital techniques	658	23
Electric Filters	150	2
Electric filters, Active Design	13	0

_____
Evaluator's Signature

02/02/16

_____

Appendix 2: Proposed and Existing Course Outlines

ENER 5123 - Active Filters

Catalog Description: The design, analysis, simulation and implementation of composite, cascaded and summation filters. Topics include: bilinear transfer functions; cascade design with first-order circuits; biquad circuits; Butterworth lowpass circuits; Butterworth bandpass circuits; the Chebyshev response; sensitivity; frequency transformations; highpass and band-elimination filters. Three (3) credit hours.

Course Outcomes: Upon successful completion of this course, students will be able to:

- Design and analyze filters making use of bilinear transforms.
- Design active filters by cascading first-order circuits.
- Demonstrate an understanding of the design and analysis of active filters using the biquad circuit.
- Design filters having a lowpass Butterworth response
- Design filters having a bandpass Butterworth response.
- Design lowpass and bandpass filters having a Chebyshev response.
- Perform sensitivity analysis upon a given active filter circuit.
- Make use of frequency transformation methods to convert prototype lowpass filters into highpass, bandpass or band-reject filters.

Instructional Method: This course will primarily be delivered via lecture, with graduate students responsible for additional independent study and dissemination.

Means of Student Evaluation*: Students taking this course for graduate credit will be required to research and disseminate findings on areas of topical interest. Grades will be calculated as follows:

Two semester exams:	60%
Final Exam:	30%
Homework Assignments:	10%

Final course grades will be assigned as follows:

90% to 100%	A
80% to 89.9%	B
70% to 79.9%	C
Less than 70%	U

* Grading policy may be modified by the instructor for each section of the course.

University Policies and Information: The following statements are provided to ensure compliance with federal regulations and SACS standards, as detailed in http://legal.uncc.edu/legal-topics/classroom-policies-and-practices/suggested-standard-syllabus-policies#disability.

- **Code of Student Academic Integrity**
  Students have the responsibility to know and observe the requirements of the UNC Charlotte Code of Student Academic Integrity. This code forbids cheating, fabrication or falsification of information, multiple submission of academic work, plagiarism, abuse of academic materials, and complicity in academic dishonestly. Students are expected to submit their own work, either as individuals or contributors to a group assignment. Faculty may ask students to produce identification at examinations and may require students to demonstrate that graded assignments completed outside of class are their own work. Violations of the Code will result in disciplinary action.
- **Code of Student Responsibility**
  Students are expected to uphold the University's Code of Student Responsibility. The purpose of the Code is to protect the health, safety, welfare, and property of the campus community; foster the personal, social, and ethical development of members; provide an environment conducive to learning; and encourage and create a community that values scholarship, integrity, respect, accountability, dignity, honor, compassion, character, and nobility. Violations of the Code will result in disciplinary action.
- **Rights and Responsibilities in Obtaining Disability Accommodations:**
  Students with disabilities may qualify for special academic accommodations. Students are encouraged to consult with the Office of Disability Services prior to the beginning of the semester to understand their rights and follow policies and procedures.
- **Definition of a Credit Hour**
  To ensure compliance with the federal and SACS definition a credit hour, the following examples are provided.
  o A 3-credit course requires three hours of classroom or direct faculty instruction and six hours of out-of-class student work for the equivalent of approximately 15 weeks. Out-of-class work may include but is not limited to: required reading; homework; studying for quizzes and exams; research; written assignments; and project design, simulation, testing and demonstration.

  o A 1-credit laboratory course requires 2.75 hours of classroom or direct faculty instruction and 2 hours of out-of-class student work each week for approximately fifteen weeks. Out-of-class work may include but is not limited to: required reading, library research, laboratory preparation, and preparing lab reports.

  *May be modified to accommodate varying credit hours or instructor expectations.

Textbook: *Analog Filter Design*, M.E. Van Valkenburg, Oxford University Press, 1995, ISBN 9780195107340

Class Topics: The following topics will be investigated in detail:
- Bilinear Transfer Functions
- Cascade design using first-order circuits
- The Biquad circuit
- Butterworth Lowpass Filters
- Butterworth Bandpass Filters
- The Chebyshev response

- Sensitivity
- Frequency transformations
- Highpass and band-eliminate filters
- Topical research as proposed or assigned by instructor

(Existing Course – reference purposes only)
ELET 4123 - Active Filters

Catalog Description: The design, analysis, simulation and implementation of composite, cascaded and summation filters. Topics include: bilinear transfer functions; cascade design with first-order circuits; biquad circuits; Butterworth lowpass circuits; Butterworth bandpass circuits; the Chebyshev response; sensitivity; frequency transformations; highpass and band-elimination filters. Three (3) credit hours.

Prerequisites: ELET3113; ELET3222; ETGR2122 and ETGR2272 or MATH1242

Course Outcomes: Upon successful completion of this course, students will be able to:

- Design and analyze filters making use of bilinear transforms.
- Design active filters by cascading first-order circuits.
- Demonstrate an understanding of the design and analysis of active filters using the biquad circuit.
- Design filters having a lowpass Butterworth response
- Design filters having a bandpass Butterworth response.
- Design lowpass and bandpass filters having a Chebyshev response.
- Perform sensitivity analysis upon a given active filter circuit.
- Make use of frequency transformation methods to convert prototype lowpass filters into highpass, bandpass or band-reject filters.

Instructional Method: This course will primarily be delivered via lecture.

Means of Student Evaluation*: Students taking this course for graduate credit will be required to research and disseminate findings on areas of topical interest. Grades will be calculated as follows and a standard 10-point scale will be used for grade assignment:

    Two semester exams: 60%
    Final Exam: 30%
    Homework: 10%

* Grading policy may be modified by the instructor for each section of the course.

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- The Biquad circuit
- Butterworth Lowpass Filters
- Butterworth Bandpass Filters
- The Chebyshev response
- Sensitivity
- Frequency transformations
- Highpass and band-eliminate filters

ENER 5152 - Digital Signal Processing

Catalog Description: Discrete-time signals; discrete-time systems; Linear constant-coefficient difference equations; Periodic sampling; reconstruction from samples; changing the sampling rate; the z-transform; z-transform properties; transform analysis of linear time-invariant systems; digital filter design techniques; discrete Fourier Transform and the FFT algorithm. Three (3) credit hours.

Course Outcomes: Upon successful completion of this course, students will be able to:

- Explain the principles involved in the sampling of discrete-time systems.
- Make use of the basic network structures used for finite impulse response filter design.
- Design IIR filters based upon an existing analog design.
- Understand and make use of the z-transform in connection with digital signal processing.
- Understand the use of, and make use of, the DFT and the FFT in signal processing.

Instructional Method: This course will primarily be delivered via lecture, with graduate students responsible for additional independent study and dissemination.

Means of Student Evaluation*: Students taking this course for graduate credit will be required to research and disseminate findings on areas of topical interest. Grades will be calculated as follows and a standard 10-point scale will be used for grade assignment:

Two semester exams:	50%
Final Exam:	25%
Project:	15%
Homework:	10%

Final course grades will be assigned as follows:

90% to 100%	A
80% to 89.9%	B
70% to 79.9%	C
Less than 70%	U

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- **Rights and Responsibilities in Obtaining Disability Accommodations:**
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- **Definition of a Credit Hour**
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  - A 3-credit course requires three hours of classroom or direct faculty instruction and six hours of out-of-class student work for the equivalent of approximately 15 weeks. Out-of-class work may include but is not limited to: required reading; homework; studying for quizzes and exams; research; written assignments; and project design, simulation, testing and demonstration.

  - A 1-credit laboratory course requires 2.75 hours of classroom or direct faculty instruction and 2 hours of out-of-class student work each week for approximately fifteen weeks. Out-of-class work may include but is not limited to: required reading, library research, laboratory preparation, and preparing lab reports.

    *May be modified to accommodate varying credit hours or instructor expectations.

Suggested Textbook: *Discrete Time Signal Processing*, A.V. Oppenheim and R.W. Schafer, Prentice Hall

Class Topics: The following topics will be investigated in detail:
- Discrete-time signals and systems
- Sampling of continuous-time signals
- The Z-transform
- Structures for discrete-time systems
- Filter design techniques
- The discrete Fourier transform

(Existing Course – reference purposes only)
ELET 4152 - Digital Signal Processing

Catalog Description: Discrete-time signals; discrete-time systems; Linear constant-coefficient difference equations; Periodic sampling; reconstruction from samples; changing the sampling rate; the z-transform; z-transform properties; transform analysis of linear time-invariant systems; digital filter design techniques; discrete Fourier Transform and the FFT algorithm. Three (3) credit hours.

Prerequisite: ELET3113

Course Outcomes: Upon successful completion of this course, students will be able to:

- Explain the principles involved in the sampling of discrete-time systems.
- Make use of the basic network structures used for finite impulse response filter design.
- Design IIR filters based upon an existing analog design.
- Understand and make use of the z-transform in connection with digital signal processing.
- Understand the use of, and make use of, the DFT and the FFT in signal processing.

Instructional Method: This course will primarily be delivered via lecture, with graduate students responsible for additional independent study and dissemination.

Means of Student Evaluation*: Students taking this course for graduate credit will be required to research and disseminate findings on areas of topical interest. Grades will be calculated as follows and a standard 10-point scale will be used for grade assignment:

Two semester exams:	50%
Final Exam:	25%
Project:	15%
Homework:	10%

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  - o A 1-credit laboratory course requires 2.75 hours of classroom or direct faculty instruction and 2 hours of out-of-class student work each week for approximately fifteen weeks. Out-of-class work may include but is not limited to: required reading, library research, laboratory preparation, and preparing lab reports.

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Suggested Textbook: *Discrete Time Signal Processing*, A.V. Oppenheim and R.W. Schafer, Prentice Hall

Class Topics: The following topics will be investigated in detail:
- Discrete-time signals and systems
- Sampling of continuous-time signals
- The Z-transform
- Structures for discrete-time systems
- Filter design techniques
- The discrete Fourier transform

ENER 5000 – Special Topics

Catalog Description: Prerequisite: Graduate standing in Engineering Technology or Construction Management or permission of the department. Examination of specific new areas which are emerging in the various fields of engineering technology and/or construction management. The course builds upon the knowledge the students have gained from their engineering technology and/or construction management curriculum. (1-4 hours) *May be repeated for credit.*

Prerequisite: Permission of the department

Course Outcomes: To be determined by instructor based on course topics.

Instructional Method: This course will primarily be delivered via lecture, with graduate students responsible for additional independent study and dissemination.

Means of Student Evaluation: Students taking this course for graduate credit will be required to research and disseminate findings on areas of topical interest in addition to undergraduate course requirements. Grade calculations will be determined by instructor based on course requirements.

University Policies and Information: The following statements are provided to ensure compliance with federal regulations and SACS standards, as detailed in http://legal.uncc.edu/legal-topics/classroom-policies-and-practices/suggested-standard-syllabus-policies#disability.

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  *May be modified to accommodate varying credit hours or instructor expectations.

Suggested Textbook: To be determined by instructor based on course content

Class Topics: To be determined by instructor based on course content.

(Proposed syllabus submitted in separate proposal)
ENER 4000 – Special Topics

Catalog Description: Examination of specific new areas which are emerging in the various fields of engineering technology and/or construction management. The course builds upon the knowledge the students have gained from their engineering technology and/or construction management curriculum. (1-4 hours) *May be repeated for credit.*

Prerequisite: Permission of the department

Course Outcomes: To be determined by instructor based on course topics.

Instructional Method: This course will primarily be delivered via lecture, with graduate students responsible for additional independent study and dissemination.

Means of Student Evaluation: Students taking this course for graduate credit will be required to research and disseminate findings on areas of topical interest in addition to undergraduate course requirements. Grade calculations will be determined by instructor based on course requirements.

University Policies and Information: The following statements are provided to ensure compliance with federal regulations and SACS standards, as detailed in http://legal.uncc.edu/legal-topics/classroom-policies-and-practices/suggested-standard-syllabus-policies#disability.

- **Code of Student Academic Integrity**
  Students have the responsibility to know and observe the requirements of the UNC Charlotte Code of Student Academic Integrity. This code forbids cheating, fabrication or falsification of information, multiple submission of academic work, plagiarism, abuse of academic materials, and complicity in academic dishonestly. Students are expected to submit their own work, either as individuals or contributors to a group assignment. Faculty may ask students to produce identification at examinations and may require students to demonstrate that graded assignments completed outside of class are their own work. Violations of the Code will result in disciplinary action.
- **Code of Student Responsibility**
  Students are expected to uphold the University's Code of Student Responsibility. The purpose of the Code is to protect the health, safety, welfare, and property of the campus community; foster the personal, social, and ethical development of members; provide an environment conducive to learning; and encourage and create a community that values scholarship, integrity, respect, accountability, dignity, honor, compassion, character, and nobility. Violations of the Code will result in disciplinary action.
- **Rights and Responsibilities in Obtaining Disability Accommodations:**
  Students with disabilities may qualify for special academic accommodations. Students are encouraged to consult with the Office of Disability Services prior to the beginning of the semester to understand their rights and follow policies and procedures.
- **Definition of a Credit Hour**
  To ensure compliance with the federal and SACS definition a credit hour, the following examples are provided.

- o A 3-credit course requires three hours of classroom or direct faculty instruction and six hours of out-of-class student work for the equivalent of approximately 15 weeks. Out-of-class work may include but is not limited to: required reading; homework; studying for quizzes and exams; research; written assignments; and project design, simulation, testing and demonstration.

- o A 1-credit laboratory course requires 2.75 hours of classroom or direct faculty instruction and 2 hours of out-of-class student work each week for approximately fifteen weeks. Out-of-class work may include but is not limited to: required reading, library research, laboratory preparation, and preparing lab reports.

   *May be modified to accommodate varying credit hours or instructor expectations.

Suggested Textbook: To be determined by instructor based on course content

Class Topics: To be determined by instructor based on course content.

Appendix 3: Proposed Catalog Copy

Degree Requirements

The program leading to the Master of Science degree in Applied Energy and Electromechanical Systems is a 30 credit-hour program. The program consists of a 15-credit hour common core, a 6-credit hour elective core in either applied energy or electromechanical systems, and a capstone experience including either a sequence of 9-credit hours of major electives or a specified 3-hour research and analytical methods course in conjunction with a formal 6-credit hour graduate research thesis. At least 15 credit hours must be in courses numbered 6000 or above. The 30-credit hour degree program is outlined below:

Common Core Courses (15 hours)
ENER 6120 Energy Generation and Conversion (3)
ENER 6135 Energy Transmission and Distribution (3)
ENER 6150 Systems Dynamics (3)
ENER 6170 Applied Mechatronics (3)
ETGR 5272 Engineering Analysis IV (3)

Master's Thesis and Research Sequence (15 hours)
CMET 6160 Research and Analytical Methods (3)
ENER 6900 Master's Research and Thesis (6)
Major Electives (6)*

OR

Coursework Sequence (15-hours)
Major Electives (15)*

*Major electives will be selected from the following list (or others with approval):

CMET 5135 Building Information Modeling (3)
CMET 5140 Building Energy Management (3)
CMET 6155 Facility Instrumentation and Controls (3)
CMET 6270 Operation of Constructed Facilities (3)
ENER 5123 Active Filters (3)
ENER 5152 Digital Signal Processing (3)
ENER 5000 Special Topics (1-4)
ENER 5250 Analysis of Renewable Energy Systems (3)
ENER 5260 Hydrogen Production and Storage (3)
ENER 5275 Air Conditioning Systems (3)
ENER 5280 Fuel Cell Technologies (3)
ENER 5285 Applied Noise and Vibration Control (3)
ENER 5290 Advanced Instrumentation (3)
ENER 6000 Special Topics in Applied Energy or
Electromechanical Systems (1-3)
ENER 6220 High Voltage Technology (3)

ENER 6235 Advanced Transmission (3)
ENER 6260 Computational Fluid Dynamics for
Energy Applications (3)
ENER 6270 Dynamic Systems Control and Design (3)
ENER 6800 Independent Study (1-3)

Additional new major electives courses may be created based on industry needs and faculty research interest. In addition, appropriate existing graduate level courses from other programs may be approved by the program director.

COURSES IN ENERGY AND ELECTROMECHANICAL SYSTEMS (ENER)
(only affected course descriptions are listed)

ENER 5000 Special Topics (1-4) Examination of specific new areas which are emerging in the various fields of engineering technology and/or construction management. The course builds upon the knowledge the students have gained from their engineering technology and/or construction management curriculum. *May be repeated for credit.*

ENER 5123 – Active Filters (3) The design, analysis, simulation and implementation of composite, cascaded and summation filters. Topics include: bilinear transfer functions; cascade design with first-order circuits; biquad circuits; Butterworth lowpass circuits; Butterworth bandpass circuits; the Chebyshev response; sensitivity; frequency transformations; highpass and band-elimination filters

ENER 5152 - Digital Signal Processing (3) Discrete-time signals; discrete-time systems; Linear constant-coefficient difference equations; Periodic sampling; reconstruction from samples; changing the sampling rate; the z-transform; z-transform properties; transform analysis of linear time-invariant systems; digital filter design techniques; discrete Fourier Transform and the FFT algorithm.